BASIC MATHEMATICAL SKILLS KNOWLEGDE AND SENIOR SECONDARY STUDENTS' PERFORMANCE IN ALGEBRA

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Abstract
This study investigated the influence of senior secondary students' knowledge of Basic Mathematical Skills (BMS) on their performance in algebra in Obio-Akpor Local Government Area (LGA) of Rivers State, Nigeria. The study adopted the analytical survey research design with a population of 18,087 senior secondary students of which 7,668 were males while 10,419 were females. A sample of 400 students selected from the population using Taro Yamane formula was selected using simple random sampling technique and used for the study. Two research questions and two hypotheses guided the study. The Basic Mathematical Skill Test (BMST) and the Algebra Performance Test (APT) were the two instruments used for data collection. The BMST and APT comprised of twenty-five (25) multiple-choice questions each. BMST was used to collect data to measure students' knowledge of basic mathematical skills while APT was used to collect data to measure students' performance in algebra. The reliabilities of BMST and APT were established by test-retest method and 0.74 and 0.78 correlation coefficients were obtained for BMST and APT respectively. Mean and standard deviation were used to answer the two research questions while Analysis of Variance (ANOVA) was used to test the two hypotheses at 0.05 significant level. The result of the study showed that students with high knowledge of basic mathematical skills performed significantly better than their counterparts with low knowledge of BMS in algebra. It was recommended among others that Mathematics teachers at the basic level of education should ensure that students learn basic mathematical skills because they are prerequisite knowledge to higher or advance Mathematics learning.

Keywords: *basic, mathematical skills, senior secondary student, algebra, performance.*

Introduction

Mathematics is the study of quantity, structure, space and change. Mathematics is indispensible for daily living. The house wives, traders, laymen, artists, musicians, bankers, economists, pharmacists, doctors, scientists, technicians, engineers and technologists need Mathematics to function effectively in their daily practices. Development in Mathematics will amount to a corresponding economic, scientific and technological advancement of any nation. It is imperative therefore, to give attention to the study of Mathematics at all levels of education.

In Nigeria, there are four levels of education which are the pre-basic or early childhood education, basic education (lower and upper basic), post basic or senior secondary education and tertiary education (Federal Republic of Nigeria, 2013). Though Mathematics is a study subject or course at all the levels of education in Nigeria, but it is made compulsory at the pre-basic, basic and post basic levels of education (Federal Republic of Nigeria, 2013). The rationales for this policy are to enable Nigerian citizens acquire the basic mathematical skills necessary to

thrive in an ever-changing technological world (National Educational Research and Development Council, 2007). The Mathematics curriculum from the pre-basic to the post basic education level is organized spirally. Spiral organization of the curriculum allows students to apply the skills or knowledge acquired at the lower level to learn new concepts at a higher level of learning. Those skills needed to learn new skills are termed basic skills and there are basic skills in Mathematics.

According to Hayes (2005), basic mathematical skills consists the ability to analyse and solve problem with addition, subtraction, multiplication, division, fractions, computational, logical and creative thinking and decimals process skills. Mathematical skills are abilities, knowledge, and competencies acquired through Mathematics instruction which are vital for higher level Mathematics learning and real-life problem solving. Examples of mathematical skills are process, problem solving, computational, translational, manipulative, accuracy, drawing, reasoning, thinking, creative and transferable skills. The mathematical skills required to learn a more advanced Mathematics are regarded as basic mathematical skills. In other words, basic mathematical skills are foundational prerequisite skills for Mathematics teaching and learning. Basic mathematical skills are the fundamental and inevitable concept of Mathematics prior to Mathematics and Science achievement. This reflects the fact that basic mathematics skills are essential.

Mathematics is one of the basic skills that we expect an individual to master. The three Rs: Reading, Writing and Arithmetic are the subjects often considered very important. And yet, while much attention is put on early literacy skills including reading and writing, arithmetic is often lost in the shuffle. But the knowledge of basic mathematical skills from early age is more important than one can think. Many experts attributed Mathematics deficiency to one or more of the following different skill types: mastery of number facts, basic computations, knowledge transfer (connecting the abstract nature of Mathematics with reality), making connections within and across mathematical experiences and understanding of the language of Mathematics which ranges from writing, reading and speaking (Diane, 2007; Paula, 2012).

Many reports explains why Mathematics matters, why it is important that we produce young people who are good at Mathematics and why it has become increasingly urgent that we address the problems with Mathematics Education. The reporters argued that today's world of rapid change in technology particularly, places an increasing demand for basic mathematical skills (Advisory Committee for Mathematics Education, 2011; Norris, 2012; Vorderman, Porkess, Budd, Dunne & Rahman-Hart, 2011). Both procedural and conceptual knowledge are important components of mathematical understanding; an issue only arises when students fail to ever grasp conceptual understanding that reveals to them why such procedural applications are appropriate and work (Linc, 2013). Students cannot only learn the procedural application of turning an improper fraction into a mixed number or finding common denominators, but also acquire the basic conceptual understanding of fractions that reveals to them why such algorithms works. According to Linc (2013), a fraction assessment was given to 143 high school students currently enrolled in a basic algebra class. Nearly 48% of the students were unable to find the sum of $\frac{5}{12}$ and $\frac{3}{8}$. One common error was that students were adding numerators and denominators, and the students who knew they needed to obtain common denominators failed to remember how to do so. This is the perfect example of students not mastering the conceptual understanding and only partially understanding procedural knowledge.

Mastery of basic mathematical skills predicts not only future Mathematics achievement; it also predicts future reading achievement. Research has shown that those children who are taught Mathematics early and learn the basic at young age are set up for a lifetime of achievement in all aspects of their academic performance. A further argument is made that Mathematics is important and its basic skills and understanding because it encourages and develops important way of thinking. For instance, Vorderman *et al* (2011) stated that Mathematics is critical in fostering logical and rigorous thinking. Ofsted (2011) noted that ensuring that children have a good grounding in Mathematics will equip them for their future lives by developing the skills valued in industry and university.

According to Harvey (2008) and Odili (2006), the basic mathematical skills developed by National Council of Supervisors of Mathematics (NCMS) are:

Problem Solving: The principal reason for studying Mathematics; posing questions, analyzing, translating and illustrating results, drawing diagrams, using trial and error, applying rules of logic, subjecting conclusion to scrutiny.

Applying Mathematics to Everyday Situation: Interrelated with all computational activities; use everyday situations, translate them into mathematics expressions, solve, interpret results in the light of initial situation.

Alertness to Reasonableness: Technique for estimating quantity length, distance, weight etc.; know when the result is précised enough for purpose at hand.

Appropriate Computational Skills: Addition, subtraction, multiplication, division with whole numbers and decimals and simple fractions, complicated computations will usually be done with a calculator.

Geometry: Concepts of points, line, plane, parallel, perpendicular, basic properties of simple geometric figures with emphasis on measurement and problem solving; recognize similarities and differences among objects.

Measurement: Minimally, measure distance, weight, time, capacity, temperature, and angles; calculate simple area, volume; use both metric and customary systems with appropriate tools.

Reading, Interpreting and Constructing Tables, Charts and Graphs: Condensing information into manageable/meaningful terms and use conclusions with simple tables, maps, charts and graphs.

Using Mathematics to Predict: Elementary notions of probability to determine likelihood of future events; identifying immediate past experiences that do not affect the likelihood of future events; use mathematics to help make predictions.

Computer Literacy: Understand what computer can/cannot do.

The knowledge of basic mathematical skill could be a prerequisite for student algebra achievement in higher Mathematics. Algebra is defined as a branch of Mathematics devoted to the study and development of named structures and their respective point sets, permissible operations, permissible relations and axioms (laws) governing (regulating and controlling) the interactions of elements thereof. Beginning to study algebra marks a cognitive milestone for learners. While Mathematics courses prior to algebra mainly focus on calculations, in algebra, students begin to deal more on abstract concepts of numeric relationship, representations and symbolism. The logical reasoning abilities developed during algebra promote deeper critical

thinking and problem-solving ability that will serve learners throughout a lifetime. Before starting on a journey through algebra, students must have essential prerequisite knowledge on the basic skills in Mathematics. Without a solid foundation in the four basic arithmetic skills – addition, subtraction, division and multiplication – students won't go very far in algebra (Linc, 2013). They will need these skills in algebra to perform the operations necessary to solve equations and simplify expressions. The knowledge of "signed numbers" simply refers to as negative and positive numbers or integers forms the basis in which students should develop in adding, subtracting, multiplying and dividing negative numbers as it forms part of algebra concept.

Developing students' basic mathematical skills requires teachers employing instructional methods which promote active and meaningful learning. Zakania, Chin and Daud (2010) concluded that positive changes take place when a teacher changes his teaching methods towards a more students-centered approach. Therefore, to enhance students' mathematical skills, students must be more active in the classroom and must creatively acquire knowledge, especially in understanding and solving mathematical problems. Students should be given the opportunities to develop, to interact, and to share with friends through cooperative learning, problem-based learning, problem-solving learning approach, peer learning, computer assisted learning and activity-based learning methods. On the part of the students, they need positive attitude, patience, confidence and willingness towards problem solving if they must develop their mathematical skills.

Students Attitude to Problem-Solving: According to Effandi and Norma (2009), students' attitudes towards Mathematics are very much related to their attitude towards problem solving in general. In education, attitude is one important element which determines student's success. They add that negative attitudes need to be overcome, so that later in life, students will not suffer from poor problem-solving skills. It is important to master problem-solving skills as these skills are essential for dealing competently with our everyday life. He proposes that solving problems requires patience, persistence, perseverance and willingness to accept risk.

Patience towards Problem-Solving: A study conducted by Faridah (2004), found that students with high level of perseverance will not stop trying until they manage to get the answer and they will continue to work on a problem until they succeed in solving. He added that most students immediately make an attempt to work out the problem without first planning any strategies to do so which resulted only moderate number of students are able to solve the mathematical terms. He posited that the students have lack of patience towards problem-solving is essential to achieve good results in mathematics.

Confidence towards Problem-Solving: Students'confidence towards problem-solving is believed to play a significant role in Mathematics achievement.

Willingness towards Problem-Solving: Students who have high level of positive attitude in Mathematics also possess high level of willingness towards problem-solving. This finding is supported by Faridah (2004) that excellent students have high level of willingness towards problem-solving.

The basic mathematical skills students learn from pre-basic and basic Mathematics are the fundamental skills upon which all higher-level Mathematics courses build. It is highly beneficial that students master previous mathematical concepts, application, and skills prior to learning

algebra and other higher-level Mathematics courses. Conversely, it is noted that students who fail to master the fundamental and conceptual understanding of basic mathematical skills such as addition, subtraction, addition, multiplication and division of whole numbers and fractions etc, commonly exhibit error pattern when learning algebra, hence, attributed to deficiency in basic mathematical skills (Brown & Quinn, 2007). But this study shall investigate the influence of senior secondary students' knowledge of basic mathematical skills on their algebra performance.

Gender which refers to the male and the female students is the moderating variable in this study. Gender is the physical or social conditions of being either male or female (Abdullahi, 2017). The effect of knowledge of basic mathematical skills on the male and the female students' performance in algebra will be investigated also.

Statement of the Problem

The consistent poor performance of students in Mathematics in external examinations has been worrisome. According to the West African Examination Council's Chief Examiner's report, 65.82% of the students who sat for the May/June West African Senior Secondary Certificate Examination (WASSCE) in general Mathematics failed having obtained pass and below (D7-F9) in the 2015 examination year (WAEC, 2015). Students' deficiency in basic mathematical skills could be one of the factors responsible for this ugly performance of students in Mathematics. Hence, the study is poised to answer the question: what is the influence of the senior secondary students' knowledge of basic mathematical skills on their performance in algebra?

Aim and Objectives of the Study

The study aimed at investigating the influence of senior secondary students' knowledge of basic mathematical skills on their performance in algebra. Specifically, the study:

1. Determined the influence of students' knowledge of basic mathematical skills on their performance in algebra.
2. Investigated the effect of students' knowledge of basic mathematical skills on the male and the female students' performance in algebra.

Research Questions

The following research questions guided the study:

1. What is the influence of basic mathematical skills knowledge on the performance of senior secondary students in algebra?
2. What is the effect of basic mathematical skills knowledge on the performance of the male and the female senior secondary students in algebra?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance in this study:

1. There is no significant influence of basic mathematical skills knowledge on the performance of senior secondary students in algebra.
2. There is no significant effect of basic mathematical skills knowledge on the performance of the male and the female senior secondary students in algebra.

Methodology

Research Design

The study adopted analytical survey research design.

Population of the Study
The population consists of 18,087 senior secondary school students which comprises of 7,668 males and 10,419 females in Obio-Akpor Local Government Area of Rivers State (RSSSSB, 2018).

Sample and Sampling Techniques
A sample of 400 students obtained from the population using Taro Yamane formula was used for the study. Simple random sampling technique was employed to select ten (10) public co-educational senior secondary schools in Obi-Akpor Local Government Area of Rivers State and 40 senior secondary class two students from each school.

Instruments for Data Collection
The Basic Mathematical Skill Test (BMST) and the Algebra Performance Test (APT) were the two instruments used for data collection. The BMST and APT comprised of twenty-five (25) multiple-choice questions each. BMST was used to collect data to measure student's knowledge of basic mathematical skills while APT was used to collect data to measure students' performance in algebra. The mean of students' scores from the BMST was used as the criterion cut-off point or bench mark to classify students into high and low knowledge of basic mathematical skills. The mean score of students in the BMST was 68.00. Students who scored 68.00 and above in BMST had high knowledge of basic mathematical skills while students who scored below 68.00 had low knowledge of basic mathematical skills.

Validity of Instrument
The face and content validity of BMST and APT were done by three authorities in Mathematics Education. Their contributions and modifications were effected to obtain valid instruments used for data collection in this study.

Reliabilities of Instruments
The reliabilities of BMST and APT were established by test-retest method. After correlating the test and re-test scores for each instrument using the Pearson product moment correlation, 0.74 and 0.78 correlation coefficients were obtained for BMST and APT respectively. The correlation coefficients of 0.74 and 0.78 showed that the instruments were reliable.

Method of Data Collection
BMST and APT were administered personally to the students in the respective schools with the support of the Mathematics teachers in the respective schools and retrieved the same day for analysis.

Method of Data Analysis
Mean and standard deviation were used to answer the two research questions while Analysis of Variance (ANOVA) was used to test the two hypotheses at 0.05 significant level.

Result Presentation
Research question one: What is the influence of basic mathematical skills knowledge on the performance of senior secondary students in algebra?

Table 1: Mean and standard deviation of the performance of senior secondary students with high and low Knowledge of Basic Mathematical Skills (KBMS) in algebra

KBMS	n	Mean	Std.	Difference		95% Confidence Interval for Mean	
				Mean	Std	Lower Bound	Upper Bound
High	241	71.80	10.08	15.60	3.26	70.52	73.08
Low	159	55.94	13.34			53.85	58.03
Total	400						

Table 1 shows the mean difference in the performance of senior secondary students with high and low knowledge of basic mathematical skills in algebra. The table revealed that students with high knowledge of basic mathematical skills performed better (M= 71.80, SD= 10.08) than those with low knowledge of basic mathematical skills (M= 55.94, SD= 13.34) in algebra. The difference in their mean performance was 15.6 (Std= 3.26). This difference indicated the influence of basic mathematical skills knowledge on students' performance in algebra.

Research question two: What is the effect of basic mathematical skills knowledge on the performance of the male and the female senior secondary students in algebra?

Table 2: Mean and standard deviation of the performance of the male and the female senior secondary students with high and low knowledge of basic mathematical skills in algebra

KBMS	Gender	n	Mean	Std.	Difference Mean	Std
High	Male	127	71.47	10.83	0.71	1.62
	Female	114	72.18	9.21		
Low	Male	73	57.34	13.36	2.60	0.07
	Female	86	54.74	13.29		
Total	Male	200	66.31	13.61	1.63	0.48
	Female	200	64.68	14.09		
	Total	400				

Table 2 shows the mean difference in the performance of the male and the female senior secondary students with high and low knowledge of basic mathematical skills in algebra. The table indicated that the female students with high knowledge of basic mathematical skills performed better (M= 72.18, SD= 9.21) than the male students with high knowledge of basic mathematical skills (M= 71.47, SD= 10.83) while the male students with low knowledge of basic mathematical skills performed better (M= 57.34, SD= 13.36) than the female students with low knowledge of basic mathematical skills (M= 54.74, SD= 13.29) in algebra. The mean differences in their performances were (M=0.71, SD=1.62) and (M=2.60, SD=0.07) for high and low KBMS respectively. The effect of KBMS on the male and the female students' performance in algebra is minimal.

H_{01}: There is no significant influence of basic mathematical skills knowledge on the performance of senior secondary students in algebra.

Table 3: Summary of analysis of variance on the performance of senior secondary students with high and low knowledge of basic mathematical skills in algebra

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24108.18	1	24108.18	182.74	.00
Within Groups	52505.81	398	131.92		
Total	76613.99	399			

Table 3 shows the analysis of variance on mean difference in the algebra performance of students with high and low knowledge of basic mathematical skills. From the table, there was a significant influence of basic mathematical skills knowledge on the performance of senior secondary students in algebra with students with high KBMS performing significantly better than students with low KBMS (F1, 398= 182.74, $p<0.05$). Hence, the null hypothesis was rejected and the alternate hypothesis retained.

H_{02}: There is no significant effect of basic mathematical skills knowledge on the performance of the male and the female senior secondary students in algebra.

Table 4: Summary of two-way analysis of variance on the performance of the male and the female students with high and low knowledge of basic mathematical skills (KBMS) in algebra

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	24405.10[a]	3	8135.03	61.70	.00
Intercept	1558071.36	1	1558071.36	11817.84	.00
BMS level	23720.64	1	23720.64	179.92	.00
GENDER	84.87	1	84.87	.64	.42
BMS level * GENDER	260.90	1	260.90	1.98	.16
Error	52208.89	396	131.84		
Total	1792452.00	400			
Corrected Total	76613.99	399			
a. R Squared = .319 (Adjusted R Squared = .313)					

Table 4 shows two-way analysis of variance on algebra performance of the male and the female students with high and low basic mathematical skills. From the table, there was a significant mean difference in the performance of senior secondary students with high and low knowledge of basic mathematical skills in algebra (F1, 396 = 179.92, $p<0.05$) but there was no significant difference in the performance of the male and the female senior secondary students with high and low basic mathematical skills in algebra (F1, 396 = 0.64, $p>0.05$). Also, the interactive effect of basic mathematical skills level and gender was not significant (F1, 396 = 1.98, $p>0.05$). The null hypothesis was therefore retained.

Discussion of Findings

Students' knowledge of basic mathematical skills and their performance in Algebra

Findings from this study shows that students who have high knowledge of basic mathematical skills performed better (Mean = 71.80, SD = 10.07) than those with low knowledge of basic mathematical skills (Mean = 55.94, SD = 13.34) in algebra. This difference in their mean performance in algebra was found to be statistically significant ($F1, 398= 182.74$, $p<0.05$). This study is in line with Linc (2013), who reported that without a solid foundation in the four basic arithmetic skills – addition, subtraction, division and multiplication, students cannot perform very well in algebra.

Gender, knowledge of basic mathematical skills and students' performance in algebra

Findings from this study shows that the female students with high knowledge of basic mathematical skills (Mean. = 72.18, SD = 9.21) performed better than the male students with high mathematical skills (M = 71.46, SD = 10.82) while the male students with low mathematical skills (Mean = 57.34, SD = 13.36) performed better than their female counterpart with low mathematical skills (Mean = 54.74, SD = 13.29) in algebra. However, the mean differences in their performance were not statistically significant ($F1, 396 = 0.64$, $p>0.05$). These findings collaborate with Mangal (2013) and Rao, Moely and Sachs (2012). They posited that the difference in performance between the two sexes (gender) was so close so as to be meaningless. They also emphasized that gender difference is ranked dead and is found not to be impacting on students' performance in Mathematics topics.

Conclusion

This study established that students' knowledge of basic mathematical skills is a prerequisite to their algebra performance at the senior secondary level of Mathematics education. The study also revealed that the difference in the knowledge of basic mathematical skills and performance in algebra between the male and the female students was not significant. Implying that gender difference in students' knowledge of basic mathematical skills and their performance in algebra was not significant.

Recommendations

From the findings of the study, the following recommendations are made:

1. Mathematics teachers at the basic level of education should ensure that students learn basic mathematical skills because they are prerequisite knowledge to higher or advance Mathematics learning.
2. Gender disparity among students in Mathematics education should be discouraged because their knowledge of basic mathematical skills and performance in algebra were not significantly influenced by gender.

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