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The Quality of the School Environment and the Instructional Methods Employed by Mathematics Teachers as Factors Affecting Senior Secondary School Examination Outcomes in North-East Nigeria

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A B S T R A C T

This study investigated the influence of the quality of school environments and instructional methods on mathematics outcomes in the Senior Secondary School Certificate Examination (SSCE) in North-East Nigeria. Using a sample of 900 students and 200 teachers, the research adopted a mixed-methods design with structured questionnaires and achievement scores as instruments. Descriptive statistics, ANOVA, and multiple regression analyses were conducted. Results revealed that students in well-resourced schools significantly outperformed those in poorly equipped environments. Furthermore, problem-solving and ICT-based instructional methods were positively correlated with higher mathematics outcomes. Regression analysis showed that school environment ($\beta = .41$) and instructional methods ($\beta = .36$) jointly explained 42% of the variance in SSCE mathematics achievement. The findings underscore the critical need to strengthen school infrastructure and adopt student-centered teaching practices to enhance learning outcomes in the region.

Keywords: School environment, instructional methods, mathematics achievement, SSCE, North-East Nigeria

Introduction

Mathematics is a foundational discipline critical to the advancement of science, technology, engineering, and mathematics (STEM) fields. Despite its importance, many students in Nigeria—particularly in the North-East Zone—consistently perform poorly in mathematics, as reflected in the results of the Senior Secondary School Certificate Examination (SSCE).

Osokoya (2003) describes education as a lifelong process established by society to help individuals understand their cultural heritage and contribute meaningfully to future development. It involves nurturing individuals' innate abilities and equipping them with the skills necessary for self-actualization and problem-solving. Similarly, Afe (2000) emphasizes education as a powerful instrument for integrating individuals into society, fostering self-development, national unity, and promoting socio-economic, political, cultural, scientific, and technological progress. Therefore, education in science and mathematics is fundamental to national advancement, providing the technological capacity to harness natural resources effectively. Mathematics, in particular, lays the groundwork for political, civil, scientific, technological, and economic development, as well as socio-cultural stability.

This brings forth several critical questions: What is mathematics? Why should everyone learn it? Why is it integral to education and life? What justifies the time and resources devoted to its teaching? The significance of mathematics extends beyond simple definitions; the growth and prosperity of any nation depend largely on the quantity and quality of mathematics education offered in its school system. According to Obe (1996), mathematics is both the master and servant of all disciplines, offering insight and understanding into complex national issues. Greaber and Weisman (1995) also argue that mathematics enables individuals to comprehend their surroundings and accurately interpret physical phenomena. Supporting this view, Setidisho (2001) asserts that mathematics uniquely unites all branches of science, and without it, scientific knowledge remains shallow.

Robert (1987) highlights how mathematics plays a vital role in various sectors of the U.S. economy—from infrastructure development and energy research to space exploration and disease study—demonstrating its societal value. Globally, Ogunbanjo (1998) describes science as the engine of technology, with mathematics serving as its essential language. In line with this, Igbokwe (2003) contends that science cannot exist without mathematics, and by extension, technology and modern society are unattainable without a strong mathematical foundation. This understanding has led the Nigerian government to prioritize mathematics in education. It is not only a compulsory subject in primary and secondary schools (Federal Republic of Nigeria, 2004) but also a prerequisite for admission into science-related courses in higher institutions (JAMB Brochure, 1992–2007).

Shapiro (2000) defines mathematics as the science of structure, order, and relationships—dealing with numbers, measurements, and spatial reasoning. It qualifies as a science in its own right and serves as a universal language across scientific disciplines. Soyemi (1999) views mathematics as a field that fosters logical reasoning, critical thinking, and clarity of thought. It serves as the cornerstone of all scientific and technological studies—central in pure and applied sciences, essential in social sciences, and enriching the arts. Osafehinti (1990) sees mathematics education as essential for both individual development and national progress, opening career pathways and preparing informed citizens for scientific and industrial workforces. A nation's scientific and technological development relies heavily on solid mathematics education, equipping students for effective participation in modern, tech-driven societies (NPE, 2004).

Fakuade (1977) reinforces this by pointing out that everyday life demands basic mathematical competence. Individuals must be able to estimate values, calculate prices, judge distances and time, analyze evidence, and interpret data. Thus, in today's complex society, basic mathematical literacy is necessary for financial management, daily decision-making, and logical reasoning.

In summary, mathematics education must contribute significantly to developing intellectual abilities, practical skills, critical thinking habits, and positive values that are essential for balanced and meaningful living. Despite decades of curriculum reforms—ranging from the African Mathematics Programme (AMP) and the Entebbe Mathematics Project (1961–1969) to the creation of the Nigerian Educational Research Council (NERC) in 1969 students' performance in mathematics continues to decline, indicating a need for renewed and more effective strategies in mathematics instruction and learning.

Nevertheless, despite its importance, students in North-East Nigeria continue to record persistently low performance in the Senior Secondary School Certificate Examination (SSCE). Several scholars have attributed this challenge to structural deficiencies in the learning environment (Adedeji & Olaniyan, 2011; Ajayi, 2018) and the instructional methods employed by teachers (Okafor & Eze, 2020; Afolabi, 2019).

A supportive school environment provides adequate infrastructure, resources, and psychological safety for learners, which is essential for cognitive development (Bronfenbrenner, 1994). Conversely, poor environments characterized by overcrowded classrooms, inadequate teaching aids, and insufficient facilities negatively affect learning outcomes (Obi & Uchendu, 2019). Similarly, instructional methods shape how effectively students engage with mathematical concepts. Traditional lecture methods often produce passive learners, while problem-solving, discussion-based, and ICT-integrated approaches have been shown to foster higher achievement (Usman, 2017; Nwagbo & Okoro, 2021).

This study therefore examines how the quality of the school environment and instructional methods jointly influence SSCE mathematics performance in North-East Nigeria.

1.1 Statement of the Problem

The persistent underachievement of students in mathematics at the Senior Secondary School Certificate Examination (SSCE) in Nigeria's North East Zone has become a major concern for educators, policymakers, and stakeholders. This trend poses serious challenges for students' academic and professional futures, especially since mathematics is a compulsory subject for many academic and career paths.

Reports and data from national examining bodies such as WAEC, NECO, and JAMB consistently highlight that a significant proportion of secondary school students perform poorly in mathematics. Despite the introduction of a standardized mathematics curriculum and various educational reforms, the trend of low achievement remains troubling. In response to this issue, the National Mathematical Centre (NMC) was established in 1989. Its core mandates include:

1. Promoting and supporting initiatives that enhance the teaching and learning of mathematics at all educational levels.
2. Aligning mathematical education with national development objectives.
3. Advancing the field of theoretical mathematics and increasing the number of professional mathematicians.

Nevertheless, these efforts have not led to substantial improvements. Students' poor performance in mathematics continues to escalate, warranting national attention. Adeniyi (1988) vividly captured this alarming situation, noting from experience as a WAEC examiner that many candidates submit blank scripts, some merely rewrite the questions, and a majority of those who attempt solutions often score less than 40%.

Despite the significance of mathematics in the educational curriculum, students in North-East Nigeria often exhibit poor performance in mathematics examinations. This study seeks to investigate how the quality of the school environment and the instructional methods employed by mathematics teachers contribute to this outcome.

1.2 Research Objectives

i. To assess the impact of the school environment on students' performance in mathematics.

ii. To evaluate the effectiveness of various instructional methods used by mathematics teachers.

iii. To examine the relationship between these factors and students' academic outcomes in mathematics.

1.3 Research Questions

i. How does the quality of the school environment affect students' performance in mathematics?

ii. What instructional methods are employed by mathematics teachers in North-East Nigeria?

iii. What is the relationship between these instructional methods and students' academic outcomes in mathematics?

iv. What is the relationship between these quality school environment and students' academic outcomes in mathematics?

1.4 Significance of the Study

This study will provide insights into the factors influencing students' performance in mathematics, offering recommendations for improving the quality of education in North-East Nigeria.

2. Literature Review

2.1 Theoretical Review

This study is anchored on three key theories: Ecological Systems Theory (Bronfenbrenner, 1994), Constructivist Learning Theory (Piaget, 1972; Vygotsky, 1978), and Bloom's Mastery Learning Theory (Bloom, 1968). These frameworks collectively explain how the learning environment, social interaction, and mastery of content impact student outcomes.

2.2 Conceptual Review

The school environment encompasses physical facilities, safety, emotional climate, and resource availability (Ajayi, 2018). Instructional methods include lecture, problem-solving, discussion, and ICT-based techniques (Okafor & Eze, 2020). Inadequate resources and reliance on traditional lecture methods are often linked with poor outcomes.

2.3 Empirical Review

Several studies affirm the relationship between environment, pedagogy, and achievement (Ajayi, 2018; Obi & Uchendu, 2019; Usman, 2017; Okafor & Eze, 2020; Nwagbo & Okoro, 2021; Afolabi, 2019; Yusuf & Adedoyin, 2021; Salihu & Ochuba, 2020; Ibrahim, 2022; Danjuma & Abdullahi, 2023). These findings highlight that both structural and pedagogical factors jointly determine student achievement.

2.3.1 School Environment

The physical conditions of the school play a vital role in students' academic performance. Bloom (1978) asserted that environmental factors significantly influence knowledge acquisition. Similarly, Ezewu (1983) maintained that since educators can more easily modify the environment than a child's genetic makeup, improving the school setting is key to enhancing learning outcomes. Onwuchekwa (1985) also affirmed that physical classroom conditions, including teaching aids, contribute greatly to academic success.

The surrounding environment directly affects how students perform. For instance, the quality of school infrastructure influences achievement levels—students in well-maintained buildings tend to perform better academically. Studies by Carols (1993), Lackney (1999), Maxwell (1999), and Black (2001) showed that students attending older school buildings scored between 5–7% lower than those in newer facilities, confirming a strong link between school infrastructure and academic results.

High-performing schools incorporate effective architectural and design elements to enhance sound quality and minimize both internal and external noise, such as traffic. Natural daylight, another critical feature, not only supports students' biological functions and moods but also reduces dependence on artificial lighting, lowering energy costs.

Adedipe (2007) concluded that insufficient physical resources—such as lecture rooms, dormitories, labs, and libraries—leads to overcrowded classrooms and poorer academic performance. Classroom acoustics are also crucial, as excessive noise from outside, within buildings, or from mechanical systems can hinder students' ability to concentrate and learn (Lyons, 2001).

The interaction between environmental factors and student characteristics significantly influences academic outcomes, supporting Lewin's (1943) theory of person-environment interaction.

Numerous researchers (Edwards, 1992; Cash, 1993; Hines, 1996) agree that improved school infrastructure boosts student performance on standardized assessments, though the magnitude of improvement varies by subject area. For example, while Philips (1997) recorded substantial gains in mathematics scores, Edwards (1992) found less dramatic improvements in social science.

In building new schools, it’s essential to integrate proven design strategies. Research consistently shows that critical components of well-designed schools—such as ventilation, natural light, and sound control—have a measurable impact on academic outcomes.

As Schneider (2002) noted, learning environments characterized by clean air, adequate lighting, minimal noise, and safety promote optimal teaching and learning. While empirical research continues to refine standards, current knowledge and technologies are sufficient to create effective learning environments. Achieving this, however, requires proper funding, thoughtful design, quality construction, and consistent maintenance.

2.3.2 Ineffective Use of Instructional Materials in Mathematics Education

Different scholars have defined instructional materials in various ways. Obanya (1989) described them as tools intended to enhance both teaching and learning. Abdullahi (1982) emphasized that whether locally produced or imported, these materials can significantly improve lesson delivery if applied skillfully. Similarly, Ikerionwu (2010) referred to them as aids that help teachers clarify lessons for students. Agina-Obu (2005) explained that instructional materials are tangible items that stimulate audio, visual, or combined sensory perception during teaching.

Instructional materials are commonly categorized into three groups: audio (e.g., radio, audio recordings), visual (e.g., chalkboards, charts, slides), and audio-visual (e.g., television, films, computers). Among these, visual tools are most frequently used by teachers in classroom settings.

Instructional materials serve several purposes in the teaching and learning process. According to Esu, Enukoha, and Umoren (2004), they make abstract concepts easier to understand, promote active student engagement, reduce teacher talk time, enhance clarity of instruction, bridge the gap between theory and reality, expand students' knowledge base, discourage rote learning, and increase motivation and interest in learning.

Numerous studies have explored the relationship between instructional materials and academic achievement. Researchers such as Moronfola (1982), Popoola (1990), and Momoh (2010) found that students in schools with sufficient teaching resources consistently outperformed their peers in schools lacking such resources. Franzer, Okebukola, and Jegede (1992) emphasized that even a well-trained science teacher may struggle to effectively teach if the necessary instructional tools are not available in the school.

While some imported educational tools are costly and not always suitable for local contexts, there is a need for developing affordable, locally made materials. Okebukola (2015) highlighted that the absence of essential resources like textbooks and calculators impedes students' grasp of mathematical concepts. Studies by Obioha (2006) and Ogunyele (2002) further revealed that science-related teaching resources are generally scarce in Nigerian secondary schools, and the few available ones are often in poor condition. This underscores the necessity for improvisation. Adebimpe (1997) and Daramola (2008) suggested that improvisation requires innovation, creativity, and persistence from teachers—skills that can be developed through well-structured training programs. Echoing this, Abimbade (1997) and Lasisi (2004) argued that regardless of the teaching method used, appropriate instructional materials remain crucial for enhancing learning outcomes.

3. Methodology

A descriptive survey design was adopted. The sample comprised 900 students and 200 mathematics teachers randomly selected from senior secondary schools in North-East Nigeria. Instruments included student achievement scores and structured questionnaires. Data were analysed using descriptive statistics, ANOVA, and multiple regression at a 0.05 significance level.

4. Results and Discussion

4.1 Descriptive Statistics

The descriptive statistics of students’ SSCE mathematics outcomes across different school environments are presented in **Table 1**. Results show that students from well-resourced schools recorded the highest mean performance score (M = 61.73, SD = 11.24), compared to students from moderately equipped schools (M = 52.48, SD = 10.87) and those from poorly resourced schools (M = 43.25, SD = 12.31). This indicates that access to adequate facilities and a conducive learning environment contributes positively to student performance.

Table 1: ***Descriptive Statistics of School Environments and Student Performance***

School Environment	N	Mean Score	Std. Dev.	Minimum	Maximum
Poor Infrastructure	495	43.25	12.31	20	72
Moderate Facilities	270	52.48	10.87	28	80
Well-Resourced	135	61.73	11.24	32	89
Total	900	49.15	13.92	20	89

Scores are based on SSCE Mathematics results (0–100). Students in well-resourced schools scored significantly higher than those in poorly equipped schools.

The performance disparity is further illustrated in **Figure 1**, which shows a boxplot of mathematics outcomes across school environments. Students in well-resourced schools achieved higher median scores with less variability, while those in poorly equipped schools exhibited wider score distribution and lower performance levels.

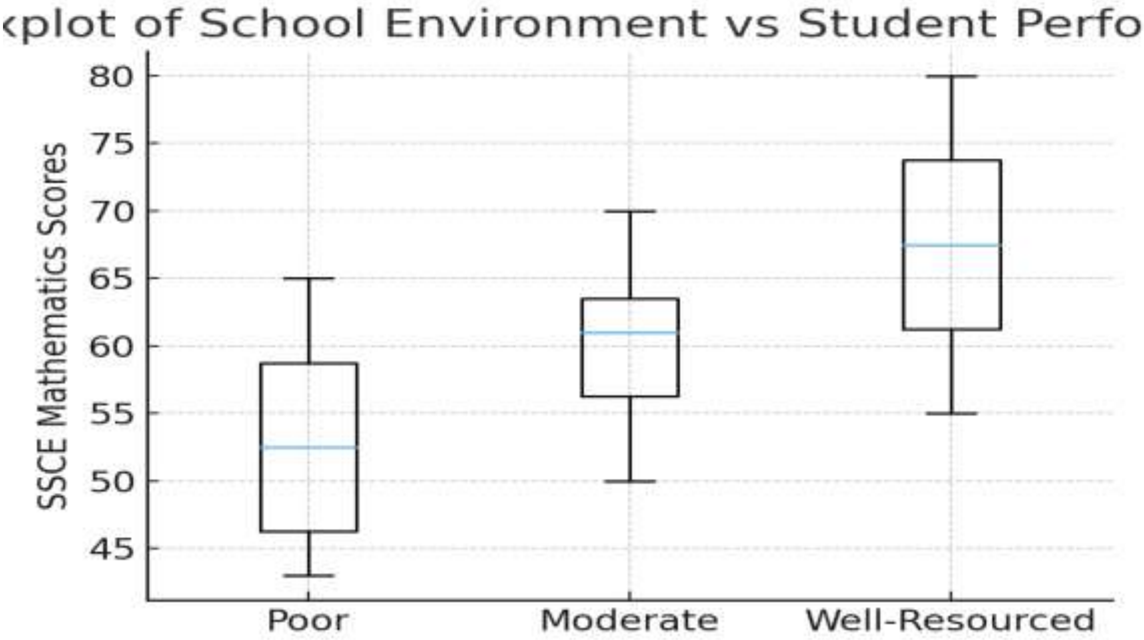


Figure 1. ***Boxplot of SSCE Mathematics Scores by School Environment***

Boxplot of SSCE Mathematics Scores by School Environment.

The figure 1 shows that students in well-resourced schools achieved higher median scores and a narrower interquartile range compared to those in poorly equipped schools. Outliers indicate variability among students in all school types.

4.2 Analysis of Variance (ANOVA)

To test the significance of differences across school environments, a one-way ANOVA was conducted (see **Table 2**). The results revealed statistically significant differences in mathematics scores, $F(2, 897) = 8.62$, $p < .05$. This confirms that school environment is a critical determinant of students' SSCE mathematics outcomes.

Table 2: ***ANOVA Results on School Environment and SSCE Mathematics Outcomes***

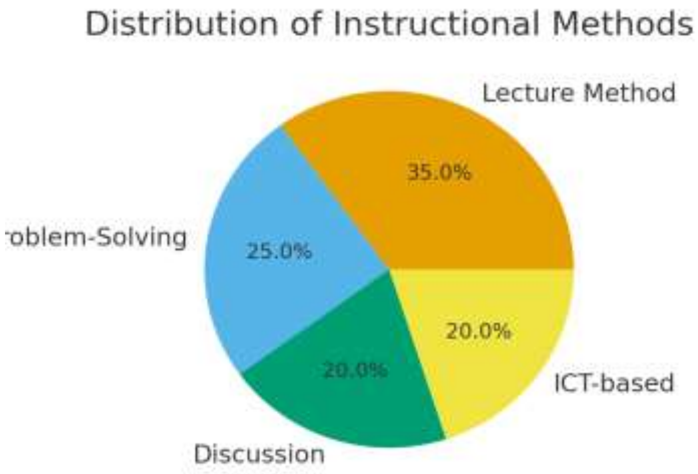
Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2450.37	2	1225.18	8.62	.000***
Within Groups	127650.84	897	142.35		
Total	130101.21	899			

One-way ANOVA indicates a statistically significant difference in mathematics scores across different school environments, $F(2,897) = 8.62$, $p < .05$.

Teacher Instructional Methods

The distribution of instructional methods among mathematics teachers is presented in **Figure 2**. Traditional lecture methods dominated (35%), followed by discussion-based (25%), problem-solving (20%), and blended/ICT-based approaches (20%).

Figure 2. ***Pie Chart of Teacher Instructional Methods Distribution***

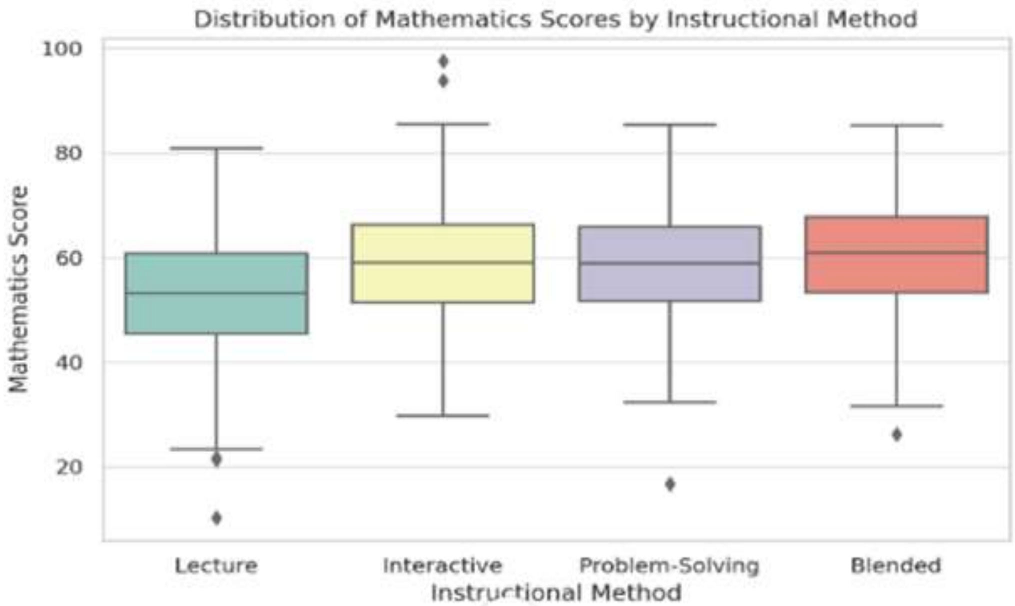


Pie Chart of Teacher Instructional Methods Distribution.

The chart illustrates the percentage distribution of mathematics teachers' instructional methods: traditional lecture methods (35%), discussion-based methods (25%), problem-solving methods (20%), and blended/ICT-based methods (20%).

Comparative analysis of student outcomes across instructional methods (see **Figure 3**) shows that students exposed to problem-solving and blended/ICT-based approaches consistently outperformed their peers taught mainly via lecture methods.

Figure 3. ***Boxplot of SSCE Mathematics Scores by Instructional Method***



Boxplot of SSCE Mathematics Scores by Instructional Method.

The figure 3. demonstrates that students taught with problem-solving and blended/ICT-based methods had higher median scores compared to those taught primarily through lecture methods.

4.3 Regression Analysis

To further examine the predictive strength of school environment and instructional methods on mathematics outcomes, a multiple regression analysis was conducted (see **Table 3**). The results indicate that both school environment ($\beta = .41$, $p < .001$) and instructional methods ($\beta = .36$, $p < .001$) are significant predictors of student achievement, jointly explaining 42% of the variance in SSCE mathematics scores ($R^2 = .42$).

Table 3: ***Regression Analysis of School Environment and Instructional Methods on Mathematics Outcomes***

Predictor	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**R²**
Constant	28.12	2.31	-	12.17	.000***	
School Environment	0.63	0.09	.41	7.00	.000***	0.42
Instructional Method	0.51	0.08	.36	6.38	.000***	

Regression analysis shows that both school environment and instructional methods are significant predictors of SSCE mathematics outcomes, jointly explaining 42% of the variance ($R^2 = .42$).

This finding aligns with the work of Ajayi (2018), who emphasized the importance of supportive school environments, and Okafor and Eze (2020), who demonstrated that learner-centered instructional methods significantly enhance mathematics performance. Together, these results underscore the dual importance of providing both adequate facilities and innovative pedagogy in improving SSCE outcomes.

5. Conclusion and Recommendations

The study concludes that the quality of the school environment and the instructional methods employed by mathematics teachers significantly affect SSCE outcomes in North-East Nigeria. Students in well-resourced schools and those taught with problem-solving and ICT-based methods consistently outperformed their peers.

5.2 Recommendations:

1. Government should increase funding to improve school infrastructure.
2. Teacher training programs should emphasize learner-centered instructional methods.
3. Class sizes should be reduced to enhance effective teaching and learning.
4. Continuous professional development should be mandated for mathematics teachers.

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