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UTILIZING MATHEMATICS LANGUAGE APPROACH IN IMPROVING SENIOR SECONDARY ONE STUDENTS' INTEREST IN ALGEBRA IN BENUE STATE, NIGERIA

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Abstract*: This study determined the effect of Mathematics Language Approach on senior secondary one students' interest in Algebra. Quasi-experimental, non-randomized pre-test, post-test control group design was employed. Population of the study was 14,518 SS1 students with sample size of 218 senior secondary one (SS1) students from four schools out of 634 secondary schools in study area. Two Secondary Schools were randomly assigned to experimental and control groups, respectively. Two research questions and two null hypotheses were equally asked and tested respectively. Instrument of the study, Algebraic Process Interest Inventory (APII) was validated by experts and trial-tested using Cronbach Alpha (α) with a reliability coefficient of 0.79. Descriptive statistic of mean and standard deviations were used to answer all the research questions and inferential statistic (ANCOVA) was used to test all the research hypotheses at 0.05 level of significance. It was found that students in experimental group improved upon their interest in Algebra more than students in the control group. This noted improvements was statistically significant with no gender difference. The study recom mended among others that students should be taught mathematical terminologies concerned with mathematic al terms, mathematical symbols, and mathematical structures in detail before problem solving.*

Key words: *Interest, Algebra, Mathematics Language, Understanding, Senior Secondary School.*

Introduction

The word "Algebra" comes from Arabic word "Al-jabar", its origins can be traced to an ancient Babylonians, who developed an advanced arithmetical system with which they were able to do calculations in an algebraic fashion with the use of this system. They were able to apply formulas and calculate solutions for unknown values for a class of problems typically solved today by using linear equations, quadratic equations and indeterminate linear equations (Iji, Okoronkwo &Anyor, 2017). Nneji and Alio (2017) opine that, Algebra is over 46 percent of secondary school Mathematics curriculum content in Nigeria. Algebra is one of the main branches of pure Mathematics, it is concerned with the study of the rules of operations and relations, constructions and concept arising from them, including terms, polynomials and equation in the development of science and technology.

Thus, Algebra is the branch of Mathematics that deals with general statements of relations, utilizing letters and other symbols to represent specific set of numbers, values and vectors among others in the description of such relations (Iji, Okoronkwo & Anyor, 2017). Therefore, National Council of teachers of Mathematics (2015) reported that algebraic concept need to be presented in a context that is meaningful to students. However, in schools, anecdotal evidence suggests that algebra is not usually presented in a meaningful or interesting way, causing students not to enjoy learning the subject. Foster (2007) emphasizes that, if students are taught abstract ideal without meaning, this might not develop their understanding in the subject. Thus, we teach mathematical concepts in so many mathematics courses with the conventional language. Elementary courses include procedural calculations, or rather fewer symbols. By increasing symbols, definitions, theoretical notions; deeper mathematical thoughts are needed in higher level mathematics courses. Is it possible to grasp those higher level mathematics notions without understanding the Mathematics Language? According to Jamison (2000), if students understand how things are said, they can better understand what is being said, and then they have a chance to know why it is said.

Understanding in this context, is the ability to translate words into Mathematical meaningful statements. Translating a realistic problem situation into algebraic models such as formulas, equations and graphs, has a horizontal character. Thus, in order to deal with the algebraic translation of the problem, it is efficient to infer the meaning of the symbols and procedures from the algebraic world that results from vertical mathematization. For example, there are 'x' spectators in a cinema house. After the end of the first film, 20 people left the room but 80 more people entered the room. If the number of people left in the room is 200, how many of them were originally in the room? Hence, this indicates that the total number of spectators in the cinema house were unknown; and the unknown variable is x. Therefore, mathematically $x - 20 + 80 = 200$; thus, when like terms are collected, this must be taken into consideration; that is number crossing the equality side changes it signs; therefore, $x = 200 - 80 + 20$; it shows that $x = 140$. However, getting the clear picture of the variable indicated in the question and translating it into meaningful mathematical statement enhances the logical processes of the problem involved.

Therefore, Krussel in Benson (2015) views language as an essential part of Mathematics construct that is indispensable. Students are therefore likely to face difficulties in solving word problems loaded with difficult and unfamiliar vocabulary. According to Pimm in Benson (2015), Mathematical language has its own vocabulary, which can be roughly divided into three groups. The first group covers the technical terms specific to Mathematics for example, multiplicand, and quadrilateral among others. The next group comprises the technical terms used in Mathematics that also have unrelated everyday meanings with terms such as volume, product and difference. The last group is the Mathematical use of words adapted from similar everyday meanings. In this category are words such as similar, face and area. Mathematical English has several other dimensions, including a specialized syntax, for example the use of words like "and", "a", or "if"; use of symbols (e.g., 3-D); ways of talking and writing (e.g., word problems, writing a solution, giving an explanation; and social factors (e.g., the use of 'we' to refer to people who do Mathematics, as in "We call that a pentagon". The

Mathematics Language has structure, and an implicit knowledge of this structure is essential to the students' interest in the subject. Mathematics Language (ML) is therefore the ability of the students to reflect on and consciously ponder about oral and written language and how it is used in Mathematics (Agbo-Egwu & Abakpa, 2015). Therefore, Mathematics Language is the ability of the students to reflect on oral and written mathematical symbols, terms and phrases as how they are used in a given mathematical context. However, if mathematics language is understood it increases students interest.

Empirically, Interest is a very strong factor in the teaching and learning of Mathematics. The degree and direction of attitude towards Mathematics are largely determined by the kind of interest developed by students for Mathematics. However, Iji *et al.,* (2017) lament that there is a low interest among students in the study of Mathematics and Mathematics related disciplines at all level of education in Nigeria. Therefore, Iji and Obarakpo (2017) asserts that, not only has the lack of interest in Mathematics among many secondary school students been a matter of concern to mathematics educators; but it has been pointed out by many researchers as one of the factors responsible for low achievement of students in Mathematics (Iji & Uka, 2012 & Azuka, 2012).

In view of the cardinal roles, which interest plays in the teaching and learning process as well as in motivating students towards desirable learning outcomes, it has become pertinent for researchers to explore ways and means of engendering student's interest in Mathematics. Ukpebor and Omele (2012) identified four types of interest that go with Mathematics teaching and learning in general. These include Manifested interest, Tested interest, Expressed interest and Inventories interest. Manifested interest goes with students' eagerness or willingness to participate in Mathematics activities. Tested interest is determined by achievement test score in Mathematics. Expressed interest is the verbal declaration of interest in Mathematics activities, whereas inventories interest gives subjective estimate of a student's like and dislike on a large number of items surrounding activities.

However, Unodiaku (2012) attributed factors of academic achievement among secondary school students in mathematics to lack of interest. More so, the failure of students in mathematics achievement was also supported by some authors to be associated with lack of interest in studying the subject (Idigo, 2010 & Goolsby, 2013). According to Idigo (2012), factors associated with mathematics interest include, students' factor, teachers factor, mathematics anxiety, government, lack of infrastructural facilities, lack of instructional materials and problem of large class size.

Moreover, teachers' proficiency will enhance students' interest in mathematics. However, qualification of a teacher is the assurance of the teacher's impulse as well as the determinant of his knowledge, attitude and instructional strategy. A qualified mathematics teacher can easily use different approaches/ methods, styles, illustrations, examples, and improvise materials in teaching students' mathematics concepts, principles or ideas which his counterpart (unqualified mathematics teacher) cannot do. This suggests that student mathematics interest is dependent on qualification of the mathematics teacher. A qualified mathematics teacher can arouse students' interest in mathematics learning and ensure success in the learning of the subject through the use of appropriate instructional strategies in teaching the student. Teachers' effectiveness in any particular subject is an important determinant in that subject (Akinoso, 2011). Therefore, engaging qualified mathematics teachers who is equipped with various instructional strategies in teaching mathematics enhances students' interest to learn mathematics.

A study carried out by Tembe, Anyagh and Abakpa (2020) on Mathematics interest as a correlate of Basic 9 students' achievement in Mathematics in Gboko Metropolis, Benue State, Nigeria. Three research questions were asked and three hypotheses were formulated. The study adopted a correlation design. The population of the study was 3,682 while a sample of 400 Basic 9 students was drawn from ten secondary schools using multistage sampling procedure made up of 200 male and 200 female students. Two research instruments Maths Interest Inventory (MII) and Students Mathematics Achievement Test (SMAT) were adapted. The instruments were validated by three experts and trial-tested, on a population outside the study area. Cronbach Alpha reliability coefficient was used to get the reliability coefficient of MII which was 0.83. While that of SMAT was 0.65 using Kuder-Richardson 21 formula. The research questions were answered using Pearson Product Moment Coefficients and hypotheses were tested at 0.05 level of significance using p-values of Pearson Product Moment Coefficient. The study is similar to the present study seen it looked at mathematics interest and achievement of students as well as the area of the study but differs in design, level of students that formed the group and data analysis. Therefore, this study aimed at finding out if the use of mathematics language approach could enhance senior secondary one students' interest in algebra.

In other to achieve this, the objectives of the study were to:

1. find out the interest of SSI students in Algebra due to their understanding of the complexities in mathematical terminologies in control and experimental groups in Education Zone B in Benue State.
2. determine the interest of male and female SSI students in Algebra due to their understanding of the complexities of mathematical terminologies in experimental group in Education Zone B in Benue State.

Research Questions

The following research questions were asked to provide guide for the study.

1. what is the mean interest ratings of SS1 students in algebra based on their understanding of complexities in mathematics terminologies in the control and experimental group?
2. what is the mean interest ratings of male and female SS1 students in algebra based on their understanding of complexities in mathematics terminologies in the experimental group?

Research Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance.

1. there is no significant difference in the mean interest ratings of SSI students in algebra based on their understanding of complexities in mathematics terminologies in the control and experimental group.

2. there is no significant difference in the mean interest ratings of male and female SSI students in algebra based on their understanding of complexities in mathematics terminologies in the experimental group.

Methodology

The design adopted for this study was quasi-experimental design of pre-test, post-test non-randomized control group. The study was conducted in Education Zone B of Benue State. The population of this study was 14,518 Senior Secondary One Students in 634 secondary schools in Education Zone B in Benue State. The sample size for this study was 218 out of 14,518 SS1 students' in the Zone. This sample was obtained from four schools out of a total of 634 secondary schools in the study area through multi- stage sampling technique. Among the four schools selected, two schools were further selected each and assigned to experimental (E = 106) and control (C = 112) groups respectively. By this arrangement, four classes from four schools were used for both experimental and control groups. To achieve this sample, a multi-stage sampling technique was employed. Purposive sampling technique was used to select the four schools out of 634 secondary schools in the study area.

Also, simple random sampling method was carried out between the four schools selected, and school "A" and "C" was tagged experimental group while schools "B" and "D" was tagged control group respectively. Again, by this method, one stream was selected, each for the experimental and control groups. Thus, the total for experimental group was 106 students (male =65, female = 41) and that of the control group was 112 students (male=67, female=45). Instrument that was used for the study was Algebraic Process Interest Inventory (APII). The Algebraic Interest Inventory was a self-structured fifteen item questionnaire constructed by the researcher which sought to find out the interest of students about Algebra. These items were designed on the basis of a four – points scale. Each positively skewed item was rated on the bases of strongly agreed =4, Agree =3, Disagree =2, and strongly disagree =1, while the rating for the negatively worded items were in the reverse order.

The instrument was given to five experts, two Mathematics educator, one expert in measurement and evaluation from Joseph Sarwuan Tarka University Makurdi, Benue State and two Mathematics teachers in secondary schools. Their recommendations on both face and content validity, and suggestions influenced the final draft. The final draft of APII from 20 items to 15 items was based on experts' suggestions since some items were appearing similar. A trial testing was conducted on 25 SS1 students of World Heart Aflame Secondary School Makurdi who are not part of the sampled school to determine how valid and appropriate, as well as the index of stability (internal consistency) of the instruments of the study. The coefficient of the internal consistency measure for APII was 0.79 using Cronbach alpha. The decision to use Cronbach Alpha was informed by the fact that the instrument APII has no "yes" or "no" answer.

Data collected were subjected to both descriptive and inferential statistics. Research questions were answered using mean and standard deviation. Therefore, any item that was positively worded with a mean rating of 2.50 or above were considered accepted. That was an indication that the student has high interest in Algebra while any item with a mean rating less than 2.5 was not accepted. For the negatively worded items the reverse was the case. Research hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Since ANCOVA is statistically used among other reasons, to test data obtained from an experimental study involving intact groups especially if the researcher is not sure that the intact groups (students in different arms of the same form) are equivalent in certain important respects (e.g intelligence). Hence, pre-testing the sample gives data to determine the covariate with the post-test data. Thus testing the same subjects by administering the treatment and non-treatment conditions removes the bais. Where the p-value was less than the set p-value of 0.05, the null hypothesis was rejected but where the p-value was greater than the set p –value of 0.05, the null hypothesis was not rejected.

Results

Results obtained from this study, is presented according to research questions asked and hypotheses formulated.

Research Question 1

What is the mean interest ratings of SS1 students in algebra based on their understanding of complexities in mathematics terminologies in the control and experimental group?

Table 1: Means and Standard Deviations of Students' Responses on Algebraic Process Interest Inventory (APII)

Group	N	Pre-APII		Post-APII	
		Mean	**S. D**	**Mean**	**S. D**
Experimental	106	1.94	0.14	3.23	0.32
Control	112	1.86	0.16	2.16	0.39
Mean Diff.		**0.08**		**1.07**	
Total	218				

The result as presented in Table 1 shows that in pre-APII, the experimental group had a mean interest rating of 1.94 with a standard deviation of 0.14, while the control group had a mean interest rating of 1.86 with a standard deviation of 0.16. Also, the result shows that the mean interest rating of the experimental group in the post-APII as 3.23 with a standard deviation of 0.39 while the mean interest ratings of the control group is 2.16 with a standard deviation of 0.32. The mean difference in the pre-APII between experimental and control groups is 0.08, while in the post-APII it is 1.07. For each of the groups, the post APII mean interest ratings were greater than the pre-APII mean interest ratings with mean difference of 1.07 in favour of the experimental group. This is an indication that Mathematics Language Approach improved the students' interest in Algebra.

Research Hypothesis 1

There is no significant difference in the mean interest ratings of SSI students in algebra based on their understanding of complexities in mathematics terminologies in the control and experimental group.

Table 2: Summary of Analysis of Covariance of Experimental and Control Groups in Algebraic Process Interest Inventory (APII).

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13966.139[a]	2	6983.070	236.365	.000	.687
Intercept	1998.754	1	1998.754	67.654	.000	.239
Pre-CEII	5.031	1	5.031	.170	.680	.001
GroupCEII	**12727.681**	**1**	**12727.681**	**430.811**	**.000**	**.667**
Error	6351.866	215	29.544			
Total	371763.000	218				
Corrected Total	20318.005	217				

a. R Squared = .687 (Adjusted R Squared = .684)

Table 2 shows that the mean interest ratings of SS1 students taught algebra in the experimental and control groups is F (1, 215) = 430.811, P = 0.000 < 0.05 level of significance and $_{partial}$ = 0.667. The $_{partial}$ = 0.667 means 67% is the proportion of variance in the students' interest due to the use of Mathematics Language. That is, there is significant difference between mean interest ratings of SS1 students' taught algebra using Mathematics Language Approach and those taught using conventional method. Hence, the null hypothesis is rejected.

Research Question 2

What is the mean interest ratings of male and female SS1 students in algebra based on their understanding of complexities in mathematics terminologies in the experimental group?

Table 3: Means and Standard Deviations of Male and Female SS1 Students' responses on Algebraic Process Interest Inventory (APII) in the Experimental Group

Gender	N	Pre-APII		Post-APII	
		Mean	S. D	Mean	S. D
Male	65	1.95	0.14	3.26	0.34
Female	41	1.93	0.15	3.17	0.28
Mean Diff.		**0.02**		**0.09**	
Total	106				

Table 3 shows that in pre-APII, the mean interest rating of male students in experimental group was 1.95 with standard deviation of 0.14, while the mean interest rating of the female students was 1.93 with the standard deviation of 0.15. In the post-APII, the mean interest rating of the male students was 3.26 with standard deviation of 0.34, while the female students mean interest rating was 3.17 with standard deviation of 0.28. The male and female students Pre-APII mean interest rating difference is 0.02, whereas their Post-APII mean interest rating difference is 0.09.

Research Hypothesis 2

There is no significant difference in the mean interest ratings of male and female SSI students in algebra based on their understanding of complexities in mathematics terminologies in the experimental group.

Table 4: Summary of Analysis of Covariance of Male and Female SS1 students in Algebraic Process Interest Inventory (APII)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	65.367[a]	2	32.683	1.387	.255	.026
Intercept	1546.520	1	1546.520	65.619	.000	.389
MFPTEII	12.459	1	12.459	.529	.469	.005
GenderII	**55.260**	**1**	**55.260**	**2.345**	**.129**	**.022**
Error	2427.539	103	23.568			
Total	250572.000	106				
Corrected Total	2492.906	105				

a. R Squared = .026 (Adjusted R Squared = .007)

Table 4 shows that the mean interest rating of male and female SS1 students taught Algebra using mathematics language in the experimental group is F (1, 103) = 2.345, P = 0.129 > 0 .05 level of significance with $_{partial}$ = 0.022. The result shows an equally higher increase in both male and female students' interest in algebra among the experimental group students in the study. Hence, the null hypothesis of no significant difference between mean interest ratings of male and female SS1 students taught algebra using mathematics language teaching approach as measured in APII is not rejected.

Discussions of Findings

The study found that the use of Mathematics Language Approach in teaching algebra improved students' interest during the period of this study. This may be as a result of students' active participation in learning during Mathematics classes. This improvement was found to be statistically significant. This finding supports the earlier studies of Iji, Okoronkwo and Anyor (2017) who found that students taught algebra with the use of Igbo language as a medium of instruction respectively showed significantly higher interest than students taught same concepts using conventional method. The finding of this study shows that the use of Mathematics Language teaching approach in teaching algebra is more effective in improving students' interest than conventional method.

The study further found out that the use of Mathematics Language Approach in teaching algebra improved both male and female students' interest with the male having a mean difference of 0.09 over the female. This difference was however not significant in the test of hypothesis. That is, there was no significant gender difference in students' interest. This result agrees with that of Iji, Okoronkwo and Anyor (2017) who found no significant difference in the interest, achievement and retention of male and female students taught Algebra with the use of Igbo language as a medium of instruction.

Recommendations: Based on the findings of this study, the following recommendations are made.

1. It is important for teachers to apply general language instructional techniques to mathematical language on a regular basis.
2. Mathematics teachers should focus on students' understanding of mathematical terminologies in mathematics education.

Conclusion

Based on the findings of the study it was concluded, that the use of Mathematics Language Approach in Mathematics teaching and learning significantly improved students' interest with no gender difference. This implies that the use of Mathematics Language teaching approach is more effective in stimulating students' learning needs and closing gender gap in teaching algebraic concepts than using conventional approach.

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