

## **STUDENTS' KNOWLEDGE OF MATHEMATICAL STRUCTURES AND ACADEMIC PERFORMANCE IN SENIOR SECONDARY TWO (2) MATHEMATICS**

By

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### **Abstract**

*The research work examines students' knowledge of mathematical structures in senior secondary two (SSII) mathematics students Academic performance. One research question and one research hypothesis was formulated and tested at 0.05 level of significance. Literature related to the study was reviewed on structures of mathematics. The sample size used for the study was two hundred (200) senior secondary two (SS2) mathematics students selected by randomization. Randomization was also used in selecting five out of the seven public secondary schools in Ukanafun Local Government Area from where the two hundred (200) students were selected.*

*The instrument used for the collection of data was test of mathematical structure Ability (TMSA) and mathematics Performance test (MPT) drawn from the area of number and numeration, set theory, geometry and general angles. The instrument was validated and its reliability found using Pearson's product moment correlation. A reliability coefficient of 0.73 was obtained indicating that the instrument was reliable. The data obtained from the instrument was subjected to Pearson's product moment ( $r$ ) correlation analysis (PPMC) and was used to test each of the hypotheses at 0.05 significant level. The result of the findings showed that, there was significant relationship between mathematical structures and students' academic performance in mathematics.*

**Keyword:** Mathematics Structures, Geometry, Performance, Skills

### **Introduction**

Mathematics is one of the most important subjects taught in all schools throughout the world due to its relevance to other subjects. Its application in the development of science and technology cannot be over looked. Mathematics is therefore considered to be an indispensable tool in the study of science, humanities and technology. The importance of mathematics as a subject in our schools and in everybody life cannot be overemphasized, since it has been an integral part of man's intellectual training throughout ages. As stipulated in the National Policy on Education (2013), mathematics is a core subject in the secondary school curriculum in Nigeria because it is the rudiment of all scientific careers such as medicine, engineering, pharmacy.

#### **Mathematical Structures**

In mathematics, a structure on a set consists of additional mathematical objects that relate to the set which makes it easier to visualize or work with, or endowing the collection with meaning or significance.

A structural set theory is a set theory which describes structural mathematics, and only structural mathematics. As conceived by the structuralist, mathematics is the study of structures whose form is independent of the particular attributes of the things that make them up. In a structural set theory ,the elements (such as 3) of a set have no identity apart from their existence as elements of that set , and whatever structure is given to that set by the functions and relations placed upon it. That is, set (together with other attendant concepts

such as elements, functions and relations) are the “raw materials” from which mathematical structures are built (Malik and Sen, 2004).

Addition and multiplication on numbers are the prototypical example of an operation that combines two elements of a set to produce a third. These operations obey several algebraic laws. For example  $a + (b + c) = (a + b) + c$  and  $a(bc) = (ab)c$ , both examples of the associative law. Also  $a + b = b + a$  and  $ab = ba$ , the commutative law.

### **Mathematical structures and students’ academic performance**

Mbugual (2012), carried out a research to examine the influence of student mathematics structures and their performance in mathematics in Kenya. A total of 18 secondary schools in Kenya and a sample of 661 (352 boys and 309 girls) students and 71 teachers (39 males and 32 females) participated in the study. Data collection was done using mathematics test (MT) and most recent end term examination papers and marks. Pearson’s product moment correlation analysis were used and the result thus ( $P < 1\%$ ) indicating that mathematical structures are significant to achievement in mathematics.

Udofia and Etuk (2014), carried out a research to examine the influence of science/mathematics language on senior secondary two (SS2) students’ achievement in chemistry in public secondary schools in Akwa Ibom State. The study used experimental design, specifically the pretest/posttest control group design. A sample of 200 students was drawn using criterion sample technique. The treatment group was empowered with special lessons on science/mathematics language while the control group was not. Both groups were taught chemistry topic. The test instruments were, Chemistry Achievement Test (CAT), chemistry interest scale and the chemistry practical manual. The reliability of the tests were 0.79, 0.84 and 0.86 respectively for each test using the test retest method of determining reliability.

Chemistry Achievement Test were developed and administered on the students to obtain their pretest and posttest mean scores which were tested at  $P < 0.05$  level of significance. Science/mathematics language ability had a significant influence on students’ achievement in chemistry test.

Mbaabu and Kinai (2011), conducted a research to investigate the factors that were considered to influence student’s attitude towards the study of physics in secondary schools in Imenti south District, Kenya. The factors under consideration were perceived adequacy of physics laboratory equipment, perceived teacher competence, the influence of calculations in the physics curriculum and sex differences in students’ attitude. The study sample consisted of 120 students. These were drawn from four secondary school sampled through stratified random technique. Descriptive survey design was used. Two instruments were used for data collection. These were a students’ questionnaire and a laboratory equipment checklist. The questionnaire was administered to the students at one sitting in each of the schools. Each of the independent variable had its items scored separately. A single attitude score was thus obtained for each attitudinal object per student. The research findings revealed that students have a positive attitude toward physics, perceive the physics’ teachers as competent and they perceive the physics laboratories as well equipped.

### **Statement of the Problem**

It is unfortunately, that it is no longer news to hear of poor performance of learners in mathematical tasks. It has however becomes worrisome for government, schools, parents and

students as the consequences of failure in math dawn on them. For example, a nation that aspires for scientific development and technological breakthrough cannot put a premium in the improvement of the teaching and learning of mathematics. A student seeking admission into the university where a credit in mathematics is required cannot put in his/her best to scale through the hurdle of mathematics. No person will take delight in his/her child/ward staying at home without admission as a result of failure in mathematics. This poor performance is attributed to numerous factors. Among these are the understanding of mathematical structures and mathematical terms or symbols (Groppello, 2003). According to Groppello (2003), the difficulty students find in mathematics could be attributed to poor appreciation of the meaning conveyed by different preposition and their connectiveness. Hence, this study seeks to examine the relationship between mathematical language skills and students' performance of senior secondary two (2) mathematics in Ukanafun Local Government Area of Akwa Ibom State.

### **Research Questions**

These question was raise to guide the study

What is the relationship between students' mathematical structures and their performance in SS 2 mathematics?

### **Hypothesis**

**Ho:** There is no significance relationship between the students' understanding of mathematical structures and their performance in senior secondary two (2) mathematics.

### **Purpose of the Study**

The purpose of this study is to find out the relationship degree of relationship existing between students' mathematical structural ability and their performances in SS (2) mathematics.

## **METHODOLOGY**

### **Research Design**

The research design used for this study was the survey design.

### **Area of Study**

The area of the study was Ukanafun Local Government Area, its geographical coordinates are  $5^{\circ}0^{\prime}0^{\prime\prime}$  North,  $7^{\circ}44^{\prime}0^{\prime\prime}$  East. Area:  $246\text{Km}^2$  – Density:  $604.6\text{inh./Km}^2$  – Change +  $3.4\%/year$  (2006-2011).

### **Population of the Study**

The population of this study was made up of all the senior secondary two (SS2) mathematics students in public secondary schools in Ukanafun Local Government Area for the 2015/2016 academic session. The number of SS2 students' in the seven public schools in Ukanafun Local Government Area was five thousand (5000) during 2015/2016 session.

### **Sample and Sampling Technique**

Random sampling technique was use in selecting five (5) out of the seven (7) pubic secondary schools in Ukanafun Local government area. Forty (40) SS2 students were selected from each of the schools resulting to a sample of two hundred (200) students.

### **Instrumentation**

Two separate instruments were developed and used by the researcher for data collection. The instruments were Test of Mathematical Structure Ability (TMSA) and the Mathematics Performance Test (MPT).

Test of Mathematical Structure Ability (TMSA) was a researcher made test and consisted of thirty (30) items. TMLRA was designed to measure the following:

(a) Ability to translate a statement in English to a corresponding mathematical statement.

Mathematics Performance Test (MPT) consists of twenty multiple choice questions drawn from the area of number and numeration, set theory, geometry and general angles. The instruments consisted two sections. Section A and B. Section A consisted personal information such as serial number, sex, name and school name. Section B contained twenty multiple choice items drawn from number and numeration, set theory geometry, and general angles. Each item had four options lettered A-D with only one correct item and three distracters. On the other hand, the researcher also designed a questionnaire of fifteen questions on a four likert scale to answer the research questions.

### **Validation of the Instrument**

The instruments were face and content validated by the Head of Department Mathematics, Airforce comprehensive school Uyo and two lecturers from university of Uyo. The face and content validation process was completed by the researcher's supervisor. All their corrections and instructions were inserted into the final form of the instruments.

### **Reliability of the Instrument**

The reliability of the instrument was obtained using the Pearson's product moment correlation coefficient technique. Forty copies of the Mathematics Performance Test and Test of Mathematical Structure Ability (TMSA) were administered to forty students selected outside the sampled schools, from the same population. The reliability of the instruments was obtained using split-half method. The total scores were computed with odd numbers taken as first test, and even numbers as second test using the Pearson's product moment correlation. A reliability coefficient of 0.73 was obtained which made the instrument reliable and 2.50 mean for the research questions on four likert scale

### **Research Procedure**

The research was carried out in the five (5) randomly selected schools in Ukanafun Local Government Area. The researcher met the principals and obtained their permission. The teachers of each class were used as research assistant. They later administered the instruments to the students. The students were then instructed on how to provide answers to the items and the order to follow. The instrument were collected back by the teachers and handed to the researcher.

### **Method of Data Analysis**

The data obtained from the students was analyzed using Pearson's product-moment correlation for hypotheses and mean statistic to answer research questions

## **RESULTS AND DISCUSSION**

The researcher presents the results of the data analysed and the interpretation and discussion that are in accord with the stated research question and hypotheses.

There is no significant relationship between students' understanding of mathematical structures and their performance in mathematics.

**Table 1: Pearson's Product Moment Correlation (r) Between Students' Mathematical Structure and their Academic Performance in Mathematics.**

Variable	N	$\Sigma X$	$\Sigma Y$	$\Sigma X^2$	$\Sigma Y^2$	$\Sigma XY$	$r_{cal}$	$r_{cri}$	Remark
Mathematical Structures (MSRA) (X)	200	2300		29500					
						29800	0.547	0.139	Significant
Mathematics Performance Tes (MPT) (Y)	200		2465		32690				

Table 1 shows that the calculated r-value is 0.547. This indicates a positive correlation between students' mathematical structures and their performance in mathematics. It implies that as the mathematical structures of the students' increases their performance also increases. Table 6 also showed that the calculated r-value is greater than the critical r-value. Therefore the null hypothesis is rejected. This implies that, there is a significant relationship between students' mathematical structures and their performance in mathematics. This result shows that students who understand mathematical structures performed well in mathematics.

### Summary of findings

The finding of the study revealed that there was a significant relationship between students' mathematical structures and their academic performance in mathematics.

This finding is in line with the work of Mbugua (2012) who reported that a correlation analysis of the mathematical structures shown that mathematics achievement is significantly correlated to the understanding of mathematical language. These observations are also in line with that of Curcio (1990) who observed that mathematical structure is significant to mathematics achievement. This finding is also in line with the work of Gecau (2001) who reported that mathematical structures are accommodated and assimilated through a series of experiences, which can be achieved through mathematical languages.

### Implications of the Findings

The importance of teaching students the language of mathematics: to enable the young students learn how to "do" mathematics; and also learn how to articulate what they are learning. Children must learn to recognize and answer why questions in order to develop problem-solving skills, and for teachers to accurately assess student progress. Children first need to acquire the means of explaining how they solve problems as well as what concepts might not be clear to them.

The implication of the findings among others is that mathematics teachers should implement mathematics curriculum with intention of increasing students' understanding of mathematical language skills.

### Recommendations

The following recommendations are made in regard to the findings:

- (i) The Federal, State and local government should increase the budget allocated to education to be able to solve the problems associated with teaching and learning.
- (ii) Students should be encouraged to read mathematics literatures in order to enrich their knowledge of mathematical language and symbolism.
- (iii) Mathematical symbolism should be integrated with other topics or subjects at the beginning of every course and be sustained at all levels of students learning.
- (iv) Achievement in mathematics could be improved by including definitions of mathematical language in lessons, set questions that would require definitions of terms, symbols and mathematical structures.
- (v) Parents/guardians should encourage their wards to attend extra classes on mathematics. This will help the students accumulate more skills on solving mathematical problems

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