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PREDICTORS OF SELF-REPORTED IMPLEMENTATION FIDELITY OF THE NEW SENIOR SECONDARY SCHOOL MATHEMATICS CURRICULUM AMONG MATHEMATICS TEACHERS IN EASTERN SIERRA LEONE: A QUANTITATIVE MULTILEVEL STUDY PROTOCOL

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ABSTRACT

Sierra Leone's new Senior Secondary School curriculum seeks to move mathematics teaching beyond examination-driven content coverage towards problem solving, reasoning, application, communication and interdisciplinary learning. This study protocol describes a quantitative cross-sectional explanatory study designed to examine self-reported implementation fidelity of the new Mathematics for STEAMM curriculum among mathematics teachers in Eastern Sierra Leone and to identify teacher-reported conditions associated with variation in implementation. The planned study covers 20 senior secondary schools distributed across Kenema, Kono and Kailahun Districts, with a working allocation of 40 mathematics teachers and 200 senior secondary students. The teacher instrument measures self-reported implementation fidelity, teacher preparedness, professional development, resource adequacy, classroom conditions, instructional workload constraints, assessment alignment and school leadership support. Student responses provide supplementary evidence on classroom implementation as experienced by learners. Analysis will begin with descriptive and reliability assessment, followed by bivariate analysis, an unconditional random-intercept model to estimate between-school variance and the intraclass

correlation coefficient, and a parsimonious multivariable random-intercept model. Because the design contains only 20 schools and a small number of teachers per school, inference will emphasise effect sizes, confidence intervals, variance-component uncertainty and a cluster-adjusted sensitivity analysis. The protocol is anchored in Rogan and Grayson's Theory of Curriculum Implementation and is designed to provide contextually relevant evidence on the teacher and organisational conditions associated with curriculum enactment in Eastern Sierra Leone.

Keywords: curriculum implementation; self-reported implementation fidelity; mathematics education; teacher preparedness; school leadership; curriculum reform; Sierra Leone

1. INTRODUCTION

Curriculum reform is a central mechanism through which education systems respond to changing social, economic, technological and developmental priorities. Adoption of a new curriculum, however, does not itself guarantee changes in classroom practice. Reform becomes educationally meaningful when teachers understand the prescribed curriculum, translate its expectations into instruction and assessment, and sustain those practices within the organisational conditions of schools. Teachers therefore occupy a pivotal position between curriculum policy and the curriculum experienced by learners.

Sierra Leone's reform of senior secondary education is particularly important in this regard. The National Curriculum Framework for Senior Secondary Education was developed in a context in which senior secondary teaching had long been strongly influenced by West African Senior School Certificate Examination syllabuses. The reform sought to establish a broader national framework and strengthen competencies extending beyond examination preparation (Ministry of Basic and Senior Secondary Education [MBSSE], 2022). The Mathematics for STEAMM syllabus reflects this shift by emphasising mathematical reasoning, problem solving, application, communication and connections across science, technology, engineering, arts and mathematics-related fields (MBSSE, 2023).

These expectations require more than completion of prescribed topics. Mathematics teachers are expected to create opportunities for learners to investigate, reason, communicate, apply mathematical ideas and engage with problems connected to practical and interdisciplinary contexts. Such changes may require modification of established instructional routines, confidence with unfamiliar pedagogies, broader assessment practices and access to resources that are not equally available across schools.

International and African evidence consistently identifies a gap between curriculum intentions and classroom enactment. Teacher understanding, sustained professional development, material resources, assessment practices and institutional support repeatedly shape implementation. Akala (2021) documented implementation challenges during Kenya's transition to competency-based education, while Sepadi and Molapo (2024) highlighted teacher understanding, training and resources in curriculum-policy

implementation in South Africa. Sancar et al. (2021) similarly argue that professional development is most effective when it is sustained, context-sensitive and connected to teachers' working conditions.

The Sierra Leone Education Sector Plan 2022–2026 identifies teacher development, curriculum implementation, resources and system capacity as central components of educational transformation (Government of Sierra Leone, 2022). In Eastern Sierra Leone, Alpha et al. (2025) reported inadequate training, limited professional-development opportunities, shortages of teaching and learning materials and infrastructural inequalities as important constraints on delivery of the new mathematics curriculum.

The available evidence establishes that implementation challenges exist, but it does not fully show the extent to which intended curriculum practices are enacted or which measured implementation conditions retain independent associations with self-reported fidelity when considered simultaneously. This analytical gap is important because policy responses may differ depending on whether variation is most closely associated with teacher preparedness, professional development, resources, workload, assessment alignment, leadership support or shared school context. Treating self-reported implementation fidelity as an explicit outcome therefore moves the investigation beyond a descriptive inventory of challenges towards an explanatory account of variation in curriculum enactment.

Accordingly, the study is designed to examine self-reported implementation fidelity of the new Senior Secondary School Mathematics curriculum among mathematics teachers in Eastern Sierra Leone. It evaluates teacher preparedness, professional development, resource adequacy, classroom conditions, instructional workload constraints, assessment alignment and school leadership support as teacher-reported explanatory conditions, while recognising school as the clustering level. Student perceptions are included as supplementary evidence of the classroom practices learners experience.

1.1 Research Questions

RQ1. What is the level of self-reported implementation fidelity of the new Senior Secondary School Mathematics curriculum among mathematics teachers in the sampled schools?

RQ2. What relationships exist between self-reported implementation fidelity and teacher preparedness, professional development, resource adequacy, classroom conditions, instructional workload constraints, assessment alignment and school leadership support?

RQ3. Which measured teacher-reported implementation conditions independently predict self-reported implementation fidelity when considered simultaneously?

RQ4. What proportion of the variance in self-reported implementation fidelity is attributable to differences between schools?

RQ5. To what extent do school-level summaries of student-perceived classroom implementation converge with school-level summaries of teacher-reported implementation fidelity?

1.2 Hypotheses

H01: Teacher preparedness is not significantly associated with self-reported implementation fidelity.

- H02: Professional development is not significantly associated with self-reported implementation fidelity.
H03: Resource adequacy is not significantly associated with self-reported implementation fidelity.
H04: Classroom conditions are not significantly associated with self-reported implementation fidelity.
H05: Instructional workload constraints are not significantly associated with self-reported implementation fidelity.
H06: Assessment alignment is not significantly associated with self-reported implementation fidelity.
H07: School leadership support is not significantly associated with self-reported implementation fidelity.
H08: The between-school variance component in self-reported implementation fidelity is zero ($H_0: \sigma^2_{\text{school}} = 0$).
H09: There is no statistically significant association between school-level student-perceived implementation and school-level teacher-reported implementation fidelity.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Implementation Fidelity and Mathematics Curriculum Reform

Implementation fidelity refers to the degree to which an intervention, programme or curriculum is delivered in accordance with its intended design. The concept is multidimensional. Carroll et al. (2007) distinguish adherence from factors such as quality of delivery, participant responsiveness and facilitation strategies, while school-based implementation research similarly emphasises that fidelity should not be reduced to the mere presence of a programme or curriculum document. Studies of implementation quality therefore commonly consider adherence, dosage, quality of delivery and participant responsiveness as complementary dimensions (Dowling & Barry, 2020).

For Sierra Leone's Mathematics for STEAMM curriculum, fidelity cannot be adequately represented by content coverage alone. A teacher may complete prescribed topics while retaining predominantly procedural and teacher-centred practices that do not enact the curriculum's broader expectations for reasoning, communication, problem solving and application. In this study, implementation fidelity is therefore conceptualised as the extent to which teachers report enacting the pedagogical, instructional and assessment practices promoted by the new curriculum. Because the principal measure is teacher self-report, the outcome is consistently termed self-reported implementation fidelity.

2.2 Teacher Preparedness

Teacher preparedness concerns the knowledge, understanding and confidence required to interpret curriculum expectations and translate them into classroom practice. Reform may remain superficial when teachers are uncertain about new curriculum goals, unfamiliar with recommended pedagogies or insufficiently confident in implementing them. Sepadi and Molapo (2024) show that curriculum understanding and implementation support remain important in teachers' enactment of reform, while Thierry et al. (2022) demonstrate more generally that teacher-level characteristics can predict variation in implementation fidelity.

Within the present framework, preparedness encompasses understanding of curriculum goals, knowledge of instructional expectations, confidence in recommended pedagogical approaches and perceived ability to design learning experiences aligned with curriculum outcomes. A positive association with self-reported fidelity is theoretically expected because curriculum intentions reach learners through teacher interpretation and enactment.

2.3 Professional Development

Curriculum reforms often introduce pedagogical and assessment expectations that cannot be sustained through initial orientation alone. Effective professional development is increasingly understood as a continuing process that is contextually relevant, connected to classroom practice and supported by collaboration and follow-up (Sancar et al., 2021). Evidence from Sub-Saharan Africa likewise indicates that capacity-building programmes may improve teacher knowledge while classroom transfer remains dependent on enabling school conditions (Agyei, 2021).

For the new mathematics curriculum in Sierra Leone, professional development is expected to be most consequential when it helps teachers interpret the curriculum, rehearse problem-solving and learner-centred strategies, design aligned assessment tasks and receive continuing support after formal training. Its effect may therefore overlap with preparedness, leadership support and access to implementation resources, which makes simultaneous modelling analytically important.

2.4 Resource Adequacy

Curriculum innovation frequently assumes access to textbooks, teacher guides, calculators, manipulatives, technological resources and suitable classroom materials. Resource constraints can limit the range of pedagogical strategies teachers are able to implement even where teachers understand and support the reform. Alpha et al. (2025) reported inequalities in access to teaching materials and infrastructure in Eastern Sierra Leone, reinforcing the need to examine resource adequacy as an analytical predictor rather than only as a descriptive challenge.

Resource adequacy refers to teachers' perceptions of the availability and usability of materials and facilities required to enact the mathematics curriculum. A positive association with self-reported implementation fidelity is expected, although the cross-sectional design can establish association rather than causal direction.

2.5 Classroom Conditions and Instructional Workload

Large classes, unsuitable learning environments, limited instructional time and heavy teaching schedules may restrict teachers' capacity to sustain interactive pedagogy. Problem solving, collaborative work, formative assessment and individual feedback typically demand greater classroom organisation and time than lecture-dominated instruction. Workload pressure may therefore create a practical gap between knowing what the curriculum expects and being able to enact it consistently.

The study distinguishes classroom conditions from instructional workload constraints. Classroom conditions capture the perceived suitability of the immediate teaching environment, whereas workload

constraints capture time pressure, class load and competing teaching responsibilities. Better classroom conditions are expected to be positively associated with self-reported fidelity, while greater workload constraints are expected to be negatively associated with it.

2.6 Assessment Alignment

Assessment can reinforce or undermine curriculum reform. When classroom and external assessments reward competencies emphasised by the intended curriculum, teachers receive coherent signals about what should be taught and how learning should be demonstrated. When high-stakes examinations reward narrower procedural reproduction, teachers may experience pressure to prioritise examination preparation over broader curriculum intentions.

Assessment alignment therefore refers to the perceived consistency between curriculum expectations, classroom assessment practices and competencies rewarded by external assessment. In the Sierra Leonean context, this construct is especially relevant because the reform was intended to broaden learning beyond an examination-driven orientation.

2.7 School Leadership Support

School leaders influence curriculum implementation through supervision, resource allocation, professional learning, monitoring, timetable decisions and the wider climate for instructional innovation. Teachers may be more able to sustain demanding reforms when school management supports experimentation, collaboration and problem solving rather than limiting supervision to administrative compliance.

Leadership support is therefore conceptualised as a teacher-reported organisational condition that may enable or constrain implementation. It is particularly relevant to Rogan and Grayson's framework because school ethos and management form part of the capacity to support innovation.

2.8 Theoretical Framework: Rogan and Grayson's Theory of Curriculum Implementation

The study is anchored in Rogan and Grayson's (2003) Theory of Curriculum Implementation, developed to explain educational change in developing-country contexts. The framework proposes three interrelated constructs: the Profile of Implementation, the Capacity to Support Innovation and Support from Outside Agencies. Rogan and Aldous (2005) subsequently demonstrated that relationships among these constructs can vary across schools, reinforcing the importance of examining implementation within organisational context.

The Profile of Implementation concerns the nature and extent of actual classroom enactment and corresponds to the study's self-reported implementation-fidelity outcome. Capacity to Support Innovation refers to internal conditions that enable or restrict implementation, including teacher characteristics, physical resources, learners, school ethos and management. Teacher preparedness, resource adequacy, classroom conditions, workload and leadership support largely fall within this domain. Support from Outside Agencies includes training, professional guidance and material support; professional development

is most directly linked to this domain. Assessment alignment operates across school and system levels because it can reinforce or contradict instructional expectations embedded in the curriculum.

The framework is appropriate because it avoids attributing curriculum success or failure exclusively to individual teachers. Instead, it treats implementation as a product of interactions among teacher capacity, organisational capacity, external support and the practical demands of classroom enactment. This theoretical logic also supports analysis that separates teacher-level variation from variation shared by teachers in the same school.

Table 1. Theoretical alignment of study constructs

Rogan and Grayson dimension	Study construct	Role in the model
Profile of Implementation	Self-reported implementation fidelity	Outcome: reported enactment of intended curriculum practices
Capacity to Support Innovation	Teacher preparedness	Teacher implementation capacity
Capacity to Support Innovation	Resource adequacy	Perceived material capacity
Capacity to Support Innovation	Classroom conditions	Immediate instructional environment
Capacity to Support Innovation	Instructional workload constraints	Practical constraint on enactment
Capacity to Support Innovation	School leadership support	Perceived organisational support
Support from Outside Agencies	Professional development	External and continuing support for teacher learning
System alignment	Assessment alignment	Coherence among curriculum, instruction and assessment

2.9 Conceptual Model

The conceptual model treats self-reported implementation fidelity as the dependent variable and teacher preparedness, professional development, resource adequacy, classroom conditions, instructional workload constraints, assessment alignment and school leadership support as explanatory variables. These constructs are measured at the teacher level. School is therefore treated as a clustering level through a random intercept rather than assuming that a teacher-reported scale is inherently a school-level construct. Any aggregation of leadership, resources or related measures to the school level will be justified only if supported by within-school agreement and intraclass-correlation evidence.

3. METHODOLOGY

3.1 Research Design and Study Setting

The study uses a quantitative cross-sectional explanatory survey design to examine self-reported implementation fidelity of the new Senior Secondary School Mathematics curriculum and the measured conditions associated with it in the Eastern Region of Sierra Leone. The study covers senior secondary schools in Kenema, Kono and Kailahun Districts and includes urban, semi-urban and rural school contexts. The design is suitable for estimating levels, associations and multivariable statistical relationships at a defined point in time. Because exposure and outcome information are collected cross-sectionally, the analysis will not be used to establish temporal ordering or causal effects.

3.2 Population, Sample and Sampling Procedure

The study population comprises mathematics teachers responsible for teaching the new senior secondary Mathematics curriculum and senior secondary students receiving mathematics instruction under the curriculum in the Eastern Region of Sierra Leone. A multistage stratified random sampling procedure will be used to select schools, mathematics teachers and students. The region will be stratified by district into Kenema, Kono and Kailahun. From the eligible senior secondary schools offering the new Mathematics curriculum, 20 schools will be selected using simple random sampling, comprising eight schools from Kenema, seven from Kono and five from Kailahun. Where reliable location classifications are available, representation of urban, semi urban and rural schools will be maintained within the district strata.

Within each selected school, eligible senior secondary mathematics teachers will constitute the teacher sampling frame. Approximately two teachers will be selected per school, giving a planned sample of 40 teachers. Where only two eligible teachers are available, both will be invited; where more than two are available, two will be selected randomly. Students will be selected independently from official class registers using simple or systematic random sampling. Approximately 10 eligible senior secondary students will be selected from each school, producing a planned student sample of 200. Where more than one eligible grade is represented, student selection will be proportionately distributed across the grades.

The resulting sample will therefore comprise 20 schools, 40 mathematics teachers and 200 students. School identification codes will be retained to preserve the hierarchical structure required for multilevel analysis. Any nonresponse, ineligibility or replacement will be documented, and replacements, where necessary, will be drawn from predetermined randomly selected reserve lists within the same sampling stratum. The final empirical report will present the number eligible, approached, participating and included in the analysis, together with the achieved response rates.

Table 2. Planned sample allocation by district

District	Schools, n (%)	Teachers, n (%)	Students, n (%)
Kenema	8 (40.0)	16 (40.0)	80 (40.0)
Kono	7 (35.0)	14 (35.0)	70 (35.0)
Kailahun	5 (25.0)	10 (25.0)	50 (25.0)
Total	20 (100.0)	40 (100.0)	200 (100.0)

3.3 Instruments and Measures

Data are obtained using separate structured questionnaires for teachers and students. The teacher questionnaire uses five-point Likert-type response scales to measure self-reported implementation fidelity and seven explanatory constructs: teacher preparedness, professional development, resource adequacy, classroom conditions, instructional workload constraints, assessment alignment and school leadership support. The instrument structure assigns 10 items to self-reported implementation fidelity and five or six items to each predictor scale. The student questionnaire includes eight items assessing students' perceptions of the extent to which recommended curriculum practices are experienced during mathematics lessons. Student data are supplementary and are used to examine convergence with teacher reports rather than as interchangeable measures of the same respondent-level construct.

3.4 Instrument Validity and Reliability

Instrument validity and reliability will be assessed through expert review, pilot testing and internal-consistency analysis using Cronbach's alpha and, where appropriate, McDonald's omega. The final report will document the number and relevant expertise of reviewers, the pilot sample and setting, revisions made after piloting, and the basis on which item content was judged to represent each construct. Internal consistency will be estimated in the observed study sample, preferably with confidence intervals were supported by the software. Reliability coefficients will not be presented as evidence of construct validity. If factor-analytic validation is undertaken, its procedures and results will be reported separately; otherwise, the absence of factor-analytic validation will be acknowledged as a measurement limitation.

3.5 Data Collection and Ethical Considerations

Participation will be voluntary, with informed consent obtained from adult participants and parental or guardian consent together with student assent obtained for minors, as applicable. Confidentiality will be maintained, and no personally identifying information will be included in the analytical dataset. Permission will be obtained from relevant education authorities and participating schools. The final submission will report the verified name of the ethics-review or approving body, approval or reference number, approval date, and the consent and assent procedures documented in the study records.

3.6 Data Management and Screening

Data screening will include checks for completeness, duplicate records, coding errors, out-of-range responses and missing values. The extent and pattern of missingness will be described before inferential analysis. Composite scores will be created only where item coding, scale direction and internal consistency support aggregation. Distributional diagnostics will include inspection of means, standard deviations, skewness, kurtosis and model residuals. Multicollinearity among explanatory variables will be assessed using tolerance and variance inflation factors. Influential observations will be investigated using diagnostics appropriate to the fitted models.

3.7 Descriptive and Reliability Analysis

Descriptive statistics will summarise participant characteristics and the distributions of the principal study variables. For composite Likert-type scores, means and standard deviations will be reported when scale construction and distributional properties support their use. Where interpretive categories such as low, moderate or high are used, their cut points will be specified a priori and justified substantively. Internal consistency will be evaluated using Cronbach's alpha and, where feasible, McDonald's omega, with uncertainty estimates reported when available.

3.8 Bivariate and Teacher-Student Convergence Analysis

Pearson correlations will be used to describe bivariate associations between self-reported implementation fidelity and the seven teacher-reported explanatory conditions when assumptions are adequately met; robust or rank-based alternatives will be considered when those assumptions are materially violated. Student responses will be summarised at school level and compared with school-level teacher means as supplementary convergence evidence. Because school aggregation reduces the effective sample for this comparison to 20 schools, the resulting association will be interpreted cautiously and reported with a confidence interval where possible.

3.9 Multilevel Model Specification

Because teachers are nested within schools, the primary hierarchical analysis will begin with an unconditional random-intercept model. For teacher i in school j , the model is $Y_{ij} = \beta_0 + u_j + e_{ij}$, where Y_{ij} denotes self-reported implementation fidelity, β_0 is the grand intercept, u_j is the school-specific random intercept with variance σ^2_u , and e_{ij} is the teacher-level residual with variance σ^2_e . The intraclass correlation coefficient will be calculated as $ICC = \sigma^2_u / (\sigma^2_u + \sigma^2_e)$, representing the proportion of total variance attributable to between-school differences.

A subsequent random-intercept regression model will evaluate teacher preparedness, professional development, resource adequacy, classroom conditions, instructional workload constraints, assessment alignment and leadership support as fixed effects. Because only 40 teachers are distributed across 20 schools, the full seven-predictor model will be treated as potentially overparameterised. The empirical analysis will therefore prioritise a parsimonious, theory-driven specification and will compare any fuller model with a reduced model supported by the conceptual framework and observed data characteristics. Coefficients will be reported as unstandardised estimates with standard errors, 95% confidence intervals and p values. Marginal and conditional R^2 may be reported when supported by the selected estimation method and software.

All seven explanatory constructs are measured from teachers in the current instrument. They will therefore not be labelled as school-level predictors unless aggregation is independently justified by appropriate within-school agreement and intraclass-correlation evidence.

3.10 Small-Sample Safeguards and Sensitivity Analysis

The planned design is statistically demanding because 40 teachers are distributed across only 20 schools, giving an average of approximately two teachers per cluster. Methodological research shows that multilevel standard errors and variance components can be unstable when the number of higher-level units is small (Maas & Hox, 2005; McNeish & Stapleton, 2016). The multilevel model will therefore remain parsimonious, and substantive interpretation will emphasise the magnitude and uncertainty of estimates rather than significance thresholds alone.

Uncertainty around the school-level variance and ICC will be reported wherever feasible, and the random effect will not be interpreted solely through a single boundary significance test. A cluster-adjusted single-level model will be fitted as a sensitivity analysis using an appropriate small-sample correction where supported by the software. The direction, magnitude and uncertainty of coefficients will be compared across approaches. The final empirical report will also provide a sample-size or power rationale and will explicitly discuss the implications of the modest number of teachers and clusters for precision and power.

3.11 Analysis Plan by Research Question

Table 3. Alignment of research questions, variables and planned analysis

Research question	Primary information	Planned analysis
RQ1	Self-reported implementation fidelity	Descriptive statistics; reliability estimates; distributional assessment
RQ2	Seven teacher-reported explanatory conditions and fidelity	Bivariate correlations with confidence intervals where feasible
RQ3	Simultaneous teacher-level predictors	Parsimonious random-intercept multivariable model; effect estimates and 95% CIs
RQ4	Between-school variation	Unconditional random-intercept model; variance components; ICC with uncertainty

RQ5	Teacher-student school-level convergence	School-level summaries and correlation; cautious interpretation at n = 20 schools
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3.12 Reporting Principles

All reported numerical results in the eventual empirical article will be generated from the observed dataset. No illustrative, simulated or development-draft statistics will be presented as findings. The abstract, tables, results, discussion, conclusion and policy implications will be checked for numerical and interpretive consistency. Cross-sectional associations will be described using non-causal language such as associated with, related to or statistically predicted within the fitted model.

4. PLANNED INTERPRETATION OF FINDINGS

The eventual empirical Discussion will answer each research question directly from observed results and interpret the direction, magnitude and uncertainty of the estimates in relation to Rogan and Grayson's framework and the wider literature. Particular attention will be paid to whether teacher preparedness, professional development, resource adequacy, classroom conditions, workload, assessment alignment and perceived leadership support show independent associations with self-reported implementation fidelity after accounting for clustering. Statistically nonsignificant estimates will not be interpreted as evidence of no practical importance; their confidence intervals, potential overlap with related predictors and the limited statistical power of the design will be considered.

Between-school variation will be interpreted as evidence concerning the extent to which teachers within the same school resemble one another in reported curriculum implementation. Any teacher-student school-level association will be treated as supplementary convergence evidence rather than validation of individual teacher self-reports, because the two respondent groups measure implementation from different perspectives and aggregation leaves only 20 school-level observations.

5. ANTICIPATED POLICY AND PRACTICE RELEVANCE

The study is designed to provide evidence that can help the Ministry of Basic and Senior Secondary Education, the Teaching Service Commission, school leaders and teacher-development providers identify conditions associated with stronger or weaker enactment of the Mathematics for STEAMM curriculum. Depending on the observed findings, policy interpretation may address sustained professional learning, equitable access to mathematics teaching and learning resources, workload and instructional time, leadership support, and coherence between curriculum expectations and assessment practices. Recommendations will be tied only to associations supported by the observed data and will not be framed as causal effects.

6. CONTRIBUTION TO KNOWLEDGE

The study is positioned to contribute to knowledge by shifting the Eastern Sierra Leone literature from

identifying implementation challenges towards explaining variation in self-reported implementation fidelity. It treats implementation fidelity as an explicit outcome rather than assuming that the presence of challenges automatically demonstrates weak implementation. It evaluates multiple teacher-reported implementation conditions simultaneously while recognising the clustering of teachers within schools. It also applies Rogan and Grayson's theory to a contemporary mathematics curriculum reform, linking teacher capacity, organisational capacity and external support within a single analytical framework.

7. STRENGTHS AND LIMITATIONS

A major strength of the protocol is the explicit alignment of theory, measurement and analysis, together with recognition of the nested structure of teachers within schools. The inclusion of student perceptions provides a supplementary perspective on classroom implementation and reduces exclusive reliance on a single respondent group for all descriptive evidence.

Several limitations require careful interpretation. The cross-sectional design can identify associations but cannot establish temporal or causal relationships. Self-reported implementation fidelity and the explanatory measures are collected from the same teacher questionnaire, creating potential common-method variance and social-desirability bias. Unless classroom observations, lesson-plan reviews or other independent evidence are available, the outcome will therefore remain explicitly described as self-reported implementation fidelity.

The 20-school structure is modest for estimating school-level variance, and approximately two teachers per school provide limited within-school information. Random-intercept models must therefore remain parsimonious, variance components should be accompanied by uncertainty information where possible, and sensitivity analysis should be reported. The seven-predictor model may be overparameterised for 40 teachers, so coefficient stability and statistical power require explicit consideration. Aggregating student and teacher reports to 20 schools also limits the precision of convergence analysis. Finally, findings from the Eastern Region should not automatically be generalised to all senior secondary schools in Sierra Leone; representativeness will depend on the documented sampling procedures and achieved response rates.

8. ETHICS, DISSEMINATION AND DATA INTEGRITY

The study will be reported in accordance with the ethical approval and consent procedures documented in the study records. Results will be disseminated through scholarly publication and may also be communicated to relevant education authorities and participating institutions in forms appropriate to the permissions granted. Only de-identified analytical data will be used for statistical reporting. No numerical result will be presented as empirical unless it can be reproduced from the observed dataset.

The final journal submission will include verified data-availability, funding, conflict-of-interest, author-contribution and protocol-registration statements, where applicable and as required by the selected journal.

9. CONCLUSION

Sierra Leone's new Senior Secondary School Mathematics curriculum represents an important attempt to strengthen the relevance, application and quality of mathematics education. Its success depends on whether pedagogical and assessment intentions are enacted consistently in classrooms. This protocol provides a structured framework for examining self-reported implementation fidelity and its associations with teacher preparedness, professional development, resources, classroom conditions, workload, assessment alignment and perceived leadership support in Eastern Sierra Leone. The planned analytical strategy recognises school clustering, places appropriate limits on causal interpretation and incorporates safeguards for the small number of teachers and schools. The study will provide a defensible empirical contribution only when all reported findings are generated from the observed dataset and the verified instrument-validation and ethical-approval details are fully documented.

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