
**MATHEMATICS ABILITY AND ATTITUDE AS DETERMINANTS OF
MATHEMATICS ACHIEVEMENT OF SENIOR SECONDARY SCHOOLS' STUDENTS
IN MATHEMATICS IN IMO STATE**

BY

CHIKA, Erinna Akukwu,

ELUWA, I. O. Ph.D,

Prof. A. O. OVUTE

And

Prof. A. O. MADU

**Department of Science Education, College of Education,
Michael Okpara University of Agriculture, Umudike.**

ABSTRACT

The purpose of this study was to examine the influence of Mathematics Ability and Attitude on Students' Achievement in Mathematics in Senior Secondary Schools in Imo State. It adopted casual comparative design. The study was guided by three research questions and three null hypotheses and were tested at 0.05 level of significance. The instruments used for data collection were Mathematics Ability Test (MAT 1), Mathematics Achievement Test (MAT 11) and Mathematics Attitude Scale (MAS). The Instruments were face validated by three Experts in the Department of Measurement and Evaluation, at Micheal Okpara College of Agriculture Umudike. In addition, Mathematics achievement test was also content validated and the reliability indices of Mathematical Ability Test (MAT 1) and Mathematical Achievement Test (MAT 11) were established using KR-20 and reliability indices of 0.76 and 0.86 were obtained. The reliability index of MAS was established using Cronbach Alpha statistics and reliability index of 0.64 was obtained respectively. The sample of the study was made up of 600 senior secondary II students in seven schools sampled using proportionate stratified simple random sampling. The data collected were analyzed using mean and standard deviation for the research questions while analysis of variance (ANOVA) and t- test for independent means were used to test the hypotheses at 0.05 level of significance. It was found that combination of Mathematics Ability and Attitude have significant influence on students' Achievement in Mathematics among others. The study then recommended that mathematics teachers should consider students' Mathematics Ability and Attitude while teaching among others.

KEYWORDS: Mathematics ability, Attitude, Mathematics Achievement and Determinant.

INTRODUCTION.

The vital role that mathematics plays in education and society in general is derived from the cultural and interdisciplinary values that the subject seeks to inculcate in the learner. It is a vital tool for the understanding and application of science and technology. Hassan (2012) posited that mathematics as a subject is universally recognized and accepted as indispensable to the self-reliance and sustainable development of any nation because of its perceived functional unity. Mathematics is the science of reasoning and computation. It is the science or study of numbers, quantities or shapes. Kitta (2014), defined mathematics as the language that helps us to describe ideas and

relationships drawn from the environment. Mathematics enables one to make the invisible visible, thereby solving problems that may be impossible otherwise.

The poor achievement of students in mathematics is further buttressed by the results of the last centrally held examination in Imo State from 2010 to 2015. The results in mathematics indicated that a high proportion of students recorded high failure and pass grades. Similarly, from 2015 to 2020, the percentage of students who obtained five credits, including mathematics ranged from 15% to 31% in the West African Examination Council (African.com, 2015).

Mathematics ability or numerical ability is school-oriented. Aptitude is used for measuring numerical abilities similar to those learned in school, such as vocabulary reading and arithmetical reasoning. In other words, aptitude tests are tests designed to measure an individual's ability to learn a new task. This is why Iwuji (as cited in Adike, 2017) defines aptitude as a set of characteristics, both natural and acquired that indicate an individual's ability to succeed in a particular job after training. Basically, mathematical ability is a form of specific test that measures an individual's ability. Based on the foregoing, mathematics ability represents acquired and natural abilities used to solve mathematics problems. Do students possess this ability and how does it influence students' achievement in mathematics especially when other factors like attitude are considered along with the students' mathematics ability? Therefore, mathematical ability is the skill used to solve various kinds of quantitative problems and number concept problems. In some studies, mathematical ability is also referred to as arithmetic ability, mathematical skill or numerical ability.

Mathematics skill is also a human construct, which may be defined as the ability to perform mathematical tasks and to effectively solve given mathematical problems. Furthermore, mathematics ability tests student's ability to analyze and understand the problem rather than memorize it (Bassey & Joshua, 2012). It is also defined as a measure of students' ability to apply knowledge of mathematical concepts and principles, demonstrate flexibility in thinking, identify critical features of new situations, make correct generalizations and compare mathematical expressions. A mathematics ability test is designed to measure the candidate's capacity to manipulate or use numbers to correctly solve problems (Ann, 2014). Such tests, according to Ann (2014), determine the student ability to relatively solve problems in number sequencing, make accurate mathematical deductions through advanced numerical reasoning, interpret complex data presented in various graphical forms, deduce information and draw logical conclusions.

Most topics under the mathematical skill focus on knowledge of rational numbers, percentages, and the law of indices, measures of central tendency, probability, trigonometry and the binomial theorem. On the other hand, an attitude is a learned predisposition to respond positively or negatively to a specific object, situation, institution, or person as such; it consists of cognitive (knowledge or intellectual), affective (emotional and motivational) and performance (behavioral or action) components (Aiken, 2014). Though the concept of attitude is similar in some respects to interest, opinion, belief or value, there are differences in the manner in which these terms are used. An interest is a feeling or preference concerning one's own activities (Aiken, 2014). Unlike attitude, which implies approval or disapproval (a moral judgment), being interested in something simply means that a person spends time thinking about it or reacting to it, regardless of whether these thoughts and behaviors' are positive or negative. (Adeoye, 2016).

Attitude, as one of the factors posited in this study to be a determinant of students' achievement in mathematics, can be seen as more or less a positive or negative disposition towards mathematics (Eguawon, 2013). On this note, attitude toward mathematics is the students' organized predisposition to think, feel, perceive and behave towards mathematics. Attitude towards

mathematics is an aggregated measure of liking or disliking mathematics, a tendency to engage in or avoid mathematical activities, or a belief that the subject is good or bad. A positive attitude towards mathematics can lead to higher achievement and higher achievement can result in a more favorable attitude. Students' attitudes towards mathematics can affect their overall achievement. Value, self-confidence, enjoyment, motivation and anxiety surrounding mathematics are all reflected in students' attitude.

Mathematics ability is the expertness to perform mathematical tasks and to effectively solve given mathematical problems. It is the capability used to solve various kinds of quantitative problems, such as mathematical word problems, computation problem and number-concept problems. It comprises a number of distinct skills, such as the verbal component (numbers knowledge, counting, computation and reasoning) and non-verbal component (mathematics notation, reasoning in time and space, and computation).

Empirical attempts to delimit students Mathematics abilities are generally situated in the context of problem solving and have engaged researchers since the last decades of the 1800s (Vilkomir & Donoghue, 2019). For example, Mary Calkins (1984), in her studies of Harvard students from different disciplines with the aim of identifying the mental operations associated with mathematics, observed that the memories of mathematicians were more concrete than verbal and that there was no difference in the ease of memorizing between mathematicians and other students.

Attitude can be defined as an unfavorable evaluative reaction towards something or someone exhibited in one's beliefs, feelings, or intended behavior. It is a social orientation-underlying inclination to respond to something either favorably or unfavorably. Attitude could also be defined as a consistent tendency to react in a particular way, often positively or negatively, toward any matter. Attitude possesses both cognitive and emotional components. Fazio and Olson (2014) explained that attitudes are important to educational psychology because they influence the way an individual thinks about and processes social information.

Psychologists define attitude as any strong belief or feeling or any approval or disapproval toward people and situations (Boyd, Landford, Loeb & Wyckoff, 2018). There are favorable and unfavorable attitudes toward people, politics, and academic subjects and so on. People favor the things they think are good and helpful and oppose the things they think are bad and harmful (Boyd, Landford, Loeb & Wyckoff, 2018). Within this context, students' attitude towards learning is a crucial factor in learning and achievement.

PURPOSE OF THE STUDY

This study investigated the influence of mathematics ability and attitude on students' achievement in mathematics. Specifically, the study examined the following:

- The extent to which mathematics ability influences students' achievement in mathematics.
- The extent to which students' attitude influence their achievement in mathematics.
- The interaction effect of students' mathematics ability, attitude on students' achievement in mathematics.

Practically, mathematical ability, interest and attitude as determinants of students' achievement in mathematics will be significant or beneficial to teachers, students, school guidance and counselors, curriculum planners, Researchers and other stakeholders in education.

RESEARCH QUESTIONS

The following research questions were stated to guide the study:

- To what extent do students' mathematical abilities influence their achievement in mathematics?
- To what extent do students' attitude towards mathematics influence their achievement in mathematics?
- What are the interaction effects of students' mathematical ability and attitude on their achievement in Mathematics?

HYPOTHESES

The following hypotheses are stated to guide the study and were tested at 0.05 level of significance.

- There is no significant difference between the mean achievement scores of low and high mathematics ability students in mathematics achievement test.
- There is no significant difference between the mean achievement scores of positive and negative students' attitude towards mathematics in mathematics achievement test.
- There is no significant interaction effect of students' mathematics ability and attitude on their academic achievement in mathematics.

METHODOLOGY

This study adopted ex-post facto or causal comparative design. The study was carried out in Imo State. The target population of the study comprise 31,400 senior secondary school 11 students in 288 public secondary schools in Imo State, from Imo state secondary Education Management Board owerri (SEMB). On the other hand, the accessible population of the study comprises 2987 senior secondary schools in Okigwe Zone 11. The sample of the study was made up of 600 Senior Secondary II students representing 20 % of the accessible population. The sample of the school was made up of seven schools also representing 20% of the accessible population schools in Okigwe Zone II Education Zone. Using purposive sampling all the 600 Secondary schools two students made up of 320 male and 280 female were used for the study at the school level. Three instruments were used for data collection. Two of the instruments contained items that measured the independent variables- Mathematics ability and attitude while one instrument contained items that measured achievement which is the dependent variable. The Mathematical ability test (MAT) contains 20 multiple choice item with option A-D. The test items were meant to be answered by students within the time limit of 20 minutes. The second instrument used for data collection was Mathematics Attitude Scale (MAS) meant to measure students' attitude towards mathematics. The instrument too was made up of two sections. Section A dealt with the background information of the Respondents while section B dealt items which measure students' Attitudes towards Mathematics. It also contains 15 items based on 4 point Likert – Scale using the response modes, Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (D).The third instrument is mathematics Achievement test (MATII) meant to measure students' achievement in mathematics. The instrument too was made up of two sections. To ensure face validity of the instruments, the instruments were given to three experts; two from Measurement and Evaluation, and one from Mathematics Education, Department of science Education. The experts checked for clarity and suitability of the language and ability of the instruments to measure the objectives they intended to measure, using Kuder-Richardson 20 method, a reliability index of 0.76 was established for the instrument. Using the same method, a reliability index of 0.86 was established for mathematics achievement test (MAT II) and Mathematics Attitude Scale (MAS) were obtained using Cronbach

Alpha Statistics. The data generated were analyzed using mean and standard deviation. While the hypotheses were tested using multiple analysis of variance (MANOVA) at 0.05 level of Significance.

RESULTS

Research Question 1

To what extent do students' mathematical abilities influence their achievement in mathematics?

Table 1:

Mean and standard deviation scores of high and low mathematical ability students in mathematics achievement test.

Mathematical abilities	N	Mean	SD
High	100	16.55	0.50
Low	500	11.30	3.10

Data in Table 1 showed the mean and standard deviation scores of high and low mathematical ability students in mathematics achievement test. Data in Table 4.1 indicated that students in high mathematical ability group obtained higher mean score of 16.55 with a standard deviation score of 0.50 while those in low mathematical ability obtained lower mean achievement score of 11.30 and standard deviation score of 3.10.

Research Question 2

To what extent do students' attitude towards mathematics influence their achievement in mathematics?

Table 2:

Influence of attitude on mean achievement scores of students in mathematics achievement test.

Students' Attitude	N	Mean	Std. Deviation
Positive	180	16.79	0.99
Negative	420	10.10	3.19

Data in Table 2 showed the mean and standard deviation mean achievement scores of students who have positive and negative attitudes towards mathematics. Students with positive attitude towards mathematics obtained higher mean achievement score of 16.79 and standard deviation score of 0.99 while those with negative attitude towards mathematics obtained lower mean score of 10.10 and standard deviation of 3.19 which showed higher variability in response more than students with positive attitude.

Research Question 3

What are the interaction effects of students’ mathematical ability and attitude on achievement in mathematics?

Table 3:

Mean and standard deviation scores on interaction effects of students’ mathematical ability and attitude in achievement in mathematics.

VARIABLES	HIGH			LOW		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Mathematical abilities	100	16.55	0.50	500	11.30	3.10
Students’ Attitude	180	16.79	0.99	420	10.10	3.19

Data in Table 3 showed the mean and standard deviation scores based on interaction effect of mathematical ability and attitude on achievement in mathematics. Students high in mathematical ability obtained higher mean achievement score of 16.55 with standard deviation of 0.50 while students low in mathematical ability obtained lower mean achievement score of 11.30 and standard deviation of 3.01. Students with high (positive attitude) obtained higher mean achievement score of 16.79 and standard deviation of 0.99 while students with low (negative attitude towards mathematics) obtained lower mean achievement score of 10.10 and standard deviation of 3.19.

HYPOTHESIS 1

There is no significant difference between the mean achievement scores of low and high mathematical ability students in mathematics achievement test.

Table 4: t-test analysis of mean achievement scores difference between high and low mathematical ability students in mathematics achievement test.

Mathematics ability	N	Mean	Std. Dev	t	P-value
High	100	16.5500	.50000	16.913	0.0001
Low	500	11.2960	3.09638		

Data in Table 4 showed a t calculated value of 16.913 with a p value of 0.0001 ($p < 0.05$) which is less than 0.5 at 0.05 level of significance set for the study. This implies that the null hypothesis stated is rejected. Therefore, there is a significant difference between the mean achievement scores of low and high mathematical ability students in mathematics achievement test in favour of those with high mathematical ability.

Hypothesis 2

There is no significant difference between the mean achievement scores of positive and negative students' attitudes towards mathematics in mathematics achievement test.

Table 5:

T-test analysis of mean difference between students with positive and negative attitudes towards mathematics

Students' attitude	N	Mean	Std. Dev	T	P-value
Positive	180	16.7889	.99152	27.568	0.001
Negative	420	10.0976	3.18971		

Data in Table 5 showed a t calculated value of 27.56 with a p value of 0.001 ($p < 0.05$).

DISCUSSIONS

The results of the study revealed that students with high mathematical ability obtained higher mean achievement score than those with low mathematical ability. The hypothesis showed that there was a significant difference between the mean achievement scores of students with high mathematical ability and those with low mathematical ability in favour of students with high mathematical ability. This support Nabihel (2013) whose result showed that there was a positive significant relationship between mathematics ability and achievement in mathematics, though the previous study used or employed co relational survey design while the present design employed casual comparative. The study revealed that students with positive attitude towards mathematics obtained higher mean achievement score than students with negative attitude towards mathematics. It was then shown that there was a significant difference between the mean achievement scores of students with positive and negative attitudes towards mathematics in favour of students with positive attitude towards mathematics. This support Mzomwe (2019) whose result indicated that there was a significant relationship between attitudes and learning of mathematics in regarding their performance. These results indicate that attitude which is predisposition of students to mathematics positively influences students' achievement in mathematics. The present finding agreed with Darm (2018) who found significant interaction of mathematical ability attitude and interact on students' achievement in mathematics.

CONCLUSION

The study was carried out to investigate how mathematical ability and attitude affect students' achievement in mathematics. Based on the findings of the study, the researcher concluded that students with high mathematical ability can perform better in mathematics than those who are low in mathematical ability. Similarly, students with a positive attitude towards learning mathematics perform better than those who have a negative attitude towards mathematics.

RECOMMEDATIONS

Based on the findings and conclusion of the study, the following recommendations were made;

- Mathematics teachers should consider students' mathematical ability and attitude during teaching.
- In order to enhance students' attitudes and abilities, mathematics teachers should always use instructional strategies that are student-centered.
- Counseling service should be regularly provided for students performing poorly in mathematics.

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