Article 12

Mathematical Language Skills as Correlates of Students' Academic Achievement and Attitude Toward Mthematics in Senior Secondary Schools in Taraba State, Nigeria

Relevance and Implications for the Ethiopian Landscape

IORTYER, Abraham Terfa and HAYATU, Ibrahim Gengle

Abstract

The study investigated mathematical language skills as correlates to students' academic achievement and attitude toward mathematics in senior secondary schools in Taraba State, Nigeria. Two research objectives, two research questions and two null hypotheses were formulated to guide the study. The study adopted correlational survey research design. The population of the study was 2220 students consisting of 1008 male and 1012 female of Jalingo education zone. A sample size of 339 students from nine schools was selected for the study. The study employed purposive sampling techniques to select nine schools out of 52 public secondary schools within Jalingo education zone. The study also employed simple random sampling techniques to select 339 SSIII students from the nine schools in Taraba state. The instruments used for data collection were the Students Mathematical Language Skills Test (SMLST), Attitude Toward Mathematics Inventory (ATMI) and a Mathematics Achievement Proforma (MAP). Cronbach Alpha statistics was used to obtain the reliability of 0.74 through pilot testing for SMLST. Similarly, Kendall'tau correlation coefficient of concordance was used to obtain the reliability of 0.88 through pilot testing for ATMI. Mean and standard deviation were used to answer research questions while, Pearson product moment correlation was used to test hypotheses at 0.05 level of significance. The results of the study indicated that mathematical language skill was moderate with a grand mean of 23.03, so also the students' academic achievement and attitude toward mathematics results with a grand mean of 48.04 and 3.19 respectively. Also, mathematical language skills significantly correlated academic achievement in mathematics with the r- value of 0.335. The result also shows that students mathematical language skills significantly correlated with attitude toward mathematics with the r- value 0.208, P = 0.00 all through. Based on the findings, it was concluded that mathematical language skills significantly correlate students' academic achievement and attitude toward mathematics in senior secondary school III in Jalingo education zone. The study recommended among others that since mathematical language significantly correlate academic achievement, the teachers of mathematics should be suitably trained in the art of using mathematical language for teaching students and hence affects their academics positively. Also, teachers should be trained on how to properly use mathematical language while teaching the students there by making them to develop positive attitude toward the subject.

Keywords: Mathematical Language, Academic Achievement, Attitude Toward Mathematics

IORTYER, Abraham Terfa, Government Day Senior Secondary School Jauro-Yinu, Taraba State Teaching Service Board, Jalingo, Nigeria.

HAYATU, Ibrahim Gengle, Department of Physical SciEducationences , Faculty of Education, Modibbo Adama University, Yola, Adamawa State, Nigeria

12-IJTETV6Jan101_p108-118.indd 108 16-01-2026 21:40:31

Introduction

Mathematics being the pivot of science is an essential component of every human culture, as every civilized society makes use of mathematics. Momozoko, Audu and Niyi (2022) opined that mathematics evolved in response to the needs of pre-history societies and that as people lived together, their interaction created problems that needed practical solutions. Activities such as trading, building of houses, working on farms, all of which had their attendant problems that found solutions in mathematics. Mathematics is a branch of science, which deals with numbers and their operations. It involves calculations, computations and solving of numerical problems. Jayanthi (2019) refers to mathematics as the Queen of sciences and very essential to the growth of many other disciplines. Mathematics plays a significant role in the national development of every nation of the world. From ancient civilization (Egyptian, Greek & Roman), mathematics has been found to be the foundation for the educational thoughts and general development. Mathematics has an enormous impact on science and society, and it is shaping our world in many ways. Sunita (2019) posited that where there is no mathematics, there is no science, where there is no science there is no technology and that the absence of technology implies absence of development. Mathematics reveals hidden patterns that help us to understand the world around us. Mathematics is a diverse discipline that deals with data, measurements and observations from science, with inference, deduction, and proof; and with mathematical models of natural phenomena, of human behavior, and of social systems. Mathematics makes its contribution to the advancement of science and technology by solving real-world problems such as designing new medical treatments, improving transportation system and developing more energy sources. Mathematics is one of the important sciences that cannot be dispensed with, and the individual's needs for mathematics is not less than the need of society.

However, academic achievement of secondary school students in mathematics has been consistently poor despite the importance of Mathematics in human and societal development. The students' poor academic achievement in Mathematics is not just a concern for particular countries but has become a global concern over the years (Slakaloba, 2024). According to WAEC Chief Examiners' Report (2020), only 39.8% of the students who sat for examination passed Mathematics with credit grade and above. Njoroge (2014) also decries the poor achievement in Mathematics despite the fact that it is one of the key subjects expected to turn Nigeria into an industrialized country. Achievement in Mathematics has been generally poor due to various factors (Ramari, 2014). The situation in Taraba State is worrisome, despite the prerequisite for a credit in mathematics for university admission, secondary schools in the state exhibit alarming low proficiency in the subject, as evidence by their performance in external examinations such as those conducted by WAEC from 2016- 2021.

Several reasons have been given to account for these variations in achievement in Mathematics. Some authors like Dugger (2014) attribute it to unfair distribution of qualified teachers in the country; while Slakaloba (2024) states that the root cause of poor achievement in Mathematics, is that Mathematics teachers are poorly prepared. Ma and Kishor (2017) have attributed the poor achievement of students in Mathematics to the fact that the subject is difficult. Poor mathematical language skills by students (Barwell, 2015). Some other researches such as Ma and Kishor (2017) have attributed students' attitude towards Mathematics as a major factor that might influence the achievement of the students.

12-IJTETV6Jan101_p108-118.indd 109 16-01-2026 21:40:31

Mathematical language skills being the foundation for students' academic achievement in mathematics is a universal language that ensures mutual communication between individuals through concepts, terms and grammars (Barwell, 2015). The language of mathematics is an important individual skill to allow understanding mathematical structures. The use of mathematical language involves the interpretation of mathematical concept by students to reflect their explanation on the ways they attain correct and incorrect answers when solving problem in mathematics (Hornburg, Schmitt & Purpura, 2018). Achieving an effective teaching of mathematics is only possible by using the language of the field of mathematics that ensures the accurate transmission of mathematics. The effective and accurate use of language is also highly important for individuals to explain what they understand and perceive, to develop the mutual communication between the student and teacher and to comprehend mathematical expressions. Students can only establish an effective communication when they are able to speak in mathematics language. As most of the terms and concepts of mathematics are inexistent or rarely seen in everyday life, students are often unfamiliar to mathematics concept and even teachers struggle to conceptualize their own thinking of mathematics concepts (Mahere & Powell, 2013). If the teacher fails to use correct concepts and terms when teaching to students the content of a lesson, students may perceive it in a different way or even attribute an incorrect meaning. Hence the students attribute the same meaning to meaning to different mathematical expressions explained by the teacher. Misusing the language of the mathematical field will entail a poor communication between the student and the teacher, leading students, in the longer term, to conceptual errors for not being able to properly structure concepts in their minds. This is why mathematics lessons require that language should be used in accordance with mathematical knowledge. Studies revealed that there are at least three main sources of students' challenges using mathematical concepts which include mathematical language, image and notation, (Alkhateeb, 2019).

In addition, attitude is a central part of human identity, everyday people love, hate, like, dislike, favour, oppose, agree, disagree, argue, persuade etc. All these are evaluative responses to an object. Hence attitudes can be defined as "a summary evaluation of an object of thought" (Florin, 2020). They are inclinations and predispositions that guide an individual's behaviour (Riboroso, 2019)). The attitude of students towards mathematics has been the subject of a great deal of attention from educators (Goldin, Hamula & Zan, 2016). A student with positive attitude towards mathematics tends to enjoy the subject, understand its values and have confidence in it. Many students look at mathematics as a difficult and abstract subject which they can never comprehend no matter the effort they put in to learn. Some perceived mathematics as an exhausted and effortful subject that triggers fear and anxiety state (Arenillo & Cruzado, 2014). Naturally, the student's response can be on a continuum of positive to negative or good to bad. Attitudes towards learning are important factors on the learner's level of goal setting, problem solving abilities, their beliefs towards learning, their inner and external motivations in the process of learning and all the academic achievement they attain. It is essential to mention that attitude is considered a psychological construct. This means you can see the consequences of the attitude but not the attitude itself. In other words, the behavior is observed to determine the attitude. For example, a child who refuses to follow orders provides evidence that they have a bad attitude. Arenillo and Cruzado (2014) itemized different aspects of students' attitudes in mathematics as follows: Perception of difficulty, mathematical language skill, teaching methods, relevance to daily life, belief in ability and peer influence. It is important to balance assessment practices and provide opportunities for intrinsic motivation, curiosity, and deep understanding of mathematical concepts ensuring that students

12-IJTETV6Jan101_p108-118.indd 110 16-01-2026 21:40:31

have good attitude to mathematical language skills. To promote a positive attitude towards mathematics, it is crucial to address the use of language of mathematics in teaching and learning. Therefore, the study determined mathematical language skill as correlate to students' academic achievement and attitude toward mathematics in senior secondary schools in Taraba State, Nigeria.

Statement of Problem

In an ideal situation, mathematics should be a subject accessible to all students, regardless of their background or career aspirations. It should serve as a foundation for developing critical thinking and problem-solving skills that are valuable in various professions. However, there is a trend of poor achievement in mathematics, which perpetuates the misconception that mathematics is only for a selected few (Siringi, 2010). In Jalingo education zone of Taraba State, Nigeria, the situation is particularly dire. Despite the prerequisite for a credit pass in mathematics for university admission, secondary school students in the state exhibit alarmingly low proficiency in the subject, as evidenced by their performance in external examinations such as those conducted by WAEC from 2016 to 2021.The result shows that 46.95% of secondary school students passed mathematics in WAEC in Taraba State in the year 2016, 41.70% in 2017, 38.41% in 2018, 49.65% in 2019, 34.25% in 2020 and 41.36% in 2021. Several interrelated factors contribute to this predicament, including the quality of learners, pedagogical methods that fail to resonate with students' experiences, teacher-centered instructional approaches, poor mathematical language skills and a dearth of innovative teaching practices. Similarly, poor attitude of students towards mathematics is another worrisome menace that often builds barriers between mathematics and the students. The factors responsible for the poor attitude towards mathematics according to Tsabalala (2013) includes poor teaching method, poor mathematical language skills, inadequate qualified teachers, teachers' relationship with students and inadequate teaching materials. To address the challenges of poor academic achievements and negative attitude towards mathematics among students in Jalingo education zone, the study investigated mathematical language skills as correlates of students' academic achievement and attitude toward mathematics in senior secondary schools in Jalingo education zone in Taraba State, Nigeria.

Purpose of the study

The purpose of the study was to investigate mathematical language skills as correlates of students' academic achievement and attitude toward mathematics in senior secondary schools in Jalingo education zone in Taraba State. Specifically, the study is designed to achieve the following objectives:

1. To determine the correlation between skills in mathematical language and students' academic achievement in Jalingo Education zone
2. To determine the correlation between skills in mathematical language and students' attitude toward mathematics in Jalingo Education zone

12-IJTETV6Jan101_p108-118.indd 111 16-01-2026 21:40:31

Research Questions

The study is guided by the following research questions

1. What is the mean academic achievement score of students in mathematics language skills in Jalingo Education Zone?
2. What is the mean attitude rating of students in mathematical language in Jalingo education zone?

Hypotheses

The following null hypotheses were formulated to guide the study.

1. Ho_1: There is no significant correlation between skills in mathematical language skills and students' academic achievement in Mathematics in Jalingo Education Zone
2. H_{O2}: There is no significant correlation between mathematical language skills and students' attitude toward mathematics in Jalingo Education

Methodology

The study adopted a correlational survey research design. The population of the study was 2220, comprising of 1008 male and 1012 female SSIII students offering mathematics in Jalingo education zone in Taraba State. A sample size of 339 students from nine schools selected for the study using purposive and simple random sampling techniques. The study employed purposive sampling techniques to select nine schools out of the fifty-two public secondary schools within Jalingo education zone on the basis that the school is having WAEC center and either B.Sc (Ed) or B. Tech (Ed) mathematics with teaching experience not less than five years. The study also employed simple random sampling techniques to select 339 SSIII students from the nine schools. Three instruments were used for the purpose of data collection. They are Students Mathematical Language Skill Test (SMLST), Attitude Towards Mathematics Inventory (ATMI) and a Mathematics Achievement Proforma (MAP). The Students Mathematical Language Skills Test was adapted from (Rodriguez, 2018), the Attitude Towards Mathematics Inventory was adapted from (Taban, 2020) while the Mathematics Achievement Proforma was prepared by the researcher and used for collecting achievement scores of students in first, second and third terms. Students Mathematical Language Skills Test **(**SMLST) was adapted from Rodriguez (2018) as it was slightly modified to meet the present research purposes. The instrument contains 25 items each in the form of fill in the blank spaces for both mathematical languages. A scoring key of two marks per each item was prepared for the purpose of scoring the right answer for each item. The Attitude Towards Mathematics Inventory (ATMI) was adapted from Taban (2020) and was slightly modify to meet the research purposes. The ATMI comprised of two sections- Section A and B. Section A contains information about the subject, name of school and local government area while, section B has two sections for convenience considering the limit; covering student's attitude towards mathematics. The student's attitude was rated using a four points Like-type rating point wherein one was the lowest and four was the highest. The four Like-type rating point response options are Strongly Agreed (SA) = 4 Points, agreed (A) = 3 points, Strongly Disagreed (SD) = 2 points and Disagreed (DA) = 1 point. The Mathematics Achievement Proforma was prepared by the researcher and used to take students' scores in terminal examination of the

12-IJTETV6Jan101_p108-118.indd 112 16-01-2026 21:40:31

mathematics students. It was used to collect already existing scores from the students via their mathematics teachers' record books for the immediate past academic session (SSII). Each MAP gave the scores of first term, second term and third terms. These scores were converted to standard scores (Z-scores) and used as mathematics achievement for this study.

The instruments were given to four experts for validation. Two experts from the department of Physical Science Education, Modibbo Adama University, Yola. One from mathematical science department, Modibbo Adama University, Yola. And one expert from the department of Educational Foundation, Taraba State University, Jalingo. Content validation was done on the skills test, while construct validation was done on Attitude. Corrections were made on the instruments after the validation and subsequently taken for pilot testing. The instruments were subjected to a trial test by administering it to 30 SS3 students of Government Day Senior Secondary School, Mutum- Biyu, Gossol L.G.A of Taraba State. Cronbach alpha statistic at 0.05% level of confidence for instruments that are questionnaire was used to test the reliability of Attitude Toward Mathematics Inventory (ATMI) and the result obtain was 0.74. Similarly, Kendall' tau correlation coefficient of concordance was used to test the reliability of Students Mathematical Language Skills Test (SMLST) and the result obtained was 0.88. The instruments were administered on the SS3 mathematics students by the researcher with the help of three research assistants and the various schools' mathematics teachers. The researcher also identified and visited the selected schools. After each school's identification and visitation, the instruments for data collection were given to the various assisting mathematics teachers. The purpose and procedure for students' participation was explained to the various mathematics teachers. Collation of all instruments from the various local governments within the zone was done with the help of the mathematics teachers. The data collected were analyzed using mean and standard deviation to answer research questions, while Pearson Product Moment Correlation statistic was used in testing the hypotheses at 0.05 level of significant.

Results

Research Question 1

What is the mean academic achievement score of students in mathematics language skills in Jalingo Education Zone?

Table 1 shows the mean and standard deviation of students' academic achievement in mathematics among 339 students in the Jalingo education zone. The mean academic achievement score is 23.03, with a standard deviation of 7.52. This indicates that students' mathematical language skills are below average. The standard deviation indicates the spreading of their score in mathematical language skills test. This implies that most students do not understand and cannot translate the language use in expressing mathematical terms and concepts.

Table 1 The Mean Academic Achievement Score of Students in Mathematical Language Skills

Variables n= 339	Mean	S. D
Mathematics Language Skills	23.03	7.52

12-IJTETV6Jan101_p108-118.indd 113 16-01-2026 21:40:31

Table 2	Mean Attitude Rating of students in Mathematical Language Skills in Jalingo Education Zone.			
S/N	**Item (n = 339)**	**Mean**	**S. D**	**Remark**
	I believe that using clear mathematical language is important for effective communication.	3.41	0.70	ML
	Understanding mathematical language makes concepts in mathematics simpler.	3.09	0.82	ML
	Mathematics is unique because of its special language.	2.98	0.77	ML
	I feel confident when mathematical concepts are explained using appropriate mathematical language.	3.17	0.85	ML
	I believe that a good grasp of mathematical language is crucial for success in mathematics.	3.04	0.86	ML
	I am happier in the mathematics class than any other class because of its language.	2.97	0.85	ML
	Mathematical language is the foundation for understanding mathematics.	3.15	0.85	ML
	I feel excited when exploring the meaning of mathematical language.	2.96	0.85	ML
	I believe understanding mathematical language helps me with problem solving in all areas of mathematics.	3.14	0.74	ML
	I believe I am good at translating mathematics word problems.	3.06	0.82	ML
	Mathematics is one of my most favorite subject because its language is simple.	2.99	0.78	ML
	I would prefer to do an assignment in mathematics than to write in an essay because mathematical language does not scare me.	3.01	0.84	ML
	understanding mathematical language could help me have a good mathematics background.	3.15	0.84	ML
	Mathematical language is necessary in the understanding of mathematics.	3.17	0.78	ML
	I get a great deal of satisfaction out of solving mathematics problems because the language is simple to understand.	2.97	0.84	ML
	Grand Mean	**3.08**	**0.76**	**ML**

Research question 2

What is the mean attitude rating of students in Mathematical Language skills in Jalingo Education Zone.

The results presented in the table 2 highlights the attitude of students in the Jalingo Education zone towards the use of mathematical language. The overall grand mean score is 3.08, indicating that students generally have moderate attitude towards mathematical language, as reflected in the majority of the item mean scores

12-IJTETV6Jan101_p108-118.indd 114 16-01-2026 21:40:31

which fall below the midpoint of 3.5 on a 5-point scale. The standard deviation (S.D.) of 0.76 suggests moderate variability in students' responses across different items. Most students agree that using clear mathematical language is important for effective communication (Mean = 3.41, S.D. = 0.70), reflecting the recognition of mathematical language's role in enhancing understanding. However, there are a few areas where students seem less enthusiastic. For instance, the mean score of 2.96 for the item "I feel excited when exploring the meaning of mathematical language." and the item " I get a great deal of satisfaction out of solving mathematics problems because the language is simple to understand." (Mean = 2.97, S.D. = 0.84) suggests that while students recognize the importance of mathematical language, they may not necessarily enjoy or find ease in working with them.

Hypotheses

Ho_1. There is no significant correlation between mathematical language skills and students' academic achievement in Mathematics in Jalingo education zone

The null hypothesis (Ho1) stated that there is no significant correlation between skills in mathematical language and students' academic achievement in Mathematics in the Jalingo Education Zone. To test this hypothesis, a Pearson Product-Moment Correlation Coefficient (PPMC) analysis was conducted with a sample size of 339 students as presented in Table 3.

The mean score for Mathematics Language Skills was 23.03 with a standard deviation (S.D.) of 7.52, indicating a moderate level of variability in language skills among the students. The mean score for Students' Academic Achievement in Mathematics was 48.04 with a standard deviation of 11.96, which also shows a moderate level of variability in academic achievement.

The correlation coefficient (r-value) between the two variables was found to be 0.335, which suggests a positive correlation between mathematical language skills and academic achievement in Mathematics. This means that as students' skills in mathematical language improve, their academic performance in Mathematics tends to increase as well.

The p-value associated with this correlation is .000, which is less than the conventional alpha level of 0.05. This indicates that the correlation is statistically significant, and we can reject the null hypothesis (Ho1). Therefore, the results support the alternative hypothesis that there is a significant correlation between skills in mathematical language and students' academic achievement in Mathematics in the Jalingo Education Zone.

Table 3 **Result of PPMC of Correlation between Mathematical Language Skills and Students' Academic Achievement in Mathematics**

Variables n= 339	Mean	S. D	r – value	p-value	Decision
Mathematics Language Skills	23.03	7.52	0.335	.000	H_{01} rejected
Students' academic achievement in Mathematics	48.04	11.96			

12-IJTETV6Jan101_p108-118.indd 115 16-01-2026 21:40:31

Table 4	Result of PPMC of Correlation between Skills in Mathematical Language and Student's Attitudes towards Mathematics in Jalingo Education Zone				
Variables n= 339	**Mean**	**S. D**	**r – value**	**p-value**	**Decision**
Mathematics Language Skills	23.03	7.52	0.208	.000	**H_{02} rejected**
Students' Attitude toward mathematics	3.19	.56			

In summary, the analysis suggests that there is a meaningful relationship between the ability to understand and use mathematical language and the level of success students achieve in their Mathematics studies.

H_{O2}. There is no significant correlation between skills in mathematical language and students' attitude toward Mathematics in Jalingo Education Zone

The results from the Pearson Product-Moment Correlation Coefficient (PPMC) analysis presented in Table 4 indicate a study conducted to explore the relationship between students' skills in mathematical language and their attitudes toward mathematics in the Jalingo Education Zone. The sample size for the study was 339 students.

For the variable 'Mathematics Language Skills', the mean score was 23.03 with a standard deviation (S.D.) of 7.52, indicating a moderate level of variability in language skills among the students. The 'Students' Attitude toward Mathematics' had a mean score of 3.19 with a lower standard deviation of 0.56, suggesting that students' attitudes were more consistent across the sample.

The correlation coefficient (r-value) between these two variables was found to be 0.208, which is a positive but weak correlation. However, the p-value associated with this correlation was .000, which is less than the conventional alpha level of 0.05 used for statistical significance tests. This means that the null hypothesis (H0), which stated that there is no significant correlation between the two variables, was rejected.

In summary, the analysis suggests that there is a statistically significant but weak positive correlation between students' skills in mathematical language and their attitudes toward mathematics. This implies that as students' mathematical language skills improve, there might be a slight increase in their positive attitude towards mathematics, but the effect is not strong.

Discussion of Findings

The findings of the study on mathematical language skills as correlate of students' academic achievement and attitudes toward mathematics in senior secondary schools in Taraba State, Nigeria. The findings revealed a moderate positive correlation between skills in mathematical language and students' academic achievement in mathematics in Jalingo education zone. This suggests that students who are adept understanding and using mathematical language tend to achieve higher in mathematics. The understanding facilitates clear communication and interpretation of mathematical ideas, which is crucial for academic success in the subject. This finding aligns with previous studies by Wanjiru (2015) and Myanmar (2020), which similarly identified a positive relationship between mathematical language comprehension and academic success in mathematics. Conversely, Abdulkareem (2022) reported no significant correlation between mathematical

12-IJTETV6Jan101_p108-118.indd 116 16-01-2026 21:40:32

language skills and students' performance, attributing this discrepancy to variations in mathematical abilities among students.

Additionally, this study found a moderate positive relationship between mathematical language skills and students' attitudes toward mathematics. This finding is in agreement with Faustin (2016) who noted that students display a moderate level of positive attitude toward mathematics. However, this result contrasts with Abdulkareem (2022), who observed significant differences in students' attitudes towards mathematics, attributing these differences to disparities in mathematical ability. The result also agrees with Mzomwe, Calkin, and Respickius (2019) who found that there is weak positive correlation between students' attitudes and performance.

Conclusion

Top of FormBottom of FormBased on the findings of this study, it can be concluded that mathematical language skills significantly correlate students' academic achievement and attitude toward mathematics in senior secondary schools in jalingo education zone. A good mastery of mathematical language skills will go a long way in improving senior secondary school students' achievement in mathematics.

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