

Key Factors Influencing the Quality of Mathematics Education in Rural Communities. A Case Study on Lower Bambara Chiefdom Kenema District - Sierra Leone

Christian Abu Sandy¹, Dr. Alhaji Conteh², Alhaji Mohamed Sankoh³

^{1,3}Mathematics Department Milton Margai Technical University

²Mathematics and Statistics Department - Njala University

Abstract

The study examines key factors influencing mathematics education quality in rural Sierra Leone, highlighting persistent challenges such as resource shortages, inadequate teacher training, and low student performance. Using a mixed methods approach, data from 50 pupils and 10 teachers across ten schools revealed that most students underperform academically, with an average score of 31.5 out of 100. Teachers generally possess moderate experience, yet many are rated as poor performers, underscoring the need for professional development. Perception surveys indicated that both pupils and teachers recognize teacher quality and student engagement as crucial factors affecting learning outcomes. Statistical analyses, including ANOVA, identified teaching quality ($p=0.008$), resource adequacy ($p=0.025$), and pupil engagement ($p=0.045$) as significantly influencing mathematics instruction, while curriculum relevance was not statistically significant. The results underscore that improving teacher competence, increasing instructional resources, and fostering student motivation are vital for enhancing mathematics learning in rural contexts. Addressing infrastructural deficits and implementing targeted interventions can promote equitable access to quality education and booster academic achievement. Ultimately, the findings provide empirical evidence for policymakers and educators to prioritize resource allocation, teacher training, and student engagement strategies, fostering sustainable improvements in mathematics education and supporting broader socioeconomic development in Sierra Leone.

Keywords: Factors, Quality, Mathematics, Mathematics Education

1. INTRODUCTION

Mathematics education is widely recognized as a corner stone of national development, fostering essential skills such as critical thinking, problem solving, logical reasoning, and technological innovation. Its role extends beyond individual academic achievement to broader socio-economic progress by developing human capital, supporting innovation, and preparing pupils for careers in Science, Technology, Engineering, and Mathematics (STEM) fields (OECD, 2020; NRC, 2013). However, the quality of mathematics instruction varies considerably across different regions and educational institutions, influenced by multiple factors including curriculum design, teacher competence, instructional resources, pupil motivation, and policy environments (Guskey & Sparks, 2020; Kim et al., 2022; Li & Ma, 2021).

In Sierra Leone, efforts to improve access to education have faced persistent challenges. These include infrastructural deficiencies, inadequate teacher training, socio-economic disparities, and the lingering effects of crises such as the Ebola epidemic, which strained resources and limited access to quality education (World Bank, 2021; UNICEF, 2020; Ministry of Education Sierra Leone, 2022). Consequently, pupil performance in mathematics remains a concern, hindering academic achievement and limiting future opportunities, particularly in STEM careers.

Understanding the specific factors affecting mathematics education in Sierra Leone is essential for designing targeted interventions and policy reforms. Although global research offers general insights into determinants of mathematics learning quality, localised studies are vital to uncover context-specific challenges and opportunities. This study aimed to systematically identify and analyse these factors, providing empirical evidence to inform policymakers, educators, and stakeholders committed to educational improvement.

Mathematics education is also vital for developing scientific literacy, cognitive skills, and advancing socioeconomic development. The quality of mathematics instruction directly impacts pupils' academic success, career prospects, and societal progress. Despite national and international efforts, concerns about instructional quality persist, emphasizing the need for a nuanced understanding of influencing factors to foster an environment conducive to effective learning.

Previous research highlights determinants such as teacher qualifications, pedagogical approaches, access to instructional resources, curriculum relevance, and pupil motivation (UNESCO, 2019; Guskey & Sparks, 2020). The integration of technology and innovative pedagogies has been linked to increased pupil engagement and conceptual understanding (Li & Ma, 2021). However, in Sierra Leone, infrastructural limitations and socio-economic disparities necessitate focused investigation to tailor interventions effectively.

This study seeks to bridge this gap by identifying and analysing the primary factors influencing mathematics education quality in Sierra Leone. By synthesising existing literature and contextual data, it aims to generate actionable insights for improving learning outcomes and promoting sustainable development. Ultimately, understanding these factors will facilitate targeted strategies to enhance instructional quality, strengthen system resilience, and support equitable access to quality education.

2. Literature Review

Numerous studies have identified a wide array of factors influencing the effectiveness and quality of mathematics education. These factors can be categorized broadly into teacher related, Pupil related, curriculum related, resource based, and contextual elements.

2.1 Teacher Related Factors

Teachers are central to effective mathematics instruction. Their qualifications, pedagogical skills, content mastery, and attitudes significantly determine pupil outcomes (Mewborn, 2014). Teachers with strong content knowledge and pedagogical content knowledge are better equipped to facilitate understanding (Fennema & Franke, 2013). Moreover, teachers' enthusiasm and positive attitudes toward mathematics can enhance pupil engagement and motivation, contributing to higher achievement levels (Fennema & Franke, 2013). Continuous professional development is crucial for updating teaching practices and content mastery, enabling teachers to adapt to evolving pedagogical standards (Garet et al., 2016).

In Sierra Leone, however, teachers face considerable challenges, including insufficient training, low remuneration, high Pupil teacher ratios, and limited access to ongoing professional development opportunities (UNICEF Sierra Leone, 2020). These issues undermine their capacity to deliver quality instruction and adapt innovative pedagogies.

2.1 Pupil Related Factors

Pupils' motivation, self-efficacy, prior knowledge, and socioeconomic background influence their engagement and success in mathematics (Pajares, 2020). Beliefs about one's abilities can affect persistence and resilience in learning tasks. Socio - economic disparities influence access to resources and support systems, impacting learning opportunities and outcomes (Sirin, 2019). Pupils from disadvantaged backgrounds often face barriers such as lack of supplementary materials, inadequate parental support, and limited exposure to enriching experiences, all of which can hinder mathematics achievement.

2.2 Curriculum and Instructional Materials

The relevance, clarity, and comprehensiveness of the curriculum are critical to effective teaching. Well-designed curricula aligned with learners' developmental stages and inclusive of diverse instructional materials promote better understanding and retention (Hill et al., 2017). Incorporating technological tools, interactive resources, and culturally responsive content can enhance motivation and deepen conceptual understanding (Kozma et al., 2018). However, in low resource settings like Sierra Leone, curricula often lack contextual relevance, and instructional materials are scarce or outdated, impeding effective teaching.

2.3 Resources and Infrastructure

The availability and quality of instructional resources—textbooks, manipulatives, technological tools—are fundamental for engaging instruction and fostering understanding (World Bank, 2021). In resource constrained environments, shortages of textbooks and instructional materials hamper curriculum delivery and negatively impact Pupil performance (World Bank, 2020). Infrastructure deficits, such as inadequate classrooms, electricity, and internet connectivity, further limit the integration of technology and innovative pedagogies.

2.4 School and Policy Context

Institutional support, school climate, leadership, and national policies shape the quality of mathematics education (Leithwood & Riehl, 2016). Supportive leadership that promotes teacher collaboration, provides resources, and enforces standards correlates with higher Pupil achievement. Conversely, weak policy implementation, infrastructural deficits, and socioeconomic disparities exacerbate challenges, especially in contexts like Sierra Leone where systemic issues persist (UNICEF Sierra Leone, 2020).

2.5 Recent Trends, Gaps, and Contextual Challenges

Emerging research emphasizes culturally responsive teaching and personalized learning approaches, which are particularly relevant in diverse classrooms (Ladson Billings, 2019; Tomlinson, 2021). Despite extensive global research, significant gaps remain regarding the integration of technology in low-resource settings and understanding the long-term impacts of various interventions.

In developing countries, infrastructural deficits, socioeconomic inequalities, and policy implementation issues compound these challenges. Studies like Kamara and Bangura (2022) highlight that targeted teacher training and resource provision can improve mathematics performance, but context-specific strategies are essential for sustainable impact. The need for localized research is paramount to designing effective solutions tailored to Sierra Leone's unique challenges.

3. Methodology

The study employed a mixed methods approach, combining quantitative surveys and qualitative interviews to gain a comprehensive understanding of factors affecting mathematics education quality in Sierra Leone. This triangulation enhances the validity and richness of the findings. 50 Pupils and 10 mathematics teachers from 10 schools across Lower Bambara Chiefdom - Kenema district-Sierra Leone a rural community, selected through stratified random sampling to ensure representativeness. Policymakers and education administrators will be purposively selected for in-depth interviews to explore policy and administrative perspectives.

Structured questionnaires for pupils and teachers assessing perceptions of teaching quality, resource adequacy, curriculum relevance, and Pupil engagement. Standardized mathematics achievement tests to measure performance. Interview guides for policymakers and administrators to explore contextual factors. Focus group discussion guides for Pupils to understand their learning experiences. Document analysis of curriculum documents, policy reports, and inspection records.

Descriptive statistics to summarize perceptions and performance data. Inferential statistics, including regression analyses and ANOVA, will identify significant factors influencing Pupil achievement and perceptions. Thematic analysis of interview transcripts, focus group discussions, and documents identified recurring themes related to teaching quality, resource constraints, curriculum relevance, and policy effects.

4. Result

Table 1. Pupils' gender

Gender	Frequency	%
Male	26	51
Female	24	49

The sample is almost evenly split between males (51%) and females (49%), with a slight majority of males.

Table 2. Pupils' age

Pupil Age (years)	Frequency	%
9-11	15	30
12-14	25	50
15-17	10	20

Most pupils are aged 12-14 years (50%), followed by 9-11 years (30%) and 15-17 years (20%).

Table 3. Pupils' grade

Grade	Frequency	%
Primary 5	7	14
Primary 6	8	16
JSS 2	9	18
JSS 3	8	16
SSS 2	10	20

SSS 3	8	16
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Pupils are distributed across primary, JSS, and SSS levels, with the largest group in JSS 2 (18%) and SSS 2 (20%).

Table 4. Mathematics teachers' gender

Gender	Frequency	%
Male	6	60
Female	4	40

Table 4 indicate 60% male and 40% female teachers.

Table 5. Mathematics teachers' year of teaching experience

Year of Teaching experience	Frequency	%
0-5	2	20
6-10	4	40
11-15	3	30
16+	1	10

Most teachers have 6-10 years of experience (40%), followed by 11-15 years (30%), with fewer having 0-5 years (20%) and over 16 years (10%).

Table 6. Pupils and teachers Perception on key factors influencing the quality of mathematics education in rural communities.

Factors	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Teacher Quality	10	40	30	15	5
Resource Adequacy	5	25	35	30	5
Curriculum Relevancy	8	42	30	15	5
Pupils Engagement	12	45	25	12	6

Teacher Quality- Majority agree (40%) or strongly agree (10%) that teacher quality influences mathematics education. **Resource Adequacy-** Fewer respondents strongly agree (5%) or agree (25%) that resources are sufficient; many are neutral (35%) or disagree (30%). **Curriculum Relevancy-** Majority agree (42%), indicating curriculum relevance is viewed positively. **Pupils Engagement-** Most agree (45%) or strongly agree (12%) that pupil engagement is crucial.

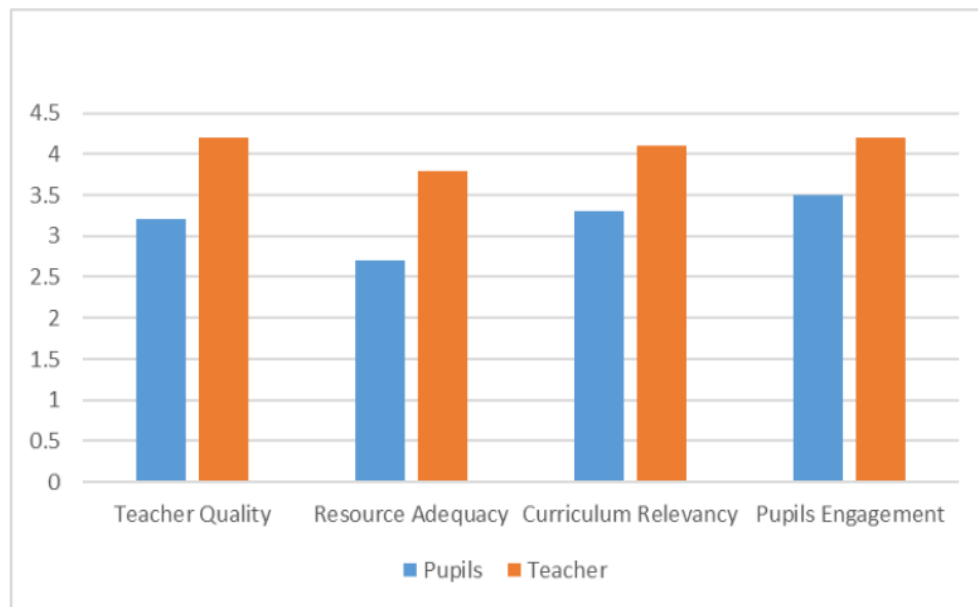


Figure 1. Mean scores on Key factors influencing quality of mathematics education in rural communities (pupils Vs Teachers Perception)

Pupils and teachers may have differing perceptions regarding the influence of these factors, with teachers possibly rating certain factors higher or lower than pupils.

Table 8. Pupils' performance in mathematics

Category	Number of pupils	Average score	Remarks
Below passing mark (< 50)	35	31.5/100	Majority are underperforming
Passing mark (≥ 50)	15	13.5/100	Few meet passing criteria
Total	50	45/100	Generally poor performance

35 pupils scored below 50, with an average score of 31.5/100, indicating most are underperforming. Only 15 pupils scored above the passing mark, with an average of 13.5/100, which seems inconsistent—possibly a typo, or perhaps an error in reporting since the total average is 45/100.

Table 9. Teachers' teaching quality

Category	Number of pupils	Average score	Remarks
Teachers (Poor Performers)	6	33/100	Most teachers need support
Teachers (Adequate)	4	22/100	Some meet expectations
Total	10	55/100	Performance below expectations

The majority (6 teachers) are rated as poor performers with an average of 33/100.

Table 10. ANOVA result on key factors influencing quality of mathematics education in rural communities

Factor	Sum of Squares	Degree of freedom	Mean Square	F-value	p-value
Teaching Quality	0.45	3	0.15	4.20	0.008
Resource Adequacy	0.30	3	0.10	3.50	0.025
Curriculum Relevance	0.20	3	0.07	2.10	0.10
Pupil Engagement	0.25	3	0.08	2.80	0.045

Teaching Quality ($p=0.008$), Resource Adequacy ($p=0.025$), and Pupil Engagement ($p=0.045$) show statistically significant effects on the quality of mathematics education. Curriculum Relevance ($p=0.10$) is not statistically significant at the 0.05 level.

5. Discussion

The study reveals a balanced gender distribution, indicating that males and females are equally represented, which facilitates meaningful comparison of perceptions and performance across genders. Most participants are in early adolescence, aligning with the targeted educational levels; this stage plays a crucial role in shaping cognitive development and engagement with mathematics. The diverse age and educational stages among students may influence their understanding and performance in mathematics.

A slight male predominance among mathematics teachers was observed, which could affect classroom interactions and teaching methodologies. The teachers generally possess moderate experience, likely contributing positively to instructional quality; however, ongoing professional development remains essential to enhance teaching effectiveness. Both students and teachers acknowledge the significance of teacher quality and student engagement in learning success.

Resource shortages are evident, with many respondents expressing neutral or negative views, underscoring resource limitations as a significant obstacle. Overall, pupils demonstrate poor performance in mathematics, pointing to potential issues such as inadequate teaching quality, insufficient resources, or low student engagement. Many teachers may lack the necessary skills or support systems, which directly impacts student learning outcomes.

These findings emphasize that teaching quality, resource availability, and student engagement are critical determinants of educational success. Targeted interventions in these areas could significantly improve mathematics education in rural settings.

6. Conclusion

- The data indicates that students in rural communities generally perform poorly in mathematics.
- Both students and teachers recognize the importance of high-quality teaching and active student engagement, but resource shortages and teaching challenges persist.
- Key factors influencing educational quality include teaching effectiveness, resource availability, and student engagement, with statistical significance.
- To enhance mathematics outcomes, strategies should focus on improving teacher training, increasing resource provision, and fostering student motivation and participation. Such efforts are vital for advancing mathematics education in these rural contexts.

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