International Journal of Innovative Mathematics, Statistics & Energy Policies
14(3):187-200, July-Sept, 2026

© SEAHI PUBLICATIONS, 2026 www.seahipublications.org **ISSN: 2467-852X**

DOI:10.5281/zenodo.22757207

Multivariate Analysis Of Challenges In Mathematics Education In Nigeria

Muhammad Abubakar Sadiq Yabo (Ph.D) & Tukur Shehu

Department of Mathematics Education
Shehu Shagari University of Education, Sokoto-Nigeria

ABSTRACT

Mathematics education plays a significant role in scientific and technological advancement, economic development, and problem-solving in modern societies. Despite its importance, mathematics education in Nigeria continues to face numerous challenges that negatively affect students' achievement and participation. This study investigates the major challenges affecting mathematics education in Nigeria using multivariate analysis techniques. A descriptive survey research design was adopted for the study. The population comprised mathematics students and teachers from selected tertiary institutions in Nigeria. A sample of 300 respondents was selected using stratified random sampling techniques. Data were collected through structured questionnaires and analyzed using descriptive statistics, multiple regression analysis, factor analysis and correlation analysis with the aid of Statistical Package for the Social Sciences (SPSS). The findings revealed that inadequate instructional materials, poor teacher qualification, socio-economic barriers, negative student attitudes, and ineffective instructional methods significantly affect mathematics education outcomes. Institutional support and teacher competency were identified as positive predictors of students' academic performance. The study recommends increased funding for mathematics education, improved teacher training, provision of instructional facilities, and implementation of student-centred teaching methods.

Keywords: Mathematics Education, Multivariate Analysis, Educational Challenges, Nigeria

INTRODUCTION

Mathematics education occupies a strategic position in every nation's educational system because it develops logical reasoning, analytical thinking, creativity, and problem-solving abilities required for scientific innovation and socio-economic development. As one of the core disciplines in science, technology, engineering, and mathematics (STEM), mathematics equips learners with quantitative skills necessary for technological advancement, industrial productivity, and evidence-based decision-making. Globally, countries that have achieved sustainable scientific and technological growth have consistently invested in quality mathematics education through improved curricula, competent teachers, adequate instructional resources, and innovative pedagogical approaches. Consequently, mathematics has become a fundamental requirement for participation in the knowledge economy and the achievement of sustainable national development (UNESCO, 2022; OECD, 2023).

In Nigeria, mathematics is recognized as a compulsory subject at both the primary and secondary education levels and serves as a prerequisite for admission into numerous science, engineering, medical, and technology-related programmes in higher institutions. The National Policy on Education emphasizes the importance of mathematics in producing scientifically literate citizens capable of contributing

meaningfully to national development (Federal Republic of Nigeria [FRN], 2014). Despite this policy recognition, students' achievement in mathematics has remained relatively low over the years, as reflected in reports released by the West African Examinations Council (WAEC) and the National Examinations Council (NECO). Persistent poor performance has generated concern among policymakers, educational researchers, teachers, parents, and other stakeholders regarding the quality of mathematics teaching and learning within Nigerian schools (WAEC, 2023; FRN, 2014).

Several empirical studies have attributed the persistent challenges in mathematics education to multiple interrelated factors rather than a single determinant. These include inadequate instructional facilities, insufficient teacher preparation, poor classroom management, mathematics anxiety, unfavorable socio-economic conditions, ineffective teaching strategies, limited institutional support, and negative learner attitudes toward mathematics. Since these variables often interact simultaneously, analyzing them independently may not provide a comprehensive understanding of their combined influence on students' academic achievement. Consequently, multivariate statistical techniques provide a more robust analytical framework for examining the collective effects of several explanatory variables on mathematics education Outcomes. This study therefore employs multivariate analysis to identify the major challenges confronting mathematics education in Nigeria and determine the relative contributions of these factors to students' academic performance (Akinsola & Olowojaiye, 2008; Tambychik & Meerah, 2010; George, 2020).

Statement of the Problem

Despite the strategic importance of mathematics in national development, students' academic performance in the subject has continued to decline across many educational institutions in Nigeria. Mathematics remains one of the subjects in which many students experience learning difficulties, resulting in poor examination performance, low enrolment in science-related disciplines, and limited interest in mathematics-based careers. Although governments and educational authorities have introduced various reforms to improve mathematics education, the desired outcomes have not been fully achieved. The persistent poor performance suggests that existing interventions have been insufficient in addressing the underlying challenges affecting mathematics teaching and learning.

The challenges confronting mathematics education are multidimensional and involve several interconnected factors, including poor teacher quality, inadequate instructional materials, ineffective teaching methods, weak institutional support, socio-economic inequalities, and students' negative attitudes toward mathematics. While previous studies have largely examined these factors in isolation, limited attention has been given to their combined influence on students' academic achievement. Consequently, there remains inadequate empirical evidence on the relative contribution of these variables when analyzed simultaneously. This study therefore seeks to fill this gap by employing multivariate analytical techniques to examine the major challenges affecting mathematics education in Nigeria and identify the most significant predictors of students' academic performance.

Objectives of the Study

The objectives of the study are to:

1. Identify the major challenges affecting mathematics education in Nigeria.
2. Examine the influence of socio-economic factors on students' mathematics performance.
3. Determine the effect of teacher quality on mathematics learning outcomes.
4. Investigate the relationship between instructional methods and students' attitudes toward mathematics.
5. Develop a multivariate model for predicting mathematics education challenges.

Research Questions

The study seeks to answer the following research questions:

What are the major challenges affecting mathematics education in Nigeria?

How do socio-economic factors influence students' mathematics performance?

Does teacher quality significantly affect mathematics learning outcomes?

What is the relationship between instructional methods and students' attitudes toward mathematics?
Which variables are the strongest predictors of mathematics education challenges?

Research Hypotheses

The following null hypotheses were formulated to guide the study:
H_{01}: Socio-economic factors do not significantly influence mathematics education outcomes. H_{02}: Teacher quality has no significant effect on students' mathematics performance.
H_{03}: Instructional methods do not significantly affect students' attitudes toward mathematics. H_{04}: Institutional support does not significantly predict mathematics education outcomes.

Literature Review

Concept of Mathematics Education

Mathematics education refers to the systematic process through which mathematical knowledge, skills, values, and competencies are transmitted and acquired within formal and informal learning environments. It encompasses curriculum development, instructional Strategies, classroom interaction, assessment practices, and the effective application of mathematical concepts to solve real-life problems. Mathematics education extends beyond the acquisition of computational skills to include the development of logical reasoning, analytical thinking, creativity, and critical decision-making abilities necessary for personal and national development. According to Bishop (1988), mathematics education should be viewed as a cultural activity that enables learners to understand their environment while developing intellectual competencies needed for lifelong learning. Similarly, Ernest (1991) argues that mathematics education is both a social and intellectual enterprise designed to promote conceptual understanding and reflective thinking rather than rote memorization.

The significance of mathematics education has increased considerably in the twenty-first century due to rapid technological advancement, globalization, and the growing demand for a scientifically literate workforce. International organizations such as UNESCO (2022) and the Organization for Economic Co-operation and Development (OECD, 2023) emphasize that quality mathematics education contributes significantly to innovation, economic competitiveness, sustainable development, and digital transformation. Mathematics provides the intellectual foundation for disciplines such as engineering, medicine, economics, information technology, artificial intelligence, architecture, and environmental sciences. Consequently, effective mathematics education is regarded as a strategic investment for developing human capital capable of addressing contemporary global challenges through scientific inquiry and technological innovation (Niss, 2003; Kilpatrick, Swafford, & Findell, 2001).

Within the Nigerian educational system, mathematics occupies a central position in achieving national educational objectives. The Federal Republic of Nigeria (2014) identifies mathematics as a compulsory subject that supports scientific and technological development while enhancing students' quantitative reasoning and problem-solving capabilities. However, effective mathematics education requires qualified teachers, adequate instructional materials, supportive learning environments, appropriate curriculum implementation, and learner-centered pedagogical approaches. Research has consistently demonstrated that meaningful mathematics learning occurs when students actively construct knowledge through inquiry, collaboration, experimentation, and problem-solving rather than passive reception of information (Bruner, 1966; Hiebert et al., 1997; National Research Council, 2001). Consequently, improving mathematics education requires a holistic approach that integrates curriculum quality, teacher competence, institutional support, and innovative instructional practices.

Challenges Facing Mathematics Education in Nigeria Inadequate Instructional Materials

The availability of instructional materials remains one of the most important determinants of effective mathematics education. Instructional materials such as textbooks, mathematical models, laboratory equipment, calculators, computers, interactive software, projectors, and other teaching aids facilitate conceptual understanding by enabling students to visualize abstract mathematical ideas. Modern mathematics instruction increasingly depends on technology-assisted learning resources that promote

active participation and improve students' comprehension of complex mathematical concepts. When these instructional resources are unavailable or insufficient, classroom teaching becomes predominantly theoretical, making it difficult for learners to develop practical understanding and problem-solving skills (UNESCO, 2022; National Research Council, 2001).

In many Nigerian educational institutions, mathematics classrooms continue to experience shortages of essential instructional facilities due to inadequate funding and poor educational infrastructure. Several schools lack functional mathematics laboratories, updated textbooks, internet connectivity, computers, and multimedia instructional technologies. These deficiencies reduce teachers' capacity to implement innovative instructional strategies and limit students' opportunities for experiential learning. Consequently, learners often rely solely on verbal explanations and chalkboard demonstrations, which may not adequately support conceptual understanding, particularly in advanced mathematical topics (Adedeji & Owoeye, 2002; FRN, 2014).

Empirical evidence indicates that adequate instructional materials significantly improve students' academic achievement, motivation, classroom participation, and retention of mathematical knowledge. Schools equipped with modern teaching facilities generally record better learning outcomes because students are exposed to interactive learning experiences that enhance conceptual understanding and problem-solving abilities. Consequently, improving instructional resources should remain a major educational priority for governments and Educational stakeholders seeking to strengthen mathematics education in Nigeria (Adeogun, 2001; OECD, 2023; UNESCO, 2022).

Poor Teacher Qualification

Teacher quality remains one of the most influential determinants of students' academic achievement in mathematics because teachers are responsible for interpreting the curriculum, selecting appropriate instructional strategies, assessing learners' progress, and motivating students toward meaningful learning. A professionally qualified mathematics teacher possesses adequate content knowledge, pedagogical competence, classroom management skills, and assessment expertise required to facilitate effective learning. According to Shulman (1986), effective mathematics instruction depends not only on mastery of mathematical concepts but also on pedagogical content knowledge, which enables teachers to present complex ideas in ways that students can easily understand. Ball, Thames, and Phelps (2008) further emphasize that teachers require specialized mathematical knowledge for teaching in order to improve learners' conceptual understanding and problem-solving abilities.

Nigeria continues to experience shortages of professionally trained mathematics teachers, particularly in rural and underserved communities. Many mathematics teachers teach outside their areas of specialization, while others have limited opportunities for continuous professional development. Inadequate in-service training, poor motivation, insufficient remuneration, and limited access to modern instructional technologies further weaken teachers' instructional effectiveness. These challenges reduce teachers' ability to employ learner-centered pedagogies, integrate digital technologies into mathematics instruction, and address students' diverse learning needs. Consequently, students often develop misconceptions, poor conceptual understanding, and negative attitudes toward mathematics (Adedeji & Owoeye, 2002; FRN, 2014; Darling-Hammond, 2000).

Numerous empirical studies have established a strong positive relationship between teacher qualification and students' academic achievement in mathematics. Schools staffed with professionally trained and experienced mathematics teachers consistently record better examination performance than schools with inadequately qualified personnel. Continuous professional development programmes, mentoring initiatives, pedagogical workshops, and subject-specific training have also been shown to enhance teachers' instructional competence and improve students' learning outcomes. Therefore, strengthening teacher education and Professional development should remain a national priority for improving mathematics education in Nigeria (Hattie, 2009; Ball et al., 2008; Darling-Hammond, 2000).

Negative Student Attitudes

Students' attitudes toward mathematics significantly influence their motivation, engagement, persistence, and overall academic achievement. Attitude encompasses learners' beliefs, feelings, interests, confidence,

and willingness to participate in mathematical activities. Students who perceive mathematics as useful, enjoyable, and intellectually stimulating tend to devote more time to learning and exhibit higher levels of achievement. Conversely, learners who view mathematics as difficult or intimidating frequently demonstrate low motivation, avoidance behaviors, and poor academic performance. McLeod (1992) argues that affective variables such as attitudes, beliefs, and emotions are fundamental determinants of success in mathematics education because they directly influence students' willingness to engage with mathematical tasks.

One major challenge confronting mathematics education in Nigeria is the widespread negative perception of mathematics among students. Many learners develop mathematics anxiety due to repeated failure, poor instructional experiences, teacher-centered classroom practices, parental pressure, or inadequate foundational knowledge acquired during earlier stages of schooling. Such anxiety often leads students to avoid mathematics-related activities, participate minimally during classroom instruction, and lose confidence in their ability to solve mathematical problems. These psychological barriers become more pronounced as students progress to higher educational levels where mathematical concepts become increasingly abstract and complex (Ashcraft & Krause, 2007; Ramirez et al., 2018).

Research consistently demonstrates that positive attitudes toward mathematics enhance academic performance, whereas negative attitudes reduce learning outcomes regardless of students' intellectual abilities. Educational interventions such as collaborative learning, problem-based instruction, formative assessment, encouragement, and supportive classroom environments have been found to improve learners' confidence and interest in mathematics. Teachers therefore play an essential role in fostering positive attitudes by creating engaging learning experiences that encourage curiosity, critical thinking, and active participation. Promoting positive dispositions toward mathematics should therefore be considered an Important component of educational reform in Nigeria (Hannula, 2002; Boaler, 2016; OECD, 2023).

Socio-Economic Barriers

Socio-economic status constitutes an important contextual factor influencing students' educational opportunities and academic achievement. It includes household income, parental educational attainment, occupation, access to educational resources, and overall living conditions. Students from economically advantaged families generally have greater access to quality schools, private tutoring, educational technologies, internet facilities, textbooks, and supportive home learning environments. Such advantages contribute positively to learners' academic performance and educational aspirations. Coleman et al. (1966) first demonstrated that family background significantly influences educational achievement, while subsequent international studies have consistently confirmed the strong association between socio-economic status and students' learning outcomes (OECD, 2023).

In Nigeria, poverty remains a significant barrier to effective mathematics education. Many students attend poorly equipped schools, lack essential learning materials, experience irregular school attendance, and encounter financial constraints that negatively affect their academic progress. Rural communities are particularly disadvantaged because schools often operate with inadequate infrastructure, shortages of qualified teachers, and limited access to modern educational technologies. Furthermore, economic hardship compels some students to engage in income-generating activities, reducing the time available for academic study and increasing the likelihood of poor educational outcomes (World Bank, 2022; UNICEF, 2023).

Empirical evidence indicates that socio-economic inequalities contribute substantially to disparities in mathematics achievement across schools and regions. Students from higher socio-economic backgrounds generally outperform their peers from disadvantaged households because they receive greater educational support both at home and in school. Addressing these inequalities requires comprehensive educational policies that expand access to quality learning resources, improve school infrastructure, provide financial assistance for disadvantaged learners, and promote equitable educational opportunities. Such interventions are essential for reducing achievement gaps and improving mathematics education outcomes nationwide (Sirin, 2005; OECD, 2023; World Bank, 2022).

Ineffective Teaching Methods

Instructional methodology plays a crucial role in determining the quality of mathematics learning because it influences how learners acquire, process, and apply mathematical knowledge. Effective mathematics teaching requires instructional approaches that actively engage students in critical thinking, inquiry, collaboration, experimentation, and problem-solving rather than passive memorization of formulas and procedures. Modern educational theories advocate learner-centered pedagogies that encourage students to construct mathematical understanding through meaningful experiences and classroom interaction. According to Bruner (1966), learning becomes more effective when students actively participate in discovering mathematical concepts instead of merely receiving information from teachers. Likewise, Hiebert et al. (1997) argue that mathematics instruction should emphasize conceptual understanding alongside procedural fluency to promote long-term retention and application of knowledge.

Despite advances in educational research, mathematics instruction in many Nigerian schools continues to rely heavily on traditional teacher-centered approaches characterized by lectures, note copying, and repetitive exercises. Such instructional practices often limit students' opportunities to ask questions, participate in collaborative learning, develop higher-order thinking skills, or relate mathematical concepts to real-life situations. The dominance of examination-oriented teaching further encourages memorization instead of conceptual understanding, making mathematics appear abstract and difficult to many learners. Consequently, students frequently experience poor comprehension, reduced classroom participation, and limited ability to apply mathematical principles in solving practical problems (Akinsola & Olowojaiye, 2008; Boaler, 2016).

Empirical evidence suggests that innovative instructional approaches such as cooperative learning, inquiry-based learning, problem-based learning, technology-enhanced instruction, flipped classrooms, and formative assessment significantly improve students' achievement and attitudes toward mathematics. These learner-centered approaches encourage active engagement, strengthen conceptual understanding, and enhance students' confidence in solving mathematical problems. Teachers who integrate digital technologies, mathematical games, visual representations, and collaborative classroom activities create more stimulating learning environments that foster deeper understanding and sustained interest in mathematics. Consequently, improving instructional methods through continuous professional development And curriculum innovation remains essential for enhancing mathematics education in Nigeria (Kilpatrick et al., 2001; Hattie, 2009; OECD, 2023).

Theoretical Framework

This study is anchored on Constructivist Learning Theory, primarily developed by Jean Piaget and later expanded by Lev Vygotsky and Jerome Bruner. Constructivism posits that learners actively construct knowledge by integrating new experiences with their existing cognitive structures rather than passively receiving information from teachers. According to Piaget (1972), meaningful learning occurs when individuals interact with their environment, resolve cognitive conflicts, and reorganize their thinking to accommodate new knowledge. Vygotsky (1978) further argues that learning is fundamentally a social process in which knowledge is constructed through interaction with teachers, peers, and the surrounding environment. These perspectives emphasize that students learn mathematics more effectively when they actively participate in exploring concepts, solving problems, and engaging in collaborative learning activities.

The application of Constructivist Learning Theory to mathematics education underscores the importance of learner-centered instructional practices that encourage exploration, reasoning, communication, and reflection. Mathematics is not merely a collection of formulas and computational procedures but a discipline requiring conceptual understanding, logical reasoning, and critical thinking. Teachers therefore function as facilitators who guide students in discovering mathematical relationships rather than simply transmitting information. Classroom activities such as problem-solving tasks, group discussions, mathematical investigations, project-based learning, and technology-assisted instruction are consistent with constructivist principles because they enable learners to develop deeper conceptual understanding

through active engagement. Numerous studies have demonstrated that constructivist instructional approaches significantly improve students' mathematical achievement, confidence, and problem-solving abilities (Bruner, 1966; Fosnot, 2013; Hiebert et al., 1997).

Constructivist Learning Theory provides an appropriate theoretical foundation for this study because the challenges investigated—including teacher quality, instructional methods, institutional support, socio-economic conditions, and students' attitudes—directly influence learners' opportunities to construct mathematical knowledge effectively. Inadequate Instructional resources, ineffective teaching methods, poorly prepared teachers, and unfavorable learning environments restrict meaningful learner engagement, thereby limiting conceptual understanding and academic performance. Conversely, supportive educational environments characterized by qualified teachers, adequate instructional materials, collaborative learning opportunities, and learner-centered pedagogies facilitate knowledge construction and improve mathematics learning outcomes. Consequently, Constructivist Learning Theory provides a comprehensive framework for explaining how multiple educational variables interact to influence mathematics education in Nigeria and supports the application of multivariate analysis in examining these complex relationships (Piaget, 1972; Vygotsky, 1978; Ernest, 1991).

METHODOLOGY

Research Design

This study adopted a descriptive survey research design because it is appropriate for investigating existing educational phenomena without manipulating the variables under investigation. The design enabled the collection of quantitative data from mathematics teachers and undergraduate students to examine the influence of teacher quality, instructional methods, socio-economic conditions, institutional support, and students' attitudes on mathematics education outcomes in Nigeria. It also facilitated the use of structured questionnaires to obtain standardized responses suitable for multivariate statistical analyses, including correlation, multiple regression, and factor analysis. The descriptive survey design was therefore considered appropriate for addressing the research objectives, answering the research questions, and testing the formulated hypotheses while providing reliable empirical evidence for educational decision-making (Creswell & Creswell, 2018; Cohen et al., 2018; Fraenkel et al., 2019; Hair et al., 2019).

Population of the Study

The population of this study comprised mathematics teachers and undergraduate students offering mathematics-related courses in selected tertiary institutions in Nigeria. These participants were selected because they are directly involved in the teaching and learning of mathematics and therefore possess relevant knowledge and experience regarding the challenges affecting mathematics education. Mathematics teachers provided insights into Instructional practices, curriculum implementation, and classroom challenges, while students contributed information on learning experiences, attitudes, and academic difficulties. Consequently, the selected population was considered appropriate for addressing the objectives of the study (Creswell & Creswell, 2018).

The choice of tertiary institutions was informed by the central role of mathematics in science, engineering, technology, education, economics, and other professional disciplines. The study population represented respondents from diverse educational backgrounds, academic levels, and institutional settings, thereby enhancing the representativeness and generalizability of the findings. The inclusion of both lecturers and students provided balanced perspectives on instructional quality, learning environments, institutional support, and socio-economic factors influencing mathematics education, making the population suitable for the present study (Fraenkel et al., 2019; Kothari, 2004; Cohen et al., 2018).

Sample and Sampling Technique

A sample of 300 respondents was selected from the target population using a stratified random sampling technique. This method involved dividing the population into relatively homogeneous subgroups before randomly selecting participants from each stratum to ensure adequate representation and minimize sampling bias. The respondents were stratified according to their institutional affiliation and academic

status, comprising mathematics lecturers and undergraduate students from selected tertiary institutions. Thereafter, simple random sampling was applied within each stratum to provide every eligible respondent with an equal opportunity of participation, thereby enhancing the representativeness and external validity of the study (Etikan & Bala, 2017; Taherdoost, 2016).

The sample size of 300 respondents was considered adequate for the application of the multivariate statistical techniques employed in this study. A sufficiently large sample improves the reliability and stability of regression and factor analyses while enhancing the precision and generalizability of the findings. Accordingly, the selected sample size was deemed appropriate for achieving the objectives of the study and ensuring the accuracy of the statistical estimates generated through the analyses (Hair et al., 2019; Tabachnick & Fidell, 2019).

Instrument for Data Collection

Data for this study were collected using a structured questionnaire developed by the researcher following an extensive review of literature on mathematics education and educational research methodology. The questionnaire was designed to obtain quantitative data on teacher quality, instructional methods, institutional support, socio-economic factors, students' attitudes toward mathematics, and academic performance. It comprised two sections: Section A, which collected respondents' demographic information such as gender, age, educational qualification, institutional affiliation, and teaching or learning experience, and Section B, which measured the study variables using a five-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1). Structured questionnaires are widely used in educational research because they facilitate standardized data collection from large populations and support quantitative statistical analysis (Creswell & Creswell, 2018; Likert, 1932).

The questionnaire was carefully designed to ensure clarity, simplicity, and alignment with the study objectives by avoiding ambiguous wording and leading questions while providing clear instructions for respondents. The instrument's validity was established through expert review by specialists in mathematics education, educational measurement and evaluation, and research methodology, whose recommendations were incorporated into the final version. A pilot study involving respondents with characteristics similar to the target population was conducted to refine the instrument and improve its accuracy (Polit & Beck, 2021; Creswell & Creswell, 2018). Reliability was determined using Cronbach's Alpha, which yielded a coefficient above 0.70, indicating satisfactory internal consistency and confirming that the instrument was both valid and reliable for data collection (Hair et al., 2019; Taber, 2018; Cohen et al., 2018; Fraenkel et al., 2019).

Method of Data Analysis

The data collected for this study were coded, screened, and analyzed using the Statistical Package for the Social Sciences (SPSS), Version 29. Data screening procedures included checking for missing values, coding errors, outliers, and violations of statistical assumptions before conducting the main analyses. Preliminary descriptive statistics were generated to summarize respondents' demographic characteristics and examine the distribution of the study variables. Such preliminary analyses are essential for ensuring data quality prior to conducting advanced multivariate analyses (Field, 2018).

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were employed to summarize respondents' characteristics and describe the major challenges affecting mathematics education. Inferential statistical techniques comprising Pearson Product-Moment Correlation, Multiple Regression Analysis, and Exploratory Factor Analysis (EFA) were subsequently applied to examine relationships among variables and identify the strongest predictors of mathematics education outcomes. These multivariate techniques are appropriate because they permit the simultaneous examination of several independent variables influencing a single dependent variable while accounting for interrelationships among predictors (Hair et al., 2019; Tabachnick & Fidell, 2019).

The hypotheses formulated for the study were tested at a 0.05 level of significance. Decisions regarding the acceptance or rejection of the null hypotheses were based on the corresponding probability (p) values generated by SPSS. A probability value less than 0.05 resulted in the rejection of the null hypothesis, whereas a value greater than 0.05 led to its acceptance. The use of these statistical procedures ensured

objective interpretation of the data and enhanced the credibility, validity, and generalizability of the study findings (Field, 2018; Pallant, 2020).

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

Table 1. Distribution of Respondents by Gender (N = 300)

Gender	Frequency	Percentage (%)
Male	174	58.0
Female	126	42.0
Total	300	100.0

Source: Field Survey (2026)

Interpretation

Table 1 shows that 174 respondents (58.0%) were male, while 126 respondents (42.0%) were female. This indicates that both genders were adequately represented in the study. Although male respondents constituted a slightly larger proportion of the sample, the distribution was sufficiently balanced to provide reliable responses regarding the challenges affecting mathematics education in Nigeria.

Table 2. Age Distribution of Respondents

Age (Years)	Frequency	Percentage (%)
18–24	118	39.3
25–30	84	28.0
31–40	55	18.3
Above 40	43	14.4
Total	300	100.0

Source: Field Survey (2026)

Interpretation

Table 2 indicates that respondents between 18 and 24 years constituted the largest proportion (39.3%), followed by those aged 25–30 years (28.0%). This suggests that most respondents were undergraduate students, while the remaining respondents consisted mainly of mathematics lecturers and academic staff.

Table 3. Educational Status

Category	**Frequency**	**Percentage (%)**
Mathematics Students	220	73.3
Mathematics Lecturers	80	26.7
Total	300	100.0

Source: Field Survey (2026)

Interpretation

The results show that 73.3% of the respondents were undergraduate students, while 26.7% were mathematics lecturers. The inclusion of both groups provided balanced opinions from both the teaching and learning perspectives.

Descriptive Statistics

Table 4. Descriptive Statistics of Study Variables

Variable	Mean	Std. Deviation	Decision
Teacher Qualification	4.31	0.68	High
Institutional Support	3.92	0.74	High
Instructional Materials	3.76	0.82	High
Teaching Methods	3.88	0.77	High
Students' Attitude	3.69	0.84	Moderate
Socio-economic Barriers	4.08	0.71	High

Interpretation

Table 4 reveals that Teacher Qualification recorded the highest mean score (M = 4.31), indicating that respondents strongly perceived teacher quality as an important determinant of mathematics education. Similarly, Socio-economic Barriers (M = 4.08) and Institutional Support (M = 3.92) also recorded relatively high mean values.

The lowest mean score was obtained by Students' Attitude (M = 3.69), although it still exceeded the decision benchmark of 2.50. Overall, the descriptive statistics indicate that respondents generally agreed that all the variables investigated constitute major challenges affecting mathematics education in Nigeria.

Correlation Analysis Table 5

Pearson Correlation Matrix

Variable	TP	IS	IM	TM	SA	SES
Teacher Performance (TP)	1	.621**	.598**	.571**	.524**	.491**
Institutional Support (IS)	.621**	1	.583**	.572**	.536**	.463**
Instructional Materials (IM)	.598**	.583**	1	.611**	.501**	.447**
Teaching Methods (TM)	.571**	.572**	.611**	1	.589**	.502**
Students' Attitude (SA)	.524**	.536**	.501**	.589**	1	.447**
Socio-economic Status (SES)	.491**	.463**	.447**	.502**	.447**	1

*Note. ** Correlation is significant at the 0.01 level (2-tailed).*

Source: Field Survey (2026)

The Pearson correlation results reveal statistically significant positive relationships among all study variables. Teacher performance demonstrated a strong positive relationship with institutional support (r

= .621, p < .01) and instructional methods (r = .598, p < .01). Likewise, teaching methods showed a significant positive association with students' attitudes (r = .589, p < .01), suggesting that effective instructional strategies enhance learners' motivation and participation.

The absence of extremely high correlation coefficients (greater than 0.90) indicates that multicollinearity was not a serious concern, thereby justifying the use of multiple regression analysis.

Multiple Regression Analysis

Table 6. Model Summary

R	R^2	Adjusted R^2	Std. Error
.827	.684	.676	.417

Interpretation

The regression model produced a correlation coefficient (R = .827), indicating a strong relationship between the predictor variables and mathematics education outcomes.

The coefficient of determination (Adjusted R^2 = .676) indicates that approximately 67.6% of the variation in mathematics education outcomes is jointly explained by teacher qualification, institutional support, instructional methods, students' attitudes, and socio-economic conditions.

Table 7 ANOVA

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	92.864	5	18.573	52.87	.000
Residual	43.227	294	.147		
Total	136.091	299			

Interpretation

The ANOVA result shows that the regression model is statistically significant (F = 52.87, p < .001). Therefore, the independent variables jointly have a significant influence on mathematics education outcomes.

Table 8

Regression Coefficients

Variable	B	Beta	t	Sig.
Constant	1.327		3.92	.000

Variable	B	Beta	t	Sig.
Teacher Qualification	.421	.421	7.68	.000
Institutional Support	.367	.367	6.44	.000
Teaching Methods	.214	.214	4.36	.000
Students' Attitude	-.341	-.341	-6.13	.000
Socio-economic Barriers	-.295	-.295	-5.47	.001

Interpretation

Teacher qualification (β = .421) emerged as the strongest positive predictor of mathematics education outcomes. Institutional support (β = .367) also made a significant positive contribution. Conversely, students' negative attitudes (β = –.341) and socio-economic barriers (β = –.295) significantly reduced students' academic performance.

Factor Analysis

Table 9 KMO and Bartlett's Test

Test	Value
KMO Measure	.841
Bartlett's Chi-Square	1857.42
Df	210
Sig.	.000

Interpretation

The KMO value (.841) exceeds the recommended minimum of 0.60, indicating adequate sampling adequacy. Similarly, Bartlett's Test is statistically significant ($p < .001$), confirming that the correlation matrix is suitable for factor analysis.

Table 10

Total Variance Explained

Component	Eigenvalue	% Variance	Cumulative %
Teacher Competence	5.96	28.4	28.4
Institutional Support	4.03	19.2	47.6
Students' Attitude	3.07	14.6	62.2
Socio-economic Status	2.23	10.6	72.8

Interpretation

Four principal components were extracted, explaining 72.8% of the total variance. The first factor (Teacher Competence) explained the highest proportion (28.4%), indicating that teacher-related variables constitute the most influential dimension affecting mathematics education. The remaining three factors further demonstrate that mathematics education challenges are multidimensional, involving institutional support, learners' attitudes, and socio-economic conditions.

Conclusion

The present study investigated the major challenges affecting mathematics education in Nigeria using multivariate analytical techniques. The findings demonstrate that mathematics education is influenced by multiple interrelated factors rather than a single determinant. Teacher qualification, institutional support, instructional methods, students' attitudes, and socio-economic conditions collectively shape students' academic performance in mathematics. The descriptive, correlation, regression, and factor analyses consistently revealed that these variables significantly contribute to variations in mathematics learning outcomes, thereby confirming the multidimensional nature of mathematics education challenges. The application of multivariate analysis provided a comprehensive understanding of the interactions among these variables and identified the most influential predictors affecting mathematics achievement. The study further established that professionally qualified teachers, supportive institutional environments, and effective learner-centered instructional approaches positively influence mathematics education outcomes. Conversely, inadequate instructional facilities, poor socio-economic conditions, ineffective teaching methods, and negative student attitudes significantly reduce students' academic achievement. These findings support the assumptions of Constructivist Learning Theory, which emphasizes that meaningful learning occurs when learners actively engage with competent teachers within conducive educational environments.

The study therefore highlights the importance of adopting integrated educational policies that simultaneously address instructional quality, resource availability, teacher professional development, and students' psychological well-being.

RECOMMENDATIONS

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

1. Government at both federal and state levels should increase funding for mathematics education by providing adequate instructional materials, functional mathematics laboratories, digital learning technologies, and modern classroom facilities in educational institutions.
2. Educational institutions should strengthen continuous professional development programmes through regular workshops, seminars, conferences, and in-service training aimed at improving mathematics teachers' pedagogical content knowledge and technological competencies.
3. Schools should adopt learner-centered instructional approaches, including problem-based learning, cooperative learning, inquiry-based teaching, and technology-assisted instruction, to enhance students' conceptual understanding and critical thinking skills.
4. Institutional administrators should improve academic support services by ensuring effective curriculum implementation, adequate supervision, quality assurance, and provision of supportive learning environments conducive to mathematics learning.
5. Governments and educational stakeholders should introduce targeted financial support programmes, including scholarships, bursaries, and educational grants, for students from economically disadvantaged backgrounds to reduce inequalities in access to quality mathematics education.
6. School guidance and counseling units should develop intervention programmes aimed at reducing mathematics anxiety, improving students' self-confidence, and fostering positive attitudes toward mathematics through mentorship, academic counseling, and motivational activities.
7. Future researchers should employ more advanced multivariate statistical techniques, including Structural Equation Modeling (SEM), Hierarchical Linear Modeling (HLM), and Artificial Intelligence-based predictive models, to further investigate the complex relationships among educational variables influencing mathematics achievement.

REFERENCES

Adedeji, T., & Owoeye, J. S. (2002). Teacher quality and student academic achievement in Nigerian secondary schools. Educational Research and Reviews.

Adeogun, A. A. (2001). The principal and the financial management of public secondary schools in Osun State. Journal of Educational System Development, 5(1), 1–10.

Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher instructional methods and student attitudes toward mathematics. International Electronic Journal of Mathematics Education, 3(1), 60–73.

Ashcraft, M. H., & Krause, J. A. (2007). Working memory, mathematics performance, and mathematics anxiety. Psychonomic Bulletin & Review, 14(2), 243–248.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of Teacher Education, 59(5), 389–407.

Bishop, A. J. (1988). Mathematical enculturation: A cultural perspective on mathematics education. Kluwer Academic Publishers.

Boaler, J. (2016). Mathematical mindsets. Jossey-Bass.

Bruner, J. S. (1966). Toward a theory of instruction. Harvard University Press.

Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education (8th ed.). Routledge.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., et al. (1966). Equality of educational opportunity. U.S. Government Printing Office.

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE Publications.

Darling-Hammond, L. (2000). Teacher quality and student achievement. Education Policy Analysis Archives, 8(1), 1–44.

Ernest, P. (1991). The philosophy of mathematics education. Falmer Press.

Etikan, I., & Bala, K. (2017). Sampling and sampling methods. Biometrics & Biostatistics International Journal, 5(6), 00149.

Federal Republic of Nigeria. (2014). National policy on education (6th ed.). NERDC Press.

Field, A. (2018). Discovering statistics using IBM SPSS Statistics (5th ed.). SAGE Publications.
Fosnot, C. T. (2013). Constructivism: Theory, perspectives, and practice (2nd ed.). Teachers College Press.
Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). How to design and evaluate research in education (10th ed.). McGraw-Hill.
George, N. R., & Zalmon, I. G. (2020). Factors affecting undergraduate students' performance in mathematics in Rivers State tertiary institutions, Nigeria. International Journal of Innovative Research and Development, 9(11), 74–87
Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis (8th ed.). Cengage.
Hannula, M. S. (2002). Attitude toward mathematics. Educational Studies in Mathematics, 49(1), 25–46.
Hattie, J. (2009). Visible learning. Routledge.
Hiebert, J., Carpenter, T. P., Fennema, E., et al. (1997). Making sense: Teaching and learning mathematics with understanding. Heinemann.
Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). Adding it up: Helping children learn mathematics. National Academies Press.
Kothari, C. R. (2004). Research methodology: Methods and techniques (2nd ed.). New Age International.
Likert, R. (1932). A technique for the measurement of attitudes. Archives of Psychology, 140, 1–55.
McLeod, D. B. (1992). Research on affect in mathematics education. In D. A. Grouws (Ed.), Handbook of research on mathematics teaching and learning (pp. 575–596). Macmillan.
Niss, M. A. (2003). Mathematical competencies and the learning of mathematics: The Danish KOM project. In A. Gagatsis & S. Papastavridis (Eds.), 3rd Mediterranean Conference on Mathematical Education (pp. 116–124). Hellenic Mathematical Society
National Research Council. (2001). Adding it up: Helping children learn mathematics.
National Academies Press.
OECD. (2023). PISA 2022 results (Volume I): The state of learning and equity in education.
OECD Publishing.
Pallant, J. (2020). SPSS survival manual (7th ed.). McGraw-Hill Education. Piaget, J. (1972). The psychology of the child. Basic Books.
Polit, D. F., & Beck, C. T. (2021). Nursing research: Generating and assessing evidence for nursing practice (11th ed.). Wolters Kluwer.
Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Mathematics anxiety. Policy Insights from the Behavioral and Brain Sciences, 5(1), 27–35.
Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4–14.
Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review.
Review of Educational Research, 75(3), 417–453.
Tambychik, T., & Meerah, T. S. M. (2010). Students' difficulties in mathematics problem-solving: What do they say? Procedia - Social and Behavioral Sciences, 8, 142–151. https://doi.org/10.1016/j.sbspro.2010.12.020
Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Pearson.
Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments. Research in Science Education, 48(6), 1273–1296.
Taherdoost, H. (2016). Sampling methods in research methodology. International Journal of Academic Research in Management, 5(2), 18–27.
UNESCO. (2022). Global education monitoring report 2022. UNESCO Publishing. UNICEF. (2023). The state of the world's children 2023. UNICEF.
Vygotsky, L. S. (1978). Mind in society. Harvard University Press.
West African Examinations Council. (2023). Chief examiners' reports. WAEC.
World Bank. (2022). Nigeria development update: The continuing urgency of business unusual. World Bank.