



Predicting Mathematics Achievement and Attitude of Senior Secondary School Students through Language Skills: A Lagos State Perspective

ODUPE Toyin Alaba Adekitan, ASANRE Akorede Ayoola, ABIODUN Taiwo Oluwadayo, OPEISA Olalekan Zaccheus and IFAMUYIWA Adebola Sunday

¹*Department of Mathematics Education, College of Science Education, Lagos State University of Education, Otto/Ijanikin, Lagos State, Nigeria*

^{2,3}*Department of Mathematics, College of Science and Information Technology, Tai Solarin Federal University of Education, Ijagun, Ijebu Ode, Ogun State.*

⁴*Department of Science Education, School of Technical Education, Yaba College of Technology, Lagos State, Nigeria*

⁵*Department of Science and Technology Education, Faculty of Education, Olabisi Onabanjo University, Ago Iwoye, Ogun State, Nigeria*

Corresponding Author: odupetoyin@gmail.com

ORCID NO 1.: <https://orcid.org/0009-0001-1589-8920>

2: <https://orcid.org/0000-0003-2787-2346>

3: <https://orcid.org/0000-0003-2614-2229>

4: <https://orcid.org/0009-0003-4138-7782>

5: <https://orcid.org/0000-0003-0138-1610>

Abstract

The role of language skills is pivotal in shaping students' mathematics academic success and attitudinal orientation. Therefore, this study examined the prediction of Students' attitudes and achievement in mathematics in senior secondary school through language skills. Descriptive survey design was adopted. Stratified and random sampling techniques were applied to select 1500 senior secondary school II (SS 2) students as sample and thirty public schools from the existing Lagos State's, Lagos East Senatorial District schools. Tools used for data collection were Mathematics Language Skills Test (MLST) with $r=0.82$, Achievement Test in Mathematics (ATM), $r=0.76$ and Attitude of Students towards Mathematics Scale (ASMS) with $r=0.70$. Two hypotheses and a research question were developed, and regression analysis was used to test at the 0.05 level of significance. Results revealed that the respondents had low possession of mathematics language skills. The result for both hypothesis 1 ($F=144.994$, $p<0.05$, $R^2=0.088$) and hypothesis 2 ($F=11.077$, $p<0.05$, $R^2=0.007$) were statistically significant indicating that variation in the students' achievement and attitude towards mathematics were influenced by language skills. The study concluded that student achievement and attitude towards mathematics were predicted by language skills.

Keywords: Achievement, Attitude, Language Skills, Mathematics, Students

Introduction

Mathematics is a foundational discipline that entails the study of numbers, quantities, structures, space, and their interrelationships through abstract reasoning and logical analysis. Amoo and Rahman, (2021), and Asanre (2023) opined that mathematics is a critical instrument for interpreting and responding to the complexities of contemporary society,

underpinning advances in science, technology, engineering, and related domains. In everyday contexts, mathematical competencies are indispensable for tasks such as budgeting, time management, and data interpretation, while professionally, they are vital in fields such as engineering, finance, healthcare, and information

technology (Adedeji et al., 2022). The pervasiveness of mathematics across personal and professional domains underscores its role in fostering analytical thinking and problem-solving skills essential for the 21st century.

In Nigeria, mathematics has been accorded a strategic role and compulsory subject in the national curriculum, integral to human capital development and national development (Okonkwo and Ezeugwu, 2023). The teaching of mathematics in all the schools is to develop quantitative and analytical abilities in learners the ability to fully participate in socioeconomic development (Federal Ministry of Education, 2020). Nevertheless, the outcomes of mathematics education have been hindered by persistent challenges, including insufficient instructional resources, under qualified teachers, and widespread negative student attitudes towards mathematics (Olagunju and Olayemi, 2021; Ugwuegbulam and Ihejirika, 2022). These factors collectively contribute to the underachievement commonly reported in national examinations.

Examination body such as National Examinations Council (NECO) Chief Examiner (2015-2018) highlighted areas of students weaknesses and strengths on selected questions and their responses in mathematics examination, pointing to why students under achieved in the subject. Inability to interpret word problem, inaccurate application of mathematical expressions and equations, illogical arrangement and inability to show step by step solution of attempted questions among others were consistently reported over the years. In quest to improve achievement, educational researchers have increasingly focused on identifying cognitive and non-cognitive predictors of students' achievement in mathematics. Among these predictors are mathematics language skills, which have garnered considerable attention. Language is one of the important mediators to build conceptions, articulate logical statements and make constructions of knowledge in learning mathematics. Mathematical language encompasses symbols, vocabulary, syntax, and the structure of arguments.

Additionally, Ede and Adigun (2021) defined Mathematics language as specialized vocabulary, symbolic representations, syntactic structures, and logical connectors, all of which are central to mathematical communication and reasoning. Similarly, Abah (2020) sees it as the conduit through which learners' access and express mathematical

meaning. Proficiency in mathematics language significantly enhances students' capacity to comprehend word problems, follow procedures, and reason logically. Empirical studies have consistently demonstrated that students with well-developed mathematics language skills perform better academically, as they are more adept at interpreting tasks, formulating strategies, and communicating solutions effectively (Ndlovu and Mhlolo, 2021; Sule et al., 2023). Conversely, Khasu and Opolot- Okurut (2022) found out that mathematics linguistic deficiencies may impede comprehension, foster misconceptions, and obstruct mathematical reasoning, thereby highlighting the imperative of embedding language development in mathematics instruction.

Students' achievement in mathematics is shaped by a constellation of factors, including cognitive capabilities, instructional quality, sociocultural influences, and affective characteristics such as motivation, self-concept, and attitude (Alonge et al., 2023). Asanre et al., (2024) define it as the proficiency shown by students in mathematics as measures based on scores obtained from test. They went further to assert that mathematics achievement is influenced by student attitude. Salawu and Adebayo (2022) defined Attitude towards mathematics as comprising of learners' interest, enjoyment, anxiety levels, and perceived values which have been shown to exert a significant influence on their engagement, perseverance, and performance in the subject. A positive attitude is correlated with sustained academic interest and achievement, while negative perceptions often culminate in disengagement and avoidance behaviors. Additionally, Asanre, et al. (2022) submitted that attitude towards mathematics can be measured based on students' achievement because students with negative attitude will have low achievement. This shows the interconnection between achievement and attitude.

The weaknesses identified above might be linked to mathematics language skills and neglecting the potential influence may be disastrous. Additionally, it is not clear if mathematics language skills are responsible for such influence. This gap presents an opportunity to leverage recent development in measuring tools, conceptual frameworks and research designs to enhance the predicting achievement and disposition towards mathematics. In this study, we aim to bridge the gap by predicting achievement and attitude of students through mathematics language skills in Lagos

State. The results are anticipated to offer evidence-based insights for instructional planning, teacher training, and policy formulation geared towards enhancing both the cognitive and affective dimensions of mathematics learning.

Literature Review

Empirical studies consistently demonstrate that language proficiency, particularly in the language of instruction, has a significant impact on students' mathematics achievement. Abah (2020) investigated the relationship between mathematics language comprehension and academic achievement among Nigerian students and found that those with stronger linguistic competence outperformed their counterparts in national examinations. The study concluded that linguistic clarity facilitates cognitive access to abstract mathematical ideas, thereby enhancing performance. In a related study, Onwuchekwa and Ogunlade (2024) examined language-focused instructional interventions and their effect on mathematics achievement in Lagos State.

Their findings showed a statistically significant improvement in students' test scores when teachers emphasized explicit teaching of mathematical terms and syntax. Ibrahim et al. (2023) further confirmed these findings in a study involving 500 secondary school students, where mathematical language proficiency emerged as a strong predictor of achievement, even when controlling prior knowledge and socioeconomic background. These studies underscore the pedagogical imperative of integrating language development strategies into mathematics instruction to improve learner outcomes. Sule et al. (2023) conducted a quasi-experimental study in Nigerian secondary schools and reported that students with higher proficiency in mathematical language demonstrated significantly better conceptual understanding and problem-solving ability than their peers.

Similarly, Ndlovu and Mhlolo (2021) emphasized that linguistic challenges often underline students' difficulties in solving word problems and interpreting mathematical expressions, particularly in multilingual contexts. Their study, conducted in South African classrooms, found a strong correlation between learners' command of mathematical language and their ability to engage in higher order thinking tasks. Khasu and Opolot - Okurut (2022) further revealed that students with well-developed language skills were more capable of constructing

coherent mathematical arguments, a skill critical for success in geometry and algebra.

Beyond cognitive outcomes, language skills have been shown to influence students' affective orientation towards mathematics. Poor comprehension of mathematical language can contribute to frustration, anxiety, and negative attitudes, especially when students are unable to follow classroom discourse or decipher textbook problems (Salawu & Adebayo, 2022). In their mixed-methods study, Ajayi and Tella (2023) found that students who struggled with mathematical vocabulary and syntax often expressed a dislike for mathematics, perceiving it as confusing and inaccessible. Conversely, those with stronger language skills reported greater confidence and enjoyment in mathematics lessons. A study by Alonge et al. (2023) reported a positive correlation between students' language proficiency and their attitudes toward mathematics, mediated by self-efficacy and perceived competence. These findings align with those of Olagunju and Olayemi (2021), who argued that enhancing language clarity in teaching practices significantly reduces mathematics anxiety and fosters a more positive learning environment.

Emerging empirical evidence also points to the interconnectedness of language skills, mathematics achievement, and students' attitudes. Adedeji et al. (2022) employed structural equation modeling to investigate the interplay among these variables and found that language proficiency directly predicted achievement and indirectly influenced it through student attitudes. Okonkwo and Ezeugwu (2023) further supported this assertion in a study conducted on public secondary schools in southeastern Nigeria. They concluded that students' ability to decode and encode mathematical ideas not only enhances academic success but also fosters a sense of agency and interest in mathematics learning. Thus, cultivating mathematical language competence appears to be a promising avenue for addressing both cognitive and affective challenges in mathematics education.

Purpose of the Study

By examining the extent to which mathematics achievement and attitude are predicted through language skills, this study aims to add to the current conversation about improving mathematics education in Nigeria.

Research Question

The question raised and answered in the study is:

- i. What is the senior secondary school students' possession level of mathematics language skills?

Hypotheses

Hypotheses that were formulated for the study are:

- Ho₁:** Senior secondary school students' mathematics achievement will not be significantly predicted through mathematics language skills.
- Ho₂:** Senior secondary school students' attitude towards mathematics will not be significantly predicted through mathematics language skills.

Methods

This study examined the prediction of mathematics achievement and attitude of senior secondary school students through language skills in Lagos State, using descriptive survey design. The achievement and attitude towards mathematics are the dependent variables while language skills are the independent variable. The research was conducted at secondary schools. A research question was raised, and two hypotheses guided the study. Two different tests and a scale were used for instrumentation.

The sample for study comprised 1500 Senior Secondary II (SS 2) students selected from 30 public schools across the existing Local Government Areas (LGAs) Somolu, Kosofe, Ikorodu, Epe and Ibeju - Lekki in Lagos East Senatorial District. A 30% stratified sampling method was applied to select 30 schools from the existing schools in each LGA followed by a random selection of 50 students per school. The respondents were all in Senior Secondary II (SS2). Five research assistants were used in administering the tools. The instruments for this study are: Mathematics Language Skill Test (MLST), Achievement Test in Mathematics (ATM) and Attitude of Students towards Mathematics Scale (ASMS) were the tools used to elicit responses for the study.

Mathematics Language Skills Test (MLST): The Mathematics Language Skills Test (MLST) is an essay test comprising nine items. The items were chosen from previous Senior School Certificate Examination (SSCE) questions from 2008 to 2018. The questions asked were to elicit responses on students' capacity to establish a connection, finding relationships among given data using a diagram to express given information, manipulating and understanding Mathematics language skills. To

establish content validity, instruments were evaluated by experienced mathematics educators. The tool was pilot tested on 30 students outside from the target sample using test-retest method over a two-week interval. The questions were rearranged before the second administration of the test. A reliability coefficient (r) of 0.82 was established.

Achievement Test in Mathematics (ATM): The Achievement Test in Mathematics (ATM) has forty multiple-choice questions with four possible responses, one right option, and three distracting answers. The ATM was designed to evaluate learners' mathematical proficiency. All themes of the mathematics curriculum were carefully selected. Each of the choices are from the senior secondary school certificate examination (SSCE) past questions (2015 – 2018). Achievement Test in Mathematics (ATM) included the topics of application, understanding, and knowledge. A blueprint was drawn to aid the development of the test items. Students' achievement scores for Mathematics was measured by the sum of their total scores obtained. The suitability and accuracy of the test items created were carefully examined. Fifty (50) of the SSII students were administered 40-item Achievement Test in Mathematics (ATM), outside the target sample. Using the test-retest reliability method, ATM's reliability was assessed. The ATM was administered twice over a three-week interval to evaluate test-retest reliability. The questions were shuffled prior to giving the second test. Pearson Product Moment Correlation (PPMC) was used for data analysis. The reliability index gotten for ATM is 0.76

Attitude of Students towards Mathematics Scale (ASMS): The instrument was created and verified by the researcher. It was created to measure how learners felt about mathematics. It was split into two separate sections A and B. Section A elicits demographic data sex, age, socioeconomic background) while section B contains 30 items on a 4-point Likert scale (4 = SA to 1 = SD). Two educational assessors were given the tool to contribute to. The instrument was modified based on their recommendations and guidance. Consequently, specific items were thrown away for its inappropriateness. The instrument comprised of both positive and negative worded items. Fifty (50) students who were not part of the target sample were given copies of the instrument. Cronbach's alpha ($\alpha = 0.70$) was used to assess internal consistency.

Results

Table 1: Descriptive statistics for independent and dependent variables (N = 1500)

Variables	Mean Score	Standard Deviation	Minimum Score	Maximum Score
Mathematics Language Skills	12.63	8.13	1	36
Mathematics Achievement	11.87	5.32	1	40
Attitude towards Mathematics	91.00	12.02	17	126

The mean score of 12.63 with a standard deviation of 8.13 in the mathematics language skills ranging from 1 to 36 indicates a broad dispersion in students' language proficiency. This variability suggests differential access to or engagement with the linguistic components essential for comprehending mathematical concepts. A score of 11.87 out of 40 representing 29.67% which is objectively low. A mean score of 11.87 out of a maximum possible score of 40 (SD = 5.32), the data reflect a low level of mathematics achievement (29.67). The relatively

lower mean compared to the maximum score points to potential challenges in mastering mathematical content. Attitude towards Mathematics indicates a mean attitude score of 91.00, followed by a standard deviation of 12.02 and a range between 17 and 126. This suggests a generally positive disposition towards mathematics within the sample. However, the wide range also indicates the presence of students with varying degrees of enthusiasm or apprehension towards the subject.

Research Question

Q1: what is the senior secondary school students' possession level of the mathematics language skills?

Table 2: Distribution of Respondents' Possession Level of Mathematics Language Skills

Mathematics Language Skills	Frequency(N)	Percent (%)
Low	737	49.1
Medium	363	24.2
High	400	26.7
Total	1500	100.0

Data provided in table 2 reveals a varied distribution of mathematics language skills obtained by grouping respondents scores as follows; (Low : 1-10, Medium : 11-20, and High : 20-40).With 49.1%

of the students exhibiting low mathematics language skill, 24.2% demonstrating medium levels, and 26.7% possessing high mathematics language skill.

Hypothesis 1: Senior secondary school students' achievement in mathematics will not be significantly predicted through mathematics language skills.

Table 3: Regression of Mathematics Language Skills on Students' Mathematics Achievement

Multiple R= 0.297

Multiple R²= 0.088

Adjusted R² = 0.088

Std. Error of the Estimate = 5.081

Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	3743.352	1	3743.352	144.994	.000*
Residual	38674.298	1498	25.817		
Total	42417.650	1499			

* Significant F at $\alpha = .05$

The results of the regression of the sampled student's mathematics language proficiency scores on the math achievement test are displayed in Table 3. The table indicates that outcome is significant ($F = 144.994$, $p < 0.05$). This implies that the respondents' mathematical language skills had a significant impact on the variation in their mathematical achievement. With a multiple correlation coefficient of 0.297 and an R^2 of 0.088 explaining just 8.8% of the variance, the results show that mathematics language

skills explained 8.8% of the variation in the dependent variable (students' mathematics achievement). Consequently, null hypothesis 1 is disproved based on the observation that linguistic proficiency in mathematics accounts for approximately 9% of the variance in the dependent variable, Senior Secondary II students' mathematics achievement are significantly predicted through mathematics language skills.

Hypothesis 2: Senior secondary school students' attitude towards mathematics will not be significantly predicted through mathematics language skills.

Table 4: Regression of Mathematics Language Skills on Students' Attitude towards Mathematics

Multiple R = 0.086 Multiple R² = 0.007 Adjusted R² = 0.007 Std. Error of the Estimate = 11.979					
Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	1589.449	1	1589.449	11.077	.001*
Residual	214957.545	1498	143.496		
Total	216546.994	1499			

* Significant F at $\alpha = .05$

Table 4 shows the findings of the regression of mathematics language skills of sampled students' scores on their attitude towards mathematics. Based on the result, the outcome is significant ($F = 11.077$ $p < 0.05$). This indicates that the difference in attitudes of the learners towards mathematics was quite significant due to variability in their mathematical language skills. The results showed that with a multiple correlation coefficient of 0.086 and an R^2 value of 0.007, mathematics language proficiency explained 0.7% of the variance in the dependent variable (students' attitude toward mathematics). Consequently, null hypothesis 2 is disproved. While statistically significant due to the large sample size ($N = 1,500$, $F = 11.08$, $p = .001$), mathematics language skills account for less than 1% of the variance ($R^2 = .007$) in student attitudes, indicating a practically negligible effect in Mathematics in Secondary School II.

Discussion

The descriptive statistics highlight the diverse levels of mathematics language skills, mathematics achievement, and attitudes towards mathematics among the sampled senior secondary school students.

The fact that a substantial proportion of students (49.1%) exhibited a low level of possession of mathematics language skills. This finding gives concern to stakeholders, as it implies that nearly half of the respondents may lack sufficient command of mathematical terminology, symbolic notation, and structural syntax essential for understanding and engaging effectively with mathematical content. Only 26.7% of the respondents demonstrated a high level of mathematics language skills, while 24.2% fell within the medium category, suggesting moderate proficiency. This buttressed the findings by Sule, et al. (2023), who identified widespread deficiencies in mathematics language competence among secondary school students in Nigeria, linking such gaps to poor conceptual understanding and under performance in mathematics assessments.

Moreso, Ndlovu and Mhlolo (2021) reported that limited mastery of mathematical language especially in multilingual and linguistically diverse classrooms was a significant barrier to students' academic success in mathematics. The group with low mathematics language skills represents a significant portion of the sampled students' population which reveals that the overall level of possession of

mathematics language skills among Senior Secondary II students is predominantly low. This finding highlights the critical role of mathematics language in mathematics learning and a pressing need for pedagogical reforms. This corroborates the findings of Abah (2020); Ede and Adigun (2021) who advocated for the explicit integration of language-focused strategies in mathematics instruction, including direct teaching of mathematical vocabulary, contextualization of symbolic expressions, and opportunities for verbal articulation of mathematical reasoning. Additionally, Ajayi and Tella (2023), reported that explicit instruction in mathematical vocabulary, syntax, and symbolic communication serve as an integral to effective mathematics pedagogy.

Findings from the regression analysis revealed that senior secondary school students' mathematics achievement were significantly predicted by mathematics language skills. These findings are consistent with recent empirical studies that underscore the role of mathematical language proficiency in facilitating conceptual understanding, problem-solving ability, and ultimately academic success. This corroborates the findings of Sule, et al. (2023) who demonstrated that learners with higher proficiency in mathematics language tend to achieve better results in problem-solving tasks and standardized assessments. Similarly, Abah (2020) reported that proficiency in mathematics language serves as a gateway to comprehension, as students must first decode the linguistic structure of a problem before engaging in computation or reasoning. This corroborates the findings of Ndlovu and Mhlolo (2021) who emphasized the centrality of language in the cognitive processing of mathematical ideas, particularly in multilingual educational contexts.

The findings showed that senior secondary school learners' attitude towards mathematics is substantially predicted through mathematics language skills. This result is consistent with prior research that identifies language competence as an influential factor not only in students' cognitive outcomes but also in their affective responses to mathematics learning. This buttresses the findings of Olagunju and Olayemi (2021), who reported that enhancing language clarity in teaching practices significantly reduces mathematics anxiety and fosters a more positive learning environment. Similarly, Ajayi and Tella (2023) found out that students with limited understanding of mathematical vocabulary often

experience frustration and reduced self-efficacy, which contribute to the development of negative attitudes toward the subject. In addition, Salawu and Adebayo (2022) buttresses that language difficulties in decoding mathematical instructions can foster anxiety and avoidance behaviors, especially among low-achieving students.

Although the proportion of variance explained is modest, it supports the research conducted by Alonge, et al. (2023), who found that students' affective orientations in mathematics are shaped by a combination of language, instructional clarity, perceived competence, and prior success. This agrees with the findings of Ede and Adigun (2021) that reinforced that affective variable, such as attitude, are often influenced indirectly by language proficiency through students' experiences of success or failure in mathematics tasks.

Conclusion

In light of the results, it is established that mathematics achievement and attitude of senior secondary school students are predicted through mathematics language skills.

Recommendation

Teachers are encouraged to prioritize mathematics language skills and integrate it in their teaching so that students can be properly grounded thereby; achievement and attitude towards mathematics can be improved. Pedagogical strategies that are learner-centered, linguistically responsive, and conceptually rich are encouraged to be increasingly advocated for improving both achievement and attitude in mathematics. Contemporary curricular reforms in Nigeria should emphasize inquiry-based learning, collaborative problem-solving, and the integration of digital technologies to make mathematics instruction more interactive, meaningful, and engaging. Educational innovations should seek not only to improve cognitive outcomes but also to foster positive dispositions towards mathematics learning. It should also aim to promote favorable attitudes by enhancing student confidence, ensuring relevance in instruction, and nurturing a supportive classroom climate.

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