

WORLDREADER GHANA DISTRICT SCALE PROJECT

EARLY GRADE READING ASSESSMENT BASELINE REPORT

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LIST OF ACRONYMS

CWPM	Correct Words per Minute
CNWPM	Correct Nonwords per Minute
DF	Degrees of Freedom
EGRA	Early Grade Reading Assessment
GDS	Ghana District Scale
MEO	Municipal Education Office
ORF	Oral Reading Fluency
P2	Primary Grade 2
SD	Standard Deviation
USAID	United States Agency for International Development

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CONTEXT OF EVALUATION

The Ghana District Scale (GDS) project is a collaboration between Worldreader and the Municipal Education Office (MEO) of Kwaebibirem in Ghana's Eastern Region. The project aims to establish a municipal-wide digital reading program in Kwaebibirem. GDS seeks to develop a replicable, systems-level approach to improving student reading behaviors and literacy outcomes through full district ownership and management of digital reading programs by the MEO.¹

The GDS project will provide technical support, management expertise, and digital content through the MEO to reach up to 90 public primary schools in the municipality between 2018 and 2020. Worldreader is delivering relevant e-books on electronic reading devices to enhance reading within schools and is building the capacity of MEO staff to manage these programs. Worldreader expects GDS to increase how much students read and the amount of enjoyment students feel about reading. Through these activities, Worldreader aims to ultimately improve student behaviors and literacy outcomes.

INTRODUCTION

This report presents the results of a baseline Early Grade Reading Assessment (EGRA) conducted by School-to-School International (STS) in October 2018 as part of the GDS evaluation framework. The GDS project aims to understand the impact of system-wide digital reading initiatives on early grade reading skills in Grade 2 (P2) primary school students. The study will follow the rollout of the intervention to three different groups over two years in Kwaebibirem District. The GDS study will examine the effect of digital reading initiatives on student reading performance by comparing P2 student EGRA scores between these three groups of schools: Treatment 2 group – those who have participated in digital reading program for two years; Treatment 1 group - those who participated for one year; and a Comparison group who do not participate in the reading program.² At baseline, data were only collected from the students Treatment 2 group and Comparison groups;³ Treatment 1 will be introduced at the midline evaluation point in 2019.

The October 2018 baseline EGRA evaluation serves to establish P2 students' baseline reading levels in both English and Akuapem Twi for comparison at future evaluation timepoints and to gauge the comparability of the Treatment 2 and Comparison groups prior to the start of the intervention.⁴

¹ Worldreader. "District Scale Project Scope." January 2018.

² The Comparison group will receive the intervention following the conclusion of the study.

³ Note: In this report "treatment group" is synonymous with "Treatment 2 group"

⁴ Note: one limitation of the study is that the project provided tablets to the students in the Treatment 2 group in September 2018, prior to the baseline data collection.

SUMMARY OF FINDINGS

The following section provides an overview of the salient findings from the EGRA, while subsequent sections explain EGRA results in greater detail.

The baseline EGRA showed that students across both groups are comparable and most students struggled to provide correct responses, with the majority of students receiving a zero score on almost all subtasks. The only exceptions were the Akuapem Twi listening comprehension and English oral vocabulary subtasks.

Zero scores by treatment and comparison group: There is no statistically significant difference between treatment and comparison groups in the percentages of students receiving a zero score on each subtask, with two exceptions: students in the comparison group had a higher percentage of zero scores on both the Akuapem Twi listening comprehension and Akuapem Twi reading comprehension subtasks.

Means by treatment and comparison group: There is no statistically significant difference between the average means of the treatment and comparison groups for any of the four timed subtasks—English and Akuapem Twi nonword reading and oral reading fluency (ORF) subtasks. On the Akuapem Twi nonword reading, Akuapem Twi ORF passage, and English nonword reading subtasks, the average fluency rates of students in both treatment and comparison groups were below one word per minute.

Zero scores by sex: There is a statistically significant difference between the percentages of boys and girls receiving a zero score on all nine subtasks. More boys received a zero score compared with girls on all subtasks except the English oral vocabulary subtask.

Means by sex: There is a statistically significant difference between the average means of boys and girls on three of the four timed subtasks: Twi ORF passage, English nonword reading, and English ORF passage. There is no statistically significant difference between the average means of boys and girls on the Twi nonword reading subtask. The only average fluency rate above one word per minute is the girls' average number of correct words per minute on the English ORF passage: girls were able to read, on average, 2.18 words per minute while boys were only able to read, on average, 0.16 words per minute. The average fluency rates for the Twi nonword reading, Twi ORF passage, and English nonword reading subtasks are below one word per minute.

DATA COLLECTION METHODS

The following section describes the October 2018 baseline's study design, tools, sample, enumerator training, and data collection.

Study Design

As part of the GDS evaluation framework, Worldreader is conducting a quasi-experimental evaluation study focusing on literacy. The goal of this literacy evaluation is to understand the

impact of systems-wide digital reading initiatives on early grade reading skills in Grade 2 (P2) primary school students. This study will follow the rollout of the intervention to three different groups over two years in Kwaebibirem District. The GDS study will examine the effect of digital reading initiatives on student reading performance by comparing P2 student EGRA scores between these three groups of schools: Treatment 2 group – those who have participated in digital reading program for two years; Treatment 1 group - those who participated for one year; and a Comparison group who do not participate in the reading program.⁵ At baseline, data were only collected from students in the Treatment 2 group and Comparison groups; Treatment 1 will be introduced at the midline evaluation point in 2019.

By the end of the GDS project in 2020, the literacy evaluation study will be able to quantify:

1. The difference between students who have received one year of treatment (Treatment 1) and students who have received no treatment (Comparison).
2. The difference between students who have received two years of treatment (Treatment 2) and students who have received no treatment (Comparison).
3. The difference between students who have received two years of treatment (Treatment 2) and students who have received one year of treatment (Treatment 1).

As part of the literacy evaluation study, other data will be collected in addition to the EGRA; however, this report focuses on the findings from the baseline EGRA completed in October 2018.

Tools

The Early Grade Reading Assessment (EGRA) methodology was developed in consultation with cognitive scientists, early grade reading experts, and assessment specialists with funding assistance from USAID, the World Bank, and other international donors. The EGRA assesses the skills needed for reading acquisition. It measures students' ability to perform on a series of subtasks related to the basic foundational skills required for fluency in reading. Although many students in the early grades are not yet fluent readers, the EGRA allows evaluators to capture what students—even nonreaders—can do and where they are in the developmental path to becoming fluent readers. The EGRA methodology has been applied in more than 30 countries and 60 languages.

EGRA is an oral assessment comprised of various subtasks that are adapted for each language's unique structure and context. It is individually administered over a period of approximately 20 minutes by a trained enumerator—who is not the student's teacher—in a location outside of the student's classroom. The enumerator begins by explaining the assessment to the student and asking if the student agrees to participate. Assent is always optional; no student is required to take the assessment. The enumerator creates a relaxed environment and assures the student that the assessment will not be used as a grade. The enumerator provides instructions and asks

⁵ The Comparison group will receive the intervention following the conclusion of the study.

questions aloud to which the student responds aloud. For certain subtasks, the enumerator places a paper stimulus in front of the student and asks specific questions about the stimulus.

The EGRA administered for the GDS baseline study consisted of nine subtasks. International EGRA experts and Ghanaian language curriculum and assessment experts developed an EGRA tool in 2015 through the Ghana Partnership for Education, the Ghana Education Service and USAID: *Testing* activity.⁶ Four EGRA subtasks in Akuapem Twi and five EGRA subtasks in English were selected from this tool to comprise the GDS baseline assessment tool used in this study. All students were asked to complete the following nine subtasks:

1. Nonword reading—Akuapem Twi
2. Oral reading fluency (ORF)—Akuapem Twi
3. Reading comprehension—Akuapem Twi
4. Listening comprehension—Akuapem Twi
5. Nonword reading—English
6. Oral reading fluency (ORF)— English
7. Reading comprehension—English
8. Oral vocabulary—English
9. Listening comprehension—English

Table 1 is a summary of the EGRA tool, including what reading skills are measured on each subtask and how each subtask is administered.

⁶ Ghana Education Service, National Education Assessment Unit, RTI International, and Education Assessment and Research Centre. “Ghana 2018 - Early Grade Reading Assessment and Early Grade Mathematics Assessment: Report of Findings.” November 2016.

Table 1. Summary of 2018 Ghana District Scale (GDS) Baseline EGRA Tool

EGRA Subtask	Type	Description
Nonword reading	Timed	Nonword reading is measured as correct nonwords read in one minute (CNWPM). Nonword reading measures decoding. Each student had the opportunity to read up to 50 nonwords on the Akuapem Twi and English subtasks.
Oral reading fluency	Timed	Oral reading fluency (ORF) is measured as correct words read in one minute (CWPM). ORF is a decoding and reading fluency measure. Each student had the opportunity to read 60 words on the Akuapem Twi subtask and 59 words on the English subtask. The ORF passages formed the textual basis for the reading comprehension subtasks.
Reading comprehension	Untimed	Reading comprehension is measured as the number of correct answers verbally delivered based on questions asked about the passage read as part of the ORF subtask. Each student had the opportunity to answer up to five questions each on the Akuapem Twi and English subtasks.
Listening comprehension	Untimed	Listening comprehension is measured as the number of correct answers verbally delivered. Listening comprehension is a measure of oral language comprehension and vocabulary knowledge. Each student had the opportunity to answer three questions based on a passage read to them in Akuapem Twi, and three questions based on a passage read to them in English.
Oral vocabulary	Untimed	Oral vocabulary is measured as the number of correct answers delivered verbally. Oral vocabulary is the measure of receptive oral vocabulary knowledge. Students had the opportunity to provide the name of eight objects in English based on eight pictures presented to them.

Sample

The purpose of the baseline EGRA evaluation was to collect assessment data from both a treatment, that will receive two years of the intervention, and a comparison group before the start of the intervention.⁷ The baseline data was collected in a sample of two groups of schools—Treatment 2 and Comparison—in October 2018. In total, the project will work in 90 schools with 31 schools in the Treatment and Comparison groups from which the sample was drawn for this study. There are 12 schools in the Treatment 2 group, and 19 schools to be split into Treatment 1 and the Comparison groups across three circuits from 2018-2020. It was determined that eight schools in each group would provide a margin of error between treatment and control of 8.3 and be reasonable given time and funding constraints. To select the eight schools, Worldreader collected information about student enrollment, number of teachers, number of trained teachers, location (rural/urban), electricity availability, attendance, academic performance through assessment data and observational data, and circuit ranking from 31 schools in the study. Worldreader then created indices to determine comparability among the schools and, using propensity matching, and selected eight schools out of the possible 12 schools to be in the Treatment 2 group, and eight out of the total 19 in the Comparison and to-

⁷ Data was collected approximately one month after treatment schools received e-readers.

be-determined Treatment 1 group.⁸ The resulting baseline data show the level of students' performance at the beginning of the project.

Table 2 shows the total number of students enrolled and sampled from each group at baseline. At each of the sixteen schools, enumerators aimed to randomly select 15 male and 15 female students from grade level Primary 2 (P2) to take the EGRA. In schools with fewer than 30 students, enumerators assessed all P2 students present.

Table 2. Summary of 2018 Ghana District Scale (GDS) Baseline School Population and Sample

Group	Total Number of Schools	Total Number of Students Enrolled in P2	Total Number of P2 Students Sampled for Baseline
Treatment	8	249	161
Comparison	8	213	151
Total	16	462	312

Table 3 shows the number and percentage of male and female students in each group sample. Both the treatment and comparison groups have slightly more boys than girls.

Table 3. Summary of 2018 Ghana District Scale (GDS) Baseline Student Sample

Group	Number of Male Students	Percentage of Male Students	Number of Female Students	Percentage of Female Students	Total Number of Students
Treatment	87	54.04%	74	45.96%	161
Comparison	78	51.66%	73	48.34%	151

Enumerator Training and Data Collection

Two enumerators were identified and trained to conduct the EGRA in both Akuapem Twi and English. Both enumerators had prior experience collecting Early Grade Math Assessments using the Tangerine software. This was their first time to conduct an EGRA.

During training, the enumerators reviewed EGRA principles and gained a comprehensive understanding of the EGRA subtasks, content, and protocols. The enumerators were given a EGRA manual containing the data collection protocols and procedures for uploading data and conducting and documenting school visits. The enumerators practiced EGRA administration and scoring procedures and learned how to troubleshoot technical issues with the tablet and with the Tangerine software. The enumerators were evaluated to ensure consistency in scoring

⁸ Currently, there are 19 schools that will either be provided the intervention after one year or after the study concludes.

the EGRA subtasks and both were able to agree with each other on scoring decisions over 90 percent of the time, a widely accepted minimum requirement threshold for reliability. Data collection took place from October 10 to November 2, 2018. The enumerators coordinated with the local circuit office prior to visiting each school. On the day of the visit, the enumerators were accompanied by a local district official. Following an introduction to the school principal, the enumerators determined where to conduct the assessment. The enumerators worked with the P2 teacher(s) to determine how many P2 students were present and either take a random sample of 15 male and 15 female students or in cases where there were less than 30 P2 students present, the enumerators conducted the EGRA with all students present that day. For quality assurance, at the end of data collection, one enumerator completed the school visit form which included information on student attendance, EGRAs completed, and any challenges collecting the data or mistakes made during the administration. The head teacher signed the school visit form at the conclusion of the data collection at their school. Each night the enumerators uploaded the EGRA data and photo of the school visit form to the Tangerine server. These data were verified by STS home office staff on a daily basis.

DATA ANALYSIS

EGRA data were analyzed using Microsoft Excel and IBM SPSS Statistics. EGRA subtask results were matched by student and subtasks' mean fluencies and zero scores are reported, including the standard deviations (SD), relevant to the mean values.⁹ Differences in scores between the intervention and comparison groups were tested for significance using independent sample t-test analysis.¹⁰ Differences in the proportion of zero scores between the treatment and comparison groups were tested for significance using the chi-square test.¹¹ Results with statistically significant differences are reported throughout the following sections of this report with an asterisk. Where results are not statistically significant, it is not possible to assume that there is any difference between the results of students in the treatment and comparison groups.

For each subtask, decision rules were applied to assess whether to remove outliers. For example, if the time remaining for a timed subtask resulted in a fluency rate that was outside a reasonable range, then that student's fluency rate was not included in the analyses. Reasonable ranges for the time remaining were based on multiple factors, including the rate at which letters or words in the language tested are typically read, the distribution—or relative performance—of students in the sample, and the mean fluency rate within and without the outlier data point(s). After considering reasonable ranges in the data, no outliers were removed.

⁹ SD describes how much observed values vary from the mean. A smaller SD indicates that most of values are close to the mean; a larger SD indicates that values are further from the mean. This report provides mean fluencies and scores of the entire sample of students. SDs are listed to understand the variability of the scores within the sample.

¹⁰ The independent sample t-test compares the difference between the means of two independent groups on the same dependent variable.

¹¹ The chi-square test is a statistical test comparing the proportion of students with zero scores that were observed in the data against what was expected.

LIMITATIONS

The following are limitations of the study and should be kept in mind while reviewing the EGRA results:

1. The GDS project began implementation in January 2018. The treatment schools involved in this study received e-readers and began the project in September 2018. The base data collection did not happen until after these treatment schools began to use the tablets, in October 2018. The intervention was provided on a rolling basis, so some students may have only used the tablets for several days while other students may have had access for almost one month before the EGRA data collection happened at their school. This represents minimal spillover but should be considered when reviewing the comparability of the two groups at the beginning of this intervention.
2. This is a baseline study of a phased intervention not a randomized control trial. Schools were not randomly assigned to the different treatment groups, nor was random selection used for choosing schools that would be in the study. Worldreader collected information about the schools to determine comparability and made determinations about which schools should be included in the study.

SUBTASK RESULTS BY GROUP

This section presents the results of the EGRA baseline evaluation that was administered to 312 P2 students in the 16 sampled schools. Results are summarized by treatment group. In total, there were eight treatment schools and eight comparison schools, with 161 and 151 students sampled, respectively. The percentages of zero scores on each subtask are presented first, followed by the distribution of scores on each subtask, and finally, the mean fluency rates are presented for the timed subtasks. Because comparisons in reading acquisition across languages are not appropriate,¹² results focus on student performance within each language. Therefore, all results are presented by language, with Akuapem Twi first and English second, as the assessment was administered.

Zero scores were calculated for all subtasks. Students receive a zero score if they are unable to respond correctly to a single item on a subtask. In this report, zero scores are presented as the number of students or as the percentage of total students unable to correctly identify at least one item on a subtask.

Akuapem Twi Results by Treatment and Comparison Group

Percentage of Zero Scores by Subtask: As shown in Table 4, over 90 percent of students were unable to respond correctly to at least one item for all Akuapem Twi subtasks except the

¹² For further explanation see RTI International. "Early Grade Reading Assessment (EGRA) Toolkit, Second Edition." March 2016, 70-71.

listening comprehension subtask. This means that more than 90 percent of students in both the treatment and comparison groups were unable to answer a single item correctly on the Akuapem Twi nonword reading, ORF passage, and reading comprehension subtasks. The percentage of students receiving a zero score on the listening comprehension subtask was comparatively much lower in both the treatment and comparison groups—23.60 percent and 38.41 percent, respectively.

The difference between the treatment and comparison groups in the percentage of students receiving a zero score was statistically significant on the listening comprehension subtask only ($Z=2.83$; $p\text{-value}=0.00$). There was no statistically significant difference between the treatment and comparison groups in the percentage of students receiving a zero score on the Akuapem Twi nonword reading, ORF passage, and reading comprehension subtasks.

Table 4. Percentage of Students Receiving Zero Scores by Subtask— Akuapem Twi

Subtask	Treatment Group		Comparison Group	
	Number of Students n ¹³	Percentage of Students %	Number of Students n	Percentage of Students %
Nonword Reading	158	98.14	150	99.34
Oral Reading Fluency Passage	148	91.93	149	98.68
Listening Comprehension*	38	23.60	58	38.41
Reading Comprehension	157	97.52	151	100.00

Note: Asterisk indicates a statistically significant difference between the treatment and comparison groups based on a p-value of less than or equal to 0.05.

Distributions of Scores by Subtask: In the following section, distributions for all Akuapem Twi subtasks are presented.

Nonword Reading and Oral Reading Fluency Subtasks: For each timed subtask, distributions of the fluency rates are shown in Table 5. The GDS EGRA included two subtasks that measured reading fluency skills in Akuapem Twi: the nonword reading subtask and the ORF subtask. On the nonword reading subtask, students were presented with 50 nonwords—or decodable words that were invented for this exercise—and asked to read as many nonwords as possible in one minute using decoding skills. Nonword reading is measured as correct nonwords read per minute (CNWPM). On the ORF subtask, students were given one minute to read a passage consisting of 60 words. Oral reading fluency is measured as correct words read per minute (CWPM).

The distributions of correct nonwords per minute (CNWPM) in the treatment and comparison groups are similar and therefore statistically equivalent. On the Akuapem Twi nonword reading subtask, there were three students in the treatment group who were able to read at least one nonword correctly within one minute. Of those three students, one student read between

¹³ Note: “n” denotes “number.” In this report, “n” refers to the number of students.

one and 10 nonwords while two students read between 11 and 40 nonwords. There was only one student in the comparison group who was able to read at least one nonword correctly; that student read three nonwords.

The distributions of correct words per minute (CWPM) in the treatment and comparison groups are also similar and statistically equivalent on the Akuapem Twi ORF subtask. There were 13 students in the treatment group and 11 students in the comparison group who were able to read at least one word of the reading passage correctly within one minute. Eleven students from the treatment group and 11 students from the comparison group read between one and 10 words correctly. Only two students were able to read more than 10 words correctly and both were part of the treatment group.

Table 5. Distribution of Fluency Rates on Nonword Reading and Oral Reading Fluency Subtasks—Akuapem Twi

Fluency Rate Intervals	Treatment Group				Comparison Group			
	Nonword Reading (CNWPM)		Oral Reading Fluency (CWPM)		Nonword Reading (CNWPM)		Oral Reading Fluency (CWPM)	
	n	%	n	%	n	%	n	%
0	158	98.14	148	91.93	150	99.34	140	92.72
1–10	1	0.62	11	6.83	1	0.66	11	7.28
11–40	2	1.24	2	1.24	0	0.00	0	0.00
41 or more	0	0.00	0	0.00	0	0.00	0	0.00

Reading Comprehension Subtask: For the reading comprehension subtask, after the student read as much of the reading passage as they could in one minute, the enumerator removed the story and then asked each student a number of comprehension questions based on how far he or she had read in the ORF passage. For instance, if a student read just the first four words of the passage, he or she would be asked only the first comprehension question. Similarly, if a student read all 60 words of the passage, he or she would be asked all five comprehension questions. Therefore, the number of questions attempted varied across students.

Students who received a zero score on the ORF subtask also received a zero score on the reading comprehension subtask because no questions were posed to them. Additionally, any student who could not correctly answer a single reading comprehension question received a zero score on this subtask.

The distributions of questions attempted and questions answered correctly on the Akuapem Twi reading comprehension subtask are shown in Table 6. Fourteen students in the treatment group were asked at least one question, and 11 students in the comparison group were asked at least one question. No students in either group were asked more than three questions. Four students in the treatment group were able to answer at least one question correctly, whereas no students in the comparison group were able to answer a question correctly. However, the

difference in number of questions answered correctly between the treatment and comparison groups is not statistically significant (chi-square=3.80; degrees of freedom (df)=4; p-value=0.14).

Table 6. Distribution of Questions Attempted and Questions Answered Correctly on Reading Comprehension Subtask—Akuapem Twi

Number of Questions	Treatment Group				Comparison Group			
	Questions Attempted		Questions Answered Correctly		Questions Attempted		Questions Answered Correctly	
	n	%	n	%	n	%	n	%
0	147	91.30	157	97.52	140	92.72	151	100
1	2	1.24	3	1.86	1	0.66	0	0
2	10	6.21	1	0.62	9	5.96	0	0
3	2	1.24	0	0.00	1	0.66	0	0
4	0	0.00	0	0.00	0	0.00	0	0
5	0	0.00	0	0.00	0	0.00	0	0

Listening Comprehension Subtask: On the listening comprehension subtask, the enumerator read a short passage aloud to students and asked them to answer three comprehension questions based on what they heard. Results for this subtask are presented as the number of questions answered correctly out of three.

The distributions of questions answered correctly on the Akuapem Twi listening comprehension subtask are shown in Table 7. This is the only Akuapem Twi subtask that has a statistically significant difference in distributions between the treatment group and comparison group (chi-square=9.52; df=3, p-value=0.01). A greater proportion of students in the comparison group were unable to answer a single question correctly compared with students in the treatment group, 38.41 percent and 23.60 percent, respectively. Additionally, students in the treatment group were able to respond to more questions correctly than students in the comparison group. For example, 13.66 percent of students in the treatment group were able to respond to all three questions correctly; however, only 9.27 percent of students in the comparison group were able to respond to all three questions correctly.

Table 7. Distribution of Questions Answered Correctly on Listening Comprehension Subtask—Akuapem Twi

Number of Questions Answered Correctly*	Treatment Group		Comparison Group	
	n	%	n	%
0	38	23.60	58	38.41
1	57	35.40	51	33.77
2	44	27.33	28	18.54
3	22	13.66	14	9.27

Note: There is a statistically significant difference between the treatment and comparison groups based on a p-value of less than or equal to 0.05.

Distribution of Mean Fluency Rates: Average fluency rates for the Akuapem Twi nonword reading and ORF subtasks are presented in Table 8. On the Akuapem Twi nonword reading subtask, students in the treatment and comparison groups were able to read, on average, less than one nonword correctly out of 50 in one minute. The difference in the average nonword fluency rate between treatment and comparison groups was not statistically significant (t-test=-1.37; p-value=0.17). On the Akuapem Twi ORF subtask, students in the treatment and comparison groups were able to read, on average, less than one word correctly out of 60 in one minute. The difference in the average ORF rate between treatment and comparison groups was also not statistically significant (t-test=-1.52; p-value=0.13). Due to the high percentage of students receiving zero scores on the nonword and ORF subtasks, the average fluency rates on both subtasks are very low. Additionally, the standard deviation (SD) of the treatment group is larger than the standard deviation of the comparison group on both the nonword reading and ORF subtasks,¹⁴ indicating more variation in fluency rates in the treatment group than in the comparison group.

Table 8. Mean Fluency Rates for Nonword Reading and Oral Reading Fluency Subtasks—Akuapem Twi

Subtask	Treatment Group			Comparison Group		
	n	Mean	SD	n	Mean	SD
Nonword Reading (CNWPM)	161	0.28	2.31	151	0.02	0.24
Oral Reading Fluency Passage (CWPM)	161	0.40	2.30	151	0.11	0.51

English Results by Treatment and Comparison Group

Percentage of Zero Scores by Subtask: The EGRA included five subtasks in English after the four subtasks in Akuapem Twi. As shown in

Table 9, over 85 percent of students were unable to respond correctly to a single item for all English subtasks except the oral vocabulary subtask. Thus, more than 85 percent of students in both the treatment and comparison groups were unable to answer a single item correctly on the English nonword reading, ORF passage, listening comprehension, and reading comprehension subtasks. The percentage of students receiving a zero score on the oral vocabulary subtask was comparatively much lower in both the treatment and comparison groups: 5.59 percent and 3.31 percent, respectively. The percentages of students receiving a zero score for each subtask are similar and statistically equivalent between the treatment and comparison groups.

¹⁴ “SD” denotes “standard deviation.” Standard deviation is a measure to gauge the amount of variation in the data.

Table 9. Percentage of Students Receiving Zero Scores by Subtask—English

Subtask	Treatment Group		Comparison Group	
	Number of Students n	Percentage of Students %	Number of Students n	Percentage of Students %
Nonword Reading	154	95.65	149	98.68
Oral Reading Fluency Passage	149	92.55	130	86.09
Listening Comprehension	156	96.89	150	99.34
Reading Comprehension	158	98.14	147	97.35
Oral Vocabulary	9	5.59	5	3.31

Distributions of Scores by Subtask: In the following section, distributions for all English subtasks are presented.

Nonword Reading and Oral Reading Fluency Subtasks: Similar to the Akuapem Twi results reported earlier, distributions of the fluency rates for each timed English subtask are shown in Table 10. The GDS EGRA included two subtasks that measured reading fluency skills in English: the nonword reading subtask and the ORF subtask. As with the Akupem Twi subtasks, students were presented with 50 nonwords and the ORF subtask, students were given one minute to read a passage consisting of 60 words.

The distributions of correct nonwords per minute (CNWPM) in the treatment and comparison groups are similar and statistically equivalent. On the English nonword reading subtask, there were seven students in the treatment group who were able to read at least one nonword correctly within one minute. Of those seven students, four students read between one and 10 nonwords while three students read between 11 and 40 nonwords. No students in the treatment group were able to read more than 41 nonwords in one minute. There were two students in the comparison group who were able to read at least one nonword correctly within one minute. Those two students read between one and 10 nonwords correctly.

The distributions of correct words per minute (CWPM) in the treatment and comparison groups are also similar and statistically equivalent on the English ORF subtask. There were 13 students in the treatment group and 21 students in the comparison group who were able to read at least one word of the reading passage correctly within one minute. Six students from the treatment group and 16 students from the comparison group read between one and 10 words correctly. Four students from the treatment group and five students from the comparison group read between 11 and 40 words correctly. Three students were able to read more than 41 words correctly and all were part of the treatment group.

Table 10. Distribution of Fluency Rates on Nonword Reading and Oral Reading Fluency Subtasks—English

Fluency Rate Intervals	Treatment Group				Comparison Group			
	Nonword Reading (CNWPM)		Oral Reading Fluency (CWPM)		Nonword Reading (CNWPM)		Oral Reading Fluency (CWPM)	
	n	%	n	%	n	%	n	%
0	154	95.65	148	91.93	149	98.68	130	86.09
1–10	4	2.48	6	3.73	2	1.32	16	10.6
11–40	3	1.86	4	2.48	0	0.00	5	3.31
41 or more	0	0.00	3	1.86	0	0.00	0	0

Reading Comprehension Subtask: The distributions of questions attempted and questions answered correctly on the English reading comprehension subtask are shown in Table 11. Twelve students in the treatment group were asked at least one question, and 19 students in the comparison group were asked at least one question. No students in either group attempted all five questions because no students finished reading the ORF passage within one minute. The majority of students who were asked a question in both groups were asked only one question. Three students in the treatment group were able to answer at least one question correctly, and four students in the comparison group were able to answer a question correctly. The difference in the number of questions answered correctly between the treatment and comparison groups was not statistically significant (chi-square=1.74; df=4, p-value=0.18).

Table 11. Distribution of Questions Attempted and Questions Answered Correctly on Reading Comprehension Subtask—English

Number of Questions	Treatment Group				Comparison Group			
	Questions Attempted		Questions Answered Correctly		Questions Attempted		Questions Answered Correctly	
	n	%	n	%	n	%	n	%
0	149	92.55	158	98.14	132	87.42	147	97.35
1	7	4.35	2	1.24	17	11.26	4	2.65
2	2	1.24	1	0.62	1	0.66	0	0.00
3	1	0.62	0	0.00	1	0.66	0	0.00
4	2	1.24	0	0.00	0	0.00	0	0.00
5	0	0.00	0	0.00	0	0.00	0	0.00

Listening Comprehension Subtask: The distributions of questions answered correctly on the English listening comprehension subtask are shown in Table 12. The treatment and comparison groups have similar and statistically equivalent distributions (chi-square=2.47; df=3, p-value=0.18). More students in the comparison group were unable to answer a single question correctly compared with students in the treatment group; however, this difference was not statistically significant. Five students in the treatment group were able to respond to one question correctly, one student in the comparison group was able to respond to one question correctly, no students in either group were able to respond correctly to more than one question.

Table 12. Distribution of Questions Answered Correctly on Listening Comprehension Subtask—English

Number of Questions Answered Correctly	Treatment Group		Comparison Group	
	n	%	n	%
0	156	96.89	150	99.34
1	5	3.11	1	0.66
2	0	0.00	0	0.00
3	0	0.00	0	0.00

Oral Vocabulary Subtask: The only subtask that was included in English but not Akuapem Twi was the oral vocabulary subtask. On this subtask, the enumerator placed a paper stimulus in front of the student with eight pictures. The enumerator then pointed to each picture, if the student was able to name the picture, it was marked correct. If the student was not able to name the picture in three seconds, the enumerator prompted the student to go to the next picture. This was an untimed subtask.

The distributions of correct responses on the oral vocabulary subtask are shown in **Table 13**. The treatment and comparison groups have similar and statistically equivalent distributions. In both the treatment and comparison groups, nearly 60 percent of students identified four or five pictures correctly—57.77 percent and 59.60 percent, respectively, with approximately 20 percent of those students who identified more than five pictures correctly—17.39 percent in the treatment group and 21.86 percent in the comparison group.

Students in the treatment group were able to identify, on average, 4.17 items out of eight correctly, and students in the comparison group were able to identify, on average, 4.54 items out of eight correctly. The difference in the average number of correct responses was not statistically significant between the two groups (t -test=1.89; p -value=0.06).

Table 13. Distribution of Correct Responses on Oral Vocabulary Subtask—English

Number of Correct Responses	Treatment Group		Comparison Group	
	n	%	n	%
0	9	5.59	5	3.31
1	5	3.11	5	3.31
2	10	6.21	5	3.31
3	16	9.94	13	8.61
4	52	32.30	41	27.15
5	41	25.47	49	32.45
6	15	9.32	16	10.60
7	9	5.59	10	6.62
8	4	2.48	7	4.64

Distribution of Mean Fluency Rates: Average fluency rates for the English nonword reading and ORF subtasks are presented in Table 14. On the English nonword reading subtask, students

in the treatment and comparison groups were able to read, on average, less than one nonword correctly out of 50 in one minute. The difference in the average nonword fluency rate between treatment and comparison groups was not statistically significant (t -test=-1.66; p -value=0.10). On the English ORF subtask, students in the treatment and comparison groups were able to read, on average, approximately one word correctly out of 59 in one minute. The difference in the average ORF rate between treatment and comparison groups was also not statistically significant (t -test=-0.43; p -value=0.67). Due to the high percentage of students receiving zero scores on the nonword and ORF subtasks, the average fluency rates on both subtasks are low. Additionally, the standard deviation (SD) of the treatment group is larger than the SD of the comparison group on both the nonword reading and ORF subtasks, indicating more variation in fluency rates in the treatment group than in the comparison group.

Table 14. Mean Fluency Rates for Nonword Reading and Oral Reading Fluency Subtasks—English

Subtask	Treatment Group			Comparison Group		
	n	Mean	SD	n	Mean	SD
Nonword Reading (CNWPM)	161	0.50	3.13	151	0.07	0.66
Oral Reading Fluency Passage (CWPM)	161	1.24	6.32	151	0.98	3.71

SUMMARY OF RESULTS BY SEX

In addition to analyzing the results by treatment and comparison group, the data were also disaggregated and analyzed by sex. The EGRA was conducted with 147 girls and 165 boys. Overall, the difference in the percentage of zero scores between boys and girls was statistically significant on all Akuapem Twi subtasks. On the English EGRA, the percentage of students receiving a zero score on each subtask was higher among boys than girls, with the exception of the oral vocabulary subtask. All results disaggregated by sex are provided in Annex A.¹⁵

CORRELATIONS

Following the EGRA administration, students were asked a few survey questions about their home environment and reading resources and practices. For example, students were asked about the languages they speak at home, as well as about reading materials and practices in their home. The responses for each question are presented in Annex B. Correlations, or relations between two variables, were analyzed between student survey responses about contextual factors and student EGRA scores. Positive numbers correlations closer to 1 indicate a strong positive relationship, and negative numbers closer to -1 indicate a strong negative, or inverse relationship. Absolute values close to 0 indicate a weak relationship. For instance, a correlation of 0.95 between two indicates that the variables are highly and positively related to one another; if one variable increases, the second variable is also likely to increase. By contrast, a correlation

¹⁵ Due to the small sample size, it was not possible to examine the results by treatment group and sex.

of 0.15 would indicate that the two variables are positively yet not strongly linked to one another. For the purposes of this report, correlations between 0.20 and 0.49 are considered weak, correlations between 0.50 and 0.79 are considered moderate, and correlations of 0.80 or greater are considered strong, following Cohen's guidelines.

Students who reported that they have books at home were more likely to score higher on both the Akuapem Twi and English subtasks, i.e., these two variables presented a positive correlation. However, the correlations between having books at home and higher student scores are weak—0.20 for the Akuapem Twi subtasks and 0.21 for the English subtasks. It was also found that students who reported reading at home and having someone else read to them at home had higher scores on the Akuapem Twi subtasks, though this same correlation was not found for the English subtasks. The correlations between these behaviors and higher Akuapem Twi scores were, however, weak—0.20 for reading at home and 0.23 for having someone else read to them at home.

RECOMMENDATIONS

Overall, the results from both the Akuapem Twi and English subtasks show that students in the comparison and treatment groups are comparable in terms of zero scores received and fluency means on all subtasks and across both languages, except of the listening comprehension results in Twi. These results show that most students in the baseline study are struggling to read words and stories and to comprehend oral stories in both languages. These results indicate that students need significant instructional support and practice in both Akuapem Twi and English to be able to read at grade level.

In terms of Akuapem Twi, students were unable to read most of the nonwords presented, many could not read the passage, and many even struggled with the listening comprehension subtask. While the majority of the students reported speaking Akuapem Twi as either the language they speak most at home (58.97%) or a second language they use at home (36.22%), most students were not able to comprehend and answer the questions about the listening story. Listening to stories told aloud involves an important set of interrelated skills and knowledge including vocabulary, familiarity with different grammatical structures, and comprehension strategies. These skills need to be developed to support more complex reading skills. The intervention should consider ways to include listening stories with comprehension questions into the electronic readers to support students' development of these requisite skills.

In addition, students demonstrated that they do not have sufficient awareness of the alphabetic principle – the association of letters with sounds – to be able to decode the unfamiliar or even read familiar words in the passage. The alphabetic principle is the foundation for transitioning vocabulary knowledge into reading. Students need to understand the language's alphabet and the different grapheme combinations used to build words. These students do not show they have this knowledge in Akuapem Twi and need practice to develop a foundation in the alphabet to be able to progress to word and passage reading. Teaching the alphabetic principle

should be done in collaboration with the school's approach to reading instruction, to ensure the activities on the tablets are sequenced in the way students are learning in their classroom.

On the English EGRA, students overall performed best on the oral vocabulary subtask, with most students able to name the simple English words associated with pictures, while the rest of the subtasks proved quite challenging for the students. While results were not strong for the Akuapem Twi listening comprehension subtask, they were much lower for the English listening story. Additionally, almost all students were unable to read any of the nonwords or the oral passage story. Taken together, these results show the students are not familiar with English and need to be provided with sufficient time to listen and become familiar with the language. The simple vocabulary knowledge is not translating into reading performance. The electronic readers could be very useful in providing English listening content, to support developing familiarity with simple words and stories.

The Worldreader GDS project should consider how best to be responsive to the needs of this student population. Students' results show they need significant support to be able to read grade-level text. Electronic readers may be able to provide the type of targeted, individualized content students need to improve their language and reading skills. The intervention should assess what types of books and activities are provided and ensure they are aligned with the levels the students need. This should also be done in collaboration with the literacy approach used and the school, to ensure maximum impact. Teachers who understand the technology and are able to pair those experiences with their classroom instruction can maximize the impact on the students' literacy skills. With ongoing, targeted support, students have the potential to practice what they need to improve and become fluent readers.

ANNEXES

Annex A. Student EGRA by Sex

Table 15. Summary by Sex of the Percentage of Students Receiving Zero Scores by Subtask—Akuapem Twi

Subtask	Boys		Girls	
	Number of Students n	Percentage of Students %	Number of Students n	Percentage of Students %
Nonword Reading*	165	100.00	143	97.28
Oral Reading Fluency Passage*	162	98.18	126	85.71
Listening Comprehension*	65	39.39	31	21.09
Reading Comprehension*	165	100.00	143	97.28

Note: Asterisk indicates a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Table 16. Distribution by Sex of Questions Attempted and Questions Answered Correctly on Reading Comprehension Subtask—Akuapem Twi

Number of Questions	Boys				Girls			
	Questions Attempted		Questions Answered Correctly		Questions Attempted		Questions Answered Correctly	
	n	%	n	%	n	%	n	%
0	161	97.58	165	100.00	126	85.71	143	97.28
1	1	0.61	0	0.00	2	1.36	3	2.04
2	3	1.82	0	0.00	16	10.88	1	0.68
3	0	0.00	0	0.00	3	2.04	0	0
4	0	0.00	0	0.00	0	0.00	0	0
5	0	0.00	0	0.00	0	0.00	0	0

Table 17. Distribution by Sex of Questions Answered Correctly on Listening Comprehension Subtask—Akuapem Twi

Number of Questions Answered Correctly*	Boys		Girls	
	n	%	n	%
0	65	39.39	31	21.09
1	53	32.12	55	37.41
2	36	21.82	36	24.49
3	11	6.67	25	17.01

Note: There is a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Table 18. Mean Fluency Rates by Sex for Nonword Reading and Oral Reading Fluency Subtasks—Akuapem Twi

Subtask	Boys			Girls		
	N	Mean	SD	n	Mean	SD
Nonword Reading (CNWPM)	165	0.00	0.00	147	0.33	2.43
Oral Reading Fluency Passage (CWPM)*	165	0.02	0.19	147	0.53	2.44

Note: Asterisk indicates a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Table 19. Summary by Sex of the Percentage of Students Receiving Zero Scores by Subtask—English

Subtask	Boys		Girls	
	Number of Students n	Percentage of Students %	Number of Students n	Percentage of Students %
Nonword Reading*	164	99.39	139	94.56
Oral Reading Fluency Passage*	159	96.36	120	81.63
Listening Comprehension*	165	100.00	141	95.92
Reading Comprehension*	165	100.00	140	95.24
Oral Vocabulary*	2	1.21	12	8.16

Note: Asterisk indicates a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Table 20. Distribution by Sex of Questions Attempted and Questions Answered Correctly on Reading Comprehension Subtask—English

Number of Questions	Boys				Girls			
	Questions Attempted		Questions Answered Correctly*		Questions Attempted		Questions Answered Correctly*	
	n	%	n	%	n	%	n	%
0	160	96.97	165	100.00	121	82.31	140	95.24
1	5	3.03	0	0.00	19	12.93	6	4.08
2	0	0.00	0	0.00	3	2.04	1	0.68
3	0	0.00	0	0.00	2	1.36	0	0
4	0	0.00	0	0.00	2	1.36	0	0
5	0	0.00	0	0.00	0	0.00	0	0

Note: Asterisk indicates a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Table 21. Distribution by Sex of Questions Answered Correctly on Listening Comprehension Subtask—English

Number of Questions Answered Correctly*	Boys		Girls	
	n	%	n	%
0	165	100.00	141	95.92
1	0	0.00	6	4.08
2	0	0.00	0	0.00
3	0	0.00	0	0.00

Note: There is a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Table 22. Distribution of Correct Responses on Oral Vocabulary Subtask—English

Number of Correct Responses*	Boys		Girls	
	n	%	n	%
0	2	1.21	12	8.16
1	4	2.42	6	4.08
2	9	5.45	6	4.08
3	13	7.88	16	10.88
4	55	33.33	38	25.85
5	52	31.52	38	25.85
6	12	7.27	19	12.93
7	10	6.06	9	6.12
8	8	4.85	3	2.04

Note: Asterisk indicates a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Table 23. Mean Fluency Rates by Sex for Nonword Reading and Oral Reading Fluency Subtasks—English

Subtask	Boys			Girls		
	n	Mean	SD	n	Mean	SD
Nonword Reading (CNWPM)*	165	0.04	0.47	147	0.57	3.30
Oral Reading Fluency Passage (CWPM)*	165	0.16	0.96	147	2.18	7.40

Note: Asterisk indicates a statistically significant difference between boys and girls based on a p-value of less than or equal to 0.05.

Annex B. Correlations

Table 24. Correlations between Contextual Factors and Student Scores¹⁶

	Student's total score on Twi subtasks	Student's total score on English subtasks	Student speaks Twi at home as first language	Student speaks English at home as first language	Student speaks Twi at home as second language	Student speaks English at home as second language	Student has books at home	Student reads at home	Someone else reads to student at home
Student's total score on Twi subtasks	1.00								
Student's total score on English subtasks	0.78	1.00							
Student speaks Twi at home as first language			1.00						
Student speaks English at home as first language				1.00					
Student speaks Twi at home as second language			-0.63		1.00				
Student speaks English at home as second language						1.00			
Student has books at home	0.20	0.21			0.15		1.00		
Student reads at home	0.20	0.18		0.13	0.12	0.12	0.57	1.00	
Someone else reads to student at home	0.23		0.12		0.12	0.24	0.34	0.60	1.00

Note: All correlations presented are statistically significant based on a p-value of less than or equal to 0.05.

¹⁶ The survey included "Akuapem Twi," "Asante Twi," and "Twi" as response options. For the purpose of this analysis, responses of either "Akuapem Twi" or "Twi" were grouped together as "Twi." "Asante Twi" was considered a separate language and not included in **Error! Reference source not found.**

Annex C. Results of Test Reliability Analysis (Cronbach’s alpha; item-total correlations)

The quality of the assessment tools was evaluated through reliability analysis which consists of analyzing the reliability of the full assessment using coefficient alpha with percentage correct scores on each subtask. This index varies between zero and one, where a value closer to one indicates that the performance of the students can be easily generalized. This analysis treats each subtask as a single item with a score ranging from 0.0 to 1.0 for each student based on their percentage correct on the subtask. Tables Table 25 through Table 30 show the results of this analysis. These results suggest that the EGRA tools had a high level of internal consistency.

Table 25. Alpha Estimates by Subtask

	Alpha
Invented words ENGLISH	0.98
Invented words TWI	0.99
Oral reading fluency ENGLISH	0.98
Oral reading fluency TWI	0.95
Oral vocabulary ENGLISH	0.4

Table 26. Point Biserial Correlations and Alpha Estimates—Nonword Reading Twi

	average						
	item-test	item-rest	interitem				
Item		Obs	Sign	correlation	correlation	covariance	alpha
R_invent~I_1		312.00	+	0.64	0.61	0.01	0.99
R_invent~I_2		312.00	+	0.98	0.98	0.01	0.99
R_invent~I_3		312.00	+	0.98	0.98	0.01	0.99
R_invent~I_4		312.00	+	0.98	0.98	0.01	0.99
R_invent~I_5		312.00	+	0.86	0.84	0.01	0.99
R_invent~I_6		312.00	+	0.86	0.84	0.01	0.99
R_invent~I_7		312.00	+	0.98	0.98	0.01	0.99
R_invent~I_8		312.00	+	0.98	0.98	0.01	0.99
R_invent~I_9		312.00	+	0.98	0.98	0.01	0.99
R_inven~I_10		312.00	+	0.98	0.98	0.01	0.99
R_inven~I_11		312.00	+	0.86	0.84	0.01	0.99
R_inven~I_12		312.00	+	0.98	0.98	0.01	0.99
R_inven~I_13		312.00	+	0.88	0.86	0.01	0.99
R_inven~I_14		312.00	+	0.88	0.86	0.01	0.99
R_inven~I_15		312.00	+	0.88	0.86	0.01	0.99
R_inven~I_16		312.00	+	0.98	0.98	0.01	0.99
R_inven~I_17		312.00	+	0.98	0.98	0.01	0.99

	average						
	item-test	item-rest	interitem				
Item		Obs	Sign	correlation	correlation	covariance	alpha
R_inven~l_18		312.00	+	0.98	0.98	0.01	0.99
R_inven~l_19		312.00	+	0.98	0.98	0.01	0.99
R_inven~l_20		312.00	+	0.78	0.76	0.01	0.99
R_inven~l_21		312.00	+	0.78	0.76	0.01	0.99
R_inven~l_22		312.00	+	0.78	0.76	0.01	0.99
R_inven~l_23		312.00	+	0.78	0.76	0.01	0.99
Test	scale		0.01	0.99			

Table 27. Point Biserial Correlations and Alpha Estimates—Oral Reading Fluency Twi

	average						
	item-test	item-rest	interitem				
Item		Obs	Sign	correlation	correlation	covariance	alpha
R_oral_r~l_1		312.00	+	0.53	0.40	0.01	0.97
R_oral_r~l_2		312.00	+	0.92	0.91	0.01	0.95
R_oral_r~l_3		312.00	+	0.66	0.63	0.01	0.95
R_oral_r~l_4		312.00	+	0.66	0.63	0.01	0.95
R_oral_r~l_5		312.00	+	0.69	0.63	0.01	0.96
R_oral_r~l_6		312.00	+	0.92	0.91	0.01	0.95
R_oral_r~l_7		312.00	+	0.75	0.72	0.01	0.95
R_oral_r~l_8		312.00	+	0.84	0.82	0.01	0.95
R_oral_r~l_9		312.00	+	0.92	0.91	0.01	0.95
R_oral_~l_10		312.00	+	0.92	0.91	0.01	0.95
R_oral_~l_11		312.00	+	0.89	0.88	0.01	0.95
R_oral_~l_12		312.00	+	0.89	0.88	0.01	0.95
R_oral_~l_13		312.00	+	0.82	0.80	0.01	0.95
R_oral_~l_14		312.00	+	0.74	0.71	0.01	0.95
R_oral_~l_15		312.00	+	0.89	0.88	0.01	0.95
R_oral_~l_16		312.00	+	0.82	0.80	0.01	0.95
R_oral_~l_17		312.00	+	0.89	0.88	0.01	0.95
R_oral_~l_18		312.00	+	0.89	0.88	0.01	0.95
R_oral_~l_19		312.00	+	0.89	0.88	0.01	0.95
R_oral_~l_21		312.00	+	0.73	0.71	0.01	0.95
R_oral_~l_23		312.00	+	0.73	0.71	0.01	0.95
R_oral_~l_25		312.00	+	0.73	0.71	0.01	0.95
Test	scale		0.01	0.95			

Table 28. Point Biserial Correlations and Alpha Estimates—Nonword Reading English

	average						
	item-test	item-rest	interitem				
Item		Obs	Sign	correlation	correlation	covariance	alpha
R_invent~d_1		312.00	+	0.73	0.69	0.01	0.98
R_invent~d_2		312.00	+	0.67	0.64	0.01	0.98
R_invent~d_3		312.00	+	0.86	0.84	0.01	0.98
R_invent~d_4		312.00	+	0.88	0.87	0.01	0.98
R_invent~d_5		312.00	+	0.86	0.85	0.01	0.98
R_invent~d_6		312.00	+	0.48	0.45	0.01	0.98
R_invent~d_7		312.00	+	0.89	0.88	0.01	0.98
R_invent~d_8		312.00	+	0.85	0.83	0.01	0.98
R_invent~d_9		312.00	+	0.88	0.87	0.01	0.98
R_inven~d_10		312.00	+	0.85	0.83	0.01	0.98
R_inven~d_11		312.00	+	0.95	0.94	0.01	0.98
R_inven~d_12		312.00	+	0.87	0.86	0.01	0.98
R_inven~d_13		312.00	+	0.92	0.91	0.01	0.98
R_inven~d_14		312.00	+	0.95	0.94	0.01	0.98
R_inven~d_15		312.00	+	0.95	0.94	0.01	0.98
R_inven~d_16		312.00	+	0.95	0.94	0.01	0.98
R_inven~d_17		312.00	+	0.82	0.80	0.01	0.98
R_inven~d_18		312.00	+	0.41	0.39	0.01	0.98
R_inven~d_19		312.00	+	0.95	0.94	0.01	0.98
R_inven~d_20		312.00	+	0.69	0.66	0.01	0.98
R_inven~d_21		312.00	+	0.86	0.85	0.01	0.98
R_inven~d_22		312.00	+	0.86	0.85	0.01	0.98
R_inven~d_23		312.00	+	0.86	0.85	0.01	0.98
R_inven~d_24		312.00	+	0.86	0.85	0.01	0.98
R_inven~d_25		312.00	+	0.86	0.85	0.01	0.98
R_inven~d_26		312.00	+	0.86	0.85	0.01	0.98
R_inven~d_27		312.00	+	0.63	0.62	0.01	0.98
R_inven~d_28		312.00	+	0.63	0.62	0.01	0.98
R_inven~d_29		312.00	+	0.63	0.62	0.01	0.98
Test	scale		0.01	0.98			

Table 29. Point Biserial Correlations and Alpha Estimates—Oral Reading Fluency English

	average						
	item-test	item-rest	interitem				
Item		Obs	Sign	correlation	correlation	covariance	alpha
R_oral_r~d_1		312.00	+	0.63	0.60	0.01	0.98
R_oral_r~d_2		312.00	+	0.63	0.59	0.01	0.98
R_oral_r~d_3		312.00	+	0.79	0.77	0.01	0.98
R_oral_r~d_4		312.00	+	0.70	0.69	0.01	0.98
R_oral_r~d_5		312.00	+	0.74	0.72	0.01	0.98
R_oral_r~d_6		312.00	+	0.72	0.70	0.01	0.98
R_oral_r~d_7		312.00	+	0.85	0.84	0.01	0.98
R_oral_r~d_8		312.00	+	0.78	0.77	0.01	0.98
R_oral_r~d_9		312.00	+	0.73	0.71	0.01	0.98
R_oral_~d_10		312.00	+	0.66	0.64	0.01	0.98
R_oral_~d_11		312.00	+	0.86	0.85	0.01	0.98
R_oral_~d_12		312.00	+	0.75	0.73	0.01	0.98
R_oral_~d_13		312.00	+	0.89	0.88	0.01	0.98
R_oral_~d_14		312.00	+	0.79	0.78	0.01	0.98
R_oral_~d_15		312.00	+	0.74	0.72	0.01	0.98
R_oral_~d_16		312.00	+	0.78	0.77	0.01	0.98
R_oral_~d_17		312.00	+	0.88	0.88	0.01	0.98
R_oral_~d_18		312.00	+	0.83	0.82	0.01	0.98
R_oral_~d_19		312.00	+	0.79	0.78	0.01	0.98
R_oral_~d_20		312.00	+	0.88	0.87	0.01	0.98
R_oral_~d_21		312.00	+	0.88	0.87	0.01	0.98
R_oral_~d_22		312.00	+	0.83	0.82	0.01	0.98
R_oral_~d_23		312.00	+	0.88	0.87	0.01	0.98
R_oral_~d_24		312.00	+	0.88	0.87	0.01	0.98
R_oral_~d_25		312.00	+	0.81	0.80	0.01	0.98
R_oral_~d_26		312.00	+	0.88	0.87	0.01	0.98
R_oral_~d_27		312.00	+	0.81	0.80	0.01	0.98
R_oral_~d_28		312.00	+	0.87	0.87	0.01	0.98
R_oral_~d_29		312.00	+	0.81	0.80	0.01	0.98
R_oral_~d_30		312.00	+	0.83	0.83	0.01	0.98
R_oral_~d_31		312.00	+	0.83	0.83	0.01	0.98
R_oral_~d_32		312.00	+	0.77	0.77	0.01	0.98
R_oral_~d_33		312.00	+	0.83	0.83	0.01	0.98
R_oral_~d_34		312.00	+	0.83	0.83	0.01	0.98
R_oral_~d_35		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_36		312.00	+	0.50	0.49	0.01	0.98
R_oral_~d_37		312.00	+	0.78	0.77	0.01	0.98
R_oral_~d_38		312.00	+	0.78	0.77	0.01	0.98

	average						
	item-test	item-rest	interitem				
Item		Obs	Sign	correlation	correlation	covariance	alpha
R_oral_~d_39		312.00	+	0.78	0.77	0.01	0.98
R_oral_~d_40		312.00	+	0.78	0.77	0.01	0.98
R_oral_~d_41		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_42		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_44		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_45		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_46		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_47		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_48		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_49		312.00	+	0.72	0.72	0.01	0.98
R_oral_~d_50		312.00	+	0.52	0.51	0.01	0.98
R_oral_~d_51		312.00	+	0.52	0.51	0.01	0.98
Test	scale		0.01	0.98			

Table 30. Point Biserial Correlations and Alpha Estimates, Disaggregated by Item—Oral Vocabulary English

	average						
	item-test	item-rest	interitem				
Item		Obs	Sign	correlation	correlation	covariance	alpha
R_oral_v~C_1		312.00	+	0.45	0.13	0.01	0.40
R_oral_v~C_2		312.00	+	0.59	0.36	0.01	0.26
R_oral_v~C_3		312.00	+	0.41	0.23	0.02	0.40
R_oral_v~C_4		312.00	+	0.53	0.32	0.01	0.29
R_oral_v~C_5		299.00	-	0.27	-0.04	0.02	0.44
R_oral_v~C_6		295.00	+	0.54	0.25	0.01	0.33
R_oral_v~C_7		293.00	+	0.46	0.17	0.01	0.38
R_oral_v~C_8		283.00	+	0.35	0.11	0.01	0.39
Test	scale		0.01	0.40			

Annex D. Intra-class Correlation Coefficient

The intraclass correlation, or the intraclass correlation coefficient, is a descriptive statistic that describes how strongly units in the same group resemble each other. A value closer to one indicates high similarity between values from the same group. For the 2018 EGRA data, STS computed the intraclass correlation coefficient for the ORF subtask by language. The results, which appear in Table 31. Intra-class correlation, indicate that the similarity in the ORF subtask performance among students in the same school is relatively low.

Table 31. Intra-class Correlation Coefficient

Intra-class correlation coefficient	ICC
Twil assessment	0.16
English assessment	0.2

Annex E. Student Survey and EGRA Results by Item

Table 32. Student Survey Results by Item—What language do you mostly speak at home?

What language do you speak mostly at home?	Frequency	Percentage	Cumulative Percentage
Akuapem Twi	184	58.97%	58.97%
Asante Twi	2	0.64%	59.62%
Dagaare	1	0.32%	59.94%
Dangme	71	22.76%	82.69%
Ewe	17	5.45%	88.14%
Fante	8	2.56%	90.71%
Ga	7	2.24%	92.95%
Kasem	1	0.32%	93.27%
English	1	0.32%	93.59%
Hausa	1	0.32%	93.91%
Do not know or not response	5	1.60%	95.51%
Other	14	4.49%	100.00%

Table 33. Student Survey Results by Item—Which other languages do you speak at home?

Which other language do you speak at home?	Yes	% Yes	No	% No
Akuapem Twi	113	36.22%	199	63.78%
Asante Twi	17	5.45%	195	62.50%
Dagaare	1	0.32%	311	99.68%
Dagbani	0	0.00%	312	100.00%
Dangme	31	9.94%	281	90.06%
Ewe	25	8.01%	287	91.99%
Fante	18	5.77%	294	94.23%
Ga	13	4.17%	299	95.83%
Gonja	0	0.00%	312	100.00%
Kasem	0	0.00%	312	100.00%
Nzema	1	0.32%	311	99.68%
English	9	2.88%	303	97.12%
Do not know or not response	111	35.58%	201	64.42%
Other	21	6.73%	291	93.27%

Table 34. Student Survey Results by Item—Apart from your school books, are there books for you to read at your home?

Apart from your school books, are there books for you to read at your home?	Frequency	Percentage	Cumulative Percentage
No	276	88%	88%
Yes	29	9%	98%
Do not know or not response	7	2%	100%

Table 35. Student Survey Results by Item—How often do you read at home?

How often do you read at home?	Frequency	Percentage	Cumulative Percentage
Never	253	81.09%	81.09%
Sometimes	47	15.06%	96.15%
Everyday	6	1.92%	98.08%
Do not know or not response	6	1.92%	100.00%

Table 36. Student Survey Results by Item—How often does someone else read to you at home?

How often does someone else read to you at home?	Frequency	Percentage	Cumulative Percentage
Never	239	76.60%	76.60%
Sometimes	62	19.87%	96.47%
Everyday	5	1.60%	98.08%
Do not know or not response	6	1.92%	100.00%

Table 37. Student EGRA Results by Item—Nonword Reading Twi

Nonwords in TWI	Correct	% Correct	Incorrect	% Incorrect
wew	2	0.64%	310	99.36%
tɔm	2	0.64%	310	99.36%
wum	2	0.64%	310	99.36%
yu	2	0.64%	310	99.36%
gam	3	0.96%	309	99.04%
don	3	0.96%	309	99.04%
nɔw	2	0.64%	310	99.36%
biw	2	0.64%	310	99.36%
rew	2	0.64%	310	99.36%
mɔm	2	0.64%	310	99.36%
mam	3	0.96%	309	99.04%
kiw	2	0.64%	310	99.36%
lem	3	0.96%	309	99.04%

Nonwords in TWI	Correct	% Correct	Incorrect	% Incorrect
low	3	0.96%	309	99.04%
fin	3	0.96%	309	99.04%
kew	2	0.64%	310	99.36%
rom	2	0.64%	310	99.36%
men	2	0.64%	310	99.36%
nuw	2	0.64%	310	99.36%
ro	1	0.32%	311	99.68%
liw	1	0.32%	311	99.68%
lew	1	0.32%	311	99.68%
duw	1	0.32%	311	99.68%
rem	0	0.00%	312	100.00%
ren	0	0.00%	312	100.00%
lom	0	0.00%	312	100.00%
gom	0	0.00%	312	100.00%
lam	0	0.00%	312	100.00%
mun	0	0.00%	312	100.00%
lim	0	0.00%	312	100.00%
lo	0	0.00%	312	100.00%
row	0	0.00%	312	100.00%
gi	0	0.00%	312	100.00%
gew	0	0.00%	312	100.00%
pum	0	0.00%	312	100.00%
lem	0	0.00%	312	100.00%
niw	0	0.00%	312	100.00%
nin	0	0.00%	312	100.00%
fen	0	0.00%	312	100.00%
li	0	0.00%	312	100.00%
gow	0	0.00%	312	100.00%
gen	0	0.00%	312	100.00%
ron	0	0.00%	312	100.00%
luw	0	0.00%	312	100.00%
pom	0	0.00%	312	100.00%
lin	0	0.00%	312	100.00%
gem	0	0.00%	312	100.00%
no	0	0.00%	312	100.00%
yom	0	0.00%	312	100.00%
gon	0	0.00%	312	100.00%

Table 38. Student EGRA Results by Item—Oral Reading Fluency Twi

Oral reading in TWI	Correct	% Correct	Incorrect	% Incorrect
Ama	23	7.37%	289	92.63%
adi	3	0.96%	309	99.04%
mfe	3	0.96%	309	99.04%
anum.	3	0.96%	309	99.04%
Ama	10	3.21%	302	96.79%
nkɔɔ	3	0.96%	309	99.04%
akuraa	2	0.64%	310	99.36%
da.	4	1.28%	308	98.72%
ɔte	3	0.96%	309	99.04%
kurow	3	0.96%	309	99.04%
kɛse	2	0.64%	310	99.36%
mu.	2	0.64%	310	99.36%
Da	3	0.96%	309	99.04%
bi,	4	1.28%	308	98.72%
ɔne	2	0.64%	310	99.36%
ne	3	0.96%	309	99.04%
papa	2	0.64%	310	99.36%
kɔɔ	2	0.64%	310	99.36%
ne	2	0.64%	310	99.36%
Nanabarima	0	0.00%	312	100.00%
akuraa.	1	0.32%	311	99.68%
Nkanea	0	0.00%	312	100.00%
nni	1	0.32%	311	99.68%
hɔ.	0	0.00%	312	100.00%
Ntontom	1	0.32%	311	99.68%
nso	0	0.00%	312	100.00%
nni	0	0.00%	312	100.00%
hɔ.	0	0.00%	312	100.00%
Nanabarima	0	0.00%	312	100.00%
wɔ	0	0.00%	312	100.00%
nnuaba	0	0.00%	312	100.00%
ahorow	0	0.00%	312	100.00%
pii.	0	0.00%	312	100.00%
Mmofra	0	0.00%	312	100.00%
no	0	0.00%	312	100.00%
tetew	0	0.00%	312	100.00%
bi	0	0.00%	312	100.00%
di	0	0.00%	312	100.00%
daa.	0	0.00%	312	100.00%
Eyi	0	0.00%	312	100.00%

Oral reading in TWI	Correct	% Correct	Incorrect	% Incorrect
nti	0	0.00%	312	100.00%
Ama	0	0.00%	312	100.00%
ani	0	0.00%	312	100.00%
gyei.	0	0.00%	312	100.00%
Wampɛ	0	0.00%	312	100.00%
sɛ	0	0.00%	312	100.00%
ɔbɛko	0	0.00%	312	100.00%
kurow	0	0.00%	312	100.00%
kɛsɛ	0	0.00%	312	100.00%
mu	0	0.00%	312	100.00%
bio.	0	0.00%	312	100.00%
Na	0	0.00%	312	100.00%
ɔkae	0	0.00%	312	100.00%
se,	0	0.00%	312	100.00%
daakye	0	0.00%	312	100.00%
mede	0	0.00%	312	100.00%
nkanea	0	0.00%	312	100.00%
bɛba	0	0.00%	312	100.00%
akuraa	0	0.00%	312	100.00%
ha.	0	0.00%	312	100.00%

Table 39. Student EGRA Results by Item—Reading Comprehension Twi

Reading Comprehension in TWI	Correct	% Correct	Incorrect	% Incorrect
Ama adi mfe ahe?	3	0.96%	309	99.04%
Ama te hefa?	2	0.64%	310	99.36%
Dɛn na enni akuraa hɔ?	0	0.00%	312	100.00%
Dɛn nti na Ama ani gyei?	0	0.00%	312	100.00%
Dɛn nti na Ama pɛɛ sɛ ɔde nkanea bɛko akuraa hɔ?	0	0.00%	312	100.00%

Table 40. Student EGRA Results by Item—Listening Comprehension Twi

Listening Comprehension in TWI	Correct	% Correct	Incorrect	% Incorrect
Maame Afua ye dɛn?	78	25.00%	234	75.00%
Ne nnuan a ɔtɔn no fi he?	143	45.83%	169	54.17%
Dɛn nti na mmea tɔ Maame Afua nnuan?	139	44.55%	173	55.45%

Table 41. Student EGRA Results by Item—Nonword Reading English

Invented words in ENGLISH	Correct	% Correct	Incorrect	% Incorrect
dit	7	2.24%	305	97.76%
fut	4	1.28%	308	98.72%
lus	6	1.92%	306	98.08%
leb	4	1.28%	308	98.72%
gak	2	0.64%	310	99.36%
huz	2	0.64%	310	99.36%
jod	4	1.28%	308	98.72%
lek	5	1.60%	307	98.40%
tob	5	1.60%	307	98.40%
kib	5	1.60%	307	98.40%
reg	3	0.96%	309	99.04%
san	5	1.60%	307	98.40%
nom	4	1.28%	308	98.72%
rop	3	0.96%	309	99.04%
hig	3	0.96%	309	99.04%
tup	3	0.96%	309	99.04%
nad	3	0.96%	309	99.04%
wix	1	0.32%	311	99.68%
ral	3	0.96%	309	99.04%
nep	3	0.96%	309	99.04%
sim	2	0.64%	310	99.36%
tat	2	0.64%	310	99.36%
yod	2	0.64%	310	99.36%
lut	2	0.64%	310	99.36%
sig	2	0.64%	310	99.36%
nup	2	0.64%	310	99.36%
sen	1	0.32%	311	99.68%
en	1	0.32%	311	99.68%
kad	1	0.32%	311	99.68%
mon	0	0.00%	312	100.00%
taw	0	0.00%	312	100.00%
lew	0	0.00%	312	100.00%
zuv	0	0.00%	312	100.00%
sal	0	0.00%	312	100.00%
paf	0	0.00%	312	100.00%
gof	0	0.00%	312	100.00%
vom	0	0.00%	312	100.00%
riz	0	0.00%	312	100.00%
ved	0	0.00%	312	100.00%
kag	0	0.00%	312	100.00%

Invented words in ENGLISH	Correct	% Correct	Incorrect	% Incorrect
beb	0	0.00%	312	100.00%
et	0	0.00%	312	100.00%
maz	0	0.00%	312	100.00%
ver	0	0.00%	312	100.00%
kol	0	0.00%	312	100.00%
lim	0	0.00%	312	100.00%
tib	0	0.00%	312	100.00%
dov	0	0.00%	312	100.00%
yag	0	0.00%	312	100.00%
lef	0	0.00%	312	100.00%

Table 42. Student EGRA Results by Item—Oral Reading Fluency English

Oral reading in ENGLISH	Correct	% Correct	Incorrect	% Incorrect
There	23	7.37%	289	92.63%
is	31	9.94%	281	90.06%
no	12	3.85%	300	96.15%
doctor	6	1.92%	306	98.08%
in	19	6.09%	293	93.91%
the	21	6.73%	291	93.27%
village	8	2.56%	304	97.44%
where	4	1.28%	308	98.72%
Ama	15	4.81%	297	95.19%
lives.	6	1.92%	306	98.08%
Father	11	3.53%	301	96.47%
is	18	5.77%	294	94.23%
sick.	7	2.24%	305	97.76%
Ama	15	4.81%	297	95.19%
says	8	2.56%	304	97.44%
that	8	2.56%	304	97.44%
when	6	1.92%	306	98.08%
she	11	3.53%	301	96.47%
grows	6	1.92%	306	98.08%
up	8	2.56%	304	97.44%
she	8	2.56%	304	97.44%
will	5	1.60%	307	98.40%
be	8	2.56%	304	97.44%
a	8	2.56%	304	97.44%
doctor.	4	1.28%	308	98.72%
She	6	1.92%	306	98.08%
will	4	1.28%	308	98.72%

Oral reading in ENGLISH	Correct	% Correct	Incorrect	% Incorrect
help	5	1.60%	307	98.40%
people	4	1.28%	308	98.72%
who	4	1.28%	308	98.72%
are	3	0.96%	309	99.04%
sick	4	1.28%	308	98.72%
like	4	1.28%	308	98.72%
father.	2	0.64%	310	99.36%
Kojo	1	0.32%	311	99.68%
wants	3	0.96%	309	99.04%
to	3	0.96%	309	99.04%
be	3	0.96%	309	99.04%
a	3	0.96%	309	99.04%
teacher.	3	0.96%	309	99.04%
He	2	0.64%	310	99.36%
will	2	0.64%	310	99.36%
teach	0	0.00%	312	100.00%
boys	2	0.64%	310	99.36%
and	2	0.64%	310	99.36%
girls	2	0.64%	310	99.36%
to	2	0.64%	310	99.36%
be	2	0.64%	310	99.36%
healthy.	2	0.64%	310	99.36%
Father	1	0.32%	311	99.68%
smiles.	1	0.32%	311	99.68%
He	0	0.00%	312	100.00%
is	0	0.00%	312	100.00%
happy	0	0.00%	312	100.00%
with	0	0.00%	312	100.00%
both	0	0.00%	312	100.00%
of	0	0.00%	312	100.00%
his	0	0.00%	312	100.00%
children.	0	0.00%	312	100.00%

Table 43. Student EGRA Results by Item—Reading Comprehension English

Reading Comprehension in ENGLISH	Correct	% Correct	Incorrect	% Incorrect
Who is sick?	5	1.60%	307	98.40%
What does Ama want to be when she grows up?	3	0.96%	309	99.04%
Why does Ama want to be a doctor?	0	0.00%	312	100.00%
What will Kojo teach boys and girls?	0	0.00%	312	100.00%
Why is father happy with his children?	0	0.00%	312	100.00%

Table 44. Student EGRA Results by Item—Listening Comprehension English

Listening Comprehension in ENGLISH	Correct	% Correct	Incorrect	% Incorrect
Why was Issa sad?	0	0.00%	312	100.00%
Who went to look for the sheep?	6	1.92%	306	98.08%
Why is Issa smiling now?	0	0.00%	312	100.00%

Table 45. Student EGRA Results by Item—Oral Vocabulary English

Oral vocabulary in ENGLISH	Correct	% Correct	Incorrect	% Incorrect
Book	173	55.45%	139	44.55%
Frog	77	24.68%	235	75.32%
Plane	285	91.35%	27	8.65%
Duck	49	15.71%	263	84.29%
Trousers	215	68.91%	97	31.09%
Monkey	89	28.53%	223	71.47%
Banana	225	72.12%	87	27.88%
Flower	243	77.88%	69	22.12%

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