

Effects Of Mathematics Language On Junior Secondary Two Students' Attitude Towards Mathematics In Bauchi Metropolis, Bauchi State

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Abstract

The study investigated the effect of mathematics language on Junior secondary two students' attitude toward mathematics. The study adopted quasi-experimental design, which involved non-equivalent pre-test and post-test design. It concerns the use of two intact classes, as experimental and control groups. The population of the study consisted of junior secondary school students in Bauchi Metropolis of Bauchi State Nigeria. There are eighty (80) Junior Schools in Bauchi Metropolis with a total of 14,828 students. A sample of 2 Schools were drawn with a total of 118 students. School A as the experimental and school B the control group. two research questions were developed and two hypotheses were used for the study. A purposeful and simple random sampling technique was used to draw the sample of the study. The instruments used for the study were Students' Attitude towards Mathematics Questionnaire (SAMQ) and Mathematics Sign and Symbols questionnaire (MSSQ). Descriptive statistics (mean scores and standard deviation) were used to answer the research questions. The hypotheses were tested using ANCOVA at the 0.05 level of significance through the Statistical package for social sciences (SPSS). It was discovered that mathematics language does change students' attitude positively towards mathematics. It was also found out that male students had a more positive attitude towards mathematics than their female counterparts when taught using mathematics language.

Keywords: Mathematics Language, Students' Attitude, Gender

INTRODUCTION

The place of Mathematics in the current Nigerian System of Education has been a priority at all levels of educational curriculum. Mathematics is offered as a compulsory subject for all students in primary school and secondary school levels. Teaching of mathematics using mathematics language and signs to be understood by learners has become necessary in the present age of technological revolution. This is because Mathematics as a subject is considered as the pillar of any scientific program. It's also regarded as Queen and Servant of natural sciences in the disciplines of Physics, Chemistry, Biology, Economics and other social sciences. It has become necessary for students to understand the subject and the language effectively so as to be well-equipped with the knowledge of mathematics. The course is considered as a life-wire of scientific undertaking, which students should master prior to their engagement in any scientific tasks (Mohammed, 2012; & Odili, 2006).

Mathematics functions in the development of any society, it is a fascinating subject and its teaching and learning in secondary school becomes important for Nigeria's technological advancement. Its value in learning and knowledge of other subjects, especially the science-based subjects cannot be over emphasized. Mathematics has been viewed as the mother and language of the science subjects which affects all aspects of human life. It is in the realization of the vast application of mathematics that made Ephram and Habila (2016) to state that a disciplined and ordered pattern of life can only be achieved through the culture of mathematics.

The mathematics curriculum has been designed by the comparative education study and adaptation centre (CESAC) to meet the requirements of mathematics in the new system. The guiding principle of this curriculum is the need to equip secondary school students with the basic knowledge and skills that will enable them to better appreciate the nature of mathematics problems in any society.

Mathematics plays a great role towards national development and yet the state of achievement in this subject at the secondary school level which incidentally serve as the foundation for advanced learning and professional course in fields such as accounting, statistics, engineering as well as other science and social science related courses which has now been a serious concern in Nigeria (Attah & Adebayo, 2018, Awolafa, 2017). The poor level of achievement in mathematics is a major concern among Nigerian parents, students and government. In the light of this weak achievement of students at the end of each academic session examinations, it is a common knowledge that students in various institutions of learning actually graduate but with low grades, this can be attributed to various factors such as teachers' related factors, students' related factors, school environment related factors, instructional materials (Wakjissa & Gizaki, 2022).

Recently, some educationists, the general public and stakeholders in education expressed concern on the poor academic achievement of students in mathematics. Researchers have advocated for the teaching of mathematics like any other school subject to be done using a language best understood by the learners if the basic concepts, principles and laws of mathematics are to be meaningful to children, and their attitudes toward the subject must also be put under consideration for any reasonable achievement in the subject. In the same vein, teachers who are the key factor in the success of any educational endeavors must put mathematics language and the students' attitude into consideration as long as they want to make a positive impact on the students' achievement in mathematics (Haruna, 2019).

The teaching and learning of mathematics, like any other subject, requires that both the teacher and learner communicate effectively in mathematical language and develop a positive attitude toward mathematics. This may be the reason why researchers (Mulwa, 2014, & Benson, 2015) posited that learning language involves 'learning how to mean'. Mathematics as a distinctive discipline, has a defined language and the

language involves learning how to make and share mathematical meanings using language appropriate to the context, which is more than recognizing and responding to words in isolation. This in turn demands the use of appropriate language (words and symbols) whose level of difficulty is suitable to the cognitive abilities of the learners concerned. The instructional Communication of mathematical ideas is adequately understood and less difficult when the teacher and learner have a common first language, but the problem is acute when their preferred language differs (Haruna, 2019).

The primary function of language in mathematics instruction is to enable both the teacher and the learner to communicate mathematical knowledge with precision. In order to realize the objectives of mathematics instruction, teachers and textbook authors need to use a language whose structure, meaning, technical vocabulary and symbolism can be understood by learners of a particular class level (Idriss, Aliyu, Waziri & Adamu, 2020, Benson, 2015). All signs and symbols must be well defined so that the students will make meaning out of it. The communication of meaning frequently involves interpretation on the part of the receiver and this should warn us that messages could be given incorrect interpretations.

Attitude is one of the most conspicuous aspects of the entire social life. Experts in the field of education are aware of the crucial role of attitudes in the overall educational development of an individual (Tseblong, Mawak & Kanda, 2023, Gurefe, 2018). Attitude toward mathematics can be referred to as a positive or negative emotional disposition toward mathematics. Attitudes play a crucial role in Mathematics since it has always been perceived as one of the most difficult subjects to study (Tahir, Ismail, Zamani & Adnan, 2013). Psychologists pointed out that the attitude of students toward Mathematics is learned in basic education. Since the elementary education teachers are influential in the formation of these attitudes, they should be knowledgeable in the effect of attitudes toward studying Mathematics. Once if the teacher has a positive or negative attitude towards mathematics it may go a long way to affect the pupils. Considering this, what kind of attitude are they going to impart to their elementary pupils? Will it contribute to low quality of education and low achievement in Mathematics? And since according to psychologists, positive and negative attitudes of students in Mathematics are developed at the early stages of their life, will it mean that the attitude of teachers will be acquired by their pupils? Based on the above premises, the researcher wants to find out students' attitudes toward Mathematics and its effect on their achievement.

Moreover, researches (Ozofor, & Onas, 2018), revealed that female students fear mathematics more than male students, to the extent that, it is believed that mathematics is masculine and therefore should be a male dominating subject, this goes with the general believe that boys are more superior to girls in terms of physique, cognition and logical reasoning and even superior in terms of academic achievement. This negative belief has limited the female gender when it comes to the study of mathematics and other science related courses but with the exception of few females that have excelled in this field of study.

Theoretical Framework

This study is anchored on Vygotsky's Sociocultural Theory, developed by Lev S. Vygotsky (1978). The theory emphasizes that learning occurs through social interaction and that language serves as the principal cultural tool through which knowledge is constructed and communicated. According to Vygotsky, learners develop higher-order thinking skills when they interact with teachers, peers, and instructional materials using meaningful language. He further introduced the concept of the Zone of Proximal Development (ZPD), which explains that learners achieve greater understanding when supported through guided instruction and collaborative learning.

In mathematics, the language used by teachers plays a significant role in shaping learners' understanding of mathematical concepts. Mathematics possesses a specialized language consisting of symbols, vocabulary, expressions, and representations that learners must understand to communicate mathematical ideas

effectively. When teachers use clear, accurate, and learner-friendly mathematical language, students are better able to comprehend mathematical concepts, participate actively in classroom discussions, and develop confidence in learning mathematics. Consequently, positive classroom experiences foster favorable attitudes towards the subject. Conversely, ambiguous or overly technical mathematical language may create confusion, frustration, and anxiety, leading to negative attitudes toward mathematics.

The theory's relevance to this study lies in its recognition of language as the foundation of learning and meaning-making. The theory explains that students' attitudes toward mathematics are influenced by the quality of linguistic interactions that occur during instruction. As teachers explain concepts, ask questions, provide feedback, and encourage mathematical discussions, students gradually internalize mathematical ideas and develop positive dispositions toward the subject. Therefore, effective use of mathematics is expected to enhance students' engagement, confidence, and attitude toward mathematics.

The aim of this study is to determine the effect of mathematics language on junior secondary two students' attitude toward Mathematics in Bauchi metropolis of Bauchi state. The specific objectives are:

1. Identify the attitude of students taught mathematics using mathematics language and those taught without using mathematics language.
2. Determine the attitude of students taught mathematics using mathematical language based on gender.

RESEARCH QUESTIONS

The following research questions were formulated to guide the study:

1. What is the mean attitude score of students towards mathematics in Junior Secondary School Students in Bauchi Metropolis?
2. What is the mean attitude score of male and female students in mathematics in the experimental group in Junior Secondary Schools in Bauchi Metropolis?

HYPOTHESES

The following hypotheses are formulated to guide the study.

1. There is no significant difference in the mean attitude score of students in mathematics.
2. There is no significant difference in the mean attitude score of male and female students in mathematics after exposed to treatment

METHODOLOGY

This study adopted a quasi-experimental design, which involved non-equivalent pre-test and post-test design. It concerns the use of two intact classes, for experimental and control groups. The population for this study consisted of Public Junior Secondary Schools in Bauchi Metropolis. There are eighty (80) Junior Schools in Bauchi metropolis with a total of 14,828 students. A sample of 2 Schools were drawn using purposeful sampling technique and simple random sampling with a total of 118 students. School A was used as the experimental group and School B was used as the control group.

The instrument used for the study was; Students' Attitude towards Mathematics Questionnaire (SAMQ) attached with some Mathematical Signs and Symbols (MSS). Descriptive statistics (mean scores and standard deviation) were used to answer the research questions. The hypotheses were tested using ANCOVA at the 0.05 level of significance through the Statistical package for social sciences (SPSS).

Administration of Pretest, treatment and posttest.

The pretest was administered on both the experimental and control groups. The students were given the

Mathematical Sign and symbols questionnaire to fill-in by writing down the meaning of sign and symbols. It scored over 100 and the students' attitude questionnaire was also given to the two groups to fill-in which will reveal their attitude toward mathematics. The data of each group were recorded and kept for future use.

Six weeks was used for the treatment on an experimental group using mathematics language. Every mathematical term, signs and symbols were defined and explained in detail and are being differentiated from normal day to day usage. Four different periods of 40 minutes each week were used as contained in the school time table with the help of a research assistant. The treatment was withheld from the control group. The control group were taught using the conventional method

At the end of the treatment, the posttest was conducted on the experimental and control groups in order to ascertain the effect of mathematics language on the students' attitude towards mathematics. The posttest questionnaires is the same with the pretest questionnaire and the same Mathematics sign and symbols questionnaire was re-administered to the students to determine the effect of the treatment on the experimental group and the pretest and posttest were scored over 100, thereafter, the pretest and posttest mean scores were compared to find the differences in the students' achievement mean score of the experimental and control groups likewise the Mathematics Sign and Symbols questionnaire.

RESULTS

Research question one

- What is the mean attitude score of students towards mathematics in Junior Secondary School Students in Bauchi Metropolis?

Table 1

Pretest and Post-test Attitude Mean Score of Mathematics Students in the Experimental and Control Groups

Group	Before			After		Mean Gain	$\bar{x}$ - difference
	N	Mean	SD	Mean	SD		
Experimental	62	26.15	11.61	59.90	8.82	33.75	28.62
Control	56	25.23	12.75	30.36	9.67	5.13	

Table 1 reveals the pre-test and post-test attitude mean score of students in the experimental and control groups. From the result, the experimental group had a post-test mean score of 59.90 and a standard deviation of 8.82 higher than the pre-test mean score ($\bar{x}$ = 26.15; SD = 11.61) with a mean gain of 33.7, indicating that there was positive change in the attitude of students towards Mathematics after treatment. Also, for the control group, the mean score was 25.23 and a standard deviation of 12.75 at the pretest. However, in the post-test the mean score of students increased to 30.36 and a standard deviation of 9.67. The findings show that students in the experimental group had a higher attitude mean score (59.90) after exposure to mathematics language than those in the control group (30.36) who were not given treatment with a mean difference of 28.62. This means that at the pre-test the students in both groups had a negative attitude towards mathematics, but after the intervention the experimental group had a more positive attitude than the control group. It can be deduced that exposure to Mathematics language do change

students' attitude positively towards Mathematics.

Research Question two

- What is the mean attitude score of male and female students in mathematics in the experimental group in Junior Secondary Schools in Bauchi Metropolis?

Table 2

Result of Pre-test and Post-test Attitude Mean Score of Male and Female Students in Mathematics in the Experimental Group

Group	Gender	N	Pretest		Posttest		Mean Gain	$\bar{X}_{Diff}$
			$\bar{x}$	SD	$\bar{x}$	SD		
Experimental	Male	40	23.18	7.89	60.05	9.33	36.87	8.78
	Female	22	31.55	15.12	59.64	8.01	28.09	

Table 2 shows the result of the pre-test and post-test attitude mean scores of male and female students in the experimental group. The pre-test attitude mean scores for the experimental group was 23.18 and a standard deviation of 7.89 for male students, while the females had a mean of 31.55 and standard deviation of 15.12. The table recorded a post-test attitude mean score of 60.05 and a standard deviation of 9.33 for male, while the female recorded a post-test attitude mean score of 59.64 and a standard deviation of 8.01. The result indicates that the attitude mean gain score of male students is 36.87 and that of female students is 28.09 with a mean difference of 8.78. This implies that male students had a more positive attitude towards Mathematics than their female counterparts when taught using Mathematics language.

Hypothesis One

There is no significant difference in the mean attitude score of students taught mathematics using mathematical language and those taught without.

Table 3

ANCOVA Result on Post-test Attitude Mean Scores of Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	25848.382 ^a	2	12924.191	152.879	.000	.727
Intercept	38719.721	1	38719.721	458.011	.000	.799
Pre-achievement	162.319	1	162.319	1.920	.169	.016
Group	25495.495	1	25495.495	301.584	.000	.724
Error	9721.957	115	84.539			

Total	283972.000	118
Corrected Total	35570.339	117

a. R Squared = .727(Adjusted R Squared = .722)

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference exists in the post-test attitude mean score of students in Mathematics in experimental and control groups. Table 3 shows that $F(1, 115) = 301.58$, $p < 0.05$, partial $\eta^2 = .724$, since the p -value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant effect of mathematics language on students' attitude in Mathematics. The result further reveals an adjusted R squared value of .722 which means that 72.2 percent of the variation in the dependent variable which is the attitude of students towards Mathematics is explained by variation in the treatment, while the remaining is due to other factors not included in this study. Hence, we can say that mathematics language can help change students' attitude towards Mathematics.

Hypothesis Two

There is no significant difference in the mean attitude score of male and female students towards Mathematics after exposure to treatment.

Table 4

ANCOVA Result on Post-test Mean Attitude Scores of Experimental Group towards Mathematics based on Gender

Source	Type III Sum of Squares	Df	Mean Square	F	P-value	Partial Eta Squared
Corrected Model	10.663 ^a	2	5.331	.066	.936	.002
Intercept	30476.125	1	30476.125	379.74	.000	.866
Pre-test	8.235	1	8.235	.103	.750	.002
Gender	.215	1	.215	.003	.959	.000
Error	4734.756	59	80.250			
Total	227226.000	62				
Corrected Total	4745.419	61				

a. R Squared = .010 (Adjusted R Squared = -.094)

The data on the attitude of students towards Mathematics were subjected to analysis of covariance (ANCOVA) having male and female in the experimental group. The main effect of male yielded ($\bar{X} = 60.05$; $SD = 9.33$) and female ($\bar{X} = 59.64$; $SD = 8.01$); $F(1, 59) = .003$, $P > 0.05$, partial $\eta^2 = .000$. Since the p -value of 0.959 is greater than the 0.05 level of significance, the null hypothesis was retained. This indicates that the attitude of male students in Mathematics do not significantly differ from those of female students. It means that students' attitude towards Mathematics is not affected by gender.

DISCUSSION

On research question one which is what is the attitude of students taught mathematics using mathematics language and those taught without. Table 1 reveals that the experimental group had a high post-test mean score and a standard deviation compared to their pre-test mean score, indicating that there was positive change in the attitude of students towards Mathematics after treatment. Also, for the control group, they also had little increase on their mean score and standard deviation between the pre-test and post-test result. The findings show that students in the experimental group had a higher attitude mean score after exposure to mathematics language than those in the control group who were not given treatment with a high mean difference. This means that at the pre-test the students in both groups had a negative attitude towards mathematics, but after the intervention the experimental group had a more positive attitude than the control group. It can be deduced that exposure to Mathematics language do change students' attitude positively towards Mathematics.

The result of the attitude of male and female students in the experimental group is shown in table 2 which is the answer to research question 2. Comparing attitude mean scores for experimental group (male and female), and the standard deviations of both pre-test and that of post-test. The gains each group (male and female) gets on the mean score and the standard deviation. The result indicates that the attitude mean gain score of male students is higher than that of female students which implies that male students had a more positive attitude towards Mathematics than their female counterparts when taught using Mathematics language.

From the findings of this study, exposing students to the mathematics language does change their attitude positively towards mathematics in Bauchi metropolis. Moreover, the finding also discovered that male students had more positive attitude towards mathematics than their female counterparts when taught using mathematics language.

CONCLUSION

From the findings of this study, it was discovered that when students are exposed to mathematics language it does change their attitude positively towards mathematics in Bauchi metropolis. Moreover, the finding also discovered that the male students had more positive attitude towards mathematics than their female counterparts when taught using mathematics language.

The study concluded that, teaching mathematics using mathematics is one of the effective approaches of teaching the subject. Students do develop positively towards mathematics when taught Mathematics using mathematics language.

RECOMMENDATIONS

The following recommendations were made based on the findings of the study:

1. Employ well trained mathematics teachers that would teach Mathematics language effectively.
2. Mathematics teachers should be motivated and encouraged to attend seminars and workshops where new instructional strategies and approaches to teaching mathematics are promoted so as to advance beyond the traditional methods of instruction.
3. Bauchi State Government and stakeholders on education should Provide fully equipped mathematics laboratories in schools with relevant teaching materials that would help students to understand mathematics language correctly.
4. Putting the right peg in the right hole, a Mathematics Teacher should be someone that studied mathematics education, who is taught the correct interpretation and usage of mathematical signs

and symbols, ideas and representation in the teaching- learning context. Using them appropriately and efficiently in communicating mathematics language to the students.

5. Teachers of Mathematics should ensure that Mathematical language required in any particular Mathematics topics are identified and taught prior to the application in the relevant lesson.

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