Ghana Numeracy Pilot Impact Evaluation
2017 Baseline Report

Final version March 2018

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<th>Description</th>
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<tr>
<td>DTST</td>
<td>District Teacher Support Team</td>
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<tr>
<td>EGMA</td>
<td>Early Grade Mathematics Assessment</td>
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<td>EMIS</td>
<td>Education Management Information System</td>
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<tr>
<td>ES</td>
<td>Evaluating Systems</td>
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<tr>
<td>GENA</td>
<td>Ghana Early Numeracy Assessment</td>
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<tr>
<td>GES</td>
<td>Ghana Education Service</td>
</tr>
<tr>
<td>HT</td>
<td>Head Teacher</td>
</tr>
<tr>
<td>HFC</td>
<td>High Frequency Check</td>
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<tr>
<td>ICC</td>
<td>Intra-Cluster Correlations</td>
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<tr>
<td>ILC</td>
<td>ILC Africa</td>
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<tr>
<td>INSET</td>
<td>In-Service Teacher Training</td>
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<td>IRB</td>
<td>Institutional Review Board</td>
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<td>MDES</td>
<td>Minimum Detectable Effect Sizes</td>
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<td>MT</td>
<td>Master Trainers</td>
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<td>MOE</td>
<td>Ministry of Education</td>
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<td>NEA</td>
<td>National Education Assessment</td>
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<td>ODK</td>
<td>Open Data Kit</td>
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<td>OLS</td>
<td>Ordinary Least Squares</td>
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<td>PCA</td>
<td>Principal Component Analysis</td>
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<tr>
<td>RAMSRI</td>
<td>Radiological and Medical Sciences Research Institute</td>
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<tr>
<td>SBI</td>
<td>School-based INSET</td>
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<td>STS</td>
<td>School to School International</td>
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<tr>
<td>SES</td>
<td>Socio-economic Status</td>
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<tr>
<td>SI</td>
<td>Social Impact</td>
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<tr>
<td>SOT</td>
<td>Structured Observation Tool</td>
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<td>SOW</td>
<td>Statement of Work</td>
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<tr>
<td>STEM</td>
<td>Science, Technology, Engineering, and Mathematics</td>
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<td>TIMSS</td>
<td>Trends in International Mathematics and Science Study</td>
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<td>ToC</td>
<td>Theory of Change</td>
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<td>TOT</td>
<td>Training of Trainers</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<td>USAID</td>
<td>U.S. Agency for International Development</td>
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EXECUTIVE SUMMARY

In 2014, the Ministry of Education (MOE) of Ghana established a national committee to examine the state of mathematics and science teaching and learning. The purpose of this committee was to develop recommendations to equip future learners with the mathematical foundations needed to succeed in an increasingly technological society. The committee’s report, *Reforming Science and Mathematics Education in Basic Schools in Ghana*, included findings on children’s achievement in mathematics and featured a national road map for improving the state of mathematics teaching and learning in Ghana. In response, USAID/Ghana’s *Learning* activity designed a Numeracy Pilot project based on the committee’s findings and recommendations.

The Numeracy Pilot was designed to put the report recommendations into action in a small group of schools in order to facilitate learning and adaptation prior to future program scale up. Concurrently, USAID/Ghana’s *Evaluating Systems* activity designed an impact evaluation to rigorously assess the extent to which the Numeracy Pilot improves performance in basic mathematics among early grade learners. This report presents results of a baseline assessment conducted in September 2017, prior to the rollout of the Numeracy Pilot. The endline assessment, scheduled for June/July 2018, will provide results on the impact of the program on learner assessment scores as well as other key outcomes of interest after one academic year of implementation. In addition, the endline report will contain an embedded process evaluation to assess the extent to which the program was delivered according to plan as well as identify obstacles to effective implementation. Through these complementary activities, *Learning* and *Evaluating Systems* aim to provide the MOE of Ghana with the information needed to make improvements to the early grade mathematics curriculum at a national level.

METHODOLOGY

To provide the MOE with this evidence, *Evaluating Systems* is using a combination of an impact evaluation and a process evaluation. The impact evaluation component is a clustered randomized controlled trial (RCT) which involves random assignment of schools to treatment or control conditions so that each group, on average, is statistically similar at baseline, thus any observed differences between the two groups at endline can be attributed to the intervention. Barring the threats and limitations discussed in this report, the RCT will provide an unbiased estimate of the program impact which can be causally attributed to the Numeracy Pilot. The endline process evaluation component is designed to capture data on constraints to effective program implementation at the student-, teacher-, classroom-, and school-level. Combined, these evaluation activities are designed to support the MOE in its approach to effectively scale the pilot at a national level.

Findings from baseline data collection are presented in this report. The team first presents baseline balance statistics on outcomes that are expected to mediate program impact in order to validate the randomization procedures in generating a credible counterfactual. In addition, the findings section examines two key components of the program theory of change: (1) baseline status of primary outcomes of interest at the teacher- and pupil-level and (2) baseline measures of those theory of change factors that are expected to be necessary conditions for outcomes to lead to impacts. Finally, the findings section uses multiple regression analysis to explore factors that predict mathematics assessment scores in order to explore this rich data set in more depth so that policy-relevant conclusions might be drawn on potential areas for further influencing mathematics performance among Ghanaian learners in the study schools and beyond.
FINDINGS AND CONCLUSIONS

Randomization procedures were effective in establishing a credible counterfactual. Statistical comparison of primary indicators and covariates—including mathematics assessment performance and a host of school, classroom, teacher, and pupil characteristics—show strong balance between treatment and control at baseline. Barring threats and limitations discussed later in this report, the evaluation team is confident that observed differences between treatment and control at endline will represent the causal impact of the Numeracy Pilot program.

With the exception of addition and subtraction, baseline zero scores were low to moderate for core mathematics assessment subtests, ranging from less than 1 percent for P2 number identification to 21 percent for P1 quantity discrimination. Zero scores for the Numeracy Pilot-aligned subtests were relatively large, due primarily to the fact that baseline took place at the start of the school year and these subtests are designed to measure performance against end-of-school-year benchmarks.

On average, pupils are receiving just 3.9 hours of math instruction per week. Adjusting the 4.6 hours of Head Teacher-reported weekly math instruction to account for teacher and pupil absences (5 and 10.6 percent, respectively), true average weekly exposure to math instruction is 3.9 hours per week on average, or 15 percent below target. Because this figure does not account for tardiness or classroom time that is off-task, actual instructional time may still be overestimated.

School-based in-service training (SBI) at the expense of instructional time is negatively associated with pupil assessment performance. In schools where pupils are regularly dismissed so that teachers can participate in SBI, pupils score 3.5 percentage points lower on average. Because students are already only receiving an average of 3.9 hours of weekly math instruction, SBI at the expense of instructional time could negatively affect student performance.

When Head Teachers provide regular classroom-based teacher coaching and feedback, pupils perform better in mathematics. In schools where Head Teachers agree with the statement, “observing maths lessons and providing coaching and feedback to teachers on their instructional practice is part of my regular duties as Head Teacher,” pupils score 6.5 percentage points higher on the core mathematics assessment.

While teachers believe in the importance of encouraging mathematical reasoning and conceptual understanding, there is misalignment between their beliefs and actual classroom practices. Despite the fact that the majority of teachers believe there are multiple methods and approaches to solving a problem, only 12 percent of teachers were observed encouraging pupils to use multiple problem-solving strategies during a lesson. In addition, only 27 percent of teachers were observed encouraging mathematical reasoning (i.e., applying existing skills and knowledge to solve unfamiliar problems).

Approximately 30 percent of pupils are in classrooms where either they or their teachers are unable to effectively communicate in the Ghanaian language of instruction. Further, while 62 percent of pupils report that their teachers use English most often when teaching them mathematics, 34 percent of pupils report being unable to speak English.

Poor pupil attendance and self-reported hunger at the beginning of the school day are negatively associated with assessment performance. Pupils who report arriving at school hungry most days score 2 percentage points lower on the core mathematics assessment.
These findings and conclusions establish a strong, foundational understanding of baseline conditions at the Numeracy Pilot target schools. They also shed light on potential barriers and catalysts to effective program implementation as well as broader factors that influence pupil mathematics performance in a subset of Ghanaian classrooms. Moving forward, baseline findings and data will support the final evaluation results in two critical ways. First, by establishing statistical equivalence between treatment and control schools prior to the start of the Numeracy Pilot, readers can feel confident that any observed differences at endline can be causally attributed to the program itself. Second, baseline data or baseline “covariates” collected from schools, teachers, and pupils will be used during the final analysis in order to improve the statistical precision of the impact estimates, thus increasing the chances of observing statistically meaningful differences at endline.
INTRODUCTION & BACKGROUND

Mathematics has become a growing focus of global education initiatives seeking to enhance economic development via a highly-educated workforce. Driven largely by concerns over shortfalls in the workforce required to compete in an increasingly technology-driven global economy, many countries are now making significant investments in Science, Technology, Engineering, and Mathematics (STEM) education. In Ghana, investments and progress in science and math education have been observed but have not kept pace with other similar middle-income countries. Results from international mathematics benchmark tests such as the Trends in International Mathematics and Science Study (TIMSS), for example, showed significant progress in Ghana between 2003 and 2011, with scores improving by 51 internationally-scaled score points. However, like all the African countries participating in TIMSS in 2011, Ghana recorded an average mathematics achievement below the TIMSS center point of 500, and below the low (400) international benchmark. Moreover, the percentage of test takers with achievements too low for estimation exceeded 25 percent. Similarly, Ghana’s 2016 National Education Assessment (NEA) showed that 45 percent and 29 percent of P4 and P6 pupils, respectively, are below minimum competency in mathematics for their grade level.

The effects of this can be seen in today’s economy in Ghana. The shortage of skills in STEM has limited private investment in this area, creating a dearth of STEM jobs which reinforces a lack of investment in STEM education among the workforce. Thus, rather than diversify the economy and develop these growing fields, Ghana continues to rely heavily on export commodities and agriculture, with the latter employing over 60 percent of the total workforce today.

A PRIORITY AND A PATH FORWARD

Recognizing the need to evolve and meet the opportunities of the global knowledge economy, in 2014, the Ministry of Education (MOE) of Ghana established a national committee to examine the state of mathematics and science teaching and learning. The purpose of this committee was to develop recommendations to equip future learners with the mathematical understanding and skills necessary to participate in an increasingly technology-focused economy and society. The committee’s report, Reforming Science and Mathematics Education in Basic Schools in Ghana, included findings on children’s achievement in mathematics and featured a national road map to improve the state of mathematics teaching and learning.

Pointing to results from recent national mathematics assessments, the report notes serious gaps in young children’s mathematical understanding. While those children performed relatively well on tasks that require

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2 TIMSS mathematics scales are based on achievement distribution across all participating countries with the mean overall distribution scaled to a center point of 500 and a standard deviation of 100.
6 Data derived from www.africaneconomicoutlook.org.
7 The 2013 National Educational Assessment and the 2013 Early Grade Mathematics Assessment.
memorization or simple procedural knowledge, they struggled with questions that require strong conceptual understanding of numbers, number relationships, or number operations. Ultimately, children are leaving primary school without the foundations required to be successful math learners and problem solvers at the secondary and tertiary levels.

The report’s roadmap included the development of a revised primary mathematics syllabus to address the learning gaps identified in recent assessments and bring the syllabus in line with international trends in mathematics education. This included three key tenets for successfully moving forward and improving mathematical education in Ghana. First, the roadmap emphasized the need to develop a more focused and coherent syllabus by reducing the number of different topics covered at each grade level, focusing on key learning outcomes for that grade level, better sequencing learning, and acknowledging children’s developmental mathematical understanding. Second, it emphasized the development of conceptual understanding, number sense, mathematical reasoning skills, the ability to see and describe relationships between numbers, number operations and shapes, mathematical communication, and conceptual understanding of place value, particularly in early primary grades. Finally, it emphasized the use of appropriate objects, models, and diagrams to help children develop or demonstrate their understandings; and develop personal strategies for adding, subtracting, multiplying, and dividing, in addition to the standard pencil and paper strategies and algorithms traditionally taught in primary school. By realizing these fundamental shifts in pedagogical approach, mathematics education in Ghana can move forward to meet the benchmarks set by the government itself.

PUTTING RESEARCH TO ACTION

The Numeracy Pilot is designed to test and put into action the recommendations of the Reforming Science and Mathematics Education report. Working under the direction of Professor D. Mereku, and supported by their mathematics education technical advisor, USAID/Ghana Learning designed a Numeracy Pilot activity based on the committee’s findings and recommendations. A draft revised syllabus was developed with these recommendations in mind by a mathematics syllabus panel and Learning contracted School-to-School (STS) International to develop classroom curriculum materials and pilot technical implementation of this revised syllabus.

Along with supporting the design and implementation of the pilot, USAID/Ghana through its Evaluating Systems activity will conduct a combined impact and process evaluation of the program. This evaluation aims to produce systematic and meaningful feedback on the effectiveness of the Numeracy Pilot, looking both to measure its impact on the mathematical abilities of P1 and P2 learners as well as analyze the program’s cost-effectiveness. This analysis is designed to support the MOE and the Ghana Education Service (GES) in its decision to refine the mathematics curriculum and potentially scale the program nationally.
PROJECT BACKGROUND

SUMMARY OF THE INTERVENTION

The Numeracy Pilot is designed to bring the early grade mathematics syllabus in Ghana in line with international trends in primary mathematics education, with a focus on scope and sequence, topic depth over breadth, and emphasis on building mathematical reasoning rather than focusing on rote memorization and narrow sets of rules for solving problems. In addition, the pilot aims to improve learners’ ability to engage in mathematical communication which can increase their ability to deconstruct mathematical concepts, helping them to clarify and justify their thinking as well as evaluate and respond to the thinking of others. Improved mathematical communication also enables teachers to be more responsive in their teaching (relative to more didactic methods of instruction).8

The Numeracy Pilot inputs and activities are as follows:

- Revised syllabi for P1, P2, and P3 mathematics, which reduces the number of concepts taught and places more emphasis on areas such as place value, number sense, the relationship between numerical quantities and systems, and relative size of numbers, all of which are key to improving mathematical reasoning.
- A Teacher Resource Guide for each grade level, which includes end-of-year performance standards, a scope and sequence / weekly lesson schemes, games and activities to reinforce learning, and bi-weekly and end-of-year pupil assessment tasks to gauge learning and monitor progress.
- Training of Math Coaches who will facilitate in-service teacher training (INSET) and weekly Learning Circles in order to help teachers put the Teacher Resource Guide into practice. In addition, coaches will help teachers develop conceptual understanding of key early primary math concepts, pedagogical content knowledge, and knowledge of effective math instructional practices; manage manipulatives and use them effectively to teach key concepts; encourage mathematical communication, critical thinking and reasoning in the classroom; and implement regular mental math activities.

A prototype of the program was developed in 2016 and was piloted in 20 schools in Ghana’s Ada West and Ga West districts in 2017. Based on lessons learned from this “pre-pilot,” the program model and materials were revised and a full pilot was launched in the 2017-18 school year. To prevent pre-pilot activities from confounding the evaluation results, the full pilot was rolled out in a different area than the pre-pilot—in the New Juabeng and Shai Osudoku districts—with teacher training taking place over the 2017 summer break.

PROJECT OBJECTIVES

The primary objective of the Numeracy Pilot is to improve early grade pupil mathematics performance through a structured pedagogy program targeting math teachers. Specifically, the project aims to:

- Improve teachers’ conceptual understanding of the curriculum, including relative size of numbers, different ways of representing quantities or numbers, relationship between numbers, place value, addition and subtraction, and patterns so they are in turn equipped to improve pupils’ conceptual understanding of mathematics.

8 School to School (2017). Concept Note: Key Modifications Introduced in Revised Primary Mathematics Syllabus.
• Ensure teachers are able to use manipulatives effectively and accurately in the classroom so pupils develop strong conceptual understanding of number, place value, basic addition and subtraction, multiplication, and division, and are able to connect their understanding to procedures for basic operations.
• Encourage teachers to better develop children’s mental math skills through designated class exercises; encourage mathematical reasoning by providing rich tasks and problems and encouraging children to represent understanding in different ways; and encourage mathematical communication in the classroom.
• Ensure teachers establish a classroom climate that is conducive to learning mathematics including using classroom materials effectively, pacing learning appropriately, supporting struggling learners, encouraging risk-taking by not punishing or demeaning students who make mistakes, and fostering an enjoyment of mathematics.

The program implementation team anticipates that the above activities will improve learners’ ability to demonstrate strong conceptual and procedural understanding of the foundations of mathematics including number and number sense, representing numbers and quantities in different ways, describing the relative size of numbers in multiple ways, and identifying and describing relationships between numbers/quantities. In addition, the program aims to improve learners’ mental mathematical skills, conceptual understanding of addition and subtraction, beginning conceptual understanding of multiplication and division, ability to classify and order objects by size and number, algebraic skills, and ability to use a variety of methods and tools to solve problems. Finally, the program will work to enhance learners’ enjoyment of mathematics as well as their ability to engage in mathematical discourse with teachers and peers.

In support of the reform agenda set forth in the Ministry of Education Math and Science Committee’s “Roadmap to 2020,” the Numeracy Pilot ultimately aims to assess whether the project can be delivered effectively at a larger scale and with minimal support. Implementation lessons combined with evidence on the program’s efficacy will inform a 2018-19 policy dialog on how to effectively leverage learnings from the pilot on a national scale.9

**TARGET BENEFICIARIES**

The Numeracy Pilot will be implemented in all P1, P2, and P3 classrooms of 60 randomly selected10 public primary schools in the New Juabeng and Shai Osudoku districts of Eastern Region and Greater Accra, respectively. These districts were selected by the implementer based on their geographic location and because their language profiles (Akwapem Twi and Dangme) were consistent with the materials and mathematical instruction vocabulary developed in the pre-pilot. According to baseline data collected from Head Teachers (HTs) at selected program schools, the treatment group consists of approximately 200 teachers and 5,700 pupils.

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10 Selection procedures are detailed in the Sampling section of this report.
EVALUATION PURPOSE & EVALUATION QUESTIONS

EVALUATION PURPOSE

In line with USAID’s Evaluation Policy and commitment to promoting learning and accountability, this evaluation aims to produce systematic and meaningful feedback on the effectiveness of USAID’s investment in the Numeracy Pilot program through the USAID/Ghana: Learning activity. The evaluation will measure the impact of the Numeracy Pilot on early grade mathematics for P1 and P2 learners and conduct cost-effectiveness analysis in order to support the MOE and GES in its decision to scale the program nationally. In addition to this impact evaluation, the design contains an embedded process evaluation. For both of these activities, the key evaluation questions—as well as the methodological rationale and approach for each—are outlined below.

EVALUATION QUESTIONS

Impact Evaluation

1. Relative to a control group, to what extent does the Numeracy Pilot improve early grade mathematics performance for P1 and P2 learners, as measured by the Early Grade Mathematics Assessment (EGMA) and select subtests of the Ghana Early Numeracy Assessment (GENA)? (goal impact)
2. Relative to a control group, are P1 and P2 classrooms targeted by the Numeracy Pilot more likely to engage in mathematical communication, participate in mathematics activities and exercises to reinforce learning, and benefit from continuous learner assessment? (outcomes and intermediate impacts)
3. What are the mediating factors that are most strongly associated with learner success?
4. What is the cost effectiveness of the intervention?

Process Evaluation

1. Is the Numeracy Pilot being implemented according to plan?
2. What are the obstacles to effective program implementation at the school, classroom, teacher, and learner level?

EVALUATION THEORY OF CHANGE AND MEASUREMENT APPROACH

To guide the evaluation design, Evaluating Systems operationalized the Numeracy Pilot program logic into a detailed theory of change (ToC) which is presented in Table 1. This ToC aims to surface the causal links and embedded assumptions that connect inputs/activities to outputs, outputs to outcomes, and outcomes to goal impacts. While the primary purpose of the impact evaluation is to test the extent to which the Numeracy Pilot has a measurable impact on learner mathematics skills (goal impact), the evaluation will also open the black box of events between inputs/activities and impact and test each of these causal links and assumptions in order to shed light on the mechanisms underlying observed changes. As such, the impact evaluation contains an embedded process evaluation which allows for the exploration of factors mediating and moderating observed impacts and—crucially—the opportunity to unpack reasons underlying limited or null effects, should they be observed.
Mapping each component of the ToC to specific data source(s) ensures that the data collection approach is aligned with the program logic. In addition, the mapping provided a starting point for structuring, selecting, and designing the data collection tools. The data collection sources/instruments identified in the Table 1 legends are elaborated on in the Evaluation Methods & Limitations section of this report.
Table 1: Program Theory of Change / Logic Model and Instrument Mapping

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Assumptions</th>
<th>Outputs</th>
<th>Assumptions</th>
<th>Outcomes</th>
<th>Assumptions</th>
<th>Goal Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Resource Guide developed (weekly work schemes, performance standards, games/activities, and pupil assessment tasks)</td>
<td>Match coaches are recruited and trained according to plan ● ●</td>
<td>Math LCs are organized and regularly convene at participating schools ● ● ●</td>
<td>Coaching and materials are of sufficient quality, intensity, dosage, and relevance ● ● ●</td>
<td>Teachers themselves have improved mathematical reasoning and conceptual understanding of mathematics ● ● ●</td>
<td>Materials and practices are an improvement upon prior materials and practices ● ● ●</td>
<td>Pupils have improved procedural and conceptual understanding of mathematics ● ● ●</td>
</tr>
<tr>
<td>Circuit Supervisors are trained as master trainers</td>
<td>Master trainers are able to effectively convey training content to math coaches ●</td>
<td>Teachers at participating schools receive Resource Guides on time ● ● ●</td>
<td>Teachers have motivation and confidence to utilize new skills and materials ● ●</td>
<td>Teachers follow weekly work schemes and pace learning appropriately ● ● ● ●</td>
<td>Pupils are confident enough to speak up in class ●</td>
<td>Pupils have improved mathematical reasoning and able to describe their reasoning in how they approach solving math problems ●</td>
</tr>
<tr>
<td>Math coaches are trained to provide in-service teacher training on use of the new syllabus and resources</td>
<td>Math coaches have time, training, and resources to effectively establish Learning Circles (LCs) ● ● ●</td>
<td>Math coaches train teachers on putting new work schemes, performance standards, games/activities, and pupil assessment tasks into practice through INSET and weekly LCs ● ● ● ●</td>
<td>Teachers enter pilot with adequate baseline training to teach math effectively ●</td>
<td>School environment is conducive for applying training and using materials ●</td>
<td>Classroom-level interventions can lead to improved mathematics outcomes regardless of home environment ●</td>
<td>Pupils have improved mental mathematics skills ●</td>
</tr>
<tr>
<td>Head Teachers (HTs) are trained to monitor implementation of new syllabus at the classroom level</td>
<td>Time for LCs can be negotiated with schools and/or teachers ● ● ●</td>
<td>Teachers don’t lose or damage Resource Guide ●</td>
<td>Teachers don’t lose or damage Resource Guide ●</td>
<td>Materials are in a language the teacher understands ●</td>
<td>Students are punctual, attentive, and attend lessons regularly ● ● ●</td>
<td>Increased enthusiasm for mathematics among learners ●</td>
</tr>
<tr>
<td></td>
<td>Teachers are willing and able to regularly participate in LCs ● ● ● ●</td>
<td>Teachers at participating schools implement new curricula ● ●</td>
<td>Teachers encourage and facilitate mathematical communication in the classroom ● ● ●</td>
<td>Teachers use games/activities and manipulatives in their lessons ● ● ● ●</td>
<td>Teachers show up for work regularly ●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacher guides are developed and delivered on time ● ● ● ● ●</td>
<td>HTs monitor and provide feedback on teacher implementation of new curricula ● ●</td>
<td>Teachers utilize pupil assessment tasks and adapt instructional approaches based on the results ● ● ● ●</td>
<td>Increased enthusiasm for mathematics among teachers ●</td>
<td>A sufficient amount of class time is devoted to mathematics instruction ●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HTs have the time and interest to monitor implementation ●</td>
<td></td>
<td></td>
<td></td>
<td>Class environment is conducive to students absorbing lessons and materials ● ●</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tools for testing theory component:</th>
<th>Process Evaluation (no Counterfactual)</th>
<th>Impact Evaluation (with Counterfactual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Administrative data</td>
<td>● Math Coach interview</td>
<td>● Materials and practices are an improvement upon prior materials and practices ● ● ●</td>
</tr>
<tr>
<td>● Head Teacher interview</td>
<td>● Structured observation</td>
<td>Pupils are confident enough to speak up in class ●</td>
</tr>
<tr>
<td>● Teacher interview</td>
<td>● GENA assessment</td>
<td>Classroom-level interventions can lead to improved mathematics outcomes regardless of home environment ●</td>
</tr>
<tr>
<td>● Student interview</td>
<td>● EGMA assessment</td>
<td>Students are punctual, attentive, and attend lessons regularly ● ● ●</td>
</tr>
</tbody>
</table>

11 “Assumptions” represent necessary conditions for inputs to lead to outputs, outputs to outcomes, and outcomes to impacts. Validating assumptions is therefore critical in testing the overall theory of change.
EVALUATION METHODS & LIMITATIONS

EVALUATION METHODOLOGY

As showcased at the bottom of Table 1, the different stages of the ToC are mapped to different types of evaluation approaches. The first two stages—from inputs/activities to “pre-outcome” assumptions—are best suited for a process evaluation, which aims to measure the extent to which the program is on track to achieve the anticipated outcomes in target schools. The next three stages—from outcomes to impacts—are best suited for an impact evaluation which will measure the extent to which the program is achieving desired outcomes and impacts relative to a counterfactual or comparison group.

The gold standard in impact evaluation involves random assignment to treatment or control conditions so that each group, on average, is statistically similar at baseline, thus any observed differences between the two groups at endline can be attributed to the intervention. Barring the risks and threats discussed later in this report, this randomized controlled trial (RCT) approach can provide an unbiased estimate of the program impact that can be causally attributed to the program. Because the intervention is delivered at the school level, schools serve as the units that are randomly assigned to treatment or control conditions; however, some schools were strategically grouped to reduce the risk of contamination. Further approaches to randomization and sampling are discussed in the subsequent section.

SAMPLING

Sample Size and Power Analysis

To calculate the effect sizes that the evaluation is powered to detect as well as determine the number of pupils to be sampled within each school and grade, the evaluation team conducted detailed statistical power analysis during the design phase, the results of which are presented in Annex I. Based on this analysis, the total sample size for schools, grades, teachers, and learners is summarized below:

- Total schools sampled: 120 schools (60 treatment and 60 control)
- Grades sampled per school: 2 grades (P1 and P2)
- Classes sampled per grade: 1 class per grade
- Pupils sampled per grade: 20 pupils (10 boys and 10 girls)
- Teachers sampled per grade: 1 teacher
- Total pupil sample: 4,800 pupils
- Total teacher sample: 240 teachers

Using actual baseline statistics, the minimum detectable effect sizes (MDES) that the evaluation is powered to detect are re-calculated with the above sample. Adopting standard assumptions of 0.8 for
statistical power ($\beta$), a partial Bonferroni-adjusted value of 0.01 for significance level ($\alpha$), a moderate R-squared value of 0.3, and a cluster size of 16, updated intra-cluster correlations (ICCs) and MDES (Cohen’s d) are presented for each of the EGMA+ subtests in Table 2 below:

Table 2: Updated Minimum Detectable Change, by EGMA+ Subtest and Grade

<table>
<thead>
<tr>
<th>EGMA+ Subtest</th>
<th>P1 ICC</th>
<th>P1 MDES</th>
<th>P2 ICC</th>
<th>P2 MDES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core EGMA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number identification</td>
<td>0.19</td>
<td>0.27</td>
<td>0.14</td>
<td>0.25</td>
</tr>
<tr>
<td>Quantity discrimination</td>
<td>0.16</td>
<td>0.26</td>
<td>0.11</td>
<td>0.23</td>
</tr>
<tr>
<td>Missing number</td>
<td>0.07</td>
<td>0.21</td>
<td>0.11</td>
<td>0.23</td>
</tr>
<tr>
<td>Addition</td>
<td>0.08</td>
<td>0.21</td>
<td>0.09</td>
<td>0.22</td>
</tr>
<tr>
<td>Subtraction</td>
<td>0.05</td>
<td>0.19</td>
<td>0.08</td>
<td>0.21</td>
</tr>
<tr>
<td>Word problems</td>
<td>0.10</td>
<td>0.23</td>
<td>0.08</td>
<td>0.21</td>
</tr>
<tr>
<td><strong>Subtests</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place value (bundles)</td>
<td>0.02</td>
<td>0.24</td>
<td>0.10</td>
<td>0.27</td>
</tr>
<tr>
<td>Number deconstruction</td>
<td>0.09</td>
<td>0.27</td>
<td>0.12</td>
<td>0.28</td>
</tr>
<tr>
<td>Describing numbers</td>
<td>0.07</td>
<td>0.26</td>
<td>0.04</td>
<td>0.19</td>
</tr>
<tr>
<td>Number operations</td>
<td>0.07</td>
<td>0.26</td>
<td>0.00</td>
<td>0.22</td>
</tr>
<tr>
<td>Doubles†</td>
<td>--</td>
<td>--</td>
<td>0.07</td>
<td>0.26</td>
</tr>
</tbody>
</table>

The overall mean MDES for all subtests, grades, and languages is 0.24, which is lower than the MDES reported in the Evaluation Design Report. This is due principally to the fact that the ICCs in the actual sample are generally lower than those in the 2015 National EGRA, which was used to inform the original sample size requirements. In other words, compared to the 2015 National EGRA, sampled students’ test scores are less correlated with their schoolmates’ scores and/or there is higher correlation across the overall student sample. Ultimately, this results in an improvement in the study’s power to detect program impacts relative to what was presented at the design stage. However, it should be noted that the updated mean MDES of 0.24 is still higher than the upper bound of 0.2 reported in the 3ie meta-analysis of structured pedagogy programs in the developing world (see Annex I for more detail). Thus despite these gains in power, the study may still be unable to statistically detect effect sizes reported by similar programs due to the limited scale (and thus sample size) of the pilot. As described in Annex I, however, MDESs of this magnitude are appropriate from a standpoint of practical

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12 Statistical power is the probability that a study will detect an effect of a given size if one in fact exists (or the inverse of the probability of a false negative/type II error).

13 Bonferroni correction is applied by dividing the standard $\alpha$ value of 0.05 by the number of hypotheses being tested (11 EGMA+ subtests) while factoring in the mean correlation between these subtests (0.41). Bonferroni adjustment is designed to correct for the increased likelihood of false positives when multiple hypotheses are being tested. For more information, see http://www.quantitativeskills.com/sisa/calculations/bonhlp.htm.

14 Statistical significance ($\alpha$) level is the pre-selected threshold at or below which the null hypothesis is rejected. It is equal to the probability of a type I error (false positive). P-values (probability values) at or below $\alpha$ indicate that the observed result is statistically significant.

15 R-squared represents the percentage of variation in outcomes of interest explained by covariates. As in a regression model, R-squared is represented by a value between 0 and 1; a higher R-squared value will increase model precision thereby increasing power, lowering MDES, and/or reducing the required sample size.

16 Cluster size was inflated by four pupils (from 16 to 20) to account for attrition. The realized sample at baseline is 17 pupils per grade on average. For subtests that were randomized to half the sample—i.e., place value (bundles), number deconstruction, number operations, and doubles—MDES was calculated using a cluster size of 8. These subtests are indicated by †.

17 Cohen’s d is equal to the difference between treatment and control divided by the pooled standard deviation.
significance and indeed, many programs similar to the Numeracy Pilot have reported effects of this magnitude and greater.

**Selection of School Sample**

The sampling frame consisted of all public primary schools in the New Juabeng and Shai Osudoku districts of Eastern Region and Greater Accra, respectively. These districts were selected by the implementer, STS, based on their geographic location and language profiles (Akwapem Twi and Dangme). According to the 2015 Education Management Information System (EMIS) Basic Schools Census data and subsequent interviews with Circuit Supervisors from both districts, there are 66 public primary schools in New Juabeng and 56 in Shai Osudoku, forming a total potential sampling frame of 121 schools. The evaluation team opted to include all 121 schools in the study to ease potential concerns over the exclusion of a single school. Because the Numeracy Pilot was planned for 60 schools, the sample was split so that 60 schools were assigned to treatment and 61 to control.

To gauge the risk of contamination between schools given their geographic proximity, SI conducted interviews with all 17 Circuit Supervisors in both districts to (a) identify which schools within a circuit share the same physical grounds, (b) identify school groups that participate in cluster-based INSET together, and (c) map school networks that regularly interact and assess the likelihood that they will share information on early grade mathematics. Based on the analysis of the data and subsequent discussions with STS, the evaluation team grouped schools prior to randomization according to the following criteria:

1. Schools that share the same physical grounds; or
2. Schools that participate in cluster-based INSET together; or
3. Schools wherein the Circuit Supervisor reports that teachers and/or pupils regularly interact and are “somewhat” to “very” likely to share information with one another on early grade mathematics

Adopting these criteria, 94 schools were grouped into clusters ranging in size from 2 to 5 schools. A summary of these groupings is below:

**Table 3: School Groupings by District**

<table>
<thead>
<tr>
<th>Cluster Count</th>
<th>New Juabeng</th>
<th>Shai Osudoku</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of clusters</td>
<td>Number of schools</td>
</tr>
<tr>
<td>One school (standalone)</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Two schools</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Three schools</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Four schools</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Five schools18</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

To select stratification variables, Evaluating Systems merged 2015 EMIS Basic Schools Census data with the 2015 EGMA data and ran regression models to identify school-level predictors of EGMA.

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18 It was later determined that one school in a cluster of five was a duplicate, thus the total number of schools in this table equals 122 rather than 121.
performance. Based on this analysis, vehicle access, urban/rural status, and frequency of Circuit Supervisor visits were determined to be significant predictors of EGMA performance and were thus selected as stratification variables for standalone schools and clusters of two. District was used as a stratification variable for all schools, regardless of cluster size. Within each strata, schools or groups of schools were then equally allocated to treatment or control. Where an uneven number of schools/clusters existed in a given strata, the remaining unit was randomly allocated to treatment or control. Applying these criteria, the evaluation team re-ran the randomization until exactly 60 schools were assigned to treatment and 61 to control.

During the initial stages of program planning in the 60 treatment schools, one school from Shai Osudoku withdrew from the pilot due to a community conflict which led to teachers vacating the school. As such, a control school from the same strata was selected to replace this treatment school, bringing the sample size to the originally planned 120 schools (60 treatment and 60 control).

Selection of Teachers and Pupils within Schools

Sampling at the school-level was done in two stages. First, data collection supervisors recorded all P1 and P2 classes and streams in consultation with the HT and then randomly selected 1 P1 and 1 P2 class using folded chits of paper. For a class to be eligible for selection, the teacher of the class had to be present and teaching a mathematics lesson that day. At the majority of schools, there was only 1 class for both P1 and P2 and in such cases, the classes were automatically selected. Teachers, classrooms, and pupils sampled at baseline will be revisited throughout the evaluation (panel design).

Once the classroom was selected, supervisors used that day’s attendance register to randomly sample 10 boys and 10 girls. An interval was first calculated by dividing the total number of boys or girls by 10 (desired sample). Then, using a die to select a random starting point, the supervisor counted off the interval and selected every nth pupil until the sample of 10 was realized. The procedure was then repeated to select 3 alternate pupils. If there was no attendance register, the procedure was completed by asking boys and girls to form a line and then counting off pupils using the same interval method. Names and sampling order of selected pupils were recorded in tracking sheets, and the children were interviewed and assessed in the order in which they were sampled. If a sampled child could not be found or did not assent to participate, alternates were enumerated in their place.

Sample Realized

The realized baseline sample is summarized below, followed by a discussion of reasons underlying discrepancies between planned and actual figures.

Table 4: Baseline Sample Realized, by Treatment and Control

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>Control</th>
<th>Total (Actual)</th>
<th>Planned</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools enumerated:</td>
<td>60</td>
<td>60</td>
<td>120</td>
<td>120</td>
<td>0</td>
</tr>
<tr>
<td>Head Teacher interviews:</td>
<td>60</td>
<td>60</td>
<td>120</td>
<td>120</td>
<td>0</td>
</tr>
<tr>
<td>P1 teacher interviews:</td>
<td>58</td>
<td>60</td>
<td>118</td>
<td>120</td>
<td>-2</td>
</tr>
<tr>
<td>P1 teacher observations:</td>
<td>58</td>
<td>60</td>
<td>118</td>
<td>120</td>
<td>-2</td>
</tr>
</tbody>
</table>

19 All schools grouped into clusters of two had the same within-group values for the selected stratification variables.
### DATA COLLECTION TOOLS

Primary data collection instruments were selected and developed based on their ability to test and triangulate the causal links and assumptions identified in the program ToC. These instruments—including the source, illustrative topics and indicators, duration, and frequency of collection—are elaborated on in Annex II. Structured survey tools were developed by the evaluation team and drew upon Learning program documentation and monitoring tools, supplementary EGMA Ghana survey tools, and an extensive bank of survey tools used for evaluating education programs. The Structured Observation tool—which aims to measure the degree of mathematical communication, participation in math games and activities to reinforce learning, use of manipulatives, and continuous learner assessment happening in treatment and control classrooms—built upon Learning’s observation tools as well as those used in other early grade math evaluations. In addition, the evaluation team employed two existing instruments to facilitate the analysis of learner math performance: EGMA and the GENA.

**Early Grade Mathematics Assessment (EGMA)**

The EGMA was developed by USAID as an open-source and easy-to-use tool for measuring basic mathematics competencies among early grade learners in developing countries. The mastery of skills assessed by EGMA are those which are considered by experts in mathematics education and cognition to be most essential for progressing to more advanced mathematics covered in the later grades. The EGMA
test is administered orally with the aid of stimulus sheets and covers the knowledge domains, subtasks, and
skills outlined below in Table 5.20

Table 5: Domains, Subtasks, and Skills Assessed by the Early Grade Math Assessment

<table>
<thead>
<tr>
<th>Domain</th>
<th>Subtask(s)</th>
<th>Skill Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural knowledge</td>
<td>Number identification</td>
<td>The ability to identify written number symbols.</td>
</tr>
<tr>
<td></td>
<td>Addition and subtraction</td>
<td>Knowledge, confidence, and fluency/automaticity with basic addition and subtraction.</td>
</tr>
<tr>
<td>Conceptual (applied) knowledge</td>
<td>Quantity discrimination</td>
<td>The ability to make judgements about differences by comparing quantities represented by numbers.</td>
</tr>
<tr>
<td></td>
<td>Missing number</td>
<td>The ability to discern and complete number patterns.</td>
</tr>
<tr>
<td></td>
<td>Word problems</td>
<td>The ability to interpret a situation (presented orally to the pupil), make a plan and solve the problem.</td>
</tr>
</tbody>
</table>

The evaluation team used item banks from the 2013 and 2015 Ghana EGMA in both paper and Tangerine (electronic) format for training and data collection, respectively. P1 and P2 pupils were tested in all six subtasks in the language of instruction of their school. To minimize leakage risk and avoid learning of the test, two equated versions of the test were used. The version to be administered at a given school was randomized at baseline, and the other version of the test will be used at endline. Approaches for ensuring reliability are discussed in the Data Quality Assurance sub-section below.

**Ghana Early Numeracy Assessment (GENA)**

The GENA was developed by STS in order to test a broader set of skills than those measured by the EGMA tool. The GENA tool is aligned with the performance standards established by the numeracy pilot curriculum and therefore measures several skills and domains that are not presently covered by EGMA, emphasizing conceptual understanding of place value and number sense, mental math, and mathematical reasoning and communication. The GENA test is administered orally, with the aid of manipulatives for certain subtasks, and covers the knowledge domains, subtasks, and skills in Table 6.

Table 6: Domains, Subtasks, and Skills Assessed by the Ghana Early Numeracy Assessment

<table>
<thead>
<tr>
<th>Domain</th>
<th>Subtask(s)</th>
<th>Skill Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural knowledge</td>
<td>Oral counting</td>
<td>Ability and automaticity in counting from 1 to 100.</td>
</tr>
</tbody>
</table>

---

### Conceptual (applied) knowledge

<table>
<thead>
<tr>
<th>Skill</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skip counting</td>
<td>Number sense, as measured by the ability to skip count forwards and backwards using even intervals (e.g., 2, 5, 10).</td>
</tr>
<tr>
<td>Mental mathematics*</td>
<td>Mental mathematics operations, as measured by the ability to identify numeric combinations quickly and accurately as well as complete mental arithmetic and simple multiplication (doubles).</td>
</tr>
<tr>
<td>Place value and numeric deconstruction using bundles*</td>
<td>Knowledge of place value and numeric deconstruction, as measured by the ability to represent numbers using 100s, 10s, and 1s.</td>
</tr>
<tr>
<td>Pattern recognition</td>
<td>Ability to recognize patterns and predict the next item in a sequence.</td>
</tr>
</tbody>
</table>

### Mathematical reasoning and communication

<table>
<thead>
<tr>
<th>Skill</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equals operations</td>
<td>Describe equals sign, apply knowledge of operation to numeric and pictorial representations, and verbally describe process for equalizing uneven quantities.</td>
</tr>
<tr>
<td>Describing quantities in multiple ways*</td>
<td>Ability to think fluidly about numbers and their relationship to one another by describing quantities in different ways (e.g., using different arithmetic combinations, placement on a number line, etc.)</td>
</tr>
</tbody>
</table>

* Indicates that subtest was randomly administered to one half of the sample (to reduce test duration)

STS piloted the tool in pre-pilot schools prior to the rollout of the intervention to verify the validity and reliability of these subtasks.

To ensure total time per pupil (assessment and interview) did not exceed 30 minutes, the evaluation team consulted with USAID/Ghana, E3’s Office of Education, and STS to determine which subtests were most important for measuring skills not captured by the “Core” EGMA subtests and which could be dropped to reduce the length of the assessment. Based on these discussions, subtasks marked with an asterisk in Table 6 were retained. Following a period of pre-testing, however, it was noted that the assessment was still exceeding 30 minutes per pupil. As such, the evaluation team again consulted with key stakeholders to determine which of the retained subtests—i.e., place value and numeric deconstruction using bundles, describing quantities in multiple ways, and equals operations—should be administered to the entire population of pupils and which could be randomized to half of the population, thus capturing data on all subtests but with a reduced sample for some. Based on both subtest-specific power analysis and the relative weight of importance placed on each subtest by the evaluation team and the implementer, it was decided to administer describing numbers to the entire sample and administer either the place value/number deconstruction or the number operations subtests to half of the sample. The Core EGMA, combined with these selected GENA subtests, will henceforth be referred to as “EGMA+.”

The interview and structured observation protocols were developed in close consultation with Learning to ensure they were aligned with the updated program design and built upon the monitoring and evaluation resources being developed both as a part of Learning’s own fidelity of implementation activities. All tools were vetted with USAID and pre-tested in a field setting prior to the launch of data collection.

Complete data collection tools and assessment instruments are included in Annex III.
DATA COLLECTION

Supervisor and Enumerator Training

Evaluating Systems contracted ILC Africa (ILC) as its local data collection partner for the evaluation. ILC has extensive experience in school-based data collection in Ghana, having previously carried out data collection for education projects supported by USAID and Department for International Development (DFID) among others. Evaluating Systems and ILC conducted data collection training in two phases. The first phase, held from August 21 to September 1, 2017, was a “Training of the Trainers” (ToT) whereby the evaluation team extensively trained field supervisors on data collection procedures, including logistics and sampling, administration of the tools, and data quality assurance. Immediately following the supervisor training, a 9-day enumerator training was held in Accra which consisted primarily of breakout sessions (according to language group and instrument) which were led by the supervisors. Following the classroom training, the enumerators conducted a pilot test in schools outside of the sampling area. Prior to launch, enumerators were also tested on inter-rater reliability for both EGMA+ and the Structured Observation Tool, which were 98 and 92 percent, respectively.

Data Quality Assurance

In order to ensure high quality data, the evaluation team closely managed the data collection process on the ground, including logistics, supervisor training, survey programming, data security and back up, and data quality assurance. All survey forms were programmed using Open Data Kit (ODK), which allows for electronic data capture and regular submission and review. Evaluating Systems worked closely with ILC to mainstream data quality systems into field work plans, including supervisor accompaniments, weekly team reporting, back checks, and high frequency data quality checks.

Supervisor Accompaniments and Co-Enumerations

Each field team had a master-trained supervisor who was onsite for the duration of data collection. The supervisor was responsible for overseeing field work logistics as well as ensuring adherence to data collection protocols (including sampling). In addition, supervisors were to observe 10 percent of all interviews, observations, and assessments, stratified by enumerator, and complete an electronic accompaniment form for each sit-in which assessed the enumerator’s performance and flagged areas for re-training. For EGMA+ and classroom observations, supervisors were also required to co-enumerate approximately 10 percent of all forms which allowed for real-time monitoring of inter-rater reliability.

Back Checks

During data collection, approximately 10 percent of schools were revisited by an independent back checker from ILC who re-interviewed the HT to ensure that the field team followed all protocols and sampling procedures. In addition, the HT was re-asked a subset of questions from the survey to verify the stability of responses over time as well as ensure the forms were completed correctly by enumerators.

High Frequency Checks

High frequency checks (HFCs) were conducted via customized Stata .do file(s) that were run on incoming, raw data at regular intervals throughout the course of data collection. The purpose of HFCs is to proactively identify and remedy issues related to survey programming, question clarity, and enumerator error/performance. Specific checks covered included date/time consistency, survey
completion, duplicates, routing/logic checks, variable distribution, “don’t know”/“refused” frequencies, “other” frequencies, outliers, and comment review. In addition, ES utilized ODK’s in-built data quality features to trigger additional review, including speed violations (advancing to the next question too quickly), module time stamps (tracking time spent on each module), and soft check suppression (bypassing warnings on outliers or illogical entries).

Following each round of review of HFC, accompaniment, and back check data, the evaluation team flagged areas of concern in a cloud-based “Issues Log” which was regularly updated and monitored by both SI and ILC. The log allowed data quality issues originating from the field to be logged/tracked by SI and addressed by ILC in real-time. Issues flagged as “most urgent” (e.g., poor reliability) were expected to be resolved in less than 24 hours whereas issues with less urgency (e.g., basic cleaning tasks that don’t require enumerator recall) could be resolved within 1 week. Overall, the log shows significant improvements in protocol adherence following the first week of data collection.

**DATA ANALYSIS**

Because this is a baseline report, data analysis is limited primarily to descriptive statistics and multiple regression modeling (more specific approaches to analysis are discussed within the appropriate subsections under “Findings”). Data cleaning was handled by Evaluating Systems, with input from ILC and field teams where appropriate. The evaluation team prepared data for analysis in October-November and submitted a draft report to USAID/Ghana on January 2, 2018.

**Sample Weights**

Because the number of classrooms and pupils sampled at each school was fixed regardless of school size, in order to make data representative of the schools sampled, it is necessary to weight the data to account for the fact that not all classes and pupils had an equal chance of selection. Using data from the HT and Teacher surveys, the team constructed sample weights which are equal to the inverse of the probability of being selected. Specifically, two weights are created—one at the classroom level, which is applied to class- and teacher-level data, and one at the pupil level which is combined with the classroom weight and applied to pupil-level data. Weights are applied to the dataset as probability weights, or *pweights*, using Stata 14’s set of survey commands.

**Principal Component Analysis**

The baseline dataset includes hundreds of variables. While having a large number of variables allows for capturing complex concepts such as school resources and quality of teaching practices, it is not practical to use all these variables in an unrestricted way during regression analysis for many reasons—including the problem of multi-collinearity, which can increase standard errors and thus reduce the precision of estimates on the relationship between independent and dependent variables.\(^{21}\) In such cases, it is usually

\(^{21}\) Multi-collinearity can cause large standard errors for the coefficients on the correlated variables, sometimes even resulting in a situation where two variables that are correlated and that should have the same signs actually end up with opposite signs. It can also cause two different but related independent variables that have been shown to have an effect on a dependent variable appear to have no significant effect whatsoever. This is because each one diminishes the effects of the other. For example, if one were to model the relationship between household assets and school performance and certain assets were highly correlated (e.g., owning a washer and dryer), the standard errors on the asset variables could change dramatically if one of the variables were included versus excluded. These kinds of unanticipated results also contribute to a second problem, which is that regression models with large numbers of variables are difficult to interpret.
best to aggregate these variables into indices, which then convey the main information contained in a group of variables.

One way to construct these indices is a method called “principal component analysis” (PCA). This method decomposes a set of correlated variables into another set of linearly unrelated components, including a principal component which is expected to represent an underlying concept that the variables have in common, which can be used as independent variables in regression models. One advantage of using this method over other approaches to constructing an index (such as adding or averaging all variables in a group) is that it allows the data itself to guide the construction of the index rather than an external determinant. This study used PCA to create indices for pupil household assets, teacher practices, and school resources which were used in the regression models presented in the Findings section.

**LIMITATIONS**

*Response Bias*

Response bias encompasses a range of tendencies among interview respondents to answer in a way that is untruthful. For this evaluation, the risk of response bias comes primarily from recall bias (inability to recall facts or past events) and social desirability bias (tendency to answer in a way that will be seen as favorable instead of answering truthfully). While it is difficult to overcome this risk in survey-based research, we worked to minimize it through question framing, shortened recall periods, and preambles to sensitive questions reminding respondents of both the strict confidentiality of their responses and the importance of accuracy in research. Moreover, these limitations should not affect the primary outcomes measured through EGMA+ testing.

Related to social desirability bias is the observer or Hawthorne effect, whereby respondents alter their ordinary behavior in response to the presence of an observer. ES believes this bias to be pervasive with respect to classroom observations, with teachers changing the way they conduct mathematics lessons to impress the observer and in some cases, developing special advanced lesson plans in preparation for the classroom observation. As a consequence, classroom observation data may not fully capture the true actual day-to-day practices of teachers. To address some of this bias, the evaluation team has built in checks on the most severe manifestation of this, actual teacher attendance when they are being observed. In this case, the attendance data during observation will be corroborated by attendance data during the evaluation planning phase when an advance team arrives in school before the data collection takes place.

*Contamination and Compliance*

Contamination occurs when there is crossover between treatment and control groups. For example, if children in treatment schools were to transfer to control schools between baseline and endline, it may lead to underestimation of program impact in treatment schools. Similarly, if teachers were to move between treatment and control schools, the internal validity of the evaluation would be threatened as

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22 To address the problem of advanced preparation, the team developed a script which was reviewed with the Head Teacher during the scheduling phase which stated, “This data collection effort involves classroom observations. Such observations will be the most valuable if teachers teach their math class as they do on a NORMAL SCHOOL DAY and as if nobody is observing them. Again, ES is not assessing the performance of teachers but rather trying to understand what happens in Ghanaian classrooms on an ordinary school day. The teachers should not prepare special lessons or change their behavior in any way – doing so will undermine the quality and the accuracy of the research and create unnecessary pressure for the teachers.”
children in the treatment group would no longer be receiving the intervention to which they were originally “assigned.” Finally, contamination may occur if similar interventions to the Numeracy Pilot target the control sites included in the study.

The risk of contamination at the teacher level is moderate to low, as teacher transfer requests typically happen between school years whereas this study takes place during a single school year. However, the evaluation will monitor movement of teachers and to the extent that contamination or non-compliance is observed, sensitivity analyses will be conducted such as testing if any observed impacts are robust to the exclusion of contaminated sites. The team will also work to capture data from HTs on whether or not programs similar to the Numeracy Pilot are operating in sampled schools and, if appropriate, analyze whether program impacts are robust to the exclusion of these contaminated sites.

**Spillovers**

Spillovers occur when members of the control group receive indirect or secondary benefits from the treatment. For example, if children in treatment schools share lessons and materials with their neighbors from control schools, it may lead to an underestimation of the program impacts since control group children are receiving a version of the intervention. The risk of spillovers was minimized through strategic grouping of schools prior to randomization based on specific feedback from Circuit Supervisors on the extent to which teachers and pupils will interact with other schools/teachers/pupils within the sampling frame.

**External Validity**

Because the intervention, and thus the sampling frame, is limited to two districts and two language groups, the results of the evaluation may not be generalizable to the broader population of schools in Ghana. Indeed, pupils in the Numeracy Pilot program areas are generally of higher socio-economic status than those from the Early Grade Reading Impact Evaluation which targets a much larger segment of the population. To explore the extent of this limitation, the evaluation team will use EMIS data at endline to analyze differences and similarities between the sampling frame and the universe of schools in Ghana.

**Disentangling Program Components**

It is important to note that while the evaluation will explore mediating factors of program impact, it is not designed to disentangle or measure the isolated effectiveness of the various program components, such as School-Based In-Service Training (SBI) and Teacher Resource Guides. As such, the impact evaluation results will only be valid for the entire “package” numeracy pilot inputs.
FINDINGS

Findings from baseline data collection are presented in this section. The team first presents baseline balance statistics on outcomes that are expected to mediate program impact in order to validate randomization procedures in generating a credible counterfactual. Such balance variables include baseline EGMA+ performance as well as several school-, teacher-, classroom-, and pupil-level variables which have been shown to predict assessment performance in similar contexts.

The next section examines two key components of the ToC: (1) baseline status of primary outcomes of interest at the teacher- and pupil-level, as identified in the “Outcomes” and “Impact” columns of Figures 2 and 3 and (2) baseline measures of those ToC factors that are expected to be necessary conditions for outcomes to lead to impacts (“Assumptions” column of Figures 2 and 3). The purpose of (1) is to provide a general baseline snapshot of pupil and school performance prior to program implementation, followed by a discussion of expected change where appropriate. The purpose of (2) is to examine whether critical assumptions of the program logic model are supported by baseline data, followed by a discussion of possible risks and/or catalysts to fidelity of implementation and program effectiveness, where appropriate.

The final findings section uses multiple regression analysis to explore factors that predict unit-weighted composite percentage scores for EGMA+. The purpose of this analysis is to explore this rich data set in more depth so that policy-relevant conclusions and recommendations might be drawn on potential areas for further influencing mathematics performance among learners in the study schools and beyond.

BALANCE STATISTICS

This section explores balance between treatment and comparison schools on primary outcome variables (EGMA+ performance) as well as those factors which may mediate program impact. For the latter, the team has purposively selected a series of school-, classroom-, teacher-, and pupil-level variables which have been shown in other contexts to be significant and robust predictors of assessment performance. Unless otherwise noted, balance tables report results of a weighted univariate regression model with standard errors clustered at the school level, including the control mean, treatment mean, and p-value indicating whether observed differences are statistically significant.23

**EGMA+ Balance Statistics**

As shown below in Table 7 and Table 8, treatment and control are well-balanced across all grades and subtasks, suggesting that randomization was successful in creating equivalent student groups at baseline. While the team adopts a p-value of 0.01 for EGMA+ subtests to account for multiple hypotheses testing, none of the observed differences between treatment and control are even marginally significant using more conventional p-value thresholds (e.g., p<0.05 or p<0.10).

23 As described in the sampling section, the team adopts a partial Bonferroni-adjusted significance level (α) of 0.01 for EGMA+ subtests, such that the team fails to reject the null hypothesis where p>0.01.
Table 7: Balance Between Treatment and Control on P1 EGMA+ Performance

<table>
<thead>
<tr>
<th>EGMA+ Subtest</th>
<th>Control Mean</th>
<th>Treatment Mean</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number identification (correct per minute)</td>
<td>9.079</td>
<td>9.468</td>
<td>0.551</td>
</tr>
<tr>
<td>Quantity discrimination (% correct)</td>
<td>32.774</td>
<td>34.463</td>
<td>0.603</td>
</tr>
<tr>
<td>Missing number (% correct)</td>
<td>16.099</td>
<td>16.495</td>
<td>0.637</td>
</tr>
<tr>
<td>Addition (correct per minute)</td>
<td>3.093</td>
<td>2.926</td>
<td>0.540</td>
</tr>
<tr>
<td>Subtraction (correct per minute)</td>
<td>1.537</td>
<td>1.419</td>
<td>0.503</td>
</tr>
<tr>
<td>Word problems (% correct)</td>
<td>28.810</td>
<td>28.190</td>
<td>0.682</td>
</tr>
<tr>
<td>Place value (bundles) (% correct)</td>
<td>24.266</td>
<td>20.319</td>
<td>0.126</td>
</tr>
<tr>
<td>Number deconstruction (% correct)</td>
<td>22.345</td>
<td>25.248</td>
<td>0.361</td>
</tr>
<tr>
<td>Describing numbers (% correct)</td>
<td>11.726</td>
<td>11.204</td>
<td>0.795</td>
</tr>
<tr>
<td>Number operations A (% correct)</td>
<td>32.948</td>
<td>32.847</td>
<td>0.978</td>
</tr>
<tr>
<td>Number operations B (% correct)</td>
<td>19.215</td>
<td>18.364</td>
<td>0.771</td>
</tr>
</tbody>
</table>

Table 8: Balance Between Treatment and Control on P2 EGMA+ Performance

<table>
<thead>
<tr>
<th>EGMA+ Subtest</th>
<th>Control Mean</th>
<th>Treatment Mean</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number identification (correct per minute)</td>
<td>15.470</td>
<td>15.682</td>
<td>0.754</td>
</tr>
<tr>
<td>Quantity discrimination (% correct)</td>
<td>61.281</td>
<td>61.689</td>
<td>0.884</td>
</tr>
<tr>
<td>Missing number (% correct)</td>
<td>26.053</td>
<td>27.108</td>
<td>0.489</td>
</tr>
<tr>
<td>Addition (correct per minute)</td>
<td>6.246</td>
<td>6.640</td>
<td>0.265</td>
</tr>
<tr>
<td>Subtraction (correct per minute)</td>
<td>3.960</td>
<td>4.313</td>
<td>0.259</td>
</tr>
<tr>
<td>Word problems (% correct)</td>
<td>41.008</td>
<td>40.942</td>
<td>0.966</td>
</tr>
<tr>
<td>Place value (bundles) (% correct)</td>
<td>63.160</td>
<td>61.534</td>
<td>0.701</td>
</tr>
<tr>
<td>Number deconstruction (% correct)</td>
<td>63.518</td>
<td>62.496</td>
<td>0.823</td>
</tr>
<tr>
<td>Describing numbers (% correct)</td>
<td>10.459</td>
<td>11.035</td>
<td>0.702</td>
</tr>
<tr>
<td>Number operations A (% correct)</td>
<td>14.232</td>
<td>16.113</td>
<td>0.349</td>
</tr>
<tr>
<td>Doubles (% correct)</td>
<td>37.903</td>
<td>39.342</td>
<td>0.637</td>
</tr>
</tbody>
</table>

Other Balance Statistics

Drawing upon an extensive synthesis of education research in developing countries,24 the evaluation team tests balance on a number of other variables at the school-, classroom-, teacher-, and pupil-level that have been shown to be significant and robust predictors of assessment performance in similar contexts. The results of this analysis are presented below in Table 9.

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Table 9: Balance Between Treatment and Control on Other Variables that Predict Assessment Performance in Similar Contexts

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control Mean</th>
<th>Treatment Mean</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional electricity at school (%)</td>
<td>76.667</td>
<td>80.000</td>
<td>0.661</td>
</tr>
<tr>
<td>Library at school (%)</td>
<td>26.667</td>
<td>33.333</td>
<td>0.430</td>
</tr>
<tr>
<td><strong>Classroom</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics textbooks available (%)</td>
<td>81.250</td>
<td>82.540</td>
<td>0.828</td>
</tr>
<tr>
<td>Mathematics workbooks available (%)</td>
<td>57.813</td>
<td>44.355</td>
<td>0.097</td>
</tr>
<tr>
<td>Sufficient desk space for all pupils (%)</td>
<td>77.344</td>
<td>77.600</td>
<td>0.969</td>
</tr>
<tr>
<td>Class size</td>
<td>30.094</td>
<td>27.730</td>
<td>0.381</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed Teacher Training College (%)</td>
<td>92.188</td>
<td>88.889</td>
<td>0.488</td>
</tr>
<tr>
<td>Years of experience</td>
<td>14.528</td>
<td>14.111</td>
<td>0.810</td>
</tr>
<tr>
<td>In-service training in Early Grade Maths (%)</td>
<td>38.281</td>
<td>50.806</td>
<td>0.079</td>
</tr>
<tr>
<td>Absenteeism rate (%)</td>
<td>3.281</td>
<td>6.667</td>
<td>0.115</td>
</tr>
<tr>
<td><strong>Pupil</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended preschool or kindergarten (%)</td>
<td>93.859</td>
<td>94.258</td>
<td>0.719</td>
</tr>
<tr>
<td>Arrives at school hungry (%)</td>
<td>46.330</td>
<td>45.037</td>
<td>0.576</td>
</tr>
<tr>
<td>Has help with math homework (%)</td>
<td>77.717</td>
<td>79.071</td>
<td>0.150</td>
</tr>
</tbody>
</table>

The school-, classroom-, teacher-, and pupil-level variables highlighted in Table 9 exhibit balance between treatment and control at p<0.05; however, a few variables—including math workbook availability and teacher participation in early grade mathematics INSET—are marginally significantly different at p<0.10. Notably, the direction of these differences is not consistent, with treatment schools having a lower proportion of classrooms with math workbooks (44.3 versus 57.8 percent) and a higher proportion of teachers with prior mathematics INSET (50.8 versus 38.3 percent). While these baseline differences will be controlled for in endline analysis as a precaution, the evaluation team believes this marginal imbalance does not pose a systematic threat to the study's internal validity.

**EXAMINING THE THEORY OF CHANGE**

*Baseline Status of Impact Indicators*

The evaluation team began exploring baseline ToC indicators by reporting out on the primary measure of program impact: sex-disaggregated pupil mathematics performance as measured by the EGMA+, including p-values indicating the extent to which differences between boys and girls are statistically significant. As is standard with the EGMA, zero scores are also reported—i.e., the percentage of pupils who scored zero on a given subtest. The final baseline impact indicator examined is self-reported enthusiasm toward mathematics among both pupils and teachers.

It is important to note that the EGMA+ test was administered at the beginning of the school year at baseline to allow for a panel design with repeated measures. As such, baseline P1 scores capture performance for pupils who recently completed KG2. P2 scores capture performance for pupils who recently completed P1. These results should therefore not be used as a diagnostic tool.
Table 10: P1 EGMA+ Performance, Overall and Disaggregated by Sex

<table>
<thead>
<tr>
<th>EGMA+ Subtest</th>
<th>Overall Mean</th>
<th>Boys Mean</th>
<th>Girls Mean</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core EGMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number identification (cpm)</td>
<td>9.268</td>
<td>9.210</td>
<td>9.326</td>
<td>0.677</td>
</tr>
<tr>
<td>Quantity discrimination (%)</td>
<td>33.596</td>
<td>34.008</td>
<td>33.188</td>
<td>0.518</td>
</tr>
<tr>
<td>Missing number (%)</td>
<td>16.292</td>
<td>16.065</td>
<td>16.517</td>
<td>0.482</td>
</tr>
<tr>
<td>Addition (cpm)</td>
<td>3.012</td>
<td>3.222</td>
<td>2.805</td>
<td><strong>0.008</strong></td>
</tr>
<tr>
<td>Subtraction (cpm)</td>
<td>1.480</td>
<td>1.544</td>
<td>1.417</td>
<td>0.364</td>
</tr>
<tr>
<td>Word problems (%)</td>
<td>28.508</td>
<td>28.847</td>
<td>28.174</td>
<td>0.564</td>
</tr>
<tr>
<td>+ Subtests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place value (bundles) (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number deconstruction (%)</td>
<td>23.737</td>
<td>21.183</td>
<td>26.290</td>
<td>0.124</td>
</tr>
<tr>
<td>Describing numbers (%)</td>
<td>11.472</td>
<td>12.350</td>
<td>10.606</td>
<td>0.127</td>
</tr>
<tr>
<td>Number operations A (%)</td>
<td>32.898</td>
<td>35.175</td>
<td>30.679</td>
<td>0.154</td>
</tr>
<tr>
<td>Number operations B (%)</td>
<td>18.797</td>
<td>21.384</td>
<td>16.276</td>
<td>0.043</td>
</tr>
</tbody>
</table>

For percentage-scored subtests, P1 pupils answered approximately one-third or less of questions correctly across all subtests. For fluency (timed) subtests, including number identification, addition, and subtraction, P1 pupils scored 9.3, 3.0, and 1.48 correct answers per minute, respectively. While these figures appear low, it is important to note that P1 pupils had limited exposure to most of these concepts at the time of test administration. Performance between P1 boys and girls did not significantly differ across all subtests with the exception of addition fluency, where boys scored 3.2 correct answers per minute compared to 2.8 for girls.

Table 11: P2 EGMA+ Performance, Overall and Disaggregated by Sex

<table>
<thead>
<tr>
<th>EGMA+ Subtest</th>
<th>Overall Mean</th>
<th>Boys Mean</th>
<th>Girls Mean</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core EGMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number identification (cpm)</td>
<td>15.571</td>
<td>15.216</td>
<td>15.947</td>
<td><strong>0.004</strong></td>
</tr>
<tr>
<td>Quantity discrimination (%)</td>
<td>61.474</td>
<td>60.962</td>
<td>62.016</td>
<td>0.380</td>
</tr>
<tr>
<td>Missing number (%)</td>
<td>26.553</td>
<td>26.172</td>
<td>26.956</td>
<td>0.368</td>
</tr>
<tr>
<td>Addition (cpm)</td>
<td>6.433</td>
<td>6.484</td>
<td>6.378</td>
<td>0.650</td>
</tr>
<tr>
<td>Subtraction (cpm)</td>
<td>4.127</td>
<td>4.162</td>
<td>4.091</td>
<td>0.757</td>
</tr>
<tr>
<td>Word problems (%)</td>
<td>40.977</td>
<td>40.850</td>
<td>41.110</td>
<td>0.779</td>
</tr>
<tr>
<td>+ Subtests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place value (bundles) (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number deconstruction (%)</td>
<td>63.032</td>
<td>60.392</td>
<td>65.532</td>
<td>0.121</td>
</tr>
<tr>
<td>Describing numbers (%)</td>
<td>10.732</td>
<td>11.540</td>
<td>9.877</td>
<td>0.273</td>
</tr>
<tr>
<td>Number operations A (%)</td>
<td>15.119</td>
<td>16.393</td>
<td>13.609</td>
<td>0.179</td>
</tr>
<tr>
<td>Doubles (%)</td>
<td>38.582</td>
<td>41.677</td>
<td>34.915</td>
<td><strong>0.007</strong></td>
</tr>
</tbody>
</table>

EGMA+ results for P2 pupils are shown above in Table 11. Performance across all EGMA+ subtests were higher for P2 than P1 at the beginning of the school year. Performance on subtests scored as percent correct varied widely, from an average of 10.7 percent correct for describing numbers to 63 percent correct for number deconstruction. Fluency subtests scores were 15.6, 6.4, and 4.1 correct items per minute for number identification, addition, and subtraction, respectively. Two subtests showed statistically significant differences by sex (p<0.01)—girls scored 0.73 more correct numbers per minute for number identification whereas boys scored 6.8 percentage points higher on the doubles subtest.
The percentage of zero scores across all grades and subtests are presented in Figure 1. With the exception of addition and subtraction, zero scores were relatively low for Core EGMA subtests, ranging from less than 1 percent for P2 number identification to 21 percent for P1 quantity discrimination. Zero scores for the Numeracy Pilot-aligned “+” subtests were relatively large, due primarily to the fact that these subtests are designed to measure performance against end-of-school-year benchmarks. It is also important to note that while the Core EGMA subtests are the same for both P1 and P2, the “+” subtests increase in difficulty between P1 and P2, which likely explains the higher zero scores for describing numbers and number operations for P2 learners relative to P1.

Because the Numeracy Pilot is also designed to foster enjoyment of mathematics, the baseline explores measures of enthusiasm toward mathematics among both pupils and teachers. Per the ToC, this indicator is considered a goal impact at the pupil level rather than an intermediate outcome because higher enthusiasm for mathematics may lead to higher-order outcomes over the longer-term, such as increased enrollments in STEM fields at the post-secondary level.
Figure 2: Teacher Self-Reported Enjoyment of Teaching and Learning Mathematics

As shown above in Figure 2, the great majority of teachers enjoy both teaching and personal engagement with mathematics. Approximately 8 percent report disliking teaching mathematics, however, and 6 percent report that they don’t enjoy learning and solving mathematics problems. This suggests there is some, albeit limited, room for improvement between baseline and endline in terms of teacher attitudes toward mathematics.

Figure 3: Pupil Self-Reported Enjoyment of and Performance in Mathematics

As shown in Figure 3, nearly 90 percent of pupils report liking mathematics with 6 percent reporting disliking it. Results are similar for P1 and P2 pupils, however P2 pupils are slightly more likely to report liking math than P1 pupils (91 and 87 percent, respectively). Despite generally positive attitudes toward mathematics, 29 percent of pupils report that they are “not very good” or “bad” at mathematics. P2 pupils are more likely to report being very good or good at math than P1 pupils (76 versus 66 percent, respectively), suggesting that exposure to math at school has a positive effect on both enjoyment and self-reported math abilities. It is noteworthy that for most of the Core EGMA subtests, there is a significant relationship between pupils’ self-reported mathematics performance and zero scores, with pupils reporting lower math performance being statistically significantly more likely to score zero. Furthermore, of the pupils who report being “not very good” or “bad” at mathematics, the vast majority report liking math (77.7 and 60.6 percent, respectively). To the extent that pupil self-reporting is accurate, these findings suggest that fostering enjoyment of mathematics among early grade learners may not by itself contribute to meaningful improvements in math abilities over the longer term.
Baseline Status for Outcome Indicators

This next section will explore baseline outcome indicators specified in the ToC, including teacher knowledge, attitudes, and practices with respect to early grade mathematics instruction.

Teachers themselves have improved mathematical reasoning and conceptual understanding of mathematics

While teachers’ own mathematical reasoning and conceptual understanding of mathematics was not measured directly at baseline, the team explores a few proxy variables, including their level of education and training in early grade mathematics instruction; self-reported attitudes and practices related to pedagogical approaches that foster conceptual understanding and reasoning; and whether teachers were observed facilitating opportunities for children to engage in mathematical reasoning in the classroom.

Over 90 percent of interviewed teachers reported completing the Teachers’ Training College, however only 44 percent reported having ever received in-service training on early grade mathematics. Over 90 percent of teachers interviewed felt that they needed more training in teaching early grade mathematics effectively. Specific early grade training topics requested include addition and subtraction, place value/tens and ones, pupil assessment, data organization, measurements, and use of manipulatives including abacus and number lines. Despite high demand for additional training, 88 percent of teachers report feeling “very confident” in teaching mathematics, with only 2 percent reporting feeling “not very confident.”

Review of teacher beliefs on pedagogical approaches for encouraging mathematical reasoning and conceptual understanding (Figure 4) reveals that teachers appreciate the need for fluid approaches to problem solving, including group work, discussing mistakes, using manipulatives, and taking multiple approaches to solving a problem.

Figure 4: Teacher Beliefs on Pedagogical Approaches for Encouraging Mathematical Reasoning and Conceptual Understanding

Classroom observations reveal some misalignment between teacher beliefs and classroom practices, however. For example, despite the fact that the great majority of teachers report believing there are multiple methods and approaches to solving a problem, only 12 percent of teachers were observed encouraging pupils to use multiple problem-solving strategies during a lesson. In addition, 73 percent of
teachers were not observed encouraging mathematical reasoning (i.e., applying existing skills and knowledge to solve unfamiliar problems). These results suggest that while teachers generally believe in the importance of mathematical reasoning and conceptual understanding, many currently lack the training, resources, and/or motivation to apply these approaches in their day-to-day lessons.

**Teachers follow weekly work schemes and pace learning appropriately**

At baseline, 96 percent of mathematics teachers reported having weekly work schemes and 70 percent reported having a Teacher’s Guide, updated versions of which will serve as key inputs of the Numeracy Pilot. Weekly work schemes, which are general descriptions of the goals and activities for the week, and lesson notes, which are hand written by the teacher in a standard, lesson-plan-like format, are the most common resources available to teachers to pace learning. Scripted lesson plans were cited as available in only one-third of the schools. Figure 5 below details the availability of teacher materials in the schools.

**Figure 5: Availability and Use of Lesson Planning Materials (Teacher-Reported)**

![Figure 5: Availability and Use of Lesson Planning Materials (Teacher-Reported)](image)

The widespread use of lesson plans/work schemes is supported by data from the structured observation, with 81 percent of teachers observed as using a lesson plan during the mathematics class.

**Teachers use games/activities and manipulatives in their lessons**

Because the Numeracy Pilot emphasizes active learning, the evaluation examines the extent to which sampled teachers are engaging in games, activities, and the use of manipulatives at baseline. Figure 6 below shows some of the different activities in which teachers and/or pupils engaged during classroom observations. Only 14 percent of teachers engaged in pairing and grouping students, and just over 1 in 3 teachers used games, puzzles, or problem-solving activities to introduce lessons; both are characteristics of the Numeracy Pilot curriculum.
As shown in the figure above, only 1 in 3 classrooms have learning resources used more frequently by students than by their teachers, which may reflect limited availability of resources at the schools. It should also be noted that in only a quarter of classrooms were pupils given adequate time to practice new learning independently.

Manipulatives, which feature prominently in the intervention curriculum, are objects that pupils can use to explore and demonstrate the meaning of number concepts and problems, such as straws, stones, dice, and other things a pupil can use to count. Shapes are also considered manipulatives and are often used in learning geometry and measurement. While 76 percent of teachers report using counters daily, 44 percent did not use them at all during the observed lesson and only 15 percent used them frequently. Shapes are much less prevalent in classrooms, with just 10 percent of teachers reporting having them and only 5 percent observed using them.

Based on teacher self-reporting, learning resources are used by teachers and pupils daily in 76 percent of classrooms, which is misaligned with classroom observation data (Figure 7). Approximately 26 percent of teachers have children use objects, models, or diagrams to demonstrate their thinking once a month or less. While the number of teachers who report engaging pupils in games and activities weekly or daily is high (87 percent), observation data suggests that such activities are more commonly teacher- versus pupil-centered.
Teachers encourage and facilitate mathematical communication in the classroom

Mathematical communication is a pedagogical technique for teaching math in the early grades and involves a combination of positive reinforcement about pupil’s ability to be good at math, the presentation of math problems as having multiple ways to arrive at a solution, and verbal explanations by pupils about how they arrived at solutions to mathematical problems. These techniques are featured in the Numeracy Pilot curriculum and pedagogy.
Figure 8 above shows the extent to which teachers were observed encouraging or facilitating mathematical communication in their classrooms. While it was observed that 42 percent of teachers at least occasionally asked pupils to explain their thinking or how they arrived at an answer, the evaluation team did not otherwise find mathematical communication to be a prominent feature of the observed mathematics lessons. These findings suggest there is considerable room for improvement with respect to equipping teachers to encourage mathematical communication.

Teachers utilize pupil assessment tasks and adapt instructional approaches based on the results

Over 90 percent of sampled teachers report that they are assessing pupil learning on a daily basis. Nearly 70 percent of teachers report assessing pupils against a benchmark or standard, meaning either standardized exams or those associated with a textbook or formal curriculum, on at least a weekly basis. Checking exercise books, written assessments, and checking homework are by far the most frequent forms of assessment, done on a daily basis as reported by more than 90 percent of teachers interviewed. Individual oral assessments are also reported as a daily practice by 82 percent of teachers. Group question and answer sessions was reported as an assessment practice that was done less frequently, but 4 in 5 teachers reported that they did this at least weekly. Figure 9 below shows the frequency of different assessment practices reported during teacher interviews.

Figure 9: Frequency of Pupil Assessment Activities (Teacher-Reported)

Almost all interviewed teachers claimed that they adjust their teaching practice based on pupil assessment. Most (94 percent) repeat lessons in response to daily informal assessments, pay increased attention to pupils who are struggling (82 percent), or change lessons to make them easier to understand (75 percent). Having lower achieving pupils interact with higher achieving pupils is not commonly practiced, nor are the needs of higher achieving pupils deliberately addressed. Figure 10 below presents teacher interview responses to the question, In what ways do you adjust your teaching based on the results of pupil evaluation or assessment?
**Testing Baseline Assumptions**

ES now explores baseline indicators as defined in the “Assumptions” column (between “Outcomes” and “Impact”) of the ToC (Table 1). The purpose of this analysis is to determine the extent to which key assumptions embedded in the program logic hold true at baseline. Where assumptions do not hold, we will discuss potential threats to implementation and/or program effectiveness so that, where possible, they might be addressed during the early stages of program implementation.

Alignment between Ghanaian language of instruction and teacher and pupil language abilities

A fundamental assumption of the Numeracy Pilot is that mathematics instruction will be delivered in a language that the pupils understand. To test this assumption, ES defines “language match” based on the extent to which teacher and pupil language abilities match with the official Ghanaian language of instruction. HTs report that the official Ghanaian language of instruction is Akuapem Twi for all schools in New Juaben and Dangme for all schools in Shai Osudoku, which is consistent with the language of instruction reported in the 2015 Basic Schools Census.

Teachers are defined as being “high,” “medium,” or “low” match if they report being very confident, somewhat confident, or not confident, respectively, in teaching in the official Ghanaian language of instruction for their school. Pupils are classified as “high” match if they report speaking the language of instruction as their mother tongue and “medium” match if they report being able to use and/or understand the official language of instruction (i.e., on the playground or in the classroom) even though it is not their mother tongue. Pupils are defined as “low” match if they do not report speaking or using the official Ghanaian language of instruction. ES then constructs a composite indicator of language match, at the level of the pupil, which is defined as “high” if both the pupil and his/her teacher are “high” match.

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25 For the purpose of this study, “mother tongue” is defined as the language or languages that the child reports his/her parents using when speaking to him/her at home.
based on the above definitions; “medium” if either the pupil or teacher is categorized as medium match (but neither is low match); and “low” if either the pupil or teacher are categorized as low match. For the latter category, it is assumed that the pupil is not able to communicate with his/her teacher in the official language of instruction.

**Figure 11: Match Between Ghanaian Language of Instruction and Pupil Language, Teacher Language, and Overall (Pupil and Teacher Combined)**

![Language Match Diagram]

As shown in Figure 11, 31 percent of pupils are “low” in the overall language match category, meaning nearly one-third of pupils do not speak the official Ghanaian language of instruction and/or their teachers are not confident teaching in it.

Despite the current language policy, many teachers in Ghana still use English as the medium of instruction in the early grades. Indeed, 62 percent of pupils report that their teachers use English most often when teaching them mathematics yet of these, 34 percent report being unable to speak English. In these English-centered classrooms, pupils’ ability to speak English is predictive of performance on the Core EGMA, with children who report speaking English scoring 5.5 percentage points higher than those who are not able speak English.\[^{26}\]

Taken together, these results suggest that the language barrier between teachers and pupils may limit the extent to which assessment score gains can be realized through a structured pedagogy intervention.

**Pupils are confident enough to speak up in class**

While not a direct measure of pupil confidence, classroom observations offer insights on the extent of pupil engagement and participation during mathematics lessons. In 80 percent of classrooms, virtually all students were reportedly actively engaged in all lessons and class activities. However, in over half of classrooms (58 percent), teachers did not present opportunities for students to engage in mathematical communication during the observed lesson (i.e., explain their thinking or how they arrived at an answer). While 62 percent of pupils report that their teachers ask them to discuss math problems or

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\[^{26}\] Value obtained through multiple regression analysis using the same model featured in Table 13: OLS Regression Results for Core EGMA but (a) restricted only to English-centered classrooms (based on individual pupil reporting) and (b) including a dummy for whether or not the pupil reports understanding the language most commonly used by his/her mathematics teacher. Significant at P=0.000.
solutions with their classmates, 38 percent report that their teachers do not provide such opportunities. More direct measures of pupils’ comfort levels in speaking up in class and explaining their thinking to others will be gathered at endline.

**Class environment is conducive to absorbing lessons and materials**

This indicator refers to the conditions under which teachers are teaching and pupils are learning. The data for this indicator are drawn from two sources: structured classroom observations and teacher interviews. The classroom observation data is split into four categories: management, behavior, inclusion, and environment. The interview data adds a fifth category: materials. Together, these five themes constitute our framework for examining and tracking changes to the classroom environment, and to what extent it is conducive to students absorbing lessons and materials.

**Class Management and Pupil Engagement**

Teachers scored comparatively high in both these categories, but it should be noted that roughly 1 in 5 classrooms were rated very poorly in management, and close to a quarter were described as having pupils who were consistently not paying attention. Figure 12 and Figure 13 below display findings from the classroom management and pupil engagement categories.

**Figure 12: Teacher Classroom Management (Observed)**

<table>
<thead>
<tr>
<th>Teacher Demonstrates Effective Classroom Management</th>
<th>Done Very Well</th>
<th>Done Sometimes</th>
<th>Not Done at All</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Actively Minimizes Classroom Time that is Off-task</td>
<td>81%</td>
<td>17%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 13: Pupil Engagement and Participation (Observed)**

<table>
<thead>
<tr>
<th>Approximate proportion of learners who are actively engaged in all lessons and class activities</th>
<th>Nearly 100%</th>
<th>About 75%</th>
<th>About half</th>
<th>25% or less/ N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%</td>
<td>17%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approximate proportion of learners who are paying attention throughout the entire class period</td>
<td>Nearly 100%</td>
<td>About 75%</td>
<td>About half</td>
<td>25% or less/ N/A</td>
</tr>
<tr>
<td>78%</td>
<td>21%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approximate proportion of learners who are participating when working in small groups or pairs</td>
<td>Nearly 100%</td>
<td>About 75%</td>
<td>About half</td>
<td>25% or less/ N/A</td>
</tr>
<tr>
<td>5%</td>
<td>4%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in Figure 13, pupil engagement during reading lessons is generally high, with 78 percent of classrooms observed as having all, or nearly all, pupils engaged for the entirety of the lesson. However, the
observations also reveal that students are either seldom put into small groups, or when they are, there is difficulty in managing them well. The main findings for the categories above do shed light on the findings for management and behavior, however, as the team finds a great number of under-resourced classrooms in the sample, where for example there are not enough materials for all students. This would likely have an effect on pupil attention and in turn, increase classroom management challenges.

**Inclusiveness and Environment**

In the inclusion category, ES found mixed results in terms of teacher inclusion practices. While teachers generally avoid language that is abusive, engage learners of all ability levels, and provide constructive, positive feedback, they were not found to regularly intervene when learners used abusive language or specifically provide encouragement that all students can be good at mathematics. From a gender perspective, while teachers avoided language that favors one gender over another, and made sure students had equal access to desks and chairs, only 47 percent of teachers were reported as doing very well at providing pupils equal access to learning materials. Figure 14 below presents other findings in the inclusion category.

**Figure 14: Teacher Inclusion Practices (Observed)**

![Figure 14: Teacher Inclusion Practices (Observed)](image-url)

In the classroom environment category, it was found that while most classrooms are spacious enough for teachers to move around, and 84 percent were described as clean and organized, it was also found that around a quarter of classrooms are under-resourced in terms of furniture and materials, mirroring the findings for the inclusion category above. Figure 15 presents the findings on the Class Environment category.
In the materials category, the data for which was drawn from the teacher interviews, ES finds that nearly all teachers interviewed report resource poor environments, especially with regards to classroom learning materials. When asked “Are the teaching and learning materials that you have sufficient to enable effective teaching of early grade mathematics,” 94 percent chose the answer, “No, they are not sufficient.” Indeed, it could be said that most teachers might respond in the same way, even those in considerably better resourced classrooms. However, the classroom observation data above confirms that most classrooms do not have enough materials for all students. Figure 16 below shows the reasons teachers chose for why materials were not sufficient.

Figure 16: Reasons Classroom Materials are Not Sufficient (Teacher-Reported)

In more than 4 of every 5 classrooms in the sample, teachers report that there are not enough materials for every pupil. Schools are described as not having enough materials for every teacher or class by more than two-thirds of all teachers interviewed.

While further observation data reveals that most classrooms were found to be well managed, clean, and organized, the findings above reveal resource-poor environments in at least three-quarters of the sampled schools, especially with regards to teacher and classroom materials like books, rulers, and pens/pencils. A smaller percentage of classrooms—around 20 percent—have further challenges in access to furniture like desks and chairs.
Pupils are punctual and attend class with enough regularity to benefit from structured pedagogy

A critical assumption of school-based programs is that students will come to school with enough regularity to actually benefit from the intervention. In the case of the Numeracy Pilot, it is assumed that pupils will attend mathematics lessons frequently enough to absorb the content as well as keep up as the lessons progress in terms of difficulty. Based on self-reporting, the average number of missed school days was 0.53 days per week (10.6 percent), with 28 percent of pupils missing at least one day of school during the week immediately preceding data collection. Approximately 72 percent of pupils reported missing no days, 21 percent reporting missing 1-2 days, 5 percent reporting missing 3-4 days, and 2 percent reporting missing all 5 days.

Figure 17: Frequency of Pupil Absenteeism and Tardiness (Self-Reported)

Pupils were also asked more generally about the frequency of absence and tardiness. The results of this self-reporting are presented in Figure 17 above. While the majority report being rarely or never absent or tardy (60 and 55 percent, respectively), 39 percent report being absent and/or tardy sometimes, however the days they attend school or are on time are greater than the days they are absent or tardy. While 6 percent of pupils report being tardy on most days, only 2 percent report being absent on most days.

Teachers teach mathematics lessons with prescribed frequency and duration

To assess whether sampled teachers are teaching reading lessons with prescribed frequency and duration, the evaluation looks at both teacher absenteeism and prescribed versus actual mathematics lesson time. According to HTs, both P1 and P2 pupils are supposed to receive approximately 4.6 hours of mathematics instruction each week, with an average lesson duration of about 61 minutes. This is consistent with the observed mathematics lessons, which were scheduled to last 59 minutes on average.

On average, teachers were absent for 0.25 days (5 percent) in the most recent completed school week. Approximately 87 percent of teachers reported not missing any days, 8 percent reported missing 1-2 days, 5 percent reported missing 3-4 days, and less than 1 percent reported missing all 5 days. While the figures reported by HT align with teacher self-reporting for P1 (about 0.16 days missed on average), HTs reported higher figures for P2 teachers than what teachers themselves reported (0.43 days absent versus 0.33 days).

27 It is important to note that some treatment schools were enumerated one week following the Numeracy Pilot training workshop in Gomoa Fetteh. As such, the training itself is responsible for teacher absences in at least 9 cases.
A sufficient amount of class time is devoted to mathematics instruction

Because the evaluation is principally interested in pupils’ exposure to actual math instruction, the evaluation team now combines data on teacher and pupil absenteeism in order to calculate pupils’ true average weekly exposure to math instruction. Adjusting the 4.6 hours of math instruction per week to account for weekly teacher and pupil absences (5 and 10.6 percent, respectively), true average weekly exposure to math instruction is 3.9 hours per week, or 15 percent below target, due to teacher and pupil absences. This figure does not account for tardiness or classroom time that is off-task.

Classroom-level interventions can lead to improved mathematics outcomes regardless of home environment

The final logic model assumption that is tested is related to pupils’ home environments. Specifically, the evaluation team examines proxies for household poverty including household resources and assets as well as whether children report experiencing hunger when they first arrive at school. In developed contexts, it has been shown that by and large, children’s socio-economic status (SES) is a considerably stronger predictor of school performance than school-level inputs. As such, it is helpful to report the extent of poverty among the sample population in order to provide important context in terms of the operating environment of the program. In addition, ES includes these proxy variables in regression models so as to control for SES among the evaluation sample.

Figure 18: Household Asset Ownership for Sampled Pupils (Self-Reported)

Among interviewed pupils, 86 percent have electricity at home and nearly 93 percent use an improved water source for drinking water (e.g., borehole or tap). While 8 percent of pupils report regularly engaging in open defecation, 38 percent report most commonly using a flush toilet. As shown in Figure

18, household ownership of durable goods is mixed, with 53 percent of pupils reporting refrigerator ownership but only 27 percent reporting car ownership. In terms of hunger, just under half of pupils (46 percent) reported experiencing hunger at least sometimes when they first get to school in the morning, with 18 percent experiencing hunger every day.

Taken together, these results suggest that while many learners are of higher socio-economic status than those from comparable studies, a considerable portion of sampled pupils still live in poverty and may therefore struggle to improve academically in response to a school-based intervention alone.

**PREDICTORS OF MATHEMATICS PERFORMANCE**

Finally, the Findings explore factors that predict EGMA+ performance. The purpose of this analysis is to explore this rich data set in more depth so that policy-relevant conclusions and recommendations might be drawn on potential areas for further influencing mathematics performance among learners in the sampling frame and beyond.

Two separate multiple regression models were estimated using unit-weighted composite percentage scores for the Core EGMA as well as the Numeracy Pilot-aligned “+” subtests as dependent variables. A host of student-, teacher-, classroom-, and school-level independent variables were included in the models in order to identify factors which significantly predict mathematics performance, as measured by the two composite scores. Lists of variables included in the regressions are summarized below in Table 12.

**Table 12: Independent Variables Used in the Estimated Regressions**

<table>
<thead>
<tr>
<th>Student</th>
<th>Teacher / Classroom</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Age</td>
<td>• Teacher confident in teaching mathematics (self-reported)</td>
<td>• Urban/rural status</td>
</tr>
<tr>
<td>• Sex</td>
<td>• Class size</td>
<td>• HT reports regularly observing math lessons and providing teacher coaching</td>
</tr>
<tr>
<td>• Grade</td>
<td>• Sufficient pupil workbooks observed during lesson</td>
<td>• School regularly dismisses pupils so teachers can participate in school-based INSET (SBI)</td>
</tr>
<tr>
<td>• Repeater status</td>
<td>• Index for general teaching practices</td>
<td></td>
</tr>
<tr>
<td>• Frequency absent</td>
<td>• Index for math teaching practices</td>
<td></td>
</tr>
<tr>
<td>• Good at math (self-reported)</td>
<td>• Index for classroom math resources</td>
<td>• Index for school resources</td>
</tr>
<tr>
<td>• Always hungry when arriving at school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Reports teacher punishes for poor performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Reports teacher rewards for good performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Index for household assets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The independent variables in Table 12 were initially identified to be associated with mathematics outcomes through a series of individual, step-wise regressions during the early stages of analysis. Most variables that were not predictive of mathematics outcomes during this stage were excluded from the final estimation, however a few variables were retained (e.g., indices for school, class, and pupil

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household resources; pupil sex) in the model because their inclusion is conventional in the literature. It is important to note that because baseline data collection took place at the start of the school year, pupils had only been with their teachers and classrooms for a few weeks. As such, many teacher- and classroom-level factors that are often predictive of pupil assessment scores were not predictive at baseline.

Each of the 5 index variables—school resources, classroom math resources, general teaching practices, math teaching practices, and student household assets—were created through separate principal component analyses (PCA). PCA is a variable reduction technique typically used to compress a set of potentially correlated variables into an index (also known as components), thus reducing the threat of multicollinearity in the final regression model.30

**Predictors of Core EGMA performance**

An Ordinary Least Squares (OLS) regression model was used to examine the relationship between the selected independent variables and composite percent correct score for the Core EGMA, the results of which are presented in Table 13. Among the variables included in the regression, ES finds the following results for Core EGMA performance (holding all else equal):

- In schools where HTs agree with the statement, “*observing maths lessons and providing coaching and feedback to teachers on their instructional practice is part of my regular duties as HT,*” pupils score 6.5 percentage points higher on the Core EGMA.
- While classroom-based coaching has a positive association with student outcomes, in schools where pupils are regularly dismissed so that teachers can participate in school-based in-service training (SBI), pupils score 3.5 percentage points lower on average.
- Pupils who report regularly missing school score 5 percentage points less than those who rarely or never miss school.
- Pupils who claim to be good at math score 11 percentage points higher than those who say they are not good at math.
- Pupils who report arriving at school hungry most days score 2 percentage points lower.
- Teacher punishment for poor performance and reward for good performance, as reported by pupils, is associated with a 2 percentage point change in assessment scores, with rewards associated with an increase in performance and punishment associated with a decrease.
- At the start of the school year, pupils who are repeaters (i.e., were in the same or higher grade in the previous school year), score 3.5 percentage points higher on average than non-repeaters.
- Relative to their urban counterparts, pupils in rural schools score nearly 3 percentage points lower on the Core EGMA.
- P2 pupils scored approximately 14 percentage points higher than P1 pupils.

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30 On a similar note, ES has inspected the variance inflation factor (VIF) of the final regression estimation and found the models VIF to be 1.12. This would indicate that threat of multicollinearity in our final estimation is minimal.
### Table 13: OLS Regression Results for Core EGMA

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupil age</td>
<td>0.008***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupil is female</td>
<td>-0.000</td>
<td>0.956</td>
</tr>
<tr>
<td>Pupil grade</td>
<td>0.144***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupil is a repeater</td>
<td>0.035***</td>
<td>0.001</td>
</tr>
<tr>
<td>Pupil reports regularly missing school</td>
<td>-0.052***</td>
<td>0.001</td>
</tr>
<tr>
<td>Pupil reports he/she is good at math</td>
<td>0.110***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupil always hungry at the start of school</td>
<td>-0.023***</td>
<td>0.000</td>
</tr>
<tr>
<td>Teacher punishes pupil for poor performance</td>
<td>-0.021***</td>
<td>0.000</td>
</tr>
<tr>
<td>Teacher rewards pupil for good performance</td>
<td>0.024***</td>
<td>0.004</td>
</tr>
<tr>
<td>Index for pupil household assets</td>
<td>0.004*</td>
<td>0.060</td>
</tr>
<tr>
<td>Teacher feels confident teaching mathematics</td>
<td>0.025</td>
<td>0.300</td>
</tr>
<tr>
<td>Class size</td>
<td>0.001***</td>
<td>0.000</td>
</tr>
<tr>
<td>Index for general teaching practices</td>
<td>0.001</td>
<td>0.786</td>
</tr>
<tr>
<td>Index for math teaching practices</td>
<td>0.001</td>
<td>0.733</td>
</tr>
<tr>
<td>Index for classroom math resources</td>
<td>0.001</td>
<td>0.854</td>
</tr>
<tr>
<td>School's locality (rural)</td>
<td>-0.026***</td>
<td>0.003</td>
</tr>
<tr>
<td>HT observes/coaches math teachers</td>
<td>0.065***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupils regularly dismissed for SBI</td>
<td>-0.035**</td>
<td>0.025</td>
</tr>
<tr>
<td>Index for school resources</td>
<td>-0.002</td>
<td>0.470</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.126***</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Number of observations: 3,929
R-squared: 0.374

*Standard errors are clustered at the school level (*** p<0.01, ** p<0.05, * p<0.1)*
Predictors of Curriculum-Aligned Additional (+) Subtests

A Tobit regression model was used to examine the relationship between the selected independent variables and composite percentage score on the Numeracy Pilot-aligned “+” subtests. Tobit analysis was selected due its ability to correct for flooring effects (i.e., left censoring) driven by the high number of zero scores for this subtest (approximately 30 percent).

Table 14: Tobit Regression Results for Additional (+) Subtests

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Marginal Effects</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupil age</td>
<td>0.014***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupil is female</td>
<td>-0.003</td>
<td>0.753</td>
</tr>
<tr>
<td>Pupil grade</td>
<td>0.063***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupil is a repeater</td>
<td>0.024**</td>
<td>0.037</td>
</tr>
<tr>
<td>Pupil reports regularly missing school</td>
<td>-0.059**</td>
<td>0.013</td>
</tr>
<tr>
<td>Pupil reports he/she is good at math</td>
<td>0.091***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupil always hungry at the start of school</td>
<td>-0.026***</td>
<td>0.001</td>
</tr>
<tr>
<td>Teacher punished pupil for poor performance (pupil-reported)</td>
<td>-0.021***</td>
<td>0.002</td>
</tr>
<tr>
<td>Teacher rewards pupil for good performance (pupil-reported)</td>
<td>0.047***</td>
<td>0.000</td>
</tr>
<tr>
<td>Index for pupil household assets</td>
<td>0.001</td>
<td>0.733</td>
</tr>
<tr>
<td>Teacher feels confident teaching mathematics</td>
<td>0.069***</td>
<td>0.004</td>
</tr>
<tr>
<td>Class size</td>
<td>0.001***</td>
<td>0.009</td>
</tr>
<tr>
<td>Index for general teaching practices</td>
<td>0.002</td>
<td>0.493</td>
</tr>
<tr>
<td>Index for math teaching practices</td>
<td>0.001</td>
<td>0.607</td>
</tr>
<tr>
<td>Index for classroom math resources</td>
<td>0.002</td>
<td>0.288</td>
</tr>
<tr>
<td>School’s locality (rural)</td>
<td>-0.025**</td>
<td>0.012</td>
</tr>
<tr>
<td>HT observes/coaches math teachers</td>
<td>0.088***</td>
<td>0.000</td>
</tr>
<tr>
<td>Pupils regularly dismissed for SBI</td>
<td>-0.026*</td>
<td>0.096</td>
</tr>
<tr>
<td>Index for school resources</td>
<td>0.000</td>
<td>0.859</td>
</tr>
</tbody>
</table>

Number of observations: 3,927

Pseudo R-squared: 0.149

Standard errors are clustered at the school level (** p<0.01, * p<0.05, * p<0.1)

We generally see similar patterns when looking at the additional subtests as we see with the Core EGMA. Pupil age, grade, repeater status, self-reported math abilities, and teacher rewards are all positively associated with performance on the program-aligned subtests whereas missing school, hunger, and teacher
punishment are negatively associated with performance. There are also few additional interesting findings from the “+” subtest regression model. Holding all else equal:

- The magnitude of the positive relationship between pupil grade and assessment performance is lower for the “+” subtests relative to the Core EGMA (6 versus 14 percentage points, respectively).
- Teacher confidence is strongly associated with “+” assessment performance, with pupils in classes with confident teachers scoring nearly 7 percentage points higher.
- Class size is statistically significant for “+” subtests (albeit practically insignificant) with a 0.1 percentage point gain for every additional pupil in the classroom (i.e., larger classes are associated with slightly higher performance).
CONCLUSIONS

Randomization procedures were effective in establishing a credible counterfactual. Statistical comparison of primary indicators and covariates—including EGMA+ performance and a host of school, classroom, teacher, and pupil characteristics—show strong balance between treatment and control at baseline. Barring threats and limitations discussed earlier in this report, the evaluation team is confident that observed differences between treatment and control at endline will represent the causal impact of the Numeracy Pilot program.

With the exception of addition and subtraction, baseline zero scores were low to moderate for Core EGMA subtests, ranging from less than 1 percent for P2 number identification to 21 percent for P1 quantity discrimination. Zero scores for the Numeracy Pilot-aligned “+” subtests were relatively large, due primarily to the fact that baseline took place at the start of the school year and these subtests are designed to measure performance against end-of-school-year benchmarks.

On average, pupils are receiving just 3.9 hours of math instruction per week. Adjusting the 4.6 hours of Head Teacher-reported weekly math instruction to account for teacher and pupil absences (5 and 10.6 percent, respectively), true average weekly exposure to math instruction is 3.9 hours per week on average, or 15 percent below target. Because this figure does not account for tardiness or classroom time that is off-task, actual instructional time may still be overestimated.

Regular dismissal of pupils from school so teachers can participate in SBI is negatively associated with assessment performance. In schools where pupils are regularly dismissed so that teachers can participate in school-based in-service training (SBI), pupils score 3.5 percentage points lower on average. Because students are already only receiving an average of 3.9 hours of weekly math instruction, SBI at the expense of instructional time could negatively affect student performance. This conclusion underscores the importance of generating rigorous evidence on effective SBI models that can offset the loss of instructional time through significant improvements in math pedagogy and pupil learning.

When HTs provide regular teacher coaching and feedback, pupils perform better in mathematics. In schools where HTs agree with the statement, “observing maths lessons and providing coaching and feedback to teachers on their instructional practice is part of my regular duties as HT,” pupils score 6.5 percentage points higher on the Core EGMA. This statement is significant in three key ways. First, it indicates the importance of holding teachers accountable to new teaching practices. Second, it stresses the importance of continuous learning in the form of coaching and feedback as necessary elements of training and capacity building. Third, it stresses the role of the head teacher and the importance of strong leadership and management for learning outcomes.

While teachers believe in the importance of encouraging mathematical reasoning and conceptual understanding, there is misalignment between their beliefs and actual classroom practices. Despite the fact that the majority of teachers believe there are multiple methods and approaches to solving a problem, only 12 percent of teachers were observed encouraging pupils to use multiple problem-solving strategies during a lesson. In addition, 73 percent of teachers were not observed encouraging mathematical reasoning (i.e., applying existing skills and knowledge to solve unfamiliar problems).

Teacher observation revealed mixed results in terms of teacher inclusion practices. Tied to the above observation, while teachers are effectively mastering certain elements of inclusive practices, there others that are not being effectively used. These include intervening when learners used abusive language,
provide encouragement that all students can be good at mathematics, and providing pupils equal access to
learning materials. The finding of association between encouragement that all students can be good at
mathematics and outcomes stresses the importance of these inclusive practices.

Approximately 30 percent of pupils are in classrooms where either they or their teachers are
unable to effectively communicate in the Ghanaian language of instruction. Further, while 62
percent of pupils report that their teachers use English most often when teaching them mathematics, 34
percent report being unable to speak English.

Poor pupil attendance and self-reported hunger at the beginning of the school day are
negatively associated with assessment performance. Pupils who report arriving at school hungry
most days score 2 percentage points lower on the Core EGMA.

LOOKING FORWARD

These findings and conclusions establish a strong, foundational understanding of baseline conditions at the
Numeracy Pilot target schools. They also shed light on potential barriers and catalysts to effective program
implementation as well as broader factors that influence pupil mathematics performance in a subset of
Ghanaian classrooms. Moving forward, baseline findings and data will support the final evaluation results in
two critical ways. First, by establishing statistical equivalence between treatment and control schools prior
to the start of the Numeracy Pilot, readers can feel confident that any observed differences at endline can
be causally attributed to the program itself. Second, baseline data or baseline “covariates” collected from
schools, teachers, and pupils will be used during the final analysis in order to improve the statistical
precision of the impact estimates, thus increasing the chances of observing statistically meaningful
differences at endline.
ES conducted sampling and power analysis based on the impact evaluation assumptions. The numeracy pilot will be implemented in 60 schools, which is fixed by the implementer. As such the focus of this section will be to (a) establish the number of pupils per school to be sampled, (b) report the minimum effect sizes that the study will be powered to detect, and (c) situate these effect sizes within the broader literature on structured pedagogy programs aimed at improving mathematics performance in developing countries.

This study is a two-stage cluster randomized controlled trial whereby schools or groupings of schools (clusters) are assigned to treatment or control conditions in the first stage and students are sampled in the second stage for the purpose of measuring outcomes of interest. While ES will also select classrooms in cases where there is more than one class per grade, the majority of schools in the selected districts have only one class per grade (90 percent for both P1 and P2 according to the 2015 EMIS Basic Schools Census) thus ES does not factor in classroom-level clustering in the power analysis.

Two-stage clustered sampling requires analysis of the intra-cluster correlation, or $\rho$, which is the ratio of variability in outcomes between clusters to the total variability in outcomes among the broader sample. The team calculates $\rho$ for each of the 2015 EGMA subtasks using Stata’s `loneway` command. The results of this analysis are reported in Table 15 below.  

Table 15: Intra-Cluster Correlations for EGMA Subtasks

<table>
<thead>
<tr>
<th>EGMA Subtask</th>
<th>Intra-Cluster Correlation ($\rho$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number identification</td>
<td>0.26</td>
</tr>
<tr>
<td>Addition</td>
<td>0.19</td>
</tr>
<tr>
<td>Subtraction</td>
<td>0.18</td>
</tr>
<tr>
<td>Quantity discrimination</td>
<td>0.26</td>
</tr>
<tr>
<td>Missing number</td>
<td>0.17</td>
</tr>
<tr>
<td>Word Problem</td>
<td>0.26</td>
</tr>
</tbody>
</table>

It is important to note that the grouping of schools prior to randomization to limit contamination (as discussed in the subsequent section) may have implications for the intra-cluster correlation assumptions in that they introduce an additional level of clustering and therefore may increase the overall $\rho$ value which would reduce the study’s statistical power. As such, we will present updated power analysis in the baseline report using actual baseline data.
To establish the number of pupils per school to be sampled, ES adopts the highest reported $\rho$ value of 0.26 as well as standard assumptions of 0.8 for statistical power ($\beta$) and a partial Bonferroni-adjusted value of 0.0232 for significance level ($\alpha$). ES then uses Optimal Design to plot minimum detectable effect size (MDES) against number of subjects per cluster ($n$) for 120 clusters ($J$) in order to explore the gains in power achieved for each additional student that is sampled. The results of this analysis are reported below in Figure 19.

**Figure 19: MDES versus Number of Subjects per Cluster**

As shown above, there are only marginal power gains for sampling more than 16 pupils. In Figure 19, ES also explores the gains in power by increasing the R-squared value, which represents the percentage of variation in outcomes of interest explained by covariate(s). Increasing the R-squared value from 0.1 to 0.5 will increase the detectable effect size by approximately 0.06 standard deviations. These large gains in power from using covariates with high predictive ability, combined with the fact that the numeracy pilot spans only one academic year, suggests that a panel approach—whereby the same students are sampled and tested at baseline and endline—is the most practical design for this study. Because student attrition is a concern in panel studies, however, ES recommends oversampling 4 pupils per grade level (25 percent) for an effective sample of 20 pupils per grade. Further approaches for dealing with pupil

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32 Bonferroni correction is applied by dividing the standard $\alpha$ value of 0.05 by the number of hypotheses being tested (in this case equal to the number of EGMA subtasks (6)) while accounting for the non-independence of these subtasks (i.e., the mean correlation of 0.52). Bonferroni adjustment is designed to correct for the increased likelihood of false positives when multiple hypotheses are being tested. For more information, see http://www.quantitativeskills.com/sisa/calculations/bonhlp.htm.
attrition are detailed in the Threats and Limitations section of this report. To ensure results can be disaggregated by gender, ES will sample 10 boys and 10 girls per grade.

Adopting a moderate R-squared value of 0.3 and using other assumptions stated above, ES now reports the MDES for each subtask in Cohen’s d form as well as the minimum detectable change in actual EGMA subtask scores in Table 16 below.

### Table 16: Minimum Detectable Change by EGMA Subtasks

<table>
<thead>
<tr>
<th>EGMA Subtask</th>
<th>Baseline (2015)</th>
<th>Standard Deviation</th>
<th>MDES (Cohen’s d)</th>
<th>Detectable Change</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number identification</td>
<td>13.82 cpm</td>
<td>4.48</td>
<td>0.28</td>
<td>1.25 cpm</td>
<td>9.04%</td>
</tr>
<tr>
<td>Addition</td>
<td>8.42 cpm</td>
<td>4.94</td>
<td>0.25</td>
<td>1.24 cpm</td>
<td>14.73%</td>
</tr>
<tr>
<td>Subtraction</td>
<td>5.48 cpm</td>
<td>4.66</td>
<td>0.25</td>
<td>1.17 cpm</td>
<td>21.35%</td>
</tr>
<tr>
<td>Quantity discrimination</td>
<td>64.42%</td>
<td>29.72</td>
<td>0.28</td>
<td>8.32 pp</td>
<td>12.92%</td>
</tr>
<tr>
<td>Missing number</td>
<td>26.73%</td>
<td>16.05</td>
<td>0.24</td>
<td>3.85 pp</td>
<td>14.40%</td>
</tr>
<tr>
<td>Word Problem</td>
<td>40.14%</td>
<td>24.01</td>
<td>0.28</td>
<td>6.72 pp</td>
<td>16.73%</td>
</tr>
</tbody>
</table>

To situate these effect sizes in within the broader literature on structured pedagogy programs aimed at improving math performance in developing countries, SI consulted a September 2016 policy brief published by 3ie which features a meta-analysis of 21 impact evaluations of structured pedagogy programs in 11 countries, including Liberia, Kenya, and Uganda. The brief defines structured pedagogy programs as those which typically include the “development of evidence-based curricula and instructional approaches, along with lesson plans and training for teachers in delivering new content and material for students.” In addition, such programs can include “regular monitoring and mentoring of, and feedback to, teachers on their delivery of the new material.” This meta-analysis reported an average standardized mean difference for math (Cohen’s d) of 0.14 with a lower bound of 0.08 and an upper bound of 0.20. In Table 17 ES reports the proposed study’s level of statistical power—that is, the probability that the study would statistically detect an effect of the specified magnitude if one in fact exists—for the range of effect sizes reported in the 3ie meta-analysis.

### Table 17: Statistical Power for Range of Effect Sizes Reported in 3ie’s Meta-Analysis of Impact Evaluations of Structured Pedagogy Programs in Numeracy

<table>
<thead>
<tr>
<th>EGMA Subtask</th>
<th>Statistical Power by Effect Size (Cohen’s d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intra-Cluster Correlation (ρ)</td>
</tr>
<tr>
<td>Number identification</td>
<td>0.26</td>
</tr>
</tbody>
</table>

33 Unweighted scores.
<table>
<thead>
<tr>
<th>Subtask</th>
<th>Effect Size 1</th>
<th>Effect Size 2</th>
<th>Effect Size 3</th>
<th>Effect Size 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition</td>
<td>0.19</td>
<td>0.09</td>
<td>0.29</td>
<td>0.58</td>
</tr>
<tr>
<td>Subtraction</td>
<td>0.18</td>
<td>0.10</td>
<td>0.30</td>
<td>0.60</td>
</tr>
<tr>
<td>Quantity discrimination</td>
<td>0.26</td>
<td>0.08</td>
<td>0.23</td>
<td>0.48</td>
</tr>
<tr>
<td>Missing number</td>
<td>0.17</td>
<td>0.10</td>
<td>0.31</td>
<td>0.62</td>
</tr>
<tr>
<td>Word Problem</td>
<td>0.26</td>
<td>0.08</td>
<td>0.23</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Based on the above figures, it is evident that the study is underpowered to detect effect sizes found in similar programs. That said, there are programs with similar designs to the numeracy pilot that have found impacts even larger than those reported in Table 16. For example, PRIMR in Kenya found an average effect size of 0.265 for grade 2 learners across these six EGMA subtasks—slightly higher than what the proposed sample is powered to detect. Furthermore, the detectable changes—in terms of EGMA scores as well as percent change—reported in Table 16 are quite small in practical terms, which suggests the study as currently designed is still of high policy relevance. Indeed, the higher-end PRIMR effects observed after a full year of the program were considered by the evaluators to be only modest to moderate.

At the recommendation of Learning, this evaluation will be limited to P1 and P2 only. The total sample for schools, grades, teachers, and learners is summarized below:

- **Total schools sampled:** 120 schools (60 treatment and 60 control)
- **Grades sampled per school:** 2 grades (P1 and P2)
- **Classes sampled per grade:** 1 class per grade
- **Pupils sampled per grade:** 20 pupils (10 boys and 10 girls)
- **Teachers sampled per grade:** 1 teacher
- **Total pupil sample:** 4,800 pupils
- **Total teacher sample:** 240 teachers

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36 While power is optimized when there is an equal allocation of units between treatment and control, there are still marginal gains in power through increasing the number of control schools. If USAID feels the detectable changes reported in Table 3 are inadequate, we strongly advise increasing the number of control schools (which will require expanding the sampling frame beyond 120 schools).
## ANNEX II – OUTCOMES AND MEASUREMENT FRAMEWORK

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Illustrative Indicators / Topics</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>Administrative / Monitoring</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>Program monitoring data to be</td>
<td>Endline</td>
</tr>
<tr>
<td></td>
<td>collected by <strong>Learning</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Endline (treatment only):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which math coaches are recruited, trained, and deployed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which LCs are established, operational, and meeting regularly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which program materials (Teacher Resource Guides) are developed and distributed on-time and according to plan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Learning circle teacher attendance / participation rates</td>
<td></td>
</tr>
<tr>
<td><strong>HT</strong></td>
<td><strong>Head Teacher Interview</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structured interviews with head</td>
<td></td>
</tr>
<tr>
<td></td>
<td>teachers at target schools</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Anticipated duration:</strong> 45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>minutes</td>
<td></td>
</tr>
<tr>
<td><strong>Baseline and Endline (treatment and control):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• School climate assessment, including data on school infrastructure and classroom materials as well as language matching conditions between learners and teachers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Data on teacher attendance as well as learner dropouts and repetitions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Beliefs on student preparedness to absorb instructional content</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which HTs support teachers in teaching mathematics by monitoring adherence to curriculum, observing lessons, providing coaching, monitoring performance standards, etc.</td>
<td></td>
</tr>
<tr>
<td><strong>Endline only (treatment only):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fidelity / timeline of training and materials distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Challenges teachers face in using participating in LCs and using new curricula and materials</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which teachers are putting the new curriculum into practice and following the Teacher Resource Guide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Beliefs on the efficacy of the new curricula</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Perception of / attitudes toward math coaches</td>
<td></td>
</tr>
<tr>
<td><strong>TI</strong></td>
<td><strong>Teacher Interview</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structured interviews with P1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and P2 teachers</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Anticipated duration:</strong> 45-60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>minutes</td>
<td></td>
</tr>
<tr>
<td><strong>Baseline and Endline (treatment and control):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which teacher uses inquiry-based learning, manipulatives, and encourages mathematical communication in the classroom (self-reported)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Methods and frequency of continuous assessment and (if appropriate) how teacher modifies approach in response to assessment data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which teachers believe available teacher and learner materials are beneficial and sufficient to improve learner outcomes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Beliefs on student preparedness to absorb instructional content and perceived challenges to learner improvement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extent to which learners engage in mathematical communication in the classroom</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Perceived self-efficacy in affecting learner improvement</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Data Collection Type</th>
<th>Baseline and Endline (treatment and control)</th>
<th>Endline only (treatment only):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student Interviews</strong></td>
<td>Types of activities child engages in during math class (e.g., games, using manipulatives, responding to teacher questions, taking assessments, etc.)</td>
<td>Review of teacher guides and lesson plans and current scope and sequence position</td>
</tr>
<tr>
<td></td>
<td>Self-reported enthusiasm for mathematics</td>
<td>Degree to which teachers understand new curricula and materials and can accurately describe core concepts covered in the lesson schemes</td>
</tr>
<tr>
<td></td>
<td>Household assets (for socio-economic index)</td>
<td>Degree to which teachers believe in, and are motivated to use, new curricula and materials</td>
</tr>
<tr>
<td></td>
<td>Language skills, including language(s) spoken at home and at school</td>
<td>Challenges teachers face in participating in LCs as well as using new curricula and materials</td>
</tr>
<tr>
<td></td>
<td>Attendance and tardiness patterns</td>
<td>Perceived efficacy of math coaches, LC format, and new materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fidelity / timeline of trainings and materials distribution</td>
</tr>
<tr>
<td><strong>Math Coach Interview</strong></td>
<td>Types of activities child engages in during math class (e.g., games, using manipulatives, responding to teacher questions, taking assessments, etc.)</td>
<td>Review of teacher guides and lesson plans and current scope and sequence position</td>
</tr>
<tr>
<td></td>
<td>Self-reported enthusiasm for mathematics</td>
<td>Degree to which teachers understand new curricula and materials and can accurately describe core concepts covered in the lesson schemes</td>
</tr>
<tr>
<td></td>
<td>Household assets (for socio-economic index)</td>
<td>Degree to which teachers believe in, and are motivated to use, new curricula and materials</td>
</tr>
<tr>
<td></td>
<td>Language skills, including language(s) spoken at home and at school</td>
<td>Challenges teachers face in participating in LCs as well as using new curricula and materials</td>
</tr>
<tr>
<td></td>
<td>Attendance and tardiness patterns</td>
<td>Perceived efficacy of math coaches, LC format, and new materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fidelity / timeline of trainings and materials distribution</td>
</tr>
<tr>
<td><strong>Structured Observation</strong></td>
<td>Types of activities child engages in during math class (e.g., games, using manipulatives, responding to teacher questions, taking assessments, etc.)</td>
<td>Review of teacher guides and lesson plans and current scope and sequence position</td>
</tr>
<tr>
<td></td>
<td>Self-reported enthusiasm for mathematics</td>
<td>Degree to which teachers understand new curricula and materials and can accurately describe core concepts covered in the lesson schemes</td>
</tr>
<tr>
<td></td>
<td>Household assets (for socio-economic index)</td>
<td>Degree to which teachers believe in, and are motivated to use, new curricula and materials</td>
</tr>
<tr>
<td></td>
<td>Language skills, including language(s) spoken at home and at school</td>
<td>Challenges teachers face in participating in LCs as well as using new curricula and materials</td>
</tr>
<tr>
<td></td>
<td>Attendance and tardiness patterns</td>
<td>Perceived efficacy of math coaches, LC format, and new materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fidelity / timeline of trainings and materials distribution</td>
</tr>
</tbody>
</table>
and practices in live classroom setting

**Anticipated duration:** 30-60 minutes (depending on length of lesson)

- Teacher’s apparent confidence in the subject matter
- Environmental assessment to determine whether classroom conditions are conducive to learning

**Endline (treatment only):**
- Extent to which teachers employ numeracy pilot best practices (e.g., following weekly scheme, appropriate use of manipulatives, etc.)

| E | **Early Grade Math Assessment (EGMA)**  
*Purposively selected sub-tasks from EGMA*  
*Anticipated duration:* 10 minutes |
|---|---|
| **Baseline and Endline (treatment and control):**  
- Number identification, addition / subtraction, quantity discrimination, missing number, and word problem subtasks  
- Strategies used in solving word problems (e.g., pencil / paper, think aloud, counting, etc.) |

| G | **Ghana Early Numeracy Assessment (GENA)**  
*Purposely selected sub-tasks from GENA*  
*Anticipated duration:* 10 minutes |
|---|---|
| **Baseline and Endline (treatment and control):**  
- Place value and numeric deconstruction, describing quantities in multiple ways, and number operations.  
- Ability to communicate approach to solving problems  
- Ability to use varied personal strategies for solving problems |
Head Teacher Questionnaire

General Background Information

Team name: 

Enumerator ID: 

Today’s date (DD-MM-YY): 

Start time (HH:MM): 

School name: 

School ID: 

Region: 

District: 

Circuit: 

Circuit code: 

Locality: 

Locality type:  
   ○ Urban (more than 5,000 people living in community/locality)  
   ○ Rural (less than 5,000 people living in community/locality)  

School address: 

Was the consent form administered and signed?  
   ○ Yes  
   ○ No (DO NOT PROCEED)  

Head Teacher Identifying Information

First name:  Last name: 

Sex:  
   ○ Male  
   ○ Female  

Telephone: 

A. Head Teacher Background Information

1. How long have you been the Head Teacher at this school?
2. How long have you been a Head Teacher overall?

Years:    Months:  

3. How long have you been in the teaching profession overall?

Years:    Months:  

4. Have you completed teacher training college?

○ Yes
○ No
○ Decline to answer

5. What is the highest level of education that you have completed? (select one) [Do not read options]

○ Middle School
○ Senior High School
○ Ordinary Level
○ Advance Level
○ Certificate A
○ Diploma in Basic Education
○ Higher National Diploma (HND)
○ Technical/Vocational (NVTI)
○ Bachelor of Education (B.Ed)
○ Other Bachelor Degrees
○ Post Graduate Diploma in Education
○ Masters of Education (M.Ed)
○ Other Master's Degree
○ Ph.D.
○ Decline to answer
○ Other (specify): ________________________.

6. Does your school have more than one Head Teacher?

○ Yes
○ No → skip to A8
○ Decline to answer

7. Which class(es) are you responsible for as Head Teacher? (select all)

  ○ KG1
  ○ KG2
  ○ P1
  ○ P2
  ○ P3
  ○ P4
  ○ P5
  ○ P6

8. In addition to your duties as Head Teacher, do you teach classes at this school?

○ Yes
○ No → skip to A10
○ Decline to answer → skip to A10

9. [If yes to A8] In a typical week, approximately what percentage of your work time is spent teaching classes?

  □ □ □
10. Were you absent any days during the most recent completed school week (Monday thru Friday)?

- Yes
- No → skip to B1
- Don’t know → skip to B1
- Decline to answer → skip to B1

11. For how many days last week were you absent?

☐
B. School Background

[READ] I will begin by collecting some basic information on this school, including the number of teachers, trained

1. In total, how many KG1-P3 teachers are there at this school?

2. For each KG and lower primary grade present at this school, please specify a) how many shifts this school has, b) how many streams the school has, c) how many teachers teach that grade level, and d) total current enrollments in that grade for each gender (across all streams/classes and shifts):

<table>
<thead>
<tr>
<th>Grade</th>
<th>Present?</th>
<th>Number of shifts</th>
<th>Number of streams</th>
<th>Number of teachers</th>
<th>Girls enrolled</th>
<th>Boys enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KG2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Are any of the KG1-P3 classes in this school combined?

- Yes
- No → skip to B5
- Don’t know → skip to B5
- Decline to answer → skip to B5

4. [If yes to B3] Which grades are combined?

5. How many hours and minutes do P1 learners spend at this school each day (length of school day)?
   Hours: [ ] Minutes: [ ]

6. In a typical 5-day school week, on how many days do P1 learners receive a maths lesson?
   [ ]

7. What is the typical duration of a maths lesson for P1 learners?
   Hours: [ ] Minutes: [ ]
8. How many P1 teachers teach maths at this school?

9. Of the P1 teachers that teach maths, how many are female? [Enter 0 if none are female]

10. How many hours and minutes do P2 learners spend at this school each day (length of school day)?
   Hours:   Minutes:

11. In a typical 5-day school week, on how many days do P2 learners receive a maths lesson?

12. What is the typical duration of a maths lesson for P2 learners?
   Hours:   Minutes:

13. How many P2 teachers teach maths at this school?

14. Of the P2 teachers that teach maths, how many are female? [Enter 0 if none are female]

15. Was the P1 teacher selected for this study absent on any days during the most recent completed school week (Monday thru Friday)?
   ○ Yes
   ○ No → skip to B17
   ○ Don’t know → skip to B17
   ○ Decline to answer → skip to B17

16. [If yes to B15] For how many days last week was he or she absent?

17. Was the P2 teacher selected for this study absent on any days during the most recent completed school week (Monday thru Friday)?
   ○ Yes
   ○ No → skip to B19
   ○ Don’t know → skip to B19
   ○ Decline to answer → skip to B19

18. [If yes to B17] For how many days last week was he or she absent?
19. For each KG and lower primary grade level, please indicate the number of pupils that have dropped out in the most recent school year (2016/17). Please do not include students who have transferred/relocated or that have died in these figures. [If no one has dropped out from the school, \( \rightarrow \) skip to B22]

<table>
<thead>
<tr>
<th>Grade</th>
<th>Girl dropouts</th>
<th>Boy dropouts</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KG2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

20. Are these students who dropped out counted in the enrollment figures you gave me earlier (question B2)?

- Yes, they are counted in the enrollment figures I provided
- No, they have already been subtracted from the enrollment figures I provided
- Don’t know
- Decline to answer

21. What are the main reasons pupils at this school drop out? [Enumerator: if the Head Teacher mentions transfers or deaths, please remind him/her that dropouts should not include transfers or deaths and go back to question B19 and make any necessary corrections]

22. For each KG and lower primary grade level, please indicate the number of pupils that are repeaters (i.e., were in the same grade level last year): [If no one has repeated, \( \rightarrow \) skip to C1]

<table>
<thead>
<tr>
<th>Grade</th>
<th>Girl repeaters</th>
<th>Boy repeaters</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KG2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23. What are the main reasons pupils at this school repeat grades?
C. Language Background

[READ] I will now ask you some questions about the use of different languages in this school. The purpose of this

1. For each of the following languages, please state whether you speak the language fluently, partially, or not at all [Enumerator: Please name each language and ask for an answer for that language before moving on. You must read out all of the languages]

<table>
<thead>
<tr>
<th>Language</th>
<th>Fluently</th>
<th>Partially</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akuapim Twi</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Asante Twi</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Dagaare</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Dagbani</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Dangme</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>English</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ewe</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Fante</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ga</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Gonja</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Gurene</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Kasem</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Kusaal</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Nzema</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other (specify):</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

2. What language(s) do children in your school speak on the playground? (select all) [Do not prompt, record any relevant answers]

- Akuapim Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- English
- Ewe
- Fante
- Ga
- Gonja
- Gurene
- Kasem
- Kusaal
- Nzema
- Decline to answer
- Don’t know
- Other (specify): ________________________.

3. What is the GES-approved Ghanaian language of instruction for lower primary at this school? (select one) [Do not prompt]

- Akuapim Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- English
- Ewe
- Fante
- Ga
- Gonja
- Gurene
- Kasem
- Kusaal
- Nzema
- Decline to answer
- Don’t know
- Other (specify): ________________________.
4. How many lower primary teachers (KG1-P3) at this school use the GES-approved Ghanaian language of instruction when teaching maths?

5. Of these, how many teach comfortably in the GES-approved Ghanaian language of instruction?

6. What other languages besides the GES-approved Ghanaian language of instruction do KG and lower primary teachers (KG1-P3) use to teach at this school? (select all) [Do not prompt, record any relevant answers]

- Akuapim Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- English
- Ewe
- Fante
- Ga
- Gonja
- Gurene
- Kasem
- Kusaal
- Nzema
- Decline to answer
- Don’t know
- Other (specify): ________________________.

7. Is your school facing any challenges in using the GES-approved Ghanaian language as the medium of instruction?

- Yes
- No → skip to C11
- Don’t know → skip to C11
- Decline to answer → skip to C11

8. [If yes in question C8] Please describe the challenges your school faces in using the GES-approved Ghanaian language as the medium of instruction:

9. In this school, at what level is English used as the primary medium of instruction for mathematics? (select all) [Do not prompt, record any relevant answers]

- KG1
- KG2
- P1
- P2
- P3
- P4
- P5
- P6
## D. School Resources

1. **School resources roster:** [Enumerator: Please name each resource and ask for an answer for that resource before moving on. You must read all out all of the resources listed here]

<table>
<thead>
<tr>
<th>Resource</th>
<th>Don't have</th>
<th>Have, and regularly functioning</th>
<th>Have, but sometimes not functioning</th>
<th>Have, but rarely or never functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Pipe-borne water</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other water (well, borehole, reservoir)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Vehicle access road (paved)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Vehicle access road (unpaved)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Toilets for pupils</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Separate toilets for girls</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Separate toilets for teachers</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>School playground</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>School library</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Free meals scheme - breakfast</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Free meals scheme - lunch</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>School Management Committee</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Parent Teacher Association</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

2. **Does this school have an approved School Performance Improvement Plan for this 2016/2017 academic year?**

- Yes
- No
- Don’t know
- Decline to answer

3. **Does this school have a trained Curriculum Leader?**

- Yes
- No
- Don’t know
- Decline to answer

4. **How often does a Circuit Supervisor visit this school? (select one)**

- At least monthly
- Twice or more a term
- Once a term
- Once a year
- Hardly ever
E. Numeracy Resources

1. What mathematics teaching and learning materials does your school have available? (select all) [Read each option and record relevant answers]

   - Teacher's Guide or Teacher Resource Guide
   - Scripted/step-by-step lesson plans
   - Unscripted/generalized lesson plans
   - Lesson notes
   - Weekly schemes of work (day-by-day description of teaching plans and activities)
   - Pupil textbooks
   - Pupil workbooks
   - Flash cards
   - Place value chart
   - Addition and/or subtraction mats/charts
   - Counters (bottle caps, stones, sticks)
   - Bundles (straws, sticks)
   - Abacus
   - 2D shapes or pattern blocks
   - 3D shapes or blocks
   - Material for teacher-made teaching aids/improvised resources
   - Other (specify) __________________________________________________________.

2. Are the teaching and learning materials that you have sufficient to enable effective teaching of early grade mathematics?

   - Yes → skip to E4
   - No
   - Don't know → skip to E4
   - Decline to answer → skip to E4

3. [If no in question E2 above] Why are the teaching and learning materials not sufficient? (select all)

   - There are not enough materials for every pupil
   - There are not enough materials for every teacher or class
   - The materials are outdated
   - The materials are damaged
   - Other (specify): __________________________________________________________.

4. What additional resources do you feel your school needs to improve early grade math performance?
F. In-Service Training and Professional Development

[READ] This next module will focus on any in-service training and professional development (including coaching)

1. During the current school year, have you attended any in-service training or professional development sessions on early grade mathematics?
   - Yes
   - No → skip to F3
   - Don’t know → skip to F3
   - Decline to answer → skip to F3

2. About how many training days did you receive in the current school year?

3. Have teachers in this school attended any in-service training or professional development sessions on early grade mathematics in the current school year?
   - Yes
   - No → skip to F7
   - Don’t know → skip to F7
   - Decline to answer → skip to F7

4. About how many training days did they receive each (average) in the current school year?

5. Please specify the training provider or providers: (select all)
   - GES Master Trainer
   - NGO Master Trainer
   - Circuit Supervisor
   - Math Coach
   - Other (specify): ____________________________________________________________.

6. Do you feel this training was enough for them to be able to use these methods correctly in the classroom?
   - Yes
   - No
   - Don’t know
   - Decline to answer

7. Do you feel they need more training?
   - Yes
   - No → skip to F9
   - Don’t know → skip to F9
   - Decline to answer → skip to F9
8. [If yes in question F7] In which topics would you like them to receive more training? (select all)

9. Have teachers in your school ever received training in assessing pupils' mathematics understanding?
   ○ Yes
   ○ No
   ○ Don’t know
   ○ Decline to answer

10. During the current school year, have teachers in this school received any mentoring, coaching, or structured feedback in teaching mathematics?
    ○ Yes
    ○ No → skip to F18
    ○ Don’t know → skip to F19
    ○ Decline to answer → skip to F19

11. [If yes in question F10 above] Who in the current school year provided them with mentoring, coaching, or structured feedback in teaching mathematics? (select all) [Read each option and record relevant answers]
    - Head Teacher
    - Curriculum Lead
    - Circuit Supervisor
    - Maths Coach
    - Other Teacher(s) at this school
    - Other Teacher(s) at nearby schools
    - Someone from GES / MOE
    - An NGO
    - Other (specify): ____________________________________________________________.

12. [If Head Teacher is selected in question F11 above] What types of mentoring, coaching, or structured feedback did you provide? (select all) [Do not prompt, record any relevant answers]
    - Weekly training or coaching session at the school
    - Monthly training or coaching session at the school
    - Help with lesson planning
    - Coaching based on observed lesson
    - Other (specify): ____________________________________________________________.

13. [If coaching is selected in question F12 above] Did teachers change how they teach maths in response to the feedback you provided?
    ○ Yes
    ○ No → skip to F15
    ○ Don’t know → skip to F16
    ○ Decline to answer → skip to F16
14. [If yes in question F13 above] In what ways did teachers change how they teach maths in response to your feedback? [Do not prompt, record any relevant answers]

☐ Better lesson planning
☐ Provide equal opportunities to students
☐ Group assessment
☐ Individual assessment
☐ Asked more challenging questions
☐ Encouraged pupils to communicate their thinking/reasoning
☐ Made class more interactive
☐ Better use of manipulatives
☐ Better use of positive reinforcement
☐ Other (specify): ____________________________________________________________.

15. [If no in question F13 above] Why did the teachers not change their teaching in response to your feedback?

☐ Lack of skill
☐ Lack of teaching materials
☐ Lack of understanding of the feedback
☐ Difference in beliefs on effective teaching
☐ Other (specify): ____________________________________________________________.

16. Do you feel this feedback was positively received by the teachers?

☐ Yes → skip to F19
☐ No
☐ Don’t know → skip to F19
☐ Decline to answer → skip to F19

17. [If no in question F16 above] Why was this feedback not received positively? → skip to F19

18. [If Head Teacher was NOT selected in question F11] What are the main reasons you do not provide mentoring, coaching, or structured feedback to your teachers in teaching maths?

☐ I am too busy with administrative responsibilities
☐ I am too busy teaching
☐ Providing mentoring or coaching is not my responsibility
☐ I don’t have the training or knowledge to provide support
☐ I do not want to
☐ The teachers do not listen to me when I provide support
☐ Other (specify): ____________________________________________________________.

19. Does your school regularly dismiss pupils early so that teachers can participate in school-based in-service training (SBI)?
O Yes
O No → skip to G1
O Don’t know → skip to G1
O Decline to answer → skip to G1

20. Approximately how many hours per week, on average, are pupils dismissed from normal instructional hours so that teachers can participate in SBI?

[ ] [ ] [ ]
**G. Head Teacher Beliefs on Numeracy Instructional Leadership**

[READ] I will now read a few statements on roles and responsibilities in building success in early grade numeracy and ask you to state whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with that statement. Remember, all of your responses are confidential.

1. Teachers alone are responsible for ensuring sufficient class time is devoted to mathematics each week:
   - Strongly agree
   - Agree
   - Neither agree nor disagree
   - Disagree
   - Strongly disagree

2. Observing maths lessons and providing coaching and feedback to teachers on their instructional practice is part of my regular duties as Head Teacher:
   - Strongly agree
   - Agree
   - Neither agree nor disagree
   - Disagree
   - Strongly disagree

3. It is NOT the Head Teacher’s responsibility to communicate numeracy standards and expectations to parents and pupils:
   - Strongly agree
   - Agree
   - Neither agree nor disagree
   - Disagree
   - Strongly disagree

*The next three questions will ask for your opinion on the relative importance of a number of activities related to Head Teacher roles/responsibilities. For each of these, please state whether you think it is very important, important, somewhat important, not very important, or not at all important.*

4. How important is it for Head Teachers to be involved in monitoring pupil absenteeism?
   - Very important
   - Important
   - Somewhat important
   - Not very important
   - Not at all important

5. How important of a role do Head Teachers play in making sure maths are taught well at their school?
   - Very important
   - Important
   - Somewhat important
   - Not very important
   - Not at all important
6. How important is it that teachers at this school have a *clear and shared* understanding of effective numeracy teaching?

- Very important
- Important
- Somewhat important
- Not very important
- Not at all important
H. Pupil Performance and Evaluation

[READ] I will now ask a few questions about pupil performance and assessment in your school. The purpose of

1. Do you believe KG and lower primary pupils (KG1-P3) in this school are on track to become proficient in early grade mathematics?
   ○ Yes → skip to H3
   ○ No
   ○ Don’t know → skip to H4
   ○ Decline to answer → skip to H4

2. [If no in question H1 above] Why do you think lower primary pupils are not on track to become proficient in maths? (select all) [Do not prompt, record any relevant answers]
   - They don’t come to class often enough
   - They don’t come to class on time
   - They don’t pay attention during class
   - Their parents do not support their learning at home
   - They are too hungry to concentrate
   - They don’t care about school
   - They are not able to understand the language of instruction
   - The class is too large for teachers to provide good instruction
   - The lessons are too short
   - Teachers don’t always teach the lessons because they are doing other things
   - Teachers don’t show up for work
   - Teachers don’t speak the language of instruction
   - The teachers don’t do a good job teaching
   - There are not enough teachers at this school
   - Teachers vacate their postings too often
   - We don’t have the teaching resources we need to teach them well
   - We don’t have the training we need to teach them well
   - The pupils don’t have enough books
   - The pupils don’t have access to learning materials other than books (e.g., manipulatives)
   - The pupils are not confident in math
   - Other (specify) ________________________________________________________________.

3. How do you know whether they are on track to become proficient in maths? (select all) [Do not prompt, record any relevant answers]
   - We assess them regularly
   - Teachers tell me they are doing OK
   - They seem to be doing OK when I observe them in class
   - I don’t know
   - Other (specify) ________________________________________________________________.
4. For each of the following methods of pupil numeracy evaluation or assessment, please state whether lower primary teachers at this school employ it daily, weekly, monthly, quarterly, annually, or not at all:

<table>
<thead>
<tr>
<th>Method</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Quarterly</th>
<th>Annually</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written assessment</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Individual learner oral assessment</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other (specify): _____________</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

5. Please describe any standardized oral or written assessments that you are currently using at this school to assess lower primary pupils in mathematics: [A standardized assessment is an assessment which uses the same questions across schools and has a standard scoring system]

Thank you! That completes the Head Teacher questionnaire.

End Time (HH:MM): __ : ___
Ghana Numeracy Pilot Impact Evaluation
Teacher Questionnaire

General Background Information

Team name: 

 Enumerator ID:  

 Today’s date (DD-MM-YY):  -   -   

 Start time (HH:MM):   :   

 School name: 

 School ID:  

 Region:  

 District:  

 Locality:  

 School address: 

 Was the consent form administered and signed?  O Yes  O No (DO NOT PROCEED)  

Teacher Identifying Information

First name:  Last name:  

 Sex:  O Male  O Female  

 Telephone:  

 Teacher Identification Number  

I. Teacher Background Information

12. How long have you been a teacher at this school?
Years: __________ Months: __________

13. How long have you been a teacher overall?
Years: __________ Months: __________

14. Have you completed teacher training college?
○ Yes
○ No
○ Decline to answer

15. What is the highest level of education that you have completed? (select one) [Do not read options]
○ Middle School Leaving
○ Senior High School
○ GCE Ordinary Level
○ GCE Advance Level
○ Certificate A
○ Diploma in Basic Education
○ Higher National Diploma (HND)
○ Technical/Vocational
○ Bachelor of Education (B.Ed)
○ Other Bachelor Degrees
○ Post Graduate Diploma in Education
○ Masters of Education (M.Ed)
○ Other Master’s Degree
○ Ph.D.
○ Decline to answer
○ Other (specify): ________________________

16. What is your current rank? [Do not read options]
○ Deputy Director
○ Assistant Director I
○ Assistant Director II
○ Principal Superintendent
○ Senior Superintendent I
○ Senior Superintendent II
○ Superintendent I
○ Superintendent II
○ Pupil Teacher (WASSCE/SSCE)
○ Not applicable
○ Don’t know
○ Decline to answer
○ Other (specify): ________________________

17. Which grades do you teach? (select all that apply)
☐ KG1
☐ KG2
☐ P1
☐ P2
☐ P3
☐ P4
☐ P5
☐ P6

18. Were you absent any days during the most recent completed school week (Monday thru Friday)?
○ Yes
○ No → skip to B1
○ Don’t know → skip to B1
○ Decline to answer → skip to B1

19. For how many days last week were you absent?
☐

J. Language Background
I will now ask you some questions about your language background and skills as well as the use of different languages in this school. The purpose of this module is to help us understand how Ghana's linguistic diversity affects the ability of teachers to teach mathematics as well as the ability of pupils to become proficient in maths. Remember, your answers are strictly confidential so please feel free to answer honestly. Some of these questions are similar, but there are slight yet important differences so please listen carefully and let me know if you require any clarifications.

10. For each of the following languages, please state whether you speak the language fluently, partially, or not at all [Enumerator: Please name each language and ask for an answer for that language before moving on. You must read out all of the languages]

<table>
<thead>
<tr>
<th>Language</th>
<th>Fluently</th>
<th>Partially</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akuapim Twi</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Asante Twi</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Dagaare</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Dagbani</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Dangme</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>English</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ewe</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Fante</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ga</td>
<td></td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Gonja</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Gurene</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Kasem</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Kusaal</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Nzema</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other (specify):</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

11. What language(s) do children in your maths class speak on the playground? (select all that apply) [Do not prompt, record any relevant answers]

- [ ] Akuapim Twi
- [ ] Asante Twi
- [ ] Dagaare
- [ ] Dagbani
- [ ] Dangme
- [ ] English
- [ ] Ewe
- [ ] Fante
- [ ] Ga
- [ ] Gonja
- [ ] Gurene
- [ ] Kasem
- [ ] Kusaal
- [ ] Nzema
- [ ] Decline to answer
- [ ] Don’t know
- [ ] Other (specify): ________________________.
12. [If more than one language is selected in question B2 above] Approximately what percentage of pupils in your maths class speak and understand each of the playground languages you specified in the previous question?

<table>
<thead>
<tr>
<th>Language</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akuapim Twi</td>
<td>___</td>
</tr>
<tr>
<td>Asante Twi</td>
<td>___</td>
</tr>
<tr>
<td>Dagaare</td>
<td>___</td>
</tr>
<tr>
<td>Dagbani</td>
<td>___</td>
</tr>
<tr>
<td>Dangme</td>
<td>___</td>
</tr>
<tr>
<td>English</td>
<td>___</td>
</tr>
<tr>
<td>Ewe</td>
<td>___</td>
</tr>
<tr>
<td>Fante</td>
<td>___</td>
</tr>
<tr>
<td>Ga</td>
<td>___</td>
</tr>
</tbody>
</table>

13. What language(s) do you use to teach mathematics to the pupils? (select all that apply) [Do not prompt, record any relevant answers]

- Akuapim Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- English
- Ewe
- Fante
- Ga

14. In what language(s) are mathematics exams given to your pupils? (select all that apply) [Do not prompt, record any relevant answers]

- Akuapim Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- English
- Ewe
- Fante
- Ga

15. What is the GES-approved Ghanaian language of instruction for lower primary at this school? (select one) [Do not prompt]

- Akuapim Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- English
- Ewe
- Fante
- Ga

16. Approximately what percentage of the pupils in your maths class speak the GES-approved Ghanaian language of instruction?

17. How confident do you feel about speaking the GES-approved Ghanaian language of instruction?

- Very confident
- Somewhat confident
18. How confident do you feel about reading the GES-approved Ghanaian language of instruction?
- Very confident
- Somewhat confident
- Not very confident
- Not at all confident

19. Are you facing any challenge(s) in using the GES-approved Ghanaian language as the medium of instruction for your maths class?
- Yes → skip to C1
- No → skip to C1
- Don’t know → skip to C1
- Decline to answer → skip to C1

20. [If yes to B10 above] Please describe the challenges you face in using the GES-approved Ghanaian language as the medium of instruction for your maths class:


K. Classroom Enrollment and Attendance

[READ] I will now ask a few quick questions on pupil enrollment and attendance. Both class size and

1. How many boys are enrolled in your maths class?

2. How many girls are enrolled in your maths class?

3. Do you maintain an attendance register for this class?
   Yes
   No → skip to C5
   Decline to answer → skip to C5

4. [If yes to C3 above, record the number of students marked as present on each of the following
days for the most recent fully completed week]:
   Day of the week:
   Monday: _____ Boys _____ Girls
   Tuesday: _____ Boys _____ Girls
   Wednesday: _____ Boys _____ Girls
   Thursday: _____ Boys _____ Girls
   Friday: _____ Boys _____ Girls

5. Do you maintain a record of whether students are late and/or leave class early?
   Yes
   No → skip to C7
   Decline to answer → skip to C7

6. [If yes to C5 above, record the number of students marked as late and/or leaving early on each
day of the following days for the most recent fully completed week]:
   Day of the week:
   Monday: _____ Boys _____ Girls
   Tuesday: _____ Boys _____ Girls
   Wednesday: _____ Boys _____ Girls
   Thursday: _____ Boys _____ Girls
   Friday: _____ Boys _____ Girls

7. On a typical day, can you estimate how many of your enrolled pupils miss more than 20 minutes
   of the maths class?
### L. Numeracy Resources

5. What mathematics teaching and learning materials do you have available? (select all that apply)

[Read each option and record relevant answers]

- Teacher’s Guide or Teacher Resource Guide
- Scripted/step-by-step lesson plans
- Unscripted/generalized lesson plans
- Lesson notes
- Weekly schemes of work (day-by-day description of teaching plans and activities)
- Pupil textbooks
- Pupil workbooks
- Flash cards
- Place value chart
- Addition and/or subtraction mats/charts
- Counters (bottle caps, stones, sticks)
- Bundles (straws, sticks)
- Abacus
- Number line
- 2D shapes or pattern blocks
- 3D shapes or blocks
- Material for teacher-made teaching aids/improvised resources
- Other (specify)_______________________.

6. For each of the materials you indicated having available in question D1, please specify whether you use it daily, weekly, monthly, termly, or rarely or never:

<table>
<thead>
<tr>
<th>Materials</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Termly</th>
<th>Rarely / Never</th>
<th>Don’t Have</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher’s Guide or Teacher Resource Guide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scripted/step-by-step lesson plans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unscripted/generalized lesson plans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson notes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Weekly schemes of work</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pupil textbooks</td>
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<td></td>
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<tr>
<td>Pupil workbooks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash cards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place value chart</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addition and/or subtraction mats/charts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counters (bottle caps, stones, sticks)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bundles (straws, sticks)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abacus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2D shapes or pattern blocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3D shapes or blocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material for teacher-made teaching aids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)_____________________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. [For materials reported in D2 as being used rarely or never] Why don’t you regularly use the materials in the classroom? (select all that apply) [Do not prompt, record any relevant answers]

☐ There are not enough for everyone
☐ The children don’t understand the language of the materials
☐ I am not comfortable teaching the language of the materials
☐ The children will damage or lose them
☐ The materials we have are already damaged
☐ The materials are not age or grade appropriate
☐ The content is dated or not effective
☐ Other (specify): ____________________________________________________________.

8. In a typical 5-day school week, on how many days does your class receive a maths lesson?

☐ ☐ ☐ ☐ ☐

9. What is the duration in minutes of a typical maths lesson for your class?

☐ ☐ ☐ ☐ ☐

10. Are the teaching and learning materials that you have sufficient to enable effective teaching of early grade mathematics?

Yes → skip to E1
No
Don’t know → skip to E1
Decline to answer → skip to E1

11. [If no to D6] Why are the teaching and learning materials not sufficient? (select all that apply)

☐ There are not enough materials for every pupil
☐ There are not enough materials for every teacher or class
☐ The materials are outdated
☐ The materials are damaged
☐ Other (specify): ____________________________________________________________.
M. In-Service Training and Professional Development

[READ] This next module will focus on any in-service training and professional development (including coaching) that you have received. Your answers to these questions will help us identify current gaps in in-service training and teacher coaching support in Ghana.

20. Have you ever attended any in-service training or professional development sessions on early grade mathematics?

   Yes
   No → skip to E5
   Don’t know → skip to E5
   Decline to answer → skip to E5

21. Have you attended any in-service training or professional development sessions on early grade mathematics in the current school year?

   Yes
   No → skip to E5
   Don’t know → skip to E5
   Decline to answer → skip to E5

22. About how many early grade mathematics training days did you receive in total over the current school year?

23. Do you feel this training was enough for you to be able to use these methods correctly in your classroom?

   Yes
   No
   Don’t know
   Decline to answer

24. Do you feel you need more training?

   Yes
   No → skip to E7
   Don’t know → skip to E7
   Decline to answer → skip to E7

25. [If yes to E6] In which topics would you like to receive more training? [Do not prompt, record any relevant answers]
26. Have you ever received training in assessing pupils’ mathematics understanding?

- Yes
- No
- Don’t know
- Decline to answer

27. During the current school year, have you received any mentoring, coaching, or structured feedback in teaching mathematics?

- Yes → skip to F1
- No → skip to F1
- Don’t know → skip to F1
- Decline to answer → skip to F1

28. [If yes to E8] Who in the current school year provided you with mentoring, coaching, or structured feedback in teaching mathematics? (select all that apply) [Read each option and record relevant answers]

- Head Teacher
- Curriculum Lead
- Circuit Supervisor
- Maths Coach
- Other Teacher(s) at this school
- Other Teacher(s) at nearby schools
- Someone from GES / MOE
- An NGO
- Other (specify): ____________________________________________________________.

29. [If yes to E8] What types of mentoring, coaching, or structured feedback did you receive? (select all that apply) [Do not prompt, record any relevant answers]

- Weekly training or coaching session at the school
- Monthly training or coaching session at the school
- Help with lesson planning
- Coaching or feedback based on observed lesson
- Other (specify): ____________________________________________________________.

30. I will now ask some questions about the amount of mentoring, coaching, or structured feedback that you have received as well as how helpful you found it to be. Of the following list of possible supervision and/or coaching providers, please estimate the approximate number of hours each provider supervised/coached you in the past two (2) years and in the last full term and then rate each coaching provider on a scale of 1-5 in accordance with the following scale: 1=very unhelpful, 2=somewhat unhelpful, 3=neither helpful nor unhelpful, 4=somewhat helpful, 5=very helpful:

<table>
<thead>
<tr>
<th>Coaching provider</th>
<th>DAYS in past 2 school years</th>
<th>HOURS in the last full term</th>
<th>Rating (1=very unhelpful; 5=very helpful)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Teacher</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curriculum Lead</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit Supervisor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math Coach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
31. What were the most useful aspects of the coaching sessions?

32. What were the least useful aspects of the coaching sessions?
N. Teacher Knowledge, Attitudes, and Practices

[READ] I will now read a number of statements about different approaches to teaching maths and ask you

7. It is important to explain things carefully to students to prevent them from making mistakes:
   - Strongly agree
   - Agree
   - Neither agree nor disagree
   - Disagree
   - Strongly disagree

8. Students learn mathematics better when they work through problems or questions in a group:
   - Strongly agree
   - Agree
   - Neither agree nor disagree
   - Disagree
   - Strongly disagree

9. In mathematics, there is usually one right way of doing something:
   - Strongly agree
   - Agree
   - Neither agree nor disagree
   - Disagree
   - Strongly disagree

10. The way I was taught mathematics is the same approach I should use to teach my pupils:
    - Strongly agree
    - Agree
    - Neither agree nor disagree
    - Disagree
    - Strongly disagree

11. Students like using objects (counters, straws, blocks, etc.,) but it doesn’t help them to be better maths students:
    - Strongly agree
    - Agree
    - Neither agree nor disagree
    - Disagree
    - Strongly disagree

12. It is important to allow students to make mistakes and to have them discuss their mistakes:
    - Strongly agree
    - Agree
    - Neither agree nor disagree
    - Disagree
    - Strongly disagree
13. Students should feel free to use any method or way they want to solve a problem or a question:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

14. I enjoy learning mathematics and solving maths problems:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

15. Most people are better at mathematics than I am:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

16. What you learn in mathematics class is useful outside of school:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

17. Mathematics is easy for me:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

18. Intelligent people don't have to work hard to do well in mathematics:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

19. I dislike teaching mathematics:

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree
20. How confident do you feel in teaching mathematics?

- Very confident
- Somewhat confident
- Not very confident
- Not at all confident

21. For each of the following practices, please state whether you engage in that practice during your maths lessons daily, weekly, monthly, rarely, or not at all: [Enumerator: Please name each practice and ask for an answer for that practice before moving on. You must read out all of the practices listed here]

<table>
<thead>
<tr>
<th>Practice</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Rarely</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a lesson plan/notes or scheme of work</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Engage students in mental maths exercises</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Use learning resources (counters, bundles of sticks and straws, place value charts, objects, shapes, etc.) to demonstrate or explain something</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Allow pupils to use learning resources (counters, bundles of sticks and straws, place value charts, objects, shapes, etc.) on their own or in groups</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ask pupils to explain their thinking or how they arrived at an answer</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ask pupils discuss with each other their approach to solving maths problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Have children use objects, models, and diagrams to develop or demonstrate their understanding of maths</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Encourage pupils to develop personal strategies for solving maths problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Engage pupils in games and activities to reinforce learning</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Encourage pupils to represent quantities of numbers in different ways</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Assess pupil learning against a benchmark or performance standard</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

22. Which of the following methods do you use during your maths lessons to help teach **number sense** (fluidity and flexibility with numbers)? (select all that apply) [Read each option and record relevant answers]

- [ ] Identify numbers
- [ ] Count (e.g., 1 to 100)
- [ ] Skip count (e.g., 5, 10, 15)
Identify larger and smaller numbers among of a set of numbers
Represent a quantity in multiple ways
Describe relationships between numbers
Decompose numbers (e.g., into 1s, 10s, or 100s)
Explain value of a digit in a given number
Other (specify)_____________________________________________________________.
I don’t teach this in my class

23. Which of the following methods do you use during your maths lessons to help teach number operations (calculations)? (select all that apply) [Read each option and record relevant answers]

Create a story or problem for a given expression
Use objects to represent a problem
Use a variety of strategies to solve a problem
Fill in missing numbers in a problem (e.g., 2 + ___ = 4)
Use a tens frame
Use an addition/subtraction chart
Other (specify)_____________________________________________________________.
I don’t teach this in my class

24. Which of the following methods do you use during your maths lessons to improve computational fluency (fast and accurate problem solving)? (select all that apply) [Read each option and record relevant answers]

Identify combinations of smaller numbers that produce a larger number
Solve addition and subtraction problems mentally
“Make tens” to solve problems
Name doubles of a number
Other (specify)_____________________________________________________________.
I don’t teach this in my class

25. Which of the following methods do you use during your maths lessons to help teach patterns and relations? (select all that apply) [Read each option and record relevant answers]

Identify and extend repeating element of a pattern sequence
Explain equals symbol and justify its use
Solve problems with an unknown value
Identify errors and omissions in pattern sequences
Other (specify)_____________________________________________________________.
I don’t teach this in my class

26. Which of the following methods do you use during your maths lessons to help teach shape and space? (select all that apply) [Read each option and record relevant answers]

Identify attributes of shapes
Sort and order objects by their features (e.g., by length, number of faces/sides, etc.)
Measure objects
Other (specify)________________________________________________________________.
I don’t teach this in my class

O. Pupil Performance and Evaluation

[READ] I will now ask a few questions about pupil performance and assessment in your class. The purpose
6. Do you believe your pupils are on track to become proficient in early grade mathematics?

   Yes → G3
   No
   Don’t know → G4
   Decline to answer → G4

7. [If no to G1 above] Why do you think your pupils are not on track to become proficient? (select all that apply) [Do not prompt, record any relevant answers]

   □ They don’t come to class often enough
   □ They don’t come to class on time
   □ They don’t pay attention during class
   □ They are not confident in maths
   □ Their parents do not support their learning at home
   □ They are too hungry to concentrate
   □ They don’t care about school
   □ They are not able to understand the language of instruction
   □ The class is too large for me to provide good instruction
   □ The lessons are too short
   □ The teacher(s) they had before me did not do a good job
   □ I don’t always teach the lessons because I am doing other things
   □ I don’t have the teaching resources I need to teach them well
   □ I don’t have the training I need to teach them well
   □ The pupils don’t have enough learning books
   □ Other (specify) _______________________________________________________.

8. How do you know whether they are on track to become proficient in early grade mathematics? (select all that apply) [Do not prompt, record any relevant answers]

   □ I assess them regularly
   □ They seem to be doing OK when I observe them in class
   □ I don’t know
   □ Other (specify) _______________________________________________________.

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9. For each of the following methods of pupil evaluation or assessment, please state whether you employ it daily, weekly, monthly, quarterly, annually, or not at all: [Enumerator: Please name each method and ask for an answer for that method before moving on. You must read out all of the methods listed here]

<table>
<thead>
<tr>
<th>Method</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Quarterly</th>
<th>Annually</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written assessments</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Individual oral assessments</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Group question and answer session</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Checking pupil exercise books</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Checking pupil homework</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other (specify):</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

10. Do you adjust your teaching based on the results of pupil evaluation or assessment?

- Yes
- No → skip to G7
- Don’t know → skip to G7
- Decline to answer → skip to G7

11. [If yes to G5] In what ways do you adjust your teaching based on the results of pupil evaluation or assessment? (select all that apply) [Read each option and record relevant answers]

- I repeat previous lessons
- I make new lessons to teach difficult content in a different way
- I pay more attention to struggling learners in class
- I pay more attention to high performing learners in class
- I provide struggling learners with tutoring outside of class
- I arrange for others to provide struggling learners with tutoring outside of class
- I pair struggling learners with stronger ones during class
- If learners are doing well, I skip lessons that aren’t useful
- If learners are doing well, I go through lessons more quickly
- Other (specify)_____________________________________________________________.

12. Do you discipline pupils who score low or unsatisfactory marks on the assessment?

- Yes
- No → skip to G9
- Don’t know → skip to G9
- Decline to answer → skip to G9

13. [If yes to G7] In what ways do you discipline pupils based on the results of pupil assessment? (select all that apply) [Do not prompt, record any relevant answers]

- Beat or cane them
- Make them sweep, clean, or pick rubbish
- Makes them hold an uncomfortable position (kneeling/squatting/hands over head)
- Verbal abuse or mockery
- Other (specify)________________________________________________________________.
Do you acknowledge or reward pupils who score high marks on the assessment?

- Yes
- No → skip to G11
- Don’t know → skip to G11
- Decline to answer → skip to G11

14. [If yes to G9] In what ways do you acknowledge or reward pupils based on the results of pupil assessment? [Do not prompt, record any relevant answers]

- Food and drink (candies, biscuits, minerals, etc.)
- Gifts
- Stickers or stars
- Words of encouragement
- Giving them a special job
- Other (specify): ____________________________________________________________.

15. Do you track your pupils’ progress over time (e.g., termly)?

- Yes
- No
- Don’t know
- Decline to answer

End Time (HH:MM): □□ : □□

Thank you! That completes the teacher interview.
General Background Information

Team name: ____________________________

Enumerator ID: ________________________

Today’s date (DD-MM-YY): ________ - ________ - ________

Start time (HH:MM): __________ : ______

School name: __________________________

School ID: ____________________________

Region: ______________________________

District: _____________________________

Locality: _____________________________

Pupil ID from tracking sheet: ____________

[Read assent script. Does the child assent to participate?]  
  O Yes  
  O No (DO NOT PROCEED)

Pupil first name: ____________________________  Pupil last name: ____________________________

Name pupil goes by in household or community: ____________________________

Sex:  
  O Male  
  O Female
20. How old are you?

Age in years:  

21. What class are you in?

P1
P2

22. In what class were you last year?

KG1 → skip to A5
KG2 → skip to A5
P1
P2
P3
class was not in school last year
Don’t know
Decline to answer

23. Did you go to nursery, pre-school, or KG before starting P1?

Yes
No
Don’t know
Decline to answer

24. Think back to last week, Monday through Friday. Were you absent from school on any days last week?

Yes
No → skip to A7
Don’t know → skip to A7
Decline to answer → skip to A7

25. How many days last week were you absent from school?

26. How often are you absent from school? [Do not prompt, record relevant answer]

I rarely or never miss school → skip to A9
I sometimes miss school (but the days I attend are more than the days I miss)
I regularly miss school (and the days I miss are more than the days I attend)
I rarely come to school
Don’t know
Decline to answer
27. What are the main reasons that you miss school? (select all) [Do not prompt, record any relevant answers]

☐ I am sick or hurt
☐ I am too tired to come
☐ It is too far to walk
☐ No transportation or money for transportation
☐ I have to help with household chores
☐ I have to babysit younger siblings
☐ I have to do work for the family
☐ I want to play instead
☐ I don’t want to come because school is hard
☐ I don’t want to come because school is boring
☐ I don’t understand the language of the lessons
☐ Other kids tease or bully me
☐ My teacher is mean
☐ The weather is bad
☐ No working toilets at school
☐ No working water supply at school
☐ Other (specify):_____________________________________________________________.

28. How often are you late to school? [Do not prompt, record relevant answer]

☐ I am rarely or never late to school → skip to A11
☐ I am sometimes late (but the days I am on time are more than the days that I am late)
☐ I am regularly late to school (and the days I am late are more than the days I am on time)
☐ I rarely come to school on time
☐ Don't know → skip to A11
☐ Decline to answer → skip to A11

29. What are the main reasons you were late to school? (select all) [Do not prompt, record any relevant answers]

☐ I wake up late
☐ I have to walk a long time
☐ I have to help with household chores
☐ I have to babysit younger siblings
☐ I have to do work for the family
☐ The person who takes me to school is late in taking me
☐ I want to play
☐ The weather is bad
☐ The classes never start on time because all the other pupils are late
☐ The classes never start on time because the teachers are late
☐ Other (specify):_____________________________________________________________.

30. Do you like coming to school or dislike coming to school?

☐ Like it
☐ Neutral
☐ Dislike it
☐ Don’t know
☐ Decline to answer

31. Does your school provide you with meals?

☐ Yes
32. How often do you feel hungry when you first get to school in the morning: every day, some days, or rarely/never?

- Every day
- Some days
- Rarely or never
- Don’t know
- Decline to answer
Q. Language Background

I will now ask some questions about the languages you speak at home and at school. I will also ask about

1. In which language(s) do your parents speak to you at home most of the time? (select all)
   - Akuapim Twi
   - Asante Twi
   - Dagaare
   - Dagbani
   - Dangme
   - English
   - Ewe
   - Fante
   - Ga
   - Gonja
   - Gurene
   - Kasem
   - Kusaal
   - Nzema
   - Decline to answer
   - Don’t know
   - Other (specify): ________________________.

2. Which language(s) do you use when playing with your friends on the playground at school? (select all)
   - Akuapim Twi
   - Asante Twi
   - Dagaare
   - Dagbani
   - Dangme
   - English
   - Ewe
   - Fante
   - Ga
   - Gonja
   - Gurene
   - Kasem
   - Kusaal
   - Nzema
   - Decline to answer
   - Don’t know
   - Other (specify): ________________________.

3. Which language(s) are used in teaching you at school? (select all)
   - Akuapim Twi
   - Asante Twi
   - Dagaare
   - Dagbani
   - Dangme
   - English
   - Ewe
   - Fante
   - Ga
   - Gonja
   - Gurene
   - Kasem
   - Kusaal
   - Nzema
   - Decline to answer
   - Don’t know
   - Other (specify): ________________________.

4. Which language is used most often in teaching you maths? (select one)
   - Akuapim Twi
   - Asante Twi
   - Dagaare
   - Dagbani
   - Dangme
   - English
   - Ewe
   - Fante
   - Ga
   - Gonja
   - Gurene
   - Kasem
   - Kusaal
   - Nzema
   - Decline to answer
   - Don’t know
   - Other (specify): ________________________.

5. Do you speak that language? Can you read that language?
O I can only speak it
I can only read it
I can speak and read it
I can neither speak nor read it
Don’t know
Decline to answer
R. Maths Practices

I am now going to ask a few questions about your mathematics practices in school and at home.

1. In your maths class, does your teacher ask you to discuss math problems or solutions with your classmates?
   - Yes
   - No
   - Don’t know
   - Decline to answer

2. Do you use counters, stones, sticks, or other items during maths class?
   - Yes
   - No
   - Don’t know
   - Decline to answer

3. In your maths class, does your teacher ask you questions about math, like the answer to a problem or to show how you use counters?
   - Yes
   - No
   - Don’t know
   - Decline to answer

4. Does anyone at home help you do your maths homework?
   - Yes
   - No
   - Don’t know
   - Decline to answer

5. Do you like maths or dislike maths?
   - Like it
   - Neutral
   - Dislike it
   - Don’t know
   - Decline to answer

6. How good are you at maths: very good, good, not very good, or bad?
   - Very good
   - Good
   - Not very good
   - Bad
   - Don’t know
   - Decline to answer
S. Maths Assessment

Teachers can see how pupils are doing in many different ways. I will now ask you about some different ways that your mathematics teacher might check in to see how you are learning. For each of these ways, please tell me if your teacher does it every day, every week, every month, or rarely.

1. Does your teacher assess you orally?
   - Yes
   - No → skip to D3
   - Don’t know → skip to D3
   - Decline to answer → skip to D3

2. [If yes to D1] How often does your teacher assess you orally?
   - Every day
   - Every week
   - Every month
   - Rarely
   - Don’t know
   - Decline to answer

3. Does your teacher check your work book?
   - Yes
   - No → skip to D5
   - Don’t know → skip to D5
   - Decline to answer → skip to D5

4. [If yes to D3] How often does your teacher check your work book?
   - Every day
   - Every week
   - Every month
   - Rarely
   - Don’t know
   - Decline to answer

5. Does your teacher check your homework?
   - Yes
   - No → skip to D7
   - Don’t know → skip to D7
   - Decline to answer → skip to D7

6. [If yes to D5] How often does your teacher check your homework?
   - Every day
   - Every week
   - Every month
   - Rarely
   - Don’t know
   - Decline to answer
7. Does your maths teacher punish you if you do poorly?

Yes
No → skip to D9
Don’t know → skip to D9
Decline to answer → skip to D9

8. [If yes to question D7] In what ways does your teacher punish you? [Do not prompt, record any relevant answers]

☐ Beats or canes me
☐ Makes me sweep, clean, or pick rubbish
☐ Makes me hold an uncomfortable position (kneeling/squatting/hands over head)
☐ Verbal abuse or mockery
☐ Other (specify): ____________________________________________________________.

9. Does your maths teacher reward you if you do well?

Yes
No → skip to E1
Don’t know → skip to E1
Decline to answer → skip to E1

10. [If yes to question D9] In what ways does your teacher reward you? [Do not prompt, record any relevant answers]

☐ Food and drink (candies, biscuits, minerals, etc.)
☐ Gifts
☐ Clapping
☐ Encourages me with words
☐ Gives me a special job
☐ Other (specify): ____________________________________________________________.
T. Household Assets

I will now ask some questions about the things you have in your house. [Enumerators: use stimulus sheet]

1. Where do you normally get drinking water from at home?
   - River or stream
   - Well or borehole
   - Communal tap
   - Tap in the home
   - Bottled or sachet water
   - Other (specify): _______________________________.
   - Don’t know
   - Decline to answer

2. Does your home have electricity?
   - Yes
   - No
   - Don’t know
   - Decline to answer

3. Where is food normally cooked at your home?
   - Outside the house
   - In a shed
   - Inside the house
   - Other (specify): _______________________________.
   - Don’t know
   - Decline to answer

4. How is food most often cooked at your home?
   - Using firewood
   - Using a coal pot
   - Using a stove
   - Using a cooker (including an oven)
   - Other (specify): _______________________________.
   - Don’t know
   - Decline to answer

5. When you are at home, what type of toilet do you use?
   - A pit toilet
   - A shared toilet
   - A communal toilet
   - A flush toilet outside your house
   - A flush toilet inside your house
   - In the bush/free range
   - Other (specify): _______________________________.
   - Don’t know
   - Decline to answer

6. Does your family have the following items in your home? (select all that apply) [Read options one by one and ask child for a yes/no answer]
<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Television</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Computer</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Bicycle</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Motorbike</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Car/truck</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Thank you! That completes the pupil questionnaire.

End Time (HH:MM): [ ] : [ ]
Ghana Numeracy Pilot Impact Evaluation  
Structured Classroom Observation

General Background Information

Team name: ________________________________  
Enumerator ID: ____________________________

Today’s date (DD-MM-YY): ______ - ______ - ______  
Lesson start time (HH:MM): ______ : ______  

School name: ________________________________  
School ID: ________________________________  
District: ________________________________  

Teacher ID from tracking sheet: ________________________________  

Was the teacher consent form administered and signed?  
Yes  
No (DO NOT PROCEED)

Teacher Identifying Information

First name: ________________________________  Last name: ________________________________  

Sex:  
Male  
Female  

Please record the grade observed:  
☐ P1  
☐ P2  

The subject of this lesson is:  
☐ Math  
☐ Other:  

Was the observed mathematics lesson split across multiple sessions?  
☐ Yes  
☐ No  

[If yes] Please enter the TOTAL duration of the observed sessions:  
(HH:MM): ______ : ______
The purpose of this tool is to record the specific maths practices that the teacher engages in during the 60-minute classroom observation. This observation instrument should reflect the entire duration of the lesson and be completed after the lesson is finished. For each “practice,” please record whether you: 1 – see the practice is not done or the opposite is done, 2 - see the practice done sometimes or partially correct, 3 - see the practice done very well and consistently where appropriate, or 4 - not applicable (practice is not relevant to the content of the lesson).

<table>
<thead>
<tr>
<th>TEACHER PRACTICES OBSERVED</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher uses a lesson plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Teacher uses a scripted lesson plan</td>
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<tr>
<td>3. Teacher introduces lesson by connecting to or reinforcing what learners have learned previously</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Teacher introduces lesson with a visual, game, puzzle, or problem-solving activity.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5. Teacher actively minimizes classroom time that is off-task</td>
<td></td>
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<tr>
<td>6. Teacher demonstrates effective classroom management (e.g., efficiently manages materials, transition(s) between activities, class start and finish, discipline)</td>
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<tr>
<td>7. Teacher uses learning resources (counters, bundles of sticks and straws, place value charts, objects, shapes…) to explain concepts, answer questions, or solve problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Teacher constructively engages all students—not just some—in classroom activities</td>
<td></td>
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<tr>
<td>9. Pupils have time to practice new learning—individually or with a partner—in their workbook, notebook, or jotter.</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
10. Teacher engages learners in **cooperative learning** activities in pairs or groups (e.g., pupils lead maths activities, talk with each other about maths, solve maths problems together…)

11. Teacher asks pupils to **explain** their thinking or how they arrived at an answer.

12. Teacher provides opportunities for learners to develop **mathematical reasoning** (e.g., using existing math skills and knowledge to solve new or unfamiliar problems, explaining in own words how a math problem might be solved, encouraging multiple approaches to solving math problems…)

<table>
<thead>
<tr>
<th>TEACHER PRACTICES OBSERVED</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Teacher uses multiple methods for <strong>assessing the understanding</strong> of learners (formal tests and quizzes, walking around class and checking students work, encouraging learners who get a problem wrong to seek assistance from other students…)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14. Teacher avoids using language that favors one gender over another and/or reinforces gender stereotypes</td>
<td></td>
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<tr>
<td>15. Teacher engages learners of all <strong>ability levels</strong></td>
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<td></td>
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<tr>
<td>16. Teacher avoids using <strong>abusive language</strong></td>
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<tr>
<td>17. Teacher provides constructive, positive, and encouraging feedback</td>
<td></td>
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<tr>
<td>18. Teacher communicates to pupils that they are all <strong>capable</strong> of being good math pupils.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
19. Teacher **intervenes** when learners use abusive or biased language with each other.

20. All students (especially girls) have equal **access** to chairs and desks.

21. All students (especially girls) have equal **access** to learning materials, such as books, pens/pencils, blocks, rulers, number charts, etc.

22. Pupils spend more time using learning resources **on their own** than the teacher does using learning resources to explain something.

23. Teacher deliberately presents questions or problems that have **more than 1 possible answer** or that can be solved in more than 1 way.

24. Teacher encourages pupils to find and share different strategies for solving a problem or answering a question.
<table>
<thead>
<tr>
<th>Indicate if any of the following materials were used:</th>
<th>Not At All</th>
<th>A Little</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Blackboard</td>
<td></td>
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<td></td>
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<tr>
<td>26. Textbook</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>27. Student notebooks/exercise books/workbooks</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>28. Fingers (to count)</td>
<td></td>
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<tr>
<td>29. Number line</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Number chart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31. Addition chart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32. Multiplication chart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. Collection of shapes (or containers of different shapes – cylinders, boxes, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34. Collections of counters (bottle tops, sticks, blocks, etc. for counting)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35. Tens frame</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36. Addition frame</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. Subtraction frame</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38. Place value chart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PUPIL BEHAVIOR</strong></td>
<td>25% or less or N/A</td>
<td>About half</td>
<td>About 75%</td>
</tr>
<tr>
<td>39. Approximate proportion of learners who are <strong>paying attention</strong> throughout the entire class period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40. Approximate proportion of learners who are <strong>actively engaged</strong> in all lessons and class activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41. Approximate proportion of learners who are <strong>participating</strong> when working in small groups or pairs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
42. Which language(s) did the teacher use during the lesson?

☐ Akuapim Twi  ☐ Gonja
☐ Asante Twi  ☐ Gurene
☐ Dagaare  ☐ Kasem
☐ Dagbani  ☐ Kusaal
☐ Dangme  ☐ Nzema
☐ English  ☐ Decline to answer
☐ Ewe  ☐ Not applicable
☐ Fante  ☐ Other (specify): ________________________.
☐ Ga

43. Which language(s) did the pupils use during the lesson?

☐ Akuapim Twi  ☐ Gonja
☐ Asante Twi  ☐ Gurene
☐ Dagaare  ☐ Kasem
☐ Dagbani  ☐ Kusaal
☐ Dangme  ☐ Nzema
☐ English  ☐ Decline to answer
☐ Ewe  ☐ Not applicable
☐ Fante  ☐ Other (specify): ________________________.
☐ Ga

44. How confident did the teacher appear to be with the subject matter of the lesson?

☐ Very confident
☐ Somewhat confident
☐ Not very confident
☐ Not at all confident

45. At any time during the lesson, did the pupil use notebooks/workbooks/exercise books?

☐ Yes
☐ No → skip to 48

46. [If yes to 46] Were there enough notebooks/workbooks/exercise books for each pupil to have his/her own?

☐ Yes
☐ No

47. Is the classroom clean and organized?

☐ Yes
☐ No
☐ The class was held outside of a classroom environment

48. Is there sufficient work space at a desk or table for all the students?

☐ Yes
☐ No
49. Is there enough space in the class for the teacher to move about freely?

☐ Yes  ☐ No

Lesson end time (HH:MM):  ______ : ______
**Task 7A: Bundles**

10 bundles 10s and 10 ones; tens mat

**Eyinom yε du kuw baako biako. Eyinom yε mmaako maako.** These are bundles of 10s. These are ones.

[Point to number 42 (but do not say the number, since in local language when the you say the number, you give numbers of 10s and 1s in the number)]

**Mepɛ sɛ wokyɛrɛ me du du kuw ne mmaako mmaako ahe ɛwɔ nɔma yi mu. Fiase.**

I want you to show me this number, using the bundles of 10s and ones. You can use the tens frame if you want. Go ahead and start.

**Ampa, eye. Afei kyɛrɛ me. Du du kuw ahe a ɛwɔ aduanan abien (42) mu.**

That's right. Now tell me, how many groups of 10s are there in the number?

**Du du kuw anann na ɛwɔ aduan abien (42) mu.**

There are four groups of 10. [count them out for the child] one group of 10, two groups of 10, three groups of 10, four groups of 10.

**Afei mmaako mmaako ahe na ɛwɔ aduan abien (42) mu. Mmaako mmaako abien na ɛwɔ aduan abien (42) mu. Baako, abien.**

Now, how many ones are in the number? [give the child time to answer]. There are 2 ones in the number. One, two.

**Metumi de du du kuw anan ne mmaako mmaako abien agyina hɔ ama aduan abien (42). Du du kuw anan ne mmaako mmaako abien na eyɛ aduan abien (42).**

I can represent the number with four groups of 10 and two ones. 
[count out and place four bundles of 10 and 2 ones in front of the child, using the tens mat].
**Afie wubetu de du kuw ne mmaako mmako no akyere me noma no?**

[Point to first number on stimulus sheet (12)] Now can you show me this number, using your bundles of 10s and 1s?

<table>
<thead>
<tr>
<th></th>
<th>(√) 1 = Correct</th>
<th>(√) 0 = Incorrect or no response</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>34</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>87</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Task 7B: Bundles Bonus**

10 bundles 10s and 10 ones; five bundles of 100

[Now put the five bundles of 100 on table]

**Eyinom ye cha cha kuw. Afie wubetu de cha cha kuw, ne dudu kuw ne maako maako no akyere me noma yi.**

These are bundles of 100. Can you use the bundles of 100 and the other bundles to show me this number?

<table>
<thead>
<tr>
<th></th>
<th>(√) 1 = Correct</th>
<th>(√) 0 = Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>243</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

- If child did not score 4/4 on Bundles.
Task 8A: Number Deconstruction

Ma tsɔɔ mo nɔma kɔmɛ. Ma suɔ ne o de mi nyɔŋɔngmanyɔŋma ke kakaaka abɔ ne nge nɔma fɛɛ nɔma mi ne o ko kane tso aloo kantɛsi ne a fi ɔmɛ.
I am going to show you other numbers. This time I want you to tell me the number of tens and ones in each number, without using the bundles and sticks.

Mepɛ sɛ wɔkyɛrɛ me du du kuw ne mmaako mmako ahe a ɛwɔ nɔma yi mu. Fi ase.
Look at this number [point to example, 12]. How many tens are there in this number?

Du du kuw baako na ɛwɔ nɔma no mu. Afei kyɛrɛ me,maako maako ahe na ɛwɔ nɔma no mu.
There is one group of ten in the number. Now tell me, how many 1s are in the number?

Mmaako mmaako abien na ɛwɔ nɔma no mu.
Nɔma no wɔ du du kuw baako.
There are two ones in the number. This number has one ten and two ones.

Du du kuw ne mmaako mmako dodow a ɛwɔ nɔma yi mu?
[Point to next number, 26, but do not say the name of the number]
How many tens and ones are in this number?

(✓) 1 = Correct
(✓) 0 = Incorrect
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>38</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>61</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

**Task 8B: Number Deconstruction Bonus**

[Now point to 352]

Afie wubetu akyerɛ me ɔha ɔha kuw, du du kuw ne mmaako mmako dodow a ɛwo nɔmɔyi mu?

Can you tell me how many 100s, 10s, and 1s there are in this number?

- 352 1 0

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

● If child did not score 4/4 on Number Deconstruction.
Task 9A: Describing Numbers

[Place stimulus sheet with cover sheet in front of child and reveal example, 7]

Nɔma ason (7) ni. Mɛtumi akyere ɛė sɔsɔ sɛn asia (6) baako ɛɛ. Na eɛsu aɛ su sɛn akron (9) aibeɛ ɛɛ. Mɛtumim aki ɛɛ nɔma bɛɛn sɔ no, Asia (6) ba anṣa na ason (7) aba. Anaaɛ metumi aki ɛɛ abiesa (3) wode anan (4) ka ho a, wubenya (7) ason. Wobetumi akyere ɔkwán baako a wode bekyerɛkyere ason (7) mu?

This is 7. I could describe 7 as...one more than 6. Or two less than 9. I could say 7 is next to 6 on the number line. Or I could say it is the same as 3 + 4. There are many, many different ways to describe 7. Can you tell me one of the ways I described 7?

[Wait for child to answer]

Ampa, metumim akyere ɛɛ sɔsɔ sɛn asia (6) baako ɛɛ. Na eɛsu aɛ su sɛn akron (9). Mɛtumim aki ɛɛ nɔma bɛɛn sɔ no, (6) asia ba anṣa na ason (7) aba. Anaaɛ metumi aki ɛɛ abiesa (3) wode anan (4) ka ho a, wubenya (7) ason.

I can describe 7 as one more than 6. Or two less than 9. I could say 7 is next to 6 on the number line. Or I could say it is the same as 3 + 4.

[Show first number, 4]

Afei, adu wo so. Fa akwan ahorow abiesa so kyerɛkyere anan (4) mu kyerɛ me.

Now it's your turn. Describe 4 to me in three different ways.

Specify TOTAL number of CORRECT responses and total number of INCORRECT responses for each item (each box should contain a number between 0 and 3, and total across boxes should not exceed 3. Non-response should be considered 0).

4 # Correct: # Incorrect:
Task 9B: Describing Numbers Bonus

Afei fa akwan abiesa so kyerkyere me 50 mu?
Now can you describe 50 for me in three different ways.

Specify TOTAL number of CORRECT responses and total number of INCORRECT responses (each box should contain a number between 0 and 3, and total across boxes should not exceed 3. Non-response should be considered 0).

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

- If child did not score 12/12 correct on Describing Numbers subtask.
### Task 10A: Number Operations

**Yerebedi agoru bi. Meka nɔma bi. Mɛɛ sɛ wokyerɛ me dodow a mede ka saa nɔma no ho a, menya anum (5). Sɛ ebia, meka anan (4) a, ɛɛ sɛ woka baako (1) ntɛɛmɛɛm, efisɛ yede baako (1) ka anan ho a, yenya anum (5). Wubetumi de wo ankasa nsam akyerɛ agoru a yerebedi no?**

We are going to play a game. I am going to say a number. I want you to tell me how much you would have to add to that number to get 5. For example, if I say 4, you need to say 1 as quickly as you can, because if we add 1 to 4, we get 5. Can you describe, in your own words, the game we are going to play?

*[If child cannot describe, go over example of 4 again]*

**Ma yemfi ase. Meka no ntɛɛmɛɛm, enti wo nso ma wo mmuae no ntɛɛmɛɛm.**

Let’s start… I am going to go quickly, so give me the answer as quickly as you can.

| (√) 1 = Correct |
| (✓) 0 = Incorrect |
| 2 (Correct answer is 3) | 1 0 |
| 1 (Correct answer is 4) | 1 0 |
| 3 (Correct answer is 2) | 1 0 |
| 4 (Correct answer is 1) | 1 0 |
| 0 (Correct answer is 5) | 1 0 |

*[What language(s) did the child use for this activity? [check all that apply]*

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

---

*If child makes three ERRORS*

*If child does not answer three consecutive questions*

Give the child up to 3 seconds to come up with an answer before moving on to next number
### Task 10B: Number Operations

**Yerebedi agoru no bio. Mprɛmpɛn deɛ, se meka nɔma bi a, wode nɔma bi bɛka ho na woanya du (10). Sɛ ebia, me kɔ ka anan (4) a, wobɛka asia (6), efisɛ asia (6) kɔ kɔka anan (4) ho a, eyɛ du (10). Wubetumi de woankasa nsɛm akyɛrɛ agoru a yɛrebedi no?**

We are going to play the game again, only this time when I say a number. I want you to tell me how much you would have to add to that number to get 10. For example, if I say 4, you need to say 6, because if we add 6 to 4, we get 10. Can you describe, in your own words, the game we are going to play?

*If child cannot describe, go over example of 4 again*

**Ma yɛmfi asɛ. Meka no ntɛmɛntɛm, enti wo nso ma wo mmuae no ntɛmɛntɛm.**

Let’s start…I am going to go quickly, so give me the answer as quickly as you can.

<table>
<thead>
<tr>
<th></th>
<th>1 = Correct</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>1 0</td>
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<td>1 0</td>
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<td></td>
<td>1 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**What language(s) did the child use for this activity? [check all that apply]**

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
**Task 10C: Number Operations Bonus**

**Yɛrebede aguro no bio. Eyi de se mɛka nɔma no a mɛpɛ se wokyere me ne mmɔho abieŋ. Tɛ se, se mɛka abieŋ (2)a na woaka anan (4) efisɛ (2) mmɔho abieŋ ye anan. Ma yemjɛ ase. Mɛka no ɲtɛmmtɛm, ɛnti wo nso ma wo mmuae no ɲtɛmmtɛm.**

We are going to play the game again, only this time when I say a number, I want you to tell me the double of that number. For example, if I say 2, you say 4, because the double of 2 is 4. Let’s start…

(✓) 1 = Correct
(✓) 0 = Incorrect

6 (Correct answer is 12) 1 0
7 (Correct answer is 14) 1 0

**What language(s) did the child use for this activity? [check all that apply]**
- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
### Task 7A: Bundles

| 10 bundles 10s and 10 ones; tens mat |

**[Point to number 26 (but do not say the number, since in local language when you say the number, you give numbers of 10s and 1s in the number)]**

**Merebɛkrɛ nɔma bi, te sɛeyi. Mepɛ sɛwode duawaa kuw du du ne mmaako mmaako yɛ saa nɔma no. Kɔsi, hyɛ ase.**

I am going to point to a number, like this one. I want you to make that number, using the bundles of 10s and ones. Go ahead and start.

**Eye Afie kyɛrɛ.me, du du kuw ahe na ɛwɔ nɔma no mu?**

That’s right. Now tell me, how many groups of 10s are in the number?

**Du du kuw abien na ɛwɔ mu. Afie mmaako mmaako ahe na ɛwɔ mu? Mmaako mmaako asia na ɛwɔ mu. baako, abien, abiesa, anan, anum, asia.**

There are two groups of 10.

Now, how many ones are in the number?

There are six ones.

One, two, three, four, five, six.

**Metumi de du du kuw abien (2)ne mmaako mmaako asia (6) agyina hɔ ama no.**

I can represent the number with two groups of 10 and six ones

[Count out and place two bundles of 10 and 6 ones in front of the child, using the tens mat]

**Du du kuw abien ne mmaako mmaako asia na ɛwɔ mu. Merebɛkrɛ wo foro.**

There are two groups of 10 and six ones in the number.

**Mepɛ sɛ wankasa wode du du kuw ne mmaako mmaako yɛ.**

---

**Note:**
- If child makes two errors, one right after the other
- If child cannot answer first 2 questions

Give the child up to 15 seconds to respond to a question. If they don’t give an answer in 15 seconds, point to next number and say, “Can you show me this number?”
I am going to show you other numbers. I want you to make each one, using the bundles of 10s and ones.

<table>
<thead>
<tr>
<th>Number</th>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>✓</td>
<td>0</td>
</tr>
<tr>
<td>81</td>
<td>✓</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>✓</td>
<td>0</td>
</tr>
<tr>
<td>97</td>
<td>✓</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>✓</td>
<td>0</td>
</tr>
</tbody>
</table>

What language(s) did the child use for this activity? [check all that apply]
- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

**Task 7B: Bundles Bonus**

<table>
<thead>
<tr>
<th>10 bundles 10s and 10 ones; five bundles of 100</th>
</tr>
</thead>
</table>

*Now put the five bundles of 100 on table*

Yɛwɔ ɔɔ ɔ. Wobetumi de ɔɔ ɔ ɔwaa kuw ne duowaa kuw horow a kyɛrɛmɛ nɔmɔ yи?
These are bundles of 100. Can you use the bundles of 100 and the other bundles to show me this number?

<table>
<thead>
<tr>
<th>Number</th>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>234</td>
<td>✓</td>
<td>0</td>
</tr>
</tbody>
</table>

What language(s) did the child use for this activity? [check all that apply]
- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

*If child did not score 5/5 on Bundles.*
**Task 8A: Number Deconstruction**

Merebɛkyɛ wo nɔma horo foro. Eyi de mepɛ sɛ wokyerɛme du du kuw ne mmaako mmaako a ɛwo mu.a womfa duawaa kuw ne mmabaa biara nye.

I am going to show you other numbers. This time I want you to tell me the number of tens and ones in each number, without using the bundles and sticks.

Hwɛsaa nɔma yi Du du ne mmaako mmaako sɛn na ɛwo mu.

Look at this number [point to example, 32]. How many tens and how many ones are there in this number?

Du du abiesa ne mmaako mmaako abien no ɛwo nɔma yi mu. Afie merebɛkyɛrɛ nɔma foro..mepɛ sɛ wokyerɛ me du du ne mmaako mmaako kuw ahe no ɛwo mu.

There are three tens and two ones in this number. Now, I am going to point to other numbers. I want you to tell me how many tens and how many ones are in each number.

<table>
<thead>
<tr>
<th>(√) 1 = Correct</th>
<th>(√) 0 = Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>0 0</td>
</tr>
<tr>
<td>35</td>
<td>1 0</td>
</tr>
<tr>
<td>53</td>
<td>1 0</td>
</tr>
<tr>
<td>64</td>
<td>1 0</td>
</tr>
<tr>
<td>90</td>
<td>1 0</td>
</tr>
</tbody>
</table>

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
Task 8B: Number Deconstruction Bonus

[Now point to 342]

O ma nyé ma de lafalafa kē nyongmanyogma kē kakaaka abc ne nge nōma nō mi lo?
Can you tell me how many 100s, 10s, and 1s there are in this number?

| ✓ | 1 = Correct |
| ✓ | 0 = Incorrect |
| 342 | 1 | 0 |

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
**Task 9A: Describing Numbers**

<table>
<thead>
<tr>
<th>Place stimulus sheet with cover sheet in front of child and reveal example, 16</th>
</tr>
</thead>
</table>

Nɔma dunsia (16) ni. Metumi akyere 16 se ebo sen durnum baako pe. Anaa esua sen dunwɔtwe abien pe Metumi aka se wufiri dunsia (16) a na wɔrem dunsia (17) wo nɔma bɛn no so. Anaa mentumi aka se eyen saia (6) a wode aka du ho ye pe, anaa adunou (20) a woatew a an firi mu ye pe. Akwaa horo pii wo ho a wode kyerɛ dunsia (16).

Wubetumi a kyerɛ me ɔkwan baako a mefaa so kyerɛ dunsia (16)?

This is 16. I could describe 16 as...one more than 15. Or two less than 18. I could say 16 is next to 17 on the number line. Or I could say it is the same as 10 + 6 or 20-4. There are many, many, different ways to describe 16. Can you tell me one of the ways I described 16?

[Wait for child to answer]

Yiw. metumi akyere dunsia se ebo sen durnum (15) baako pe anaa esua sen dunwɔtwe (18) abien (2) pe. Metumi aka se wu firi dunsia (16) a na wɔrem dunsia (17) wo numa laen no so. Akwaa horow pii wo ho wode kyerɛ mu.

I can describe 16 as one more than 15. Or two less than 18. I could say 16 is next to 17 on the number line. There are many different ways to describe 16.

[Show first number, 40]

Fa akwaa horow so kyerɛkyerɛ adunan (40) mu kyerɛ me.

Describe 40 for me in three different ways

<table>
<thead>
<tr>
<th>If child cannot say anything about the first two numbers</th>
</tr>
</thead>
</table>

• If child says nothing within 10 seconds, say “Can you describe this number in 1 different way?”

If child still does not begin describing number, after full 25 seconds have expired, move on to next number.

Specify TOTAL number of CORRECT responses and total number of INCORRECT responses for each item (each box should contain a number between 0 and 3, and total across boxes should not exceed 3. Non-response should be considered 0).
<table>
<thead>
<tr>
<th>40</th>
<th>#</th>
<th>Correct:</th>
<th># Incorrect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>#</td>
<td>Correct:</td>
<td># Incorrect:</td>
</tr>
<tr>
<td>36</td>
<td>#</td>
<td>Correct:</td>
<td># Incorrect:</td>
</tr>
<tr>
<td>98</td>
<td>#</td>
<td>Correct:</td>
<td># Incorrect:</td>
</tr>
</tbody>
</table>

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other

**Task 9B: Describing Numbers Bonus**

Fa akwaa horow so kyerekyere cha aduowotwe abiesa (183) mu kyere me.
Describe 183 for me in three different ways.

Specify TOTAL number of CORRECT responses and total number of INCORRECT responses (each box should contain a number between 0 and 3, and total across boxes should not exceed 3. Non-response should be considered 0).

| 183 | # | Correct: | # Incorrect: |

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
Task 10A: Number Operations


We are going to play a game. I am going to say a number. I want you to say the number that is 10 more than that number. For example, if I say 4, you need to say 14 as quickly as you can, because 10 more than 4 is 14. Can you describe, in your own words, the game we are going to play?

[If child cannot describe, go over example of 4 again]

Afei mayɛnhyɛ ase...Merebekɔ ntɛmtɛm enti ma me emuayɛ nte mntɛm sɛ nɛa wɔbɛtumi.

Let’s start…I am going to go quickly, so give me the answer as quickly as you can.

(✓) 1 = Correct
(✓) 0 = Incorrect

| 30 (Correct answer is 40) | 41 (Correct answer is 51) | 26 (Correct answer is 36) | 65 (Correct answer is 75) | 82 (Correct answer is 92) |

What language(s) did the child use for this activity? [check all that apply]

Akuapem Twi  Asante Twi  Dagaare  Dagbani  Dangme  Ewe  Fante  Ga  Gonja
Kasem  Nzema  English  Other

Task 10B: Number Operations Bonus

Wubetumi akyerɛ me du (10) a ɛboroɔ cha ne aduanum asia (156)?
Can you tell me what is 10 more than 156?

• If child did not score 5/5 on
### Task 11A: Doubles

Yerebedi agrc bi na afie se meka noa bia mepe se woka saa noa no mmnoho abien. Fa no se se mereka annan (4) a se se wokase awctwe efirisemannmnoho abien ye awctwe. Wubetumi akyrykyear mu se nea wote agorc yrebedi yi ase? We are going to play the game again, this time when I say a number, I want you to say the double of that number. For example, if I say 4, you need to say 8, because the double of 4 is 8. Can you describe, in your own words, the game we are going to play?

*If child cannot describe, go over example of 4 again*

Mayenhye ase...
Let's start...I am going to go quickly, so give me the answer as quickly as you can.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Number Operations.

Give the child up to 5 seconds to answer.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- If child makes three ERRORS
- If child does not answer three consecutive questions

Give the child up to 3 seconds to come up with an answer before moving on to next number

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

(✓) 1 = Correct  
(✓) 0 = Incorrect

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

156 (Correct answer is 166)
<table>
<thead>
<tr>
<th>What language(s) did the child use for this activity? [check all that apply]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akuapem Twi</td>
</tr>
<tr>
<td>Kasem</td>
</tr>
</tbody>
</table>

**Task 11B: Doubles Bonus**

**Wubetumi akyerɛ me du annum (15) mmɔho abien?**
Can you tell me what the double of 15 is?

- **(✓) 1 = Correct**
- **(✓) 0 = Incorrect**

15 (Correct answer is 30)  

<table>
<thead>
<tr>
<th>What language(s) did the child use for this activity? [check all that apply]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akuapem Twi</td>
</tr>
<tr>
<td>Kasem</td>
</tr>
</tbody>
</table>
Task 1: Number Identification

Nɔma ahorow bi ni. Mɛpɛ sɛ wode wo nsa si nɔma biara so na bɔ din. Mêkyɛɛ wɔ bere a ɣɛde befi ase ne bere a ɣebegyae.
Here are some numbers. I want you to point to each number and tell me what the number is. I will tell you when to begin and when to stop.

- Fi ase wɔ ha. Woayɛ krado? Fi ase.
- Nɔma bɛn ni?
- What number is this?

(/) Incorrect or no response
(\) After the last number read

<table>
<thead>
<tr>
<th>5</th>
<th>9</th>
<th>0</th>
<th>12</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>54</td>
<td>39</td>
<td>23</td>
<td>48</td>
</tr>
<tr>
<td>91</td>
<td>33</td>
<td>70</td>
<td>87</td>
<td>65</td>
</tr>
<tr>
<td>108</td>
<td>245</td>
<td>587</td>
<td>671</td>
<td>989</td>
</tr>
</tbody>
</table>

Time left (seconds):

What language(s) did the child use for this activity? [check all that apply]

Akuapem Twi  Asante Twi  Dagaare  Dagbani  Dangme  Ewe  Fante  Ga  Gonja
Kasem  Nzema  English  Other
### Task 2: Number Discrimination - Practice

<table>
<thead>
<tr>
<th>B1</th>
<th>✔️ ×</th>
</tr>
</thead>
</table>

**P1:**

- Look at these numbers. Tell me which number is bigger.

  8 4

- **Eye/Woatwa. Awotwe (8) na eso pa ara. Ma ye nye baako.**
  That’s correct, 8 is bigger. Let’s do another one.

- **Noma a eso ne awotwe (8). Eyi ye awotwe (8). Eyi ye anan (4). Awotwe (8) so sen anan (4). Ye nye baako bi.**
  The bigger number is 8. *[Point to 8]* This is 8. *[Point to 4]* This is 4. 8 is bigger than 4. Let’s do another one.

<table>
<thead>
<tr>
<th>B2 &amp; B3</th>
<th>✔️ ×</th>
</tr>
</thead>
</table>

**P2:**

- **Hwe noma ahorow yi. Na nea eso wo mu kyere me.**
  Look at these numbers. Tell me which number is bigger.

  10 12

- **Eye. Dumien (12) so. Ye ntoa so.**
  That’s right, 12 is bigger. Let’s continue.

- **Noma a eso no ne dumien (12). Noma yi ye du (10). Eyi ye dumien (12). Dumien so sen du (10). Ye ntoa so.**
  The bigger number is 12. *[Point to 10]* This number is 10. *[Point to 12]* This is 12. 12 is bigger than 10. Let’s continue.

---

### Task 2: Number Discrimination

| ✔️ | ☑ |

**Eye:**

- **(✓) 1 = Correct.**
- **(✗) 0 = Incorrect or no response.**

| 7 5 7 | 1 | 0 | 94 78 | 94 | 1 | 0 |
| 11 24 24 | 1 | 0 | 146 153 | 153 | 1 | 0 |
| 47 34 47 | 1 | 0 | 287 534 | 534 | 1 | 0 |
| 58 49 58 | 1 | 0 | 623 632 | 632 | 1 | 0 |
| 65 67 67 | 1 | 0 | 967 965 | 967 | 1 | 0 |

- **If the child makes 4 successive errors**
- **If the child doesn’t respond after 5 SECONDS.**

**Language(s) used:**

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
Task 3: Missing number - Practice

P1

ícula: Nɔma ahorow bi ni. Baako (1), abien (2) ne anan (4). Nɔma bɛn na ɛba ha?

Here are some numbers. 1, 2, and 4, what number goes here?

1 2 (3) 4

✓: Woatwa (3) abiɛsa. Ma ɣɛnyɛ baako bia.

That’s correct, 3. Let’s do another one.

✗: Abiɛsa (3) na ɛba ansa. Wo ne me nka nɔma ahorow yi. Baako, abien, abiɛsa, anan. Abiɛsa (3) na ɛhyɛ ha. ɣɛnyɛ baako nso nka ho.

The number 3 goes here. Say the numbers with me. [Point to each number] 1, 2, 3, 4. 3 goes here. Let’s do another one.

P2:


Here are some numbers. 5, 10, and 15, what number goes here?

5 10 (15) (20)

✓: Ɛyɛ aduonu (20) woatwa.

That’s correct, 20. Let’s do some more.

✗: Aduonu (20) na ɛba. Wo ne me nka nɔma ahorow yi anum (5), du (10), dunum (15), aduonu (20). Aduonu (20) na ɛba ha. Ma ɣɛnyɛ bebree nka ho.

The number 20 goes here. Say the numbers with me. [Point to each number] 5, 10, 15, 20. 20 goes here. Let’s do some more.
**Task 3: Missing number**

Nɔma ahorow bi nso ni. Nɔma bɛn na ɛhyɛ ha?

Here are some more numbers. [Point to the box] What number goes here? [Repeat for each item]

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>(8)</td>
<td>348</td>
<td>349</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>15</td>
<td></td>
<td>17</td>
<td>28</td>
<td>(26)</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>50</td>
<td>60</td>
<td></td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>(200)</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>320</td>
<td>310</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>(8)</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

What language(s) did the child use for this activity? [check all that apply]

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
**Task 4A: Addition: Level 1**

<table>
<thead>
<tr>
<th>D1 &amp; D2</th>
<th>60 seconds</th>
</tr>
</thead>
</table>

1. **Nkekaho dwumadi bi nso ni.**
   *Mɛkyereɛ wo bere a wubefi ase ne bere a wubegyae. Ka dwumadi biara mmuae. Sɛ wunnim mmuae no a, kɛ nea edo so no so. Woayɛ krado?**
   *Fi ase wo ha.*

Here are some addition problems *[glide hand from top to bottom]*. I will tell you when to start and when to stop. Say the answer for each problem. If you don’t know an answer, move to the next problem. Are you ready? Start here *[point to first problem]*.

<table>
<thead>
<tr>
<th>Incorrect or no response</th>
<th>After last problem attempted</th>
</tr>
</thead>
</table>

| 1 + 3 = (4) | 11 + 3 = (14) |
| 3 + 2 = (5) | 13 + 4 = (17) |
| 6 + 2 = (8) | 16 + 3 = (19) |
| 4 + 5 = (9) | 8 + 5 = (13) |
| 4 + 4 = (8) | 7 + 8 = (15) |
| 8 + 1 = (9) | 9 + 7 = (16) |
| 7 + 3 = (10) | 8 + 8 = (16) |
| 2 + 7 = (9) | 1 + 14 = (15) |
| 5 + 5 = (10) | 10 + 2 = (12) |
| 3 + 7 = (10) | 8 + 10 = (18) |

**Time left (seconds):**

**What language(s) did the child use for this activity? [check all that apply]**

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
### Task 4B: Addition: Level 2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paper and pencil.</strong></td>
<td></td>
</tr>
</tbody>
</table>

- **Nkekaho dwumadi bi nso ni.**
  - **Sɛ wopɛ a, wubetumi de krataa ne pɛnsere ayɛ. Wopɛ nso a, wubegyae.**
  - **Fi ase wɔ ha.**
  - Here are more addition problems.
  - You may use this paper and pencil if you want to. You do not have to do so.
  - Start here [point to first problem].

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(✓) 1 = Correct.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>(✓) 0 = Incorrect or no response.</strong></td>
<td></td>
</tr>
<tr>
<td>13 + 6 = (19)</td>
<td>1 0</td>
</tr>
<tr>
<td>18 + 7 = (25)</td>
<td>1 0</td>
</tr>
<tr>
<td>14 + 25 = (39)</td>
<td>1 0</td>
</tr>
<tr>
<td>22 + 37 = (59)</td>
<td>1 0</td>
</tr>
<tr>
<td>38 + 26 = (64)</td>
<td>1 0</td>
</tr>
</tbody>
</table>

The child:  
- used fingers/tick marks,  
- used paper & pencil,  
- solved the problem(s) in his/her head

- **What language(s) did the child use for this activity?** [check all that apply]  
  - Akuapem Twi  
  - Asante Twi  
  - Dagaare  
  - Dagbani  
  - Dangme  
  - Ewe  
  - Fante  
  - Ga  
  - Gonja  
  - Kasem  
  - Nzema  
  - English  
  - Other
### Task 5A: Subtraction: Level 1

<table>
<thead>
<tr>
<th>Incorrect or no response</th>
<th>After last problem attempted</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 – 1 = (3)</td>
<td>14 – 3 = (11)</td>
</tr>
<tr>
<td>5 – 2 = (3)</td>
<td>17 – 4 = (13)</td>
</tr>
<tr>
<td>9 – 3 = (6)</td>
<td>19 – 3 = (16)</td>
</tr>
<tr>
<td>9 – 5 = (4)</td>
<td>15 – 6 = (9)</td>
</tr>
<tr>
<td>6 – 3 = (3)</td>
<td>15 – 7 = (8)</td>
</tr>
<tr>
<td>9 – 1 = (8)</td>
<td>16 – 9 = (7)</td>
</tr>
<tr>
<td>10 – 3 = (7)</td>
<td>16 – 8 = (8)</td>
</tr>
<tr>
<td>9 – 6 = (3)</td>
<td>14 – 12 = (2)</td>
</tr>
<tr>
<td>10 – 5 = (5)</td>
<td>12 – 2 = (10)</td>
</tr>
<tr>
<td>10 – 8 = (2)</td>
<td>18 – 10 = (8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time left (seconds):</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 seconds</td>
</tr>
</tbody>
</table>

**What language(s) did the child use for this activity? [check all that apply]**

- Akuapem Twi
- Asante Twi
- Dagaare
- Dagbani
- Dangme
- Ewe
- Fante
- Ga
- Gonja
- Kasem
- Nzema
- English
- Other
Task 5B: Subtraction: Level 2

 Nyifim dwumadi bi nso ni. 
*Së wopɛ a, wubetumi de krataa ne pɛnsere aye. Wopɛ nso a, wubegyae.*
Fi ase wɔ ha.
Here are more subtraction problems.
You may use this paper and pencil if you want to. You do not have to do so.
Start here [point to first problem].

(✓) 1 = Correct.
(✓) 0 = Incorrect or no response.

<table>
<thead>
<tr>
<th>Problem</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 − 6 = (13)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>25 − 7 = (18)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>39 − 14 = (25)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>59 − 37 = (22)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>64 − 26 = (38)</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

The child: □ used fingers/tick marks, □ used paper & pencil, □ solved the problem(s) in his/her head

What language(s) did the child use for this activity? [check all that apply]

Akuapem Twi | Asante Twi | Dagaare | Dagbani | Dangme | Ewe | Fante | Ga | Gonja
Kasem | Nzema | English | Other
**Task 6: Word Problems – Practice**

<table>
<thead>
<tr>
<th>Counters, paper and pencil.</th>
<th>x</th>
</tr>
</thead>
</table>

- **Mewɔ dwumadi bi a mɛpɛ sɛ wɔyɛ ma me.**
  - *Nneɛma bi a ebetumi aboa wo ni. Sɛ wuhia a, wubetumi de ayɛ. Wunɛhia nso a, gyae.*
  - *Tie asemmsa biara yiye. Sɛ wopɛ a, meti mu bio ama wo. Eye.*
  - *Ma yemfi ase.*
  
  I have some problems that I am going to ask you to solve for me. Here are some things to help you. You can use them if you need them, but you don’t have to use them. Listen very carefully to each problem. If you need, I will repeat problem for you. Okay, let’s get started.

- **Mmofra baasa te bɔɔso mu. [pause and check]**
  - **Abofra baako asi fam. [pause and check]**
  - **Mmofra baahe na aka wɔ bɔɔso nomu?**
    - There are three children on the bus. *[pause and check]*
    - One child gets off the bus. *[pause and check]*
    - How many children are left on the bus?

- **Eye. Aka mmofra baanu wɔ bɔɔso no mu. Ma yɛnyɛ bi nka ho.**
  
  That’s right. There are two children left on the bus. Let’s do some more.

- **Fa no sɛ mmofra no yɛ adekande (counters).**
  - **Kan mmofra baasa. Saa mmofra yi te bɔɔso no mu.**
  - **Abofra baako asi afi bɔɔso no mu. Adekandeɛ baako kyɛrɛ abofra baako a ɔresi fam no.**
  - **Aka mmofra baahe wɔ bɔɔso no mu?**
  - **Eye. Mmofra baanu (2) na aka wɔ bɔɔso no mu. Ma yɛnyɛ bi nka ho.**
    
    Pretend these counters are children.
    Count out three children. These children are on the bus.
    One child gets off the bus. Show me one child getting off the bus with the counters.
    How many children are left on the bus?
    That’s right. There are two children left on the bus. Let’s do some more.
### Task 6: Word Problems

#### Comment:
The "[pause and check]"s in each problem indicate that you should be certain that the child understands what you have said before continuing. You may want to ask, “Do you understand?”

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<tr>
<th>Problem</th>
<th>Description</th>
<th>Correct</th>
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<th>Note</th>
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<tbody>
<tr>
<td><strong>Problem 1</strong></td>
<td>Mmofra baanum (5) te bɔɔso no mu. [pause and check] Mmofra baanu (2) asi fam. [pause and check] Mmofra baah na mprempren aka wo bɔɔso no mu? There are 5 children on the bus. [pause and check] 2 children get off the bus. [pause and check] How many children are there on the bus now?</td>
<td>1</td>
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<td>If the child makes 4 successive errors OR If a child stops on an item for 5 SECONDS. (and does not attempt to use counters, fingers, paper, or pencil)</td>
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<td><strong>Problem 2</strong></td>
<td>Mmarimaa baasa (3) te bɔɔso mu. [pause and check] Mmeawa baanan (4) nso woɔ bɔɔso no mu. [pause and check] Mmofra dodow ahe na woɔ bɔɔso no mu? There are 3 boys on the bus. [pause and check] There are 4 girls on the same bus. [pause and check] How many children are there on the bus altogether?</td>
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<td>If the child doesn’t respond to a question after one minute.</td>
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<td><strong>Problem 3</strong></td>
<td>Akutu abien (2) gu Kofi kwɛntɛn mu. [Gyae kakra na hwɛ.] Akutu ason (7) gu Amma kwɛntɛn mu. [Gyae kakra na hwɛ.] Akutu ahe na ɛsɛ ɛc wɔyi fi Amma kwɛntɛn no mu ma akutu a ɛwɔ nkɛntɛn abien no mu ayɛ ɛɛ? There are 2 oranges in Kofi’s basket. [pause and check] There are 7 oranges in Amma’s basket. [pause and check] How many oranges must be taken from Amma’s basket so that both baskets have the same number of oranges?</td>
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<td><strong>Problem 4</strong></td>
<td>Mmofra bi te bɔɔso bi mu. [pause and check] Mmofra baanu (2) bi nso kɔtena bɔɔso no mu. [pause and check]</td>
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Problem 5

- Mprempren mmofra baakron (9) na wɔte bɔɔso no mu. [pause and check]
- Mfiase no na mmofra baahε na na wɔte bɔɔso no mu?
  There is a bus with some children. [pause and check]
  2 more children get on the bus. [pause and check]
  Now there are 9 children on the bus. [pause and check]
  How many children were on the bus to begin with?

Problem 6

- Tɔfe dumien (12) gu ɔ [pause and check]
- Mmofra baanan kyɛ tɔfe no pɛɛɛɛɛɛ. [pause and check]
- Abofra biara benya tɔfe ahe?
  There are 12 toffees. [pause and check]
  4 children share the toffees equally. [pause and check]
  How many toffees does each child get?

Problem 6

- Nkongua anum (5) wɔ bɔɔso bi mu. [pause and check]
- Mmofra baanu (2) te akongua baako biara so. [pause and check]
- Mmofra baahε na wɔte bɔɔso no mu?
  There are 5 seats on a bus. [pause and check]
  There are 2 children on each seat. [pause and check]
  How many children are on the bus altogether?

The child: used fingers/tick marks/counters,
used paper & pencil,
solved the problem(s) in his/her head

What language(s) did the child use for this activity? [check all that apply]
Akuapem Twi, Asante Twi, Dagare, Dagbani, Dangme, Ewe, Fante, Ga, Gonja, Kasem, Nzema, English, Other
Ghana Numeracy Pilot Impact Evaluation

PI EGMA+ Stimulus Sheets

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Practice:

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Practice:

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**General Information About Research**

As previously mentioned, I am ________________ from Ivy League Consultants (ILC) Africa, an independent data collection firm working with USAID and Social Impact.

We are conducting a research study to assess the impact of a new Early Grade Numeracy Pilot program which will be piloted in a randomly selected subsample of 60 schools in Shai Osudoku and New Juabeng districts. The Numeracy Pilot project will revise the primary school mathematics curriculum and train teachers to use the new curriculum. The revised curriculum is designed to bring the national mathematics syllabus in line with international trends in primary mathematics education, with a focus on topic depth over breadth and greater emphasis on building mathematical reasoning. The purpose of this study is to evaluate the extent to which this pilot curriculum improves pupils' learning outcomes in mathematics relative to the current national curriculum.

As Head Teacher of this school, we would like to interview you one-on-one to get some information that will be useful for this study, including administrative data on pupils and teachers, teacher instructional practices in this school, your experiences with coaching teachers in mathematics instruction, and your beliefs on current models of instruction for improving early grade mathematics. The interview will last approximately 45 minutes. We will also return to this school at the end of school year in 2018 to repeat the same procedures.

**Possible Risks and Discomforts**

There are no known risks or discomforts associated with participating in this study.

**Possible Benefits**

There are no direct benefits to you for participating in the study, however, information collected in this study may benefit this and other schools in the future by improving early grade mathematics programming.

**Confidentiality**

If you choose to participate, your responses will be strictly confidential. Your responses will be combined with those from other schools in the study and presented in the form of summary tables. Neither you nor your school will be individually identified or named in any reports.

In order to keep the information you provide safe, each member of the research staff has signed a confidentiality agreement prior to conducting any data collection tasks. Any papers or electronic data with personal identifying information will be stored on password-protected electronic devices or in a locked room and no person outside of the research team will have access to this information. Upon conclusion of the study, all personal identifying information will be destroyed.

**Compensation**

There is no monetary compensation provided for participating in this study.
Voluntary Participation and Right to Leave the Research
You can choose not to participate at all or to leave the study at any time, without penalty. Regardless of your decision to participate in the research or not, there will be no negative consequences.

Contacts for Additional Information
If you have any questions regarding this interview or this research project in general, please contact the ILC Africa Program Manager Jennifer Pierre at +233-(0)-508-809672 or Kerry Bruce from Social Impact at +001-703-465-1884.

Your Rights as a Participant
This research has been reviewed and approved by the Radiological and Medical Sciences Research Institute (RAMSRI-ERC). If you have any questions about your rights as a research participant you can contact the ERC Office between the hours of 8:30 am-4:30 pm at email addresses: ramsrierc@yahoo.com or the ERC Administrator on tishjon@yahoo.com and on telephone numbers: 0303-968-932 or 0200402735.

Do you have any questions? Do you agree to participate?

VOLUNTEER AGREEMENT:

The above document describing the benefits, risks and procedures for the research titled “Ghana Numeracy Pilot Impact Evaluation” has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

Head Teacher Name  Head Teacher Signature  Date

STATEMENT OF PERSON OBTAINING INFORMED CONSENT:

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Name of Person Obtaining Informed Consent  Signature of Person Obtaining Informed Consent  Date

Please provide one signed copy of this form to the Head Teacher and retain one copy for ILC Africa’s records.
General Information About Research
Good morning or afternoon. My name is ______________, and I am from Ivy League Consultants (ILC) Africa, an independent data collection firm working with the United States Agency for International Development (USAID)’s mission in Ghana and Social Impact, Inc., a research firm based in the Washington D.C. area in the United States of America. We are conducting a research study to assess the impact of a new Early Grade Numeracy Pilot program which will be piloted in a randomly selected subsample of 60 schools in Shai Osudoku and New Juabeng districts. The Numeracy Pilot will revise the primary school mathematics curriculum and train teachers to use the new curriculum. The revised curriculum is designed to bring the national mathematics syllabus in line with international trends in primary mathematics education, with a focus topic depth over breadth and greater emphasis on building mathematical reasoning. The purpose of this study is to evaluate the extent to which this pilot curriculum improves pupils’ learning outcomes in mathematics relative to the current national curriculum.

Within this school, you and your mathematics class have been selected to be included in the study. This will involve observing a mathematics lesson followed by a 45-minute one-on-one interview with you. The purpose of the classroom observation is to document what teachers and pupils are doing during mathematics lessons as well as learn about teacher approaches to teaching mathematics. Please note that you are not being assessed or evaluated on your teaching performance and all the data collected will be used for statistical and research purposes only. As such, your mathematics lesson should proceed as if today were an ordinary day and you were not being observed. The 45-minute one-on-one interview will help us learn how teachers plan mathematics lessons, what materials and textbooks they use, how they go about assessing learners, and beliefs on effective methods for teaching mathematics. We will also return to this school at the end of school year in 2018 to repeat the same procedures with you and your classroom.

Possible Risks and Discomforts
There are no known risks or discomforts associated with participating in this study.

Possible Benefits
There are no direct benefits to you for participating in the study, however, information collected in this study may benefit this and other schools in the future by improving early grade mathematics programming.

Confidentiality
If you choose to participate, your responses will be strictly confidential. Your responses will be combined with those from other schools in the study and presented in the form of summary tables. Neither you nor your school will be individually identified or named in any reports.

In order to keep the information, you provide safe, each member of the research staff has signed a confidentiality agreement prior to conducting any data collection tasks. Any papers or electronic data with personal identifying information will be stored on password-protected electronic devices or in a
locked room and no person outside of the research team will have access to this information. Upon conclusion of the study, all personal identifying information will be destroyed.

**Compensation**
There is no monetary compensation provided for participating in this study.

**Voluntary Participation and Right to Leave the Research**
You can choose not to participate at all or to withdraw from the study at any time, without penalty. Regardless of your decision to participate in the research or not, there will be no negative consequences.

**Contacts for Additional Information**
If you have any questions regarding this interview or this research project in general, please contact the ILC Africa Program Manager Jennifer Pierre at +233-(0)-508-809672 or Kerry Bruce from Social Impact at +001-703-465-1884.

**Your Rights as a Participant**
This research has been reviewed and approved by the Radiological and Medical Sciences Research Institute (RAMSRI-ERC). If you have any questions about your rights as a research participant you can contact the ERC Office between the hours of 8:30 am-4:30 pm at email addresses: ramsrierc@yahoo.com or the ERC Administrator on tishjon@yahoo.com and on telephone numbers: 0303-968-932 or 0200402735.

Do you have any questions? Do you agree to participate?

**VOLUNTEER AGREEMENT:**

The above document describing the benefits, risks and procedures for the research titled “Ghana Numeracy Pilot Impact Evaluation” has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

Teacher Name  Teacher Signature  Date

**STATEMENT OF PERSON OBTAINING INFORMED CONSENT:**

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Name of Person Obtaining Informed Consent  Signature of Person Obtaining Informed Consent  Date

*Please provide one signed copy of this form to the Teacher and retain one copy for ILC Africa’s records.*
CONSENT FORM: Pupil assent script
STUDY TITLE: Ghana Numeracy Pilot Impact Evaluation
PRINCIPLE INVESTIGATOR: Erika Keaveney, Senior Program Manager, Impact Evaluation
Social Impact, Inc.
ADDRESS: BLK 07, Section 017, Obenesu Crescent, East Cantonments, Accra

My name is ___________. I am working with a study for the Ghana Education Service. We are trying to understand how children learn mathematics in the early grades. Yours is one of the schools we have chosen to help us. We would like your help in this process too. However, you do not have to participate in the study if you do not want to. You can also choose to leave the study at any time without penalty.

I will be asking you different questions about numbers as well as present you with some maths problems. This assessment can be in [GHANAIAN LANGUAGE OF INSTRUCTION] or English, whichever you prefer. This is NOT a test and it will not affect your marks in class. Nobody at your school will know your performance in this assessment.

I will also ask some questions about which languages you use and some things that your family has at home. This should take 30 minutes or less.

We will NEVER share your name or your answers with anyone who is not participating in the study. If there are any questions you do not want to answer after we have already started, you can choose not to answer them. Can we start?
CONSENT FORM:  

In loco parentis Head Teacher consent for school participation in the study including consent for participation of minors under his/her care

STUDY TITLE:  
Ghana Numeracy Pilot Impact Evaluation

PRINCIPLE INVESTIGATOR:  
Erika Keaveney, Senior Program Manager, Impact Evaluation Social Impact, Inc.

ADDRESS:  
BLK 07, Section 017, Obenesu Crescent, East Cantonments, Accra

General Information About Research

Hi, my name is _____________, and I am from Ivy League Consultants (ILC) Africa, an independent data collection firm working with the United States Agency for International Development (USAID)’s mission in Ghana and Social Impact, Inc., a research firm based in the Washington D.C. area in the United States of America. We are conducting a research study to assess the impact of a new Numeracy Pilot program which will be piloted in a randomly selected subsample of 60 schools in Shai Osudoku and New Juabeng districts. The numeracy pilot will focus on improving the mathematics curriculum of primary schools. The purpose of the evaluation is to determine if the pilot curriculum can improve pupil math performance relative to the current national curriculum.

The results of this study will be used by the Ghana Education Service and USAID to inform future programs aimed at helping children in Ghana to effectively learn mathematics in primary schools. All 121 public primary schools in the Shai Osudoku and New Juabeng Municipal districts have been selected to take part in this study.

Should you agree for your school to participate, this will involve an interview with you, an interview with one P1 and one P2 mathematics teacher, observation of these teachers’ maths lessons, and learning assessments and interviews with a group of P1 and P2 pupils. Specifically, twenty pupils (10 boys and 10 girls) per grade in P1 and P2 are to be randomly selected from a randomly selected class for each grade.

Since children in this school are under your care during school hours, we are asking for your consent for their participation, on behalf of the children’s parents. If you agree to allow the children to participate, they will be asked to take a mathematics assessment in the Ghanaian language of instruction or English (whichever they prefer). The learning assessments will provide us with information on their numeracy abilities. In addition, we will ask some questions about attendance, languages spoken, math practices at school and home, and household assets. The assessment and interview should take about 30 minutes per pupil to complete and will take place at school during regular school hours as the school schedule allows. All data collection activities at this school should be completed within the school day. We will also return to this school at the end of school year in 2018 to repeat the same procedures, with the same sample of teachers and pupils.

Possible Risks and Discomforts

There are no known risks associated with this study, other than time lost from the classroom, which is expected to be no more than 30 minutes per pupil. To ease the disruption of class time that this might cause, the team will try to engage students for the assessments at a time convenient with their class schedules.

Possible Benefits

There are no direct benefits to yourself, students, teachers, or the school for participating in the study, however, information collected in this study may benefit this and other schools in the future by improving early grade mathematics programming.
Confidentiality
Every effort will be made to keep any information collected about yourself, children, teachers, and this school strictly confidential. To keep information about participants safe, each member of the research staff has signed a confidentiality agreement prior to conducting any data collection tasks. Any papers or electronic data with personal identifying information will be stored on password-protected electronic devices or in a locked room and no person outside of the research team will have access to this information. Upon conclusion of the study, all personal identifying information will be destroyed.

Compensation
There is no monetary compensation provided for participating in this study.

Voluntary Participation and Right to Leave the Research
You and each of the teachers and children involved can choose not to participate at all or to leave the study at any time, without penalty. In addition, we will provide the pupils with a Parent Information Sheet to take home, which provides information on the study and describes the parent/guardian’s right to withdraw their child from participating at any time, for any reason. Regardless of your or any teacher, child, or parent’s decision to participate in the research or not, there will be no negative consequences.

Contacts for Additional Information
If you, the teachers, the children, or their parents have any questions regarding the data collection tools or this research project in general, please contact the ILC Africa Program Manager Jennifer Pierre at +233-(0)-508-809672 or Kerry Bruce from Social Impact at +001-703-465-1884.

Your Rights as a Participant
This research has been reviewed and approved by the Radiological and Medical Sciences Research Institute (RAMSRI-ERC). If you have any questions about your rights as a research participant you can contact the ERC Office between the hours of 8:30 am-4:30 pm at email addresses: ramsrierc@yahoo.com or the ERC Administrator on tishjon@yahoo.com and on telephone numbers: 0303-968-932 or 0200402735.

Do you have any questions? Do you agree for your school to participate?

VOLUNTEER AGREEMENT:

The above document describing the benefits, risks, and procedures for the research titled “Ghana Numeracy Pilot Impact Evaluation” has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I voluntarily agree to allow the children in my school to participate in this study provided they verbally assent to do so.

Head Teacher Name  Head Teacher Signature  Date

STATEMENT OF PERSON OBTAINING INFORMED CONSENT:

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

Name of Person Obtaining Informed Consent  Signature of Person Obtaining Informed Consent  Date
Please provide one signed copy of this form to the Head Teacher and retain one copy for ILC Africa’s records.

Parent Information Sheet
Ghana Numeracy Pilot Impact Evaluation

Today’s date: _______________________

Dear Parent or Guardian,

The Ministry of Education, Ghana Education Service (GES), and United States Agency for International Development (USAID)/Ghana are jointly implementing an Early Grade Numeracy Pilot project aimed at improving teaching and learning of mathematics in Ghanaian primary schools. The Numeracy Pilot project will be rolled out in 60 schools in Shai Osudoku and New Juabeng districts and involves revising the primary school mathematics curriculum and training teachers to use the new curriculum. USAID/Ghana has contracted Social Impact to conduct an evaluation to see whether the new pilot curriculum improves pupil math performance as compared to the existing national curriculum. The results of the study will be used by the Ghana Education Service and USAID to inform future programs aimed at helping children in Ghana to learn mathematics. Your child was randomly selected among other children in their school to participate in this study. Our data collection team led by ILC Africa, a local data collection firm, administered an oral mathematics assessment and a pupil questionnaire to your child and intends to do so again toward the end of the school year in 2018. Since children in school are under the care of the Head Teacher during school hours, consent to assess and interview your child was obtained from the Head Teacher of the school. This information sheet is intended to provide you information about your child’s participation in the study.

Risks and Benefits: You are assured that there are no known risks associated with participating in this study, other than time lost from the classroom, which is anticipated to be no more than 30 minutes per pupil. To ease the disruption of class time that this might cause, the team worked to engage pupils for the assessments at times convenient with their class schedules. Additionally, there are no direct benefits to you or your child for participating in the study. However, information collected in this study may help the GES improve mathematics instruction in your child’s school as well as other primary schools in Ghana.

Confidentiality: Any information collected about your child will be kept strictly confidential and will not appear in any part of the study report nor will it be shared with anyone outside of the study team, including anyone at his or her school. To ensure confidentiality, each member of the research staff has signed a confidentiality agreement prior to conducting any data collection tasks. Any papers or electronic data with personal identifying information will be stored on password-protected devices or in a locked room and no person outside of the research team will have access to this information. Upon conclusion of the study in 2019, all information that could be used to potentially identify your child will be destroyed.

Voluntary Participation: Your child was given the option to choose not to participate at all or to leave the study at any time, without penalty. Similarly, you as his/her parent or guardian have the option to withdraw your child from the study. If you wish to do so, please contact the ILC Africa Program Manager at the number below.

Contacts for Additional Information: If you have any questions regarding this research kindly contact the ILC Africa Program Manager Jennifer Pierre at +233-(0)-508-809672 or Kerry Bruce from Social Impact at +001-703-465-1884.
**Rights as a Participant:** This research has been reviewed and approved by the Radiological and Medical Sciences Research Institute (RAMSRI-ERC). If you have any questions about your child’s rights as a research participant you can contact the Ethics Review Committee’s (ERC) Office between the hours of 8:30 am-4:30 pm at email addresses: ramsrierc@yahoo.com or the ERC Administrator on tishjon@yahoo.com and on telephone numbers: 0303-968-932 or 0200402735.

**Awofo /Shwefo a psombo,**

Aban krabata a, ŋwe sukuu so wɔ Ghana, Ghana adesua kuo (GES), e ne Amerika kuo a ɔhe ameleon mpuntuo so (USAID, Ghana), won aka abom redi dwumadi bi afa mmofra nkontabuo ho. Won botae ne se wobeboa ama nkontabuo adekyere ne n’adesua atu mpon wo mmofra sukuu wo Ghana. Saa nkontabuo dwumadie yi, yebeye wo sukuu aduosia (60) mu wo Shai Osudoku ne New Juabeng mansim mu. Yebe sakra mfiase sukuu nkontabuo nyehyeye no mu na yama akyerekyerefo no ntetee afa saa nyehyeye fororo yi ho. USAID/Ghana abo social impact foo paa se ṣomo nyẹ saa nsusueye yi na wonhwe se nyehyeye fororo no aboa ama mmofra mmodoabo wo nkontabuo mu atu mpon sen nee ɛwe ho dada no. Adee a yebena efri suahwe yi mu biara no, Ghana adesua kuo (GES) ene USAID de bedi dwumu sẹ ɛmo reye daakye nyehyeye a ɛbe boa ama mmofra asua nkontabuo. Yeyi wo ba no ne mmofra afoforo wo won sukuu no mu se won fa won ho mfra dwumadi yi. Yen nhwehwe mu kuo ILC Africa ena eda ano. Yebsiaa wo ba no nkontabuo nsem na ye san so beye birom se afe a ɛba no reko awie a. Ye maa akyerekyerefo no pene so maa yen ansa na ɣerifu dwumadie no ase efise mmofra awofo ensu sukuu no mu bi. Saa ammance Bɔ kraata wo nkyeremu afa suahwe dwumadi a yene woba no dii ye ho ho.

**Asane ne mfaso:** Yesi no pi ka kyere wo se, asane biara enni ho se wodi saa dwumadie yi, agye se bere a ṣomo tena sukuu dan no mu a 0bɛ hwere no p1. Bere a yede susu abofra biara no nboro sima adauso so. Senea ebe ye a, yensei adesua bere no enti, ye ye adwuma no bere a ɛse mu. Ne eka ho biom ne se, mfaso biara enni ho ma wo ne woba no mprenpren yi, nanso adesua a yebena afriri suahwe yi mu bebo ama nkontabuo adesua wo woba no sukuu ene sukuu ahorow ppi wo ghana mu atu mpon.

**Awerchyemu:** Nya awerchyemu se ade bi biara a yebeye no wo ye ye yen tam pe, na yen ka nkypere obia anaa se ne sukuu no so. Yepe se yema wo nya awerchyemu enti obi biara a oka saa dwumadi yi ho eed nensa ahye contragi ase. Nkrataa epe nneama a edo woho adanse biara no yede bestie ye senea obira a onka dwumadi yi ho nsa ennka. Se ye ye suahwe no nyinna (2019), ade biara a edo woho adanse biara no yebeye se no.

**Firi wope mu ye:** Ye姆aa w’abofo na akwanya se ṣe nkyere se ɔbe ye aana ɔnye, ene se obegyea bere biara a ɔpe a yetwii naso. Biom so, se wope se wo yi w’abofo no firi dwumadi yi mu a, wobetumi afo ILC Africa adwuma mu panyin no wo ne eddi so yi so.

**Nea wone no bedi nkitaho, se wope nkyeremu biom a:** Se wo wɔ nsemisida bi fa saa suahwe yi ho a, wone ILC Africa adwuma mu panyin *Jennifer Pierre* ndi nkitahoo wo +233-(0)-508-809672 anaa Kerry Bruce a ɔwo social impact wo +001-703-465-1884 so.

**Akwanya tumi se wode wo ho fra mu a:** Saa suahwe yi afa mpensenpensemu wo Radiological and Medical Science Research Institute (RAMSRI-ERC). Se wo wɔ nsemisida bi fa saa suahwe yi ho a, wobetumi ne won adi nkitafo efiri anopa non wotwe ne fa kosi awia non nan ne fa wo email address: ramsrierc@yahoo.com anaa nea ɔkorakora ERC ɛwɔ tishjon@yahoo.com ɛna wo ahomatrofo so: 0303-968-932 anaa 0200402735.
ANNEX IV. STATEMENT OF WORK

From Evaluating Systems Contract:

C.2.1 Early Grade Math Pilot Impact Evaluation

The objective of the early grade math pilot, which will be conducted under USAID Partnership for Education: Learning and will be national in scope, is to identify and address the key barriers to improved children’s performance in early grade math in Ghana. The Contractor will conduct an impact evaluation for the early grade math pilot.

(a) Activities

- Design an EDR using a format provided by USAID for Early Grade Math Pilot impact evaluation.

- In close collaboration and coordination with the Learning contractor and the MOE/GES, develop or build on proposed or existing statistical tools (such as design of forms, questionnaires, surveys and/or census) to gather baseline data on relevant indicators, particularly impact indicators at the relevant levels and conduct subsequent data collection.

- Design the evaluation approach, including collection of baseline data, mid-term and final data collection, analysis and dissemination of results.

- Complete impact evaluation, including developing testable hypotheses and samples to show whether or not USAID activities have had an impact on numeracy skills, teaching and learning.

(b) Expected Outputs

- Early Grade Math Pilot Impact Evaluation Design Report developed using format to be provided by USAID.
- Entrance briefing(s) conducted.
- Exit briefing(s) conducted.

(c) Deliverables

- Draft work plan and data collection protocols.
- Final work plan and data collection protocols.
- Evaluation data sets.
- Draft Early Grade Math Pilot impact evaluation report.
- Final Early Grade Math Pilot impact evaluation report.
- PowerPoint presentation for Early Grade Math Pilot impact evaluation to USAID, MOE/GES and relevant development partners.
## ANNEX V. DISCLOSURE OF CONFLICT OF INTEREST FORMS

**Disclosure of Conflict of Interest for USAID Evaluation Team Members**

<table>
<thead>
<tr>
<th>Name</th>
<th>Erika Keaveney</th>
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<tbody>
<tr>
<td>Title</td>
<td>Senior Program Manager</td>
</tr>
<tr>
<td>Organization</td>
<td>Social Impact, Inc.</td>
</tr>
<tr>
<td>Evaluation Position?</td>
<td>☐ Team Leader □ Team member</td>
</tr>
<tr>
<td>Evaluation Award Number (contract or other instrument)</td>
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</tbody>
</table>
| USAID Project(s) Evaluated (include project name(s), implementer name(s) and award number(s), if applicable) | Ghana Early Grade Reading Program  
Ghana Early Grade Numeracy Program |
| I have real or potential conflicts of interest to disclose. | ☐ Yes □ No |

If yes answered above, I disclose the following facts:

1. Close family member who is an employee of the USAID operating unit managing the project(s) being evaluated or the implementing organization(s) whose project(s) are being evaluated.
2. Financial interest that is direct, or is significant through indirect, in the implementing organization(s) whose projects are being evaluated or in the outcome of the evaluation.
3. Current or previous direct or significant through indirect experience with the project(s) being evaluated, including involvement in the project design or previous iterations of the project.
4. Current or previous work experience or seeking employment with the USAID operating unit managing the evaluation or the implementing organization(s) whose project(s) are being evaluated.
5. Current or previous work experience with an organization that may be seen as an industry competitor with the implementing organization(s) whose project(s) are being evaluated.
6. Preconceived ideas toward individuals, groups, organizations, or objectives of the particular projects and organizations being evaluated that could bias the evaluation.

I certify (1) that I have completed this disclosure form fully and to the best of my ability and (2) that I will update this disclosure form promptly if relevant circumstances change. If I gain access to proprietary information of other companies, then I agree to protect their information from unauthorized use or disclosure for as long as it remains proprietary and refrain from using the information for any purpose other than that for which it was furnished.

<table>
<thead>
<tr>
<th>Signature</th>
<th>Erika Keaveney</th>
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<tr>
<td>Date</td>
<td>16 October 2017</td>
</tr>
<tr>
<td>Name</td>
<td>Mike Duthie</td>
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<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Title</td>
<td>Senior Advisor</td>
</tr>
<tr>
<td>Organization</td>
<td>Social Impact</td>
</tr>
<tr>
<td>Evaluation Position?</td>
<td>Team Leader</td>
</tr>
<tr>
<td>USAID Project(s) Evaluated (Include project name(s), implementer name(s) and award number(s), if applicable)</td>
<td></td>
</tr>
<tr>
<td>I have real or potential conflicts of interest to disclose.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

If you answered yes above, I disclose the following facts:

1. Direct financial interest, or a significant indirect financial interest, in the implementing organization(s) whose project(s) are being evaluated, including involvement in the project design or previous iterations of the project.
2. Current or previous work experience or taking employment with the USAID operating unit managing the evaluation or the implementing organization(s) whose project(s) are being evaluated.
3. Current or previous work experience with or organization that may be seen as an industry competitor or with the implementing organization(s) whose project(s) are being evaluated.
4. Preconceived biases towards individuals, groups, organizations, or objectives of the particular projects and organizations being evaluated that could bias the evaluation.

I certify [1] that I have completed this disclosure form fully and to the best of my ability and [2] that I will update this disclosure form promptly if relevant circumstances change. If I gain access to proprietary information of other companies, then I agree to protect their information from unauthorized use or disclosure for as long as it remains proprietary and refrain from using the information for any purpose other than that for which it was furnished.

<table>
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<tr>
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Disclosure of Conflict of Interest for USAID Evaluation Team Members

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<tr>
<th>Name</th>
<th>Yi Rong Hao</th>
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<tbody>
<tr>
<td>Title</td>
<td>Project Assistant</td>
</tr>
<tr>
<td>Organization</td>
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<tr>
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<td>□ Team Leader  ❌ Team member</td>
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<tr>
<td>Evaluation Award Number (contract or other instrument)</td>
<td>Ghana Education Evaluating Systems</td>
</tr>
<tr>
<td>USAID Project(s) Evaluated (include project name(s), implementer name(s) and award number(s), if applicable)</td>
<td></td>
</tr>
<tr>
<td>I have real or potential conflicts of interest to disclose.</td>
<td>□ Yes  ❌ No</td>
</tr>
</tbody>
</table>

If yes answered above, I disclose the following facts:

- Real or potential conflicts of interest may include, but are not limited to,
  1. Close family member who is an employee of the USAID operating unit managing the project(s) being evaluated or the implementing organization(s) whose projects are being evaluated.
  2. Financial interest that is direct, or so significant through interest, in the implementing organization(s) whose projects are being evaluated or in the outcome of the evaluation.
  3. Current or previous direct or significant though indirect, involvement in the implementation or management of the project(s) being evaluated that could influence the evaluation.
  4. Current or previous work experience or pending employment with the USAID operating unit managing the evaluation or the implementing organization(s) whose projects are being evaluated.
  5. Current or previous work experience with an organization that may be seen as an industry competitor with the implementing organization(s) whose projects are being evaluated.
  6. Prearranged ideas regard confidentiality, group, organization, or philosophy of the particular project and organization being evaluated that could influence the evaluation.

I certify (1) that I have completed this disclosure form fully and to the best of my ability and (2) that I will update this disclosure form promptly if relevant circumstances change. If I gain access to proprietary information of other companies, I agree to protect their information from unauthorized use or disclosure for as long as it remains proprietary and refrain from using the information for any purpose other than that for which it was furnished.

<table>
<thead>
<tr>
<th>Signature</th>
<th>Illy</th>
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<tbody>
<tr>
<td>Date</td>
<td>14th August 2017</td>
</tr>
</tbody>
</table>
Disclosure of Conflict of Interest for USAID Evaluation Team Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Mohammad Amin Dawuda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Senior Monitoring and Evaluation Specialist</td>
</tr>
<tr>
<td>Organization</td>
<td>Social Impact Inc.</td>
</tr>
<tr>
<td>Evaluation Position?</td>
<td>☐ Team Leader ☐ Team member</td>
</tr>
<tr>
<td>Evaluation Award Number (contract or other instrument)</td>
<td>GS-10f-0294V</td>
</tr>
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</table>
| USAID Project(s) Evaluated (include project name(s), implementer name(s) and award number(s), if applicable) | Ghana Early Grade Reading Impact Evaluation  
Ghana Numeracy Pilot Impact Evaluation  
Social Impact Inc.  
September 30, 2014 |

I have real or potential conflicts of interest to disclose: ☐ Yes ☐ No

If yes answered above, I disclose the following facts:

Real or potential conflicts of interest may include, but are not limited to:

1. Close family member who is an employee of the USAID operating unit managing the project(s) being evaluated or the implementing organization(s) whose project(s) are being evaluated.
2. Financial interest that is direct, or is significant though indirect, in the implementing organization(s) whose projects are being evaluated or in the outcome of the evaluation.
3. Current or previous direct or significant though indirect experience with the project(s) being evaluated, including involvement in the project design or previous limitations of the project.
4. Current or previous work experience or ownership interest in an organization with which the USAID operating unit managing the evaluation or the implementing organization(s) whose project(s) are being evaluated.
5. Current or previous work experience with an organization that may be seen as an industry competitor with the implementing organization(s) whose project(s) are being evaluated.
6. Preconceived biases toward individuals, groups, organizations, or objectives of the particular projects and organizations being evaluated that could bias the evaluation.

I certify (1) that I have completed this disclosure form fully and to the best of my ability and (2) that I will update this disclosure form promptly if relevant circumstances change. If I gain access to proprietary information of other companies, then I agree to protect their information from unauthorized use or disclosure for as long as it remains proprietary and refrain from using the information for any purpose other than that for which it was furnished.

Signature

Date: October 30, 2017
Disclosure of Conflict of Interest for USAID Evaluation Team Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Jennifer Pierce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Organization</td>
<td>ILO Africa</td>
</tr>
<tr>
<td>Evaluation Position?</td>
<td>Team Leader Team member</td>
</tr>
<tr>
<td>Evaluation Award Number (contract or other instrument)</td>
<td>AID-641-M-14-0002</td>
</tr>
<tr>
<td>USAID Project(s) Evaluated (Include project name(s), implementer name(s) and award number(s), if applicable)</td>
<td>Ghana Partnership for Education Social Impact G008-600-S-17-0006</td>
</tr>
<tr>
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<td>Yes/No</td>
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If yes answered above, I disclose the following facts:
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2. Financial interest that is direct, or is significant through indirect means in the implementing organization(s) whose projects are being evaluated or in the outcome of the evaluation.
3. Current or previous direct or significant through indirect means experience with the project(s) being evaluated, including involvement in the project design or previous iterations of the project.
4. Current or previous work experience or seeking employment with the USAID operating unit managing the evaluation or the implementing organization(s) whose project(s) are being evaluated.
5. Current or previous work experience with an organization that may be seen as an industry competitor with the implementing organization(s) whose project(s) are being evaluated.
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I certify (1) that I have completed this disclosure form fully and to the best of my ability and (2) that I will update this disclosure form promptly if relevant circumstances change. If I gain access to proprietary information of other companies, then I agree to protect their information from unauthorized use or disclosure for as long as it remains proprietary and refrain from using the information for any purpose other than that for which it was furnished.

Signature

Date: 29th October 2017
## Disclosure of Conflict of Interest for USAID Evaluation Team Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Andrew Epstein</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Senior Education and Evaluation Technical Specialist</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Social Impact, Inc.</td>
</tr>
<tr>
<td><strong>Evaluation Position?</strong></td>
<td>■ Team Leader □ Team member</td>
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| **Signature** |  |
| **Date**      | 31 October 2017 |
ANNEX VI. EVALUATION TEAM

**Erika Keaveney** is a Senior Program Manager for Impact Evaluation at SI, and was responsible for leading the evaluation design, data collection, and fieldwork for the EGRA, which included training field supervisors. Ms. Keaveney has over eight years of experience in international development research, evaluation and project management and currently manages an $8 million portfolio of USAID-supported impact evaluations in Ghana and Malawi, focusing on early grade literacy and numeracy. Ms. Keaveney also serves as a Board Member of SI’s Institutional Review Board. She holds an MA in International Comparative Education from Stanford University and a BA in Political Science from the University of California-San Diego.

**Dr. Andrew Epstein** serves as Senior Education and Evaluation Technical Specialist at SI and was a lead researcher for the EGRA, supporting the EGRA design, data collection, and fieldwork trainings. At SI, Dr. Epstein implements impact and performance evaluations of international development and humanitarian aid projects across multiple sectors, focusing specifically on the areas of education and youth. He has designed impact evaluations of three educational pilot projects in Ghana in the areas of teacher retention, language of instruction policy, and mathematics education. Dr. Epstein has a Ph.D. from the University of Wisconsin-Madison where he focused on International and Comparative Education. He also holds an M.Ed. in Educational Leadership and Policy Studies from the University of Washington.

Data collection for the EGRA was supported by members of the **ILC Africa** team, led by **Jennifer Pierre**. Ms. Pierre has over ten years of experience in project monitoring and evaluation services, impact evaluation, and performance management frameworks, as well as experience supporting assessments in Ghana for organizations including USAID and CARE. She holds a Masters in Science, Population and International Health/Management Studies from the Harvard School of Public Health.

The evaluation team was also supported by **Mohammed Dawuda**, Senior Monitoring and Evaluation Specialist for **Evaluating Systems** in Ghana, who trained field supervisors on data collection procedures and monitored data collection quality and progress. SI’s Sr. Technical Advisor, **Mike Duthie** provided oversight over and support to the design of the project, tool development and report writing. Program Manager **Hira Siddiqui** and Project Assistant **Michael Wang** provided data analysis and report preparation.