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Task Order 7
Early Grade Reading and Mathematics in Rwanda

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Task Order 7
Early Grade Reading and Mathematics in Rwanda

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Abbreviations

EGAT/ED	USAID's Office of Education in the Bureau of Economic Growth, Agriculture, and Trade
EGMA	Early Grade Mathematics Assessment
EGRA	Early Grade Reading Assessment
GDP	gross domestic product
ORF	oral reading fluency
RTI	RTI International (trade name of Research Triangle Institute]
SES	socioeconomic status
SSME	Snapshot of School Management Effectiveness
USAID	United States Agency for International Development
wpm	words per minute

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Introduction

The Economist magazine[1] includes Rwanda among the world's top 10 fastest growing economies for the period from 2001 to 2010. During the past 10 years, the education system in Rwanda has benefited from the country's strong economic growth. Rwanda increased the share of its gross domestic product (GDP) expended on education from 3.2% in 1996 to over 5% in 2009, fueling a rapid expansion of basic education. Rwandans are rightfully proud of the success they have had in developing their country and expanding basic education to achieve near universal access. The quality of education has also improved over the past decade, with increases in teacher qualifications, higher rates of primary school completion, and greater transition from primary to lower secondary school.[2] However, Rwandans are far from satisfied. Vision 2020 states that Rwanda aspires to become a modern, strong, and united nation with a middle-income, knowledge-based economy.[3] Rwanda is also positioning itself as a beacon for investment in East Africa. That strategy includes switching from French to English as the official medium of instruction in school, as well as building a sound base of human capital. This places great emphasis on literacy in Kinyarwanda and English and on strong numeracy as the foundations for the higher-order math, science, technology, and critical-thinking skills that Rwanda sees as essential to its future.

Rwanda recognizes that education for all has to mean more than children enrolling in school. Access to education must lead to learning. Education systems around the world may emphasize different learning objectives and different aspects of children's social, emotional, and cognitive development, but all educators would agree that children should acquire basic reading and math skills in primary school.

When measuring an education system's quality or effectiveness, we can pose some basic questions: Are children learning to read? Are they learning basic math skills? Are they acquiring those skills early enough in primary school to secure the foundation for further learning? In Rwanda, like in many countries, more than one language is used in school. Therefore, students are expected to learn to read and must understand and express basic math concepts in at least two languages: Kinyarwanda and English. Thus, when measuring the effectiveness of Rwandan primary schools, these two languages must also be taken into account. English replaced French as an official language of instruction in 2008, so expectations for what children (and teachers) can do in English at this point in time should be limited. In 2011, Kinyarwanda became the official language of instruction in the first three years of primary school. However, children must learn English well enough in the early grades of primary school to use it as the medium of their continued education.

[1] The lion kings?. (2011, January 6). The Economist, 39(2), 21.
[2] Lynd, Mark. (2010). *Assessment report and proposal for an education strategy.* Prepared for U.S. Agency for International Development/Rwanda. Kigali, Rwanda.
[3] Ministry of Finance and Economic Planning. (2000) *Rwanda Vision 2020.* Kigali, Rwanda.

It is one thing to measure whether students are learning to read and master basic math skills. Also of interest is understanding why students may learn more or learn faster in some schools than in others. Therefore, in addition to assessing learning outcomes, we want to measure which schools create environments that support learning. We want to ask questions such as: Do students and teachers have the materials they need? Do students and teachers spend enough time engaged in activities that support learning? And, what instructional practices are teachers using?

To answer these questions about learning and the factors influencing it in Rwanda, the USAID-funded Education Data for Decision Making (EdData II) Project partnered with USAID/Rwanda and the Rwandan Ministry of Education to conduct a study of reading and math skills and the learning environments that support them in a nationally representative sample of 42 primary schools. **Table 1** below summarizes the sample, and additional details are provided in **Annex A.**

Table 1. Summary of the Survey Sample

	Total	% Female
Schools	42	
Head Teachers	42	17%
Teachers	203	32%
Students	840	53%
Parents	82	39%

In March 2011, a research team evaluated the skills of 420 P4 and 420 P6[4] students with an Early Grade Mathematics Assessment (EGMA) instrument adapted to the Rwandan curriculum and context. An English-language Early Grade Reading Assessment (EGRA) instrument was adapted to the Rwandan context, while a Kinyarwanda-language instrument was developed based on the linguistic structure of the Kinyarwanda language.[5] We gathered a diverse range of information using the Snapshot of School Management Effectiveness (SSME) instruments developed by the EdData II project and customized for the Rwandan context. A random selection of districts and non-private schools in Rwanda were included in the survey, and therefore students from a range of socioeconomic backgrounds are represented. The majority of students in this survey were at the lower end of the socioeconomic distribution, based on analysis of the kinds of possessions which their families had. For example, only 11% of students reported having electricity and 4% reported having water from a tap.

[4] P4 and P6 are equivalent to primary school Grade 4 and primary school Grade 6.
[5] Details on the sample of students and schools are provided in **Annex A** of this report.

The findings of the EGRA, EGMA and SSME surveys are presented and discussed in this report.

How Well Are Students Learning to Read in Kinyarwanda?

Oral Reading Fluency and Comprehension

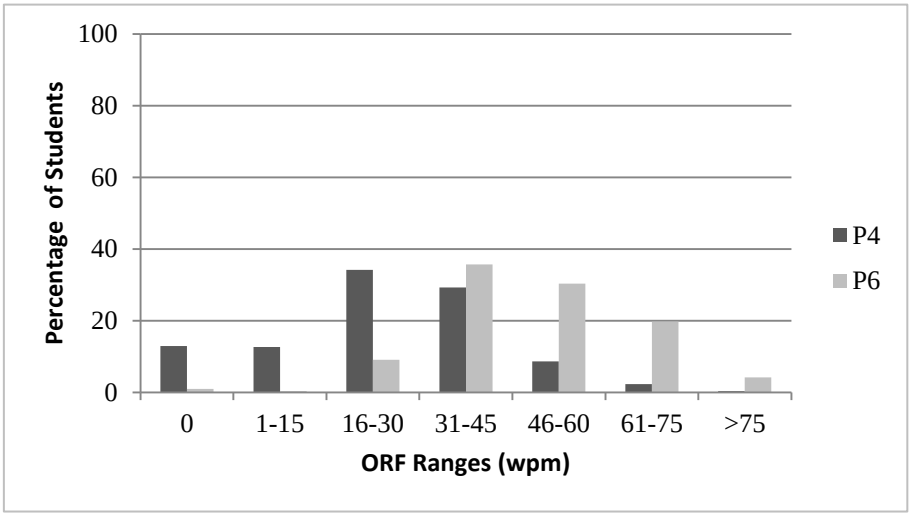
The Kinyarwanda reading skills of P4 students were evaluated using an instrument geared towards a P2–P3 expected level of reading.[6] Students at the P6 level were evaluated using the same instrument, permitting easy comparison of any differences in the levels of skill acquisition between the two grades. **Figure 1** below shows the oral reading fluency demonstrated by P4 and P6 students. The following conclusions can be drawn:

- Students in P6 could read simple text more fluently than students in P4. Average oral reading fluency was 26 words read correctly per minute for P4 students and 48 words read correctly per minute for P6 students.
- Girls in P6 had a higher reading fluency, averaging 51 words per minute (wpm), compared to 46 wpm for boys in the same grade.
- Even after three full years of instruction, 13% of students in P4 could not read a single word of a P2–P3-level text. Another 13% were reading less than 15 wpm.
- Most students in P6 could read more than 31 wpm of P2–P3-level text, although only 32% could read more than 50 words per minute.[7]
- Oral reading fluency appeared to be low for Rwandan students overall, given that Kinyarwanda was the mother tongue for 98% of them and that a very basic level text was used in the EGRA assessment.

[6] Because the study was conducted at the start of the academic year, it was deemed appropriate to evaluate students at the start of P4 using P2–P3-level content.

[7] Between 45 and 60 wpm is considered the minimum required level of fluency for solid comprehension for beginning English language readers. It is likely that the minimum level for Kinyarwanda is somewhat lower given the difference in word length from English. However, it would be desirable for P6 students to well surpass the minimum level on a P2–P3 level text.

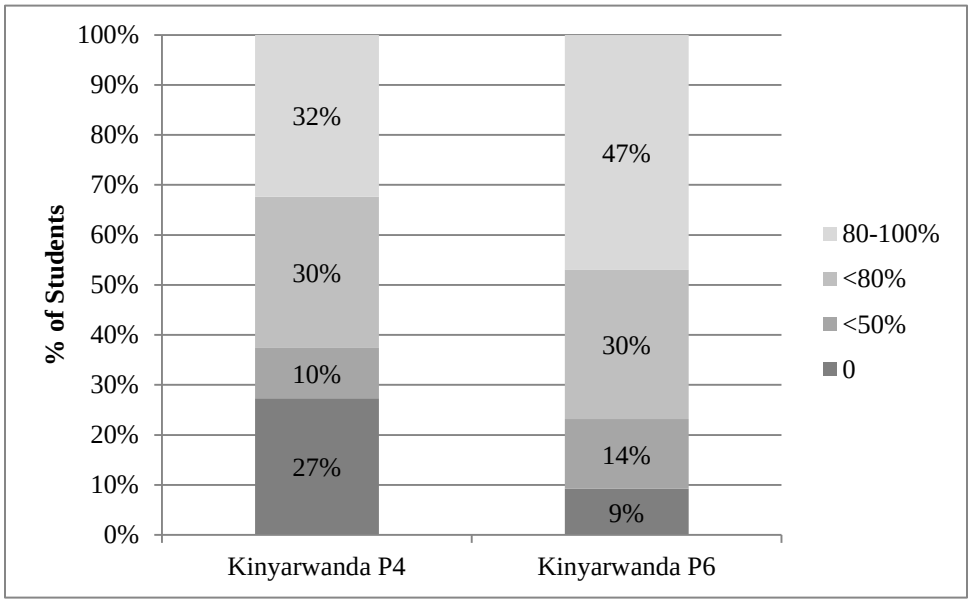
Figure 1. Kinyarwanda Oral Reading Fluency (ORF) – P4 and P6 (Beginning of Academic Year)



More important than how fluently students can read a text is whether or not they understand what they have read. The passage text reading subtask of the Kinyarwanda EGRA included a reading comprehension section where students were asked questions about the text they had read. This section included both literal and inferential questions.

Comprehension was examined by calculating the percent of comprehension questions correct out of those posed to the student, since students reading more slowly may not have finished the entire text. Figure 2 shows the percentage of students for each range of comprehension scores (correct/attempted). This figure shows improvement from P4 to P6. It indicates that almost half of the P6 students were able to answer 80% of the questions they were asked on a P2–P3-level text. Still, almost 40% of P4 students are not able to answer even 50% of the questions posed based on a P2–P3-level text.

Figure 2. Kinyarwanda Reading Comprehension Levels – P4 and P6 (Beginning of Academic Year) – Percent Correct / Attempted



It would appear that students are learning some of the mechanics of reading in Kinyarwanda, but many are not reading with sufficient comprehension to use text to support their learning of subject area content (some even after five years of schooling).

Literacy Skill Areas in Kinyarwanda

In addition to evaluating how well students can read a short example of P2–P3-level connected text, the EGRA instrument used in Rwanda also assessed students' ability in five other literacy skill areas. These include:

- Phonemic awareness (understanding the sounds letters make in words—e.g., naming the beginning sound of a word);
- Letter sound knowledge (saying the sound that a letter makes);
- Reading syllables (a consonant and a vowel together—e.g., *ba*);
- Reading short, familiar words; and
- Reading invented words (a way to assess decoding skills).

EGRA assesses whether students have the above skills, but by also timing how quickly students perform these tasks, EGRA evaluates whether students have achieved a desired level of automaticity in these skill areas. For example, when children first learn their letters, they may take some time to recognize and distinguish each letter in the alphabet. However, as they progress in their skill development, we fully expect that they will quickly and easily recognize letters and the sounds they make, as well as easily recognize familiar words and decode simple, short, unfamiliar words. In fact, the skill of decoding

unfamiliar words is most critical to becoming an independent reader, because students will encounter more unfamiliar words as they read more advanced texts, especially across different subject areas.

Table 2. Average Student Performance in Kinyarwanda Literacy Skill Areas, by Grade

Subtask	P4		P6	
	Fluency (/min.)	Accuracy (% correct/attempted)	Fluency (/min.)	Accuracy (% correct/attempted)
Phonemic awareness	N/A	20%	N/A	30%
Letter-sound knowledge	18 letters/min.	31%	26 letters/min.	33%
Syllable reading	48 syll./min.	81%	79 syll./min.	97%
Familiar word reading	29 words/min.	79%	51 words/min.	95%
Unfamiliar nonword decoding	15 words/min.	61%	28 words/min.	80%
Oral passage reading	26 words/min.	80%	49 words/min.	96%
Reading comprehension	N/A	53%	N/A	68%
Listening comprehension	N/A	70%	N/A	78%

Table 2 summarizes students' performance in the literacy skill areas mentioned above. Students at the P4 and P6 levels did very poorly on phonemic awareness. More than 90% of both groups were only able to correctly identify the beginning sound of a word on, at most, 3 or 4 out of the 10 items in this subtask. Both P6 and P4 students did much better at reading two-letter syllables than at identifying individual letters. Analysis of the items contained in the phonemic awareness and letter-sound recognition subtasks reveals that P4 and P6 students correctly identify the sounds of vowels, but not of consonants. The low scores in both of these subtasks result from the high rates at which students incorrectly identify the sounds of consonants. In contrast, P4 and P6 students

Vowels versus Consonants

- **96% of the time, students correctly identified the sound of a vowel**
- **1% of the time, they correctly identified the sound of a consonant (in isolation)**
- **Over 90% of the time, they correctly read a syllable (containing a consonant and a vowel)**

read syllables at a high rate of accuracy. Clearly, students are not learning the sounds of consonants in isolation. Consonants are only introduced as elements of a syllable (combining a consonant and vowel sound). This could explain why both groups read familiar words with greater automaticity than they read unfamiliar (invented) words, which require letter by letter decoding to read. Student who are unable to read unfamiliar words will be disadvantaged when they attempt to read higher level text.

Students at the P4 and P6 levels are able to accurately decode a P2–P3-level text. Both groups read the text presented to them with an 80% or higher accuracy (80% on average in P4, 96% in P6). However, both groups are also reading much slower than should be expected of students in those grades. On average, P4 students were able to progress only halfway through the short text, and P6 students, on average, also did not finish reading the simple text. Learning to read means being able to accurately identify words, but students must also identify those words and extract meaning from the text they read at a much quicker pace, especially by the time they reach the end of primary school.

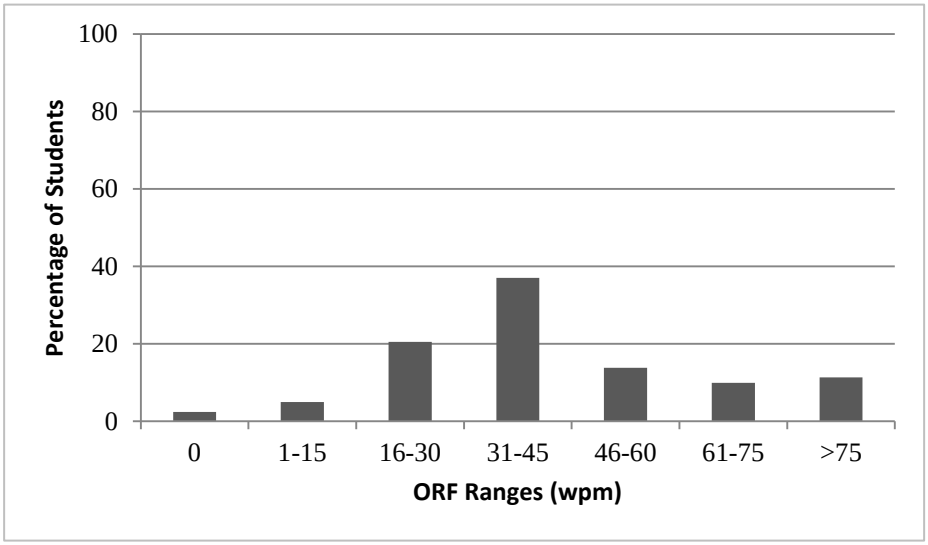
How Well Are Students Learning to Read in English?

Oral Reading Fluency and Comprehension

Assessment of students' ability in English has to recognize that English became the official language of instruction only in 2008. Students in P4 and P6 in the 2010/11 school year have only had limited instruction in English and any instruction they have received is from teachers who themselves have limited English.[8] As a result of the policy adopted in 2011, students now begin their primary schooling being instructed in Kinyarwanda, are expected to learn English during the first three years of school, and then transition in P4 into classrooms where English is used as the medium of instruction. Acquisition of strong literacy skills in English is, therefore, required for success in upper primary school and beyond.

[8] A survey conducted by the British Council in 2009 found that 85% of primary teachers only have beginner level English.

Figure 3. English Oral Reading Fluency (ORF) – P6 (Beginning of Academic Year)



Text Used on the English EGRA:

"My name is Senga. I live on a farm with my mother, father, and sister Ana. Every year, the land gets very dry before the rains come. We watch the sky and wait. One afternoon as I sat outside, I saw dark clouds. Then something hit my head, lightly at first and then harder. I jumped up and ran towards the house. The rains had come at last."

Figure 3 above shows the results for the P6 English-language EGRA instrument. Although English was a second language for all students, there were few zero scores for oral reading fluency in P6. On average, P6 students read 43 wpm in English and approximately 35% of the P6 students were reading above 45 wpm. Recall that the text used (shown in the adjacent text box) was at a P2–P3 level.[9] P6 students appear to have been transferring to English the decoding skills that they were gaining in their first language. However, only 21% of P6 students reached a reading speed of 60 words or more per minute. By U.S. standards, a student reading below 82 wpm at the beginning of P6 is considered "at risk" of failure in school.

There were no differences in the performance of boys and girls on any of the English language reading subtasks.

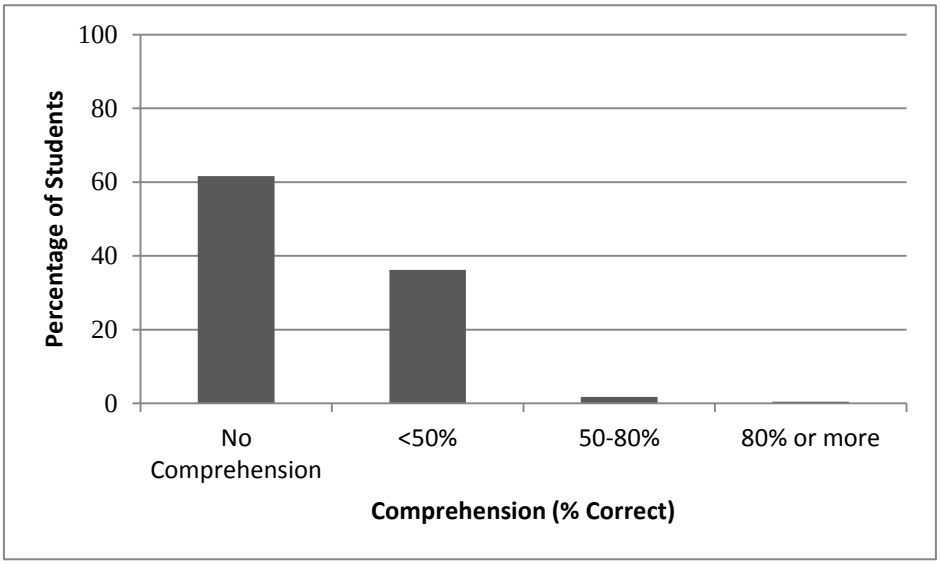
Figure 4 below, however, shows that students' reading comprehension in English was extremely poor, which is not surprising given that instruction in English was only introduced three years prior to this survey. Research shows that children can learn the sounds of a second language and learn to decode words, but they will have great

[9] Additional examples of EGRA subtasks are provided in **Annex 2.**

difficulty comprehending what they read if they have not achieved a sufficient level of functionality in that language.[10]

The great majority of P6 students (98%) could not respond to more than half of the comprehension questions, with 62% unable to respond to even a single question correctly. No students demonstrated comprehension of at least 80%. Again, these P6 comprehension results are not surprising given the recent shift to the English language as the medium of instruction. However, it is important to note that P6 students were not gaining enough understanding of the language to be able to comprehend a basic P2–P3-level text, let alone read grade-level subject matter in English.

Figure 4. English Comprehension – P6 (Beginning of Academic Year)



Oral English Language Comprehension in P4

Students' poor comprehension results were echoed in the P4 English language assessment. The P4 instrument included only oral English tasks, and focused on vocabulary and listening comprehension. Here students were tested to see if they could identify common vocabulary. For example, 27% of students were not able to point to the appropriate body part when asked, and 57% were not able to follow simple spatial instructions (such as "on" and "in front"). Given the limited amount of instruction they had had and the likely low level of English proficiency of their teachers, P4 students had not yet been able to build even a basic vocabulary in English.

[10] See, for example, Lesaux, N. & Siegel, L. (2003). The development of reading in children who speak English as a second language. *Developmental Psychology, 39*, 1005–1019.

Literacy Skill Areas in English

As in Kinyarwanda, we assessed several specific literacy skills in English, but only for P6 students. The English EGRA evaluated students' phonemic awareness, letter recognition, and familiar and unfamiliar (invented) word reading.[11] Students' phonemic awareness in English was much worse than in Kinyarwanda; 76% of P6 students could not identify the initial sound in a single word presented to them. Also, P6 students' letter recognition and familiar word reading were less automatic in English than in Kinyarwanda.

Table 3. Average Student Performance in English Literacy Skill Areas, P6

Subtask	P6	
	Fluency (/min.)	Accuracy (% correct/attempted)
Phonemic awareness	N/A	<1 out of 10 correct
Letter-sound knowledge	22	37%
Familiar word reading	37	68%
Unfamiliar nonword decoding	32	66%
Oral passage reading	43	70%
Reading comprehension	N/A	11%
Listening comprehension	N/A	16%

As was the case in Kinyarwanda, P6 students could identify the sounds of vowels much more accurately than they could identify the sounds of consonants in isolation. Clearly, there is an issue with how Rwandan teachers introduce letter sounds and how they help students develop the skill of sounding out letters in words. In neither Kinyarwanda nor English do students adequately learn how to use the sounds of consonants to decode words. Although teaching reading at the syllable-level may work to some degree for Kinyarwanda, it is not an effective approach for English, where students need to be able to recognize individual letter sounds to decode unfamiliar words.

[11] The syllable subtask was included for Kinyarwanda because it is an agglutinating language and, as such, there may be a tendency to teach reading at the syllabic level. The English language does not share this trait, so no syllable subset was included in the English version of the EGRA.

When presented with a simple English text, on average, P6 students were not reading quickly enough to finish the short passage. Although P6 students attempted to read more of the English passage than the Kinyarwanda one, they read the English passage much less accurately. On average, students read only 68% of the words correctly, with certain words, in particular, being read incorrectly most often. The text box presented here highlights the words that more than half the students read incorrectly.

Words most frequently misread:

"My name is Senga. I live on a farm with my mother, father, and sister Ana. Every year, the land gets very dry before the rains come. We watch the sky and wait. One afternoon as I sat outside, I saw dark clouds. Then something hit my head, lightly at first and then harder. I jumped up and ran towards the house. The rains had come at last."

How Well Are Students Learning Mathematics?

We used the Early Grade Mathematics Assessment (EGMA) instrument to evaluate P4 and P6 students' basic skills in math. All items on the test, except the written exercises for P6, were presented orally to students in Kinyarwanda. The EGMA included several subtasks that measured students' skill across the following areas of basic math:

- Number identification—timed reading of numbers; more complex numbers were used for P6 as appropriate to the Rwandan curriculum (e.g., P6 included numbers with decimals);
- Quantity discrimination—choosing the greater of presented quantities, with more complex numbers used for P6 than P4, as appropriate to the Rwandan curriculum (e.g., P6 students had to compare numbers with decimals);
- Missing number—filling in a number in a presented sequence, with more complex numbers used for P6 than P4, as appropriate to the Rwandan curriculum;
- Word problems—solving short calculation problems given orally to students in Kinyarwanda, using the same items for P4 and P6;
- Addition—timed completion of simple two-number addition examples, using the same items for P4 and P6;
- Subtraction—timed completion of simple two-number subtraction examples, using the same items for P4 and P6;
- Geometry—identifying shapes, using the same items for P4 and P6;
- Multiplication—providing the answer to simple multiplication examples (only given to P6); and
- Written exercises—solving addition and subtraction problems presented in written form (only given to P6).

The vast majority of students were able to complete some items correctly in each category, with few zero scores on most of the mathematics subtasks. **Table 4** below presents the P4 and P6 mean scores on the subtasks that assessed automaticity (number

identification, simple addition, and simple subtraction, which were each timed for one minute, as well as basic multiplication in P6).

Table 4. Mean Scores for P4 and P6 EGMA Subtasks That Assessed Automaticity

	P4					P6				
	Mean (per minute)	Std. Error	Min.	Max.	Accuracy	Mean (per minute)	Std. Error	Min.	Max.	Accuracy
Number Identification (per minute)	18.9	.995	1	46	83%	10.8	.571	0	25	69%
Addition (per minute)	10.7	.653	0	32.7		19.1	.794	4	53	93%
Subtraction (per minute)	7.7	.530	0	24	64%	15.5	.646	0	36.3	86%

Students did demonstrate some automaticity on addition and subtraction by the beginning of P6. However, their mastery of basic addition and subtraction (examples shown in text box at the right and in **Annex 2**) needs to be more automatic if, as expected in P6 and beyond, students are to perform more complicated calculations. Students did less well on subtraction than addition, both in terms of how automatically they were able to respond and in the percentage of items they answered correctly. They most frequently struggled with numbers greater than 10.

The mean score for number identification was lower in P6 than P4—this is probably because of the more difficult, albeit P6-appropriate, items that were included at this level. P6 students, on average, correctly completed more than half of the basic multiplication facts, but with a wide variation in their performance.

Examples of EGMA Items

Addition:
4 + 2; 5 + 6; 10 + 5

Subtraction:
9 – 4; 14 – 6; 8 – 3

Multiplication:
2 x 3; 9 x 7; 5 x 6

About half of the students who were tested read the entire problem aloud before providing the answer (for example, when shown 4 + 2, they would say “four plus two equals six,” instead of just saying “six”). For P6 students, those who read out the problem before providing the answer did have a lower correct score. P4 students showed no significant difference in automaticity when reading each item aloud (perhaps those who provided just the answer were nevertheless reading out the item in their heads). More importantly, the fact that half the P6 students recited the problem to before providing the answer may indicate something about the way math is taught and practiced in Rwandan

classrooms. Such simple math facts should be practiced for automatic recognition and calculation, not repeated verbatim.

Table 5 below presents the P4 and P6 mean scores on the subtasks that did not measure automaticity (quantity discrimination, missing number, and word problems). These items involved greater conceptual understanding.

Table 5. Mean Scores for Untimed P4 and P6 EGMA Subtasks

	P4				P6			
	Mean	Standard Error	Min.	Max.	Mean	Standard Error	Min.	Max.
Quantity Discrimination No. correct (10)	7.8 (78%)	.258	0	10	6.3 (63%)	.222	0	10
Missing Number No. correct (10)	2.7 (27%)	.394	0	10	4.0 (40%)	.436	0	10
Word Problems No. correct (5 for Grade 4; 6 for Grade 6)	3.5 (70%)	.078	0	5	4.2 (69%)	.149	0	6
Multiplication No. Correct (8)					4.1 (51.6%)	.020	0	8

Students in P4 and P6 performed better on quantity discrimination and word problems than they did on the timed subtasks presented in **Table 5** above. P6 students, on average, correctly compared quantities only 63% of the time, but they had to work with more difficult numbers (e.g., fractions and decimals). P6 students did well on word problems, answering correctly on average 69% of the time. However, the word problems required only a single simple operation to solve. P4 and P6 students performed the worst on the missing number subtask, where the average score was 2.7 out of 10 for P4 students and 4 out of 10 for P6, indicating that they had a better working understanding of number values and sequences, even when presented with more complex numbers (although they did perform more poorly on decimals and numbers greater than three digits).

In no case did the results of P4 or P6 students represent full mastery of basic math skills. Students should be able to answer these kinds of simple questions with a very high degree of accuracy, and they should be able to demonstrate much greater automaticity when identifying numbers or recalling basic addition and subtraction facts.

The final section of the EGMA instrument for both grades focused on geometry. This subtask measured whether students could identify the characteristics or attributes of different shapes and whether they knew the correct names/terms for common geometric forms. In P4, only 50% of the students were able to indicate the correct shape when given its attributes. Of P4 students, 56% were unable to name any of the shapes presented (in

either English or Kinyarwanda). In P6, the majority of students could indicate the correct shape based on its attributes, but 38% could name only one of the shapes.

On all the subtasks in math, P6 boys outperformed P6 girls. They scored between 10% and 20% higher on almost all the subtasks, with the biggest difference being in identifying missing numbers and shape attributes. P4 boys outperformed P4 girls on subtraction and word problems.

What Is Happening in Rwandan Primary Schools?

Student performance in reading and math depends on whether they have received adequate instruction in the skill areas assessed by the EGRA and EGMA. We, therefore, present here the findings from classroom observations and interviews with teachers and students. Our team observed P4 and P6 lessons during Kinyarwanda, English, and math classes at every school visited, using a detailed observation protocol to record at timed intervals throughout a lesson the actions of teachers and students, as well as the content being covered and the materials used. We observed the following:

- Instruction across subjects and grades was almost exclusively whole class;
- The most frequently observed teacher action was writing on the blackboard and student action was writing in their notebooks;
- Although 60% of teachers reported always using ministry textbooks in their classrooms, textbooks were observed actually being used only during some Kinyarwanda lessons. We noted textbooks being used on average during:
  - 1% of observations in a math class
  - 4% of observations in an English class
  - 22% of observations in a Kinyarwanda class;
- In many observed lessons, textbooks were not used at any time:
  - 90% of the English and math lessons involved no textbook use at any time
  - 49% of the Kinyarwanda classes involved no textbook use at any time;
- Other materials, such as flashcards or posters in language classes, or pictures or objects in math, were essentially never used.

When visiting a school, the field data collection team asked to see "reading" lessons in Kinyarwanda and English for P4 and P6 levels, as summarized in **Table 6** below. What the team observed during those "reading" lessons was content primarily focused on language, dealing mostly with grammar (especially in English) rather than also on the instruction activities needed to develop and reinforce foundational literacy skills.[12] Any

[12] See, for example, Blair, T. R., Rupley, W. H., and Nichols, W. D. (2007). The effective teacher of reading: Considering the "what" and "how" of instruction. *The Reading Teacher 60*, pp. 432-439; or Saunders, W. M., Foorman, B. R., Carlson, C. D. (2006, November). Do we need a separate block of time for oral English language development in programs for English learners? *Elementary School Journal*, *107*(2), 181-198.

reasonable amount of reading instruction occurred most often during the Kinyarwanda classes.

Table 6. Content of "Reading" Lessons

	Kinyarwanda			English		
	P4	P6	Overall	P4	P6	Overall
Spelling	1%	6%	4%	6%	3%	4%
Grammar	43%	40%	42%	68%	83%	76%
Reading Words	2%	0%	1%	3%	1%	2%
Reading Sentences	3%	1%	2%	3%	2%	2%
Vocabulary	12%	13%	13%	7%	2%	5%
Writing/Dictation	0%	0%	0%	1%	0%	0%
Reading Text	13%	18%	15%	6%	1%	4%
Reading Comprehension	14%	16%	15%	2%	0%	1%
Writing/Creating Text	1%	0%	1%	0%	0%	0%
Other	8%	6%	7%	4%	2%	3%

A Kinyarwanda lesson was noted as being focused on reading (words, sentences, text, or comprehension), on average, during 33% of observations overall, but only on 9% of observations overall during an English lesson. It is important to note, however, that during 36% of the observed Kinyarwanda lessons and 68% of the observed English ones, there was no reading content. Overall, when analyzing multiple observation points from across almost 150 lessons, we would expect to see considerably more balance in terms of the content covered.

Math lessons covered a broad spectrum of content, but with most activity centered on use of the blackboard, with students listening to or watching the teacher (on average during 30% of observations in a lesson), writing on the board (15% of observations), copying from the board (10% of observations), or working individually at their desks (11% of observations). Math classes can be characterized as fairly traditional—the teacher demonstrated or explains something at the board; students watched and/or copied it into their notebooks; perhaps a student or two did an example at the board; and then students completed a practice example individually. Support materials or teaching aides of any kind were rarely, if ever, observed being used.

Teachers were giving homework regularly, with most students reporting having an assignment two or more times in the previous week. Most students (82%) had some

evidence of their teachers marking their exercise books, but in the majority of exercise books (54%), teachers had not made any written comments. In almost all exercise books (97%), there were no examples of original writing that children themselves had composed.

It is interesting to note that standard "chalk and talk" pedagogy, which is clearly the predominant teaching approach in Rwandan primary schools, in a math lesson does include some opportunity for students to practice their math skills. In reading lessons, this is not the case. Students are not getting enough opportunities to practice reading, or to practice any of the important subskills associated with becoming independent readers. This may, in part, be explained by the fact that 84% of teachers reported not having received pre-service training in teaching reading, and 73% reported not having had any related in-service training.

What teachers and students spend time doing is a function of teacher training, but it is also influenced by the nature of the classroom and school environment within which they find themselves each day.

One factor influencing almost all primary schools is the workload that teachers must bear. Of the 42 schools, 40 (95%) in the sample were functioning on a double shift. In those schools, teachers had responsibility for at least two sets of students, and about 70% of teachers were teaching more than one grade and more than one subject. A total of 51% of teachers were responsible for four or more preparations each day, with some having more than six.

Table 7. Additional Materials

	Do NOT Have
Books (other than textbooks)	62%
Posters	63%
Teacher-made materials	61%
Student work on walls	95%
Magazines	96%
Any of the above	35%

Another factor to consider is the presence of materials (see **Table 7**). Two thirds of students had exercise books and 84% had something with which to write. A clear subset of students was disadvantaged; 11% did not have exercise books. Over half of the school directors reported not having received textbooks as expected at the time of data collection, almost two months into the school year. Although data on the presence of textbooks in class was lost because of problems with data collection/entry, classroom observations showed that any textbooks that were present were rarely used, despite teachers stating the contrary. A total of 65% of teachers did report having a teacher's manual.

Reading materials other than textbooks were not frequently found in Rwandan primary schools. Table 7 also shows some data about these other reading materials. Nine schools in the sample (21%) did have a library, but the numbers of books in those libraries were fairly limited.

In terms of the quality of the physical environment, most classrooms (80%) had a good blackboard and had adequate lighting (80%). Many classrooms (41%) did not have enough desks, but in 98% of classrooms the team observed no students sitting on the floor. Students simply crowded onto the available benches. In almost all cases, desks were arranged in traditional rows, but in 5% of classrooms, desks were arranged in small groupings.

Lastly, how frequently teachers or students miss school can also impact the learning process. None of the schools reported having been closed other than on official holidays. It was noted that 71% of principals reported that one or more teachers were absent on the previous day (usually due to illness). Also, 20% of students reported having been absent the previous week, most frequently because they had been sick. Over 40% of students reported having been tardy, almost always because they had other work to do at home.

Which Factors Are Most Strongly Associated with Better Student Performance?

This section of the report presents the results of several analyses conducted to determine how much of the variation in student performance on the reading assessment can be explained by the kinds of factors discussed in the previous section. We analyzed the data gathered from student, teacher, and head teacher interviews, as well as the data from school and classroom observations, to isolate the variables that correlated significantly with variation in reading assessment results. We focused our analysis on reading in Kinyarwanda, as the variation in student performance and the fact that both grades were able to take the same test lent themselves better to analysis of correlations.

We found many factors that correlated with student performance in reading. These can be organized into four broad categories: (1) the instructional environment, (2) the school environment, (3) the home reading culture, and (4) the socioeconomic status (SES) of students' families. As an overview of these factors, we examined the characteristics of good readers (at least 80% comprehension in Kinyarwanda) and nonreaders (not able to read one word) across factors that correlated with student performance. **Table 8** summarizes these factors and how these student groups differ across them. The factors are discussed in more detail below.

Table 8. Characteristics of Nonreaders and Good Readers

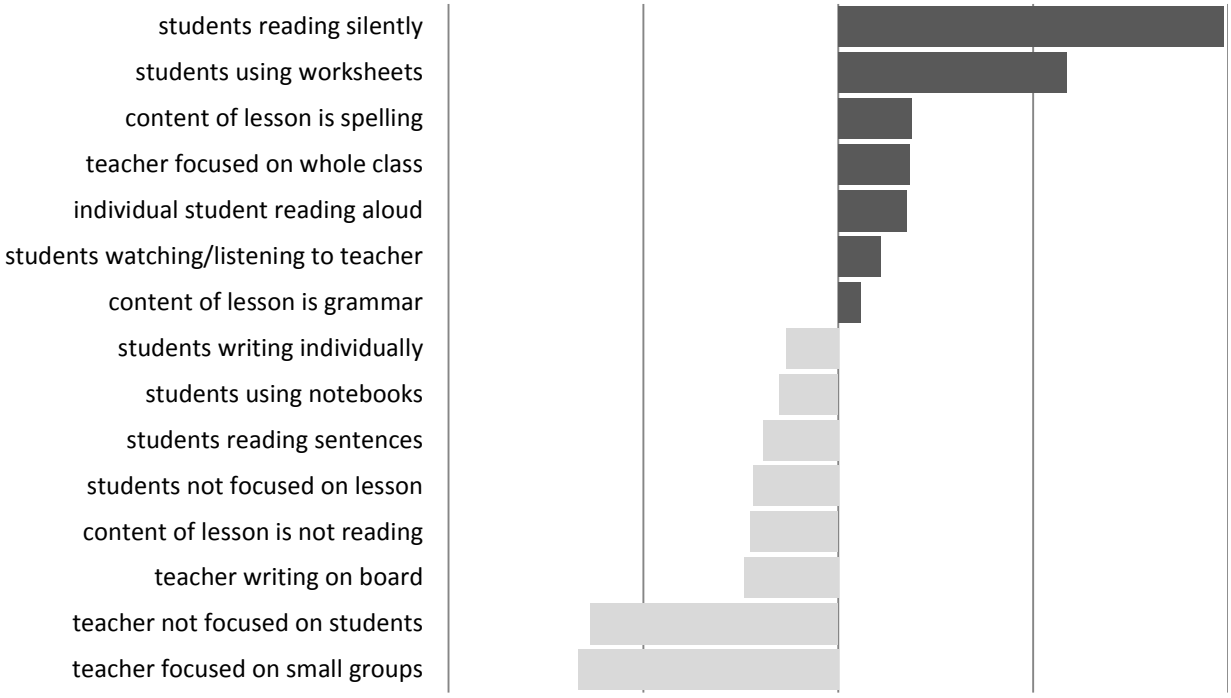
	Nonreader	Good Reader
Student is repeating the grade	9.4%	2.5%
Teacher writes comments in notebook	28.8%	58.4%
Student was NOT absent last week	65.7%	82.7%
Student has other reading materials at home	27%	44.5%
Student feels safe at school	62.3%	84.9%
Teacher has professional qualifications	41.1%	71.4%
The school received books on time	50.1%	73%
School has book storeroom, with books used	38.8%	61.5%

Instructional Environment

Using the classroom observations, we determined the relative significance of observed differences in teacher and student behavior in classrooms during Kinyarwanda reading lessons. The graph in **Figure 5** shows the classroom practices that had significant relationships with students' oral reading fluency in Kinyarwanda, and plots them in such a way as to show which correlated positively (black bars) and negatively (gray bars) with reading performance. The size of a bar indicates how strong the relationship is between each factor by itself and with reading performance.[13]

[13] Each individual factor was analyzed in isolation—that is, tests of correlation were calculated as if all other factors were constant, and the factor being examined could be isolated and increased. The bars represent the resulting increase or decrease in reading performance.

Figure 5. Relative Impact on Kinyarwanda Oral Reading Fluency of the Listed Factors



It is worth noting which factors are at the top and bottom of this chart. The two factors at the top of the chart have the strongest positive relationships with Kinyarwanda reading fluency. Students in classrooms where silent reading occurred and where individual worksheets were used had better oral reading fluency scores. The two factors at the bottom of the chart have the strongest negative relationships with reading. That students scored poorly if their teacher was observed to not be focused on them during a lesson is not surprising. However, it is surprising to find that reading fluency scores were lowest in classrooms where teachers were observed to be more focused on small groups. An observation that a teacher was focused on small groups was not necessarily an indicator of students doing small group work. It may simply have indicated that the teacher was directing the lesson to only a fraction of the class rather than the whole class. For example, a teacher might have been neglecting many of the students in the room by focusing attention only on those sitting in the front. Because Rwandan teachers do receive training in child-centered instruction that includes use of small groups, the negative relationship between focusing on small groups of students and reading performance may also indicate that teachers are attempting, but are not properly assigning and managing, group work.

School Environment

Students in schools that were better equipped (that had electricity or water from a tap) had better Kinyarwanda oral reading fluency scores. Students in schools that made use of learning materials also performed better. For example, we found that students performed slightly better in reading if their school had a storeroom with books that showed obvious evidence of being used regularly. How teachers evaluated student work was also a determining factor. Students who had regular written comments in their exercise book, whose teachers reported using written tests to evaluate their performance, and whose teachers discussed their school work with them, had better reading performance. The strongest school environment factor associated with reading performance was having a teacher with professional qualifications.

Home Environment

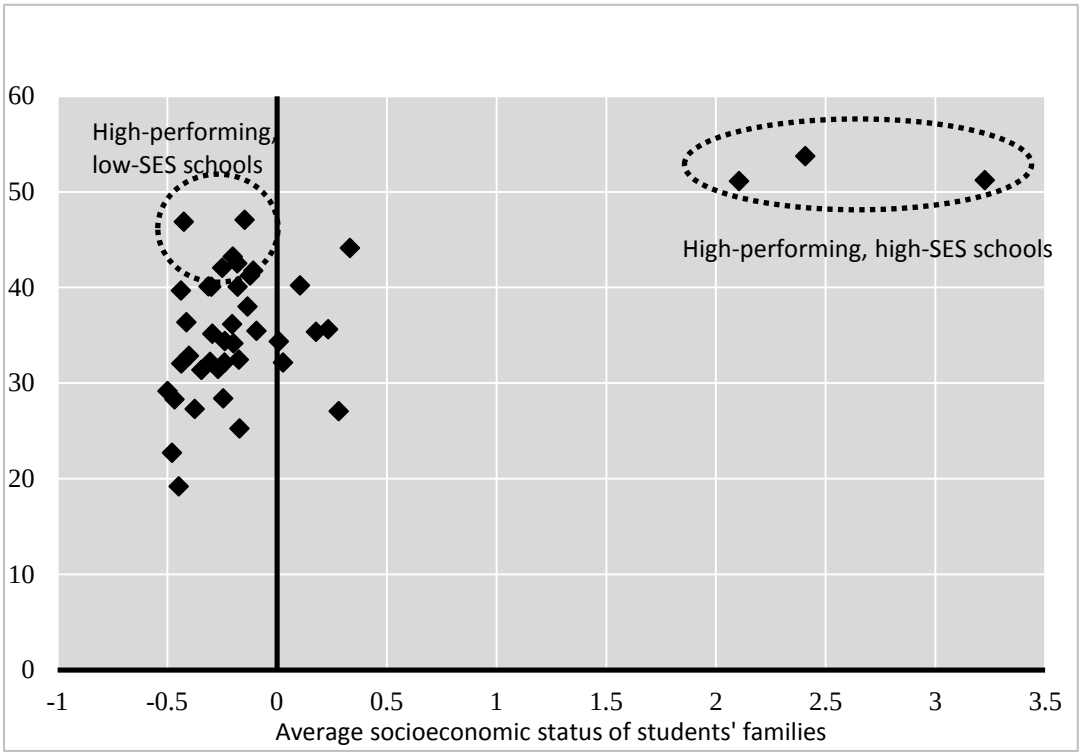
Students from families in which no one could read had lower reading outcomes than those who were from families in which the mother or father, or another relative at home, could read. Students from families in which someone could read also performed better in math. Having books other than school books available at home also showed up as a factor associated with higher performance in reading.

Socioeconomic Status[14]

As would be expected, students from families with higher SES had higher reading performance. For example, students who reported that their families had electricity, piped water, or a television, performed better than those who did not have these things. However, we did try to determine if schools could help students overcome the typical learning advantages that accrue to students from higher-SES families. **Figure 6** below shows students' average oral reading fluency in Kinyarwanda and the average socioeconomic status of the families served by each school.

[14] An SES proxy was created by asking students a series of questions about possessions in the household. Factor analysis was then used to create a composite SES variable.

Figure 6. SES and Reading Performance



In the upper right portion of the graph in **Figure 6,** we find the usual set of schools that on average were serving students from much higher SES families and that had higher average oral reading fluency outcomes. The more interesting group of schools is the one circled in the upper left portion of the graph. These schools, on average, were serving families with a low socioeconomic status, but were able to produce average oral reading fluency results that were higher than those of other schools serving similarly low-SES families. These schools were able to provide the resources and instructional approaches that enabled their students to overcome some of the disadvantages normally associated with less well-resourced home environments.

Conclusions

In Rwandan primary schools, most students were learning to read in both Kinyarwanda and English and to do mathematics. Reading skills in Kinyarwanda were better than in English, with some evidence that basic skills were transferring from the maternal to the foreign language. However, many students were not learning to read well enough in either language to fully comprehend text, and many of them did not receive adequate instruction in the important skills needed to successfully decode and read unfamiliar words and make meaning out of text. Mathematics skills appear to have been better

taught than reading, although students were not learning to automatically perform the basic calculations that underpin further work in mathematics and the sciences. Some important number concepts also appear to not have been fully developed.

A recent study conducted by Uwezo in Kenya, Tanzania, and Uganda evaluated students' reading of Standard II level English text.[15] Very few Standard IV students in Tanzania and Uganda demonstrated Standard II level competency, and disappointing percentages of Standard VI students in those two countries were able to adequately read English at the Standard II level. Kenya had much better results. Although the EGRA used in Rwanda was different from the instruments used in the Uwezo study, we do see comparable levels of performance among P6 students and the Standard VI students in Tanzania and Uganda, all of which were well below what students in those grades should be able to do in education systems that expect them to be learning in English. As in Rwanda, the results in Tanzania and Uganda were better for mathematics than for reading, but again with not all Standard VI (or P6) students mastering Standard II (P2) level material.

This study of reading and math performance draws our attention to the classroom practices that are needed to support improved acquisition of basic skills in Rwandan primary schools.

First, teachers need to receive adequate training in classroom practices that support the development of their students' foundational reading and math skills. As mentioned in discussing the classroom observation results, classroom time is spent mostly on the language instruction—e.g., grammar, syntax, and punctuation—to the detriment of instruction in the basic features of literacy acquisition. To learn to read in alphabetic languages, students need to be taught the sound each letter makes; must learn to recognize those sounds at the beginning, middle, and ends of words; and must learn to blend sounds together to form words. They must learn how to and spend time practicing decoding unfamiliar words. Teachers will need to learn how to incorporate these kinds of activities into their daily lessons.[16]

Second, emphasis needs to be placed on using classroom time as productively as possible, giving students ample practice in reading (which also means making sure more reading materials are available in school) and doing math (which will require teachers making better use of pictures and objects to reinforce number concepts, quantity differentiation, and mathematical applications). While we observed some practicing of basic math skills, what was being done is far from adequate. Teachers need to learn the techniques for managing classroom time to ensure adequate practice in basic math and reading skills. Teachers should learn why it is important to provide daily practice (in class and in students' assignments) in math and in oral reading (the only way to develop fluency). Research has shown that the amount of time spent learning basic skills is a

[15] Hoogeveen, H. and D. Andrew. (June 2011) *Are our children learning? Numeracy and literacy across East Africa*. Report prepared by the Uwezo Unit, Kenya; based at Twaweza East Africa, Tanzania.
[16] See for example, Gove, A. and Cvelich, P. (2010). *Early reading: Igniting education for all. A report by the Early Grade Reading Community of Practice*. Research Triangle Park, North Carolina: RTI International.

critical determinant of students' levels of achievement, especially for students who come to school with less than the desired level of language development. Given the language transition issues in Rwanda, students are trying to learn to read (and do math) in languages for which their vocabularies are underdeveloped, so therefore more time is needed to make up for that language deficiency and to build requisite basic skills.[17]

The issues of instructional content and allocation and use of adequate time for developing and practicing basic skills are further compounded by the recent switch to English as a medium of instruction. If more time and instructional technique are devoted to developing solid foundations of reading and math skills in Kinyarwanda, students will be better positioned to switch to English. However, introduction of English and development of sufficient oral vocabulary (something this survey revealed is not happening) needs to be targeted as a specific area of intervention. The success Rwanda has had providing English language training to teachers needs to be build on and reinforced; teachers need to build strong enough English skills themselves to be able to promote the development of their students' language skills.

Once they have acquired sufficient knowledge of and working vocabularies in English, students will then need good instruction in the basic phonetics of the English language so that they can learn to easily decode words. And they need abundant practice reading increasingly challenging English text so that they can build fluency and comprehension. Students need to develop much stronger reading and comprehension skills than those these assessments revealed, before they can be expected to encounter and understand subject matter taught in English in upper primary and post-primary grades.

Once the above improvements have been made, it will be important to utilize instruments like EGRA and EGMA in order to examine whether, and how quickly, proficiency is improving. In the Rwandan context, the results presented here show that the EGRA/EGMA instruments are most appropriate at the earlier grade levels (P1–P3 for Kinyarwanda, and P4 for English). That is, while students at the end of P3 and P5 (or beginning of P4 and P6, as targeted in this study) showed areas of need for improvement, the results were positive enough to indicate that with targeted support, as described above, there is potential for moving students to mastery and beyond relatively quickly. It will be important, then, to assess students in the earlier grades in order to ensure they learn to read with fluency and comprehension before they are expected to use their mastery of reading skills in order to learn across the subjects.

[17] See for example, Brown, B., & Saks, D. (1986). Measuring the effects of instructional time on student learning: Evidence from the beginning teacher evaluation study. *American Journal of Education, 94*(4): 480-500.

Annex A. Further Discussion of the Students and Schools Included in the Sample

This annex presents additional technical details about the sampling process for the EdData II survey, as well as characteristics of the final sample.

Randomized, clustered sampling was used to obtain a nationally representative sample of non-private schools (public or government-aided schools only). The clustered sampling process involved randomly selecting 14 districts and then randomly selecting 2–4 schools within each district, depending on the number of schools in each district, for a total of 42 non-private schools. Within each school, one P4 and one P6 section was selected to participate in the study. From each of these sections, 10 students were randomly selected to participate, resulting in a sample of 420 P4 and 420 P6 students. Each student was assessed using an English EGRA instrument, a Kinyarwanda EGRA instrument, and an EGMA instrument in Kinyarwanda. The tests were given to each student in random order, and each was asked to participate in a student questionnaire. The subject teachers for mathematics, English, and Kinyarwanda from these same classes were interviewed, and their lessons were observed. In each school, the head teacher was also interviewed, as well as 1–2 parents.

Table A-1 below shows the overall sample of schools and students participating in the study.

Table A-1. Schools and Students in the Sample, by District

District	No. of Schools	P4 students	P6 students	Total Students
Gakenke	4	40	40	80
Gatsibo	3	30	30	60
Gicumbi	4	40	40	80
Gisagara	2	20	20	40
Huye	3	30	30	60
Karongi	4	40	40	80
Kicukiro	2	20	20	40
Kirehe	2	20	20	40
Nyagatare	3	30	30	60

District	No. of Schools	P4 students	P6 students	Total Students
Nyamagabe	3	30	30	60
Nyaruguru	4	40	40	80
Rubavu	3	30	30	60
Rusizi	2	20	20	40
Rutsiro	3	30	30	60
TOTAL	**42**	**420**	**420**	**840**

Student Characteristics

The gender of participating students is shown in **Table A-2**, with girls representing slightly more than half of the student sample.

Table A-2. Students in the Sample, by Gender

	P4	P6
Male	195 (46%)	197 (47%)
Female	225 (54%)	223 (53%)

The average age of P4 students, as reported in the class register, was 12.4 years, but with a wide range (from 6 years to 20 years). The average age of P6 students was 14.6 years, ranging from 10 to 19. If the appropriate age for P4 could be generously considered to be from 7 to 11 years of age, then 65% of P4 students were over age. Similarly, if for P6 we allow the appropriate age to be considered from 9 to 13 years, then 73.6% of P6 students were over age. In addition, 13% of the P4 students reported having been in P4 last year (they were repeating the year), while only 2% of P6 students reported repeating the grade. When asked to identify their own absence or tardiness during the previous week of school, 20.2% of students stated that they had been absent, while 46.7% said they had been tardy. Illness and other work to do at home were the primary reasons reported for both absence and tardiness.

The students were also asked which language they primarily use at home. From the study sample, 98% of children reported that they mostly speak the Kinyarwanda language at home—only one child reported speaking in English at home. In addition, students were asked a number of questions about the support they received at home. This information is presented in **Table A-3** below.

Table A-3. Student Support at Home

The percentage of students who . . .	P4	P6
Have someone at home who can read	90%	93%
Bring books home from school	42%	66%
Have other (non-schoolbook) reading materials at home	35%	37%
Read at least sometimes at home	67%	69%
Have someone read to them at home at least sometimes	54%	45%
Receive help on English homework at home	71%	57%
Receive help on Kinyarwanda homework at home	73%	67%
Receive help on math homework at home	72%	66%

School Characteristics

Within the study sample, 17 schools (40%) had at least one secondary grade (S1–S3), while the rest had grades P1–P6 only. Of the 42 sample schools, 40 reported that they operated on a double-shift in at least some of the primary grades. The average enrollment for P1–P6 was 1,045 students, within a range of 400 to 2,881. While the average class size, as reported by teachers, was 40 students, class sizes ranged from 13 to 64. Still, 80% of the reported class sizes were between 30 and 50 students. Of the schools sampled, 82% had a male head teacher, while on average, female teachers made up slightly over half (53%) of the teaching staff for P1–P6.

Data collected on training and qualifications of school personnel revealed that head teachers had an average of five years of experience in that position; at the time of the survey, over 50% of them had been a head teacher for three years or less. Of the 42 head teachers interviewed, 32 reported having received specialized training in school management. Teachers participating in the study had, on average, nine years of teaching experience. Among these teachers, 22% reported that they did not have professional qualifications. The majority of teachers (61%) had A2/S6 (three years at a teacher training college) as their highest level of academic education.

Data collected on class visits, in-service training, and parental involvement showed that 79% of teachers interviewed reported being visited or observed in their classes at least once a month. Of the study sample teachers, 78% reported being visited or observed in their class by an education officer (external to the school) at most once a year, and 55% of head teachers reported that their schools were visited by an education officer at most once a year. As for training, 64% of English and Kinyarwanda teachers reported having neither pre-service nor in-service training in methods for teaching reading, and 58% of math teachers reported having had neither pre-service nor in-service training related to math instruction.

Annex B. Reliability of EGRA/EGMA Instruments

We undertook a number of tests in order to determine whether and how the various subtasks on the EGRA and EGMA assessments used in Rwanda were reliable, and whether they were testing an underlying skill, presumably early grade reading and math skills. For the English EGRA, we focused on P6, as the P4 assessment was an abbreviated form of the core EGRA assessment and focused only on oral language and pre-reading skills.

In order to examine reliability, we first performed a Cronbach's alpha reliability test, the results of which are presented in **Tables B-1 through B-5.**

Table B-1 shows the reliability analysis for the full English P6 EGRA instrument. Note that the lowest item-test correlations were found for the phonemic awareness and comprehension subtasks. This indicates that these sections do not appear to "fit" as well with the other subtasks. Even with those issues, however, the entire test's Cronbach's alpha is 0.71, which is generally considered acceptable. If we remove these subtasks and examine only the fluency measures, shown in Table B-2, we find a Cronbach's alpha of 0.81, which is considered good for a low-stakes assessments such as EGRA. As shown in the body of the report, the results from the phonemic awareness and comprehension sections of the English assessment did not seem as tightly linked with the fluency sections as is normally expected.

Table B-1. Reliability Analysis of P6 English EGRA

Item	Item-test correlation	Item-rest correlation	Alpha
Phonemic awareness	0.16	0.13	0.73
Letter-sound fluency	0.46	0.26	0.72
Familiar word fluency	0.92	0.83	0.53
Unfamiliar word fluency	0.84	0.71	0.59
Connected text fluency	0.87	0.74	0.57
Reading comprehension	0.26	0.25	0.73
Listening comprehension	0.31	0.30	0.73
Overall test			0.71

Table B-2. Reliability Analysis of P6 EGRA: Fluency Measures

Item	Item-test correlation	Item-rest correlation	Alpha
Letter-sound fluency	0.46	0.26	0.89
Familiar word fluency	0.92	0.83	0.64
Unfamiliar word fluency	0.84	0.71	0.72
Connected text fluency	0.87	0.74	0.70
Overall test			0.81

Table B-3 shows the reliability analysis for the Kinyarwanda EGRA instrument. The item-test correlations for phonemic awareness and listening comprehension were lower than for the other subtasks; however, the entire test's Cronbach's alpha is 0.84, which is generally considered good for a low-stakes assessments such as EGRA.

Table B-3. Reliability Analysis of Kinyarwanda EGRA

Item	Item-test correlation	Item-rest correlation	Alpha
Phonemic awareness	0.22	0.20	0.86
Letter-sound fluency	0.73	0.67	0.82
Syllable reading fluency	0.95	0.88	0.80
Familiar word fluency	0.96	0.93	0.76
Unfamiliar word fluency	0.89	0.85	0.79
Connected text fluency	0.92	0.87	0.77
Reading comprehension	0.65	0.65	0.85
Listening comprehension	0.32	0.31	0.86
Overall test			0.84

Both of the EGMA instruments show good Cronbach's alphas, 0.81 and 0.80 respectively, with no particularly low subtask correlations (Tables B-4 and B-5).

Table B-4. Reliability Analysis of P4 EGMA

Item	Item-test correlation	Item-rest correlation	Alpha
Number identification	0.72	0.61	0.77
Quantity discrimination	0.70	0.54	0.78
Missing number	0.63	0.42	0.82
Word problems	0.69	0.54	0.79
Addition	0.77	0.66	0.76
Subtraction	0.82	0.70	0.75
Overall test			0.81

Table B-5. Reliability analysis of P6 EGMA

Item	Item-test correlation	Item-rest Correlation	Alpha
Number identification	0.73	0.62	0.77
Quantity discrimination	0.63	0.46	0.79
Missing number	0.74	0.56	0.78
Word problems	0.72	0.58	0.77
Addition	0.67	0.61	0.79
Subtraction	0.72	0.64	0.77
Multiplication			
Overall test			0.80

Next, we performed principal components analyses[18] to investigate whether there was an underlying construct that all of the EGRA subtasks and EGMA subtasks were evaluating. The results from these tests are presented in **Tables B-6 through B-7.**

[18] Principal components analysis is another means of determining whether the components of this particular assessment measure an underlying skill, and how much of the variation in the sub-task achievement this particular underlying component measures.

Table B-6. Principal Components Analyses: EGRA

English P6 EGRA		Kinyarwanda EGRA	
Phonemic awareness	0.14	Phonemic awareness	0.10
Letter-sound fluency	0.22	Letter-sound fluency	0.31
		Syllable reading fluency	0.42
Familiar word fluency	0.54	Familiar word fluency	0.45
Unfamiliar word fluency	0.47	Unfamiliar word fluency	0.41
Connected text fluency	0.52	Connected text fluency	0.44
Reading comprehension	0.27	Reading comprehension	0.37
Listening comprehension	0.30	Listening comprehension	0.16

Table B-7. Principal Component Analyses: EGMA

P4 EGMA		P6 EGMA	
Number identification	0.43	Number identification	0.39
Quantity discrimination	0.40	Quantity discrimination	0.32
Missing number	0.31	Missing number	0.37
Word problems	0.39	Word problems	0.40
Addition	0.45	Addition	0.41
Subtraction	0.46	Subtraction	0.37
		Multiplication	

The resultant principal component 1 loads at or above .32 on the majority of subtasks on the Kinyarwanda EGRA and on all the fluency measures on the English EGRA. The principal component 1 for both EGMA instruments is near or above .32 for all subtasks.[19]

[19] See Tabachnick, B. G., & Fidell, L. S. (1996). Using multivariate statistics (3rd ed.). New York: HarperCollins, which recommends .32 as a minimum loading level.

Further, we created screeplots to identify how much of the variation in the full instruments is explained by the new principal components that we created. These screeplots are presented in **Figures B-1 through B-4.**

Figure B-1. Screeplot of Eigenvalues for Principal Components 1, "English early grade reading skill," and Other Potential Principal Components

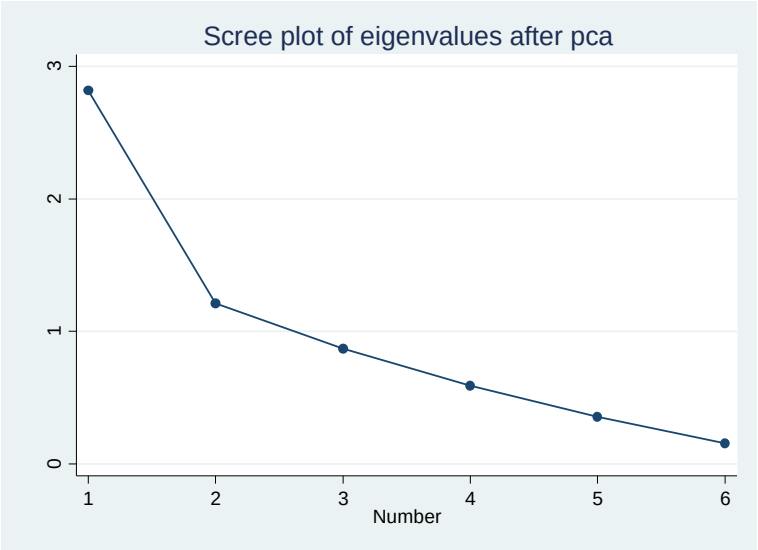


Figure B-1, which shows the screeplot for the English P6 EGRA, indicates that the first component explains just under 3 eigenvalues of variation. In other words, nearly half of the entire variation of all the subtasks is found within this one component, which we would argue is early grade reading skill, with an emphasis on fluency. The second principal component, which emphasizes comprehension (that is, loads more heavily on reading and listening comprehension subtasks), has an eigenvalue of over 1.0, indicating that the comprehension subtasks do not fit together with the fluency subtasks as much as is generally expected, likely because of underlying language issues.

Figures B-2 through B-4 show the screeplots for Kinyarwanda EGRA, and the two EGMA instruments (P4 and P6). In each of these figures, the first component explains about half, or more, of the entire variation of all the subtasks, which we would argue is early grade reading skill in respect to Kinyarwanda EGRA and mathematics in respect to EGMA. The fact that, in each case, the second principal components are so low, with less than 1.0 eigenvalue, suggests that the variation of the underlying constructs in the first principal components is doing a reasonably good job of identifying the true underlying skills of early grade reading and early grade mathematics.

Figure B-2. Screeplot of Eigenvalues for Principal Components 1, "Kinyarwanda early grade reading skill," and Other Potential Principal Components, All of Which Have Eigenvalues of Less Than 1

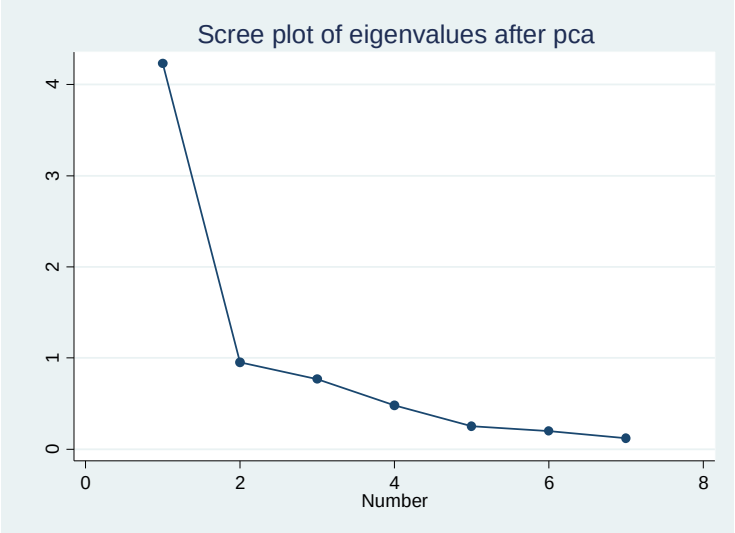


Figure B-3. Screeplot of Eigenvalues for Principal Components 1, "P4 early grade mathematics skill," and Other Potential Principal Components, All of Which Have Eigenvalues of Less Than 1

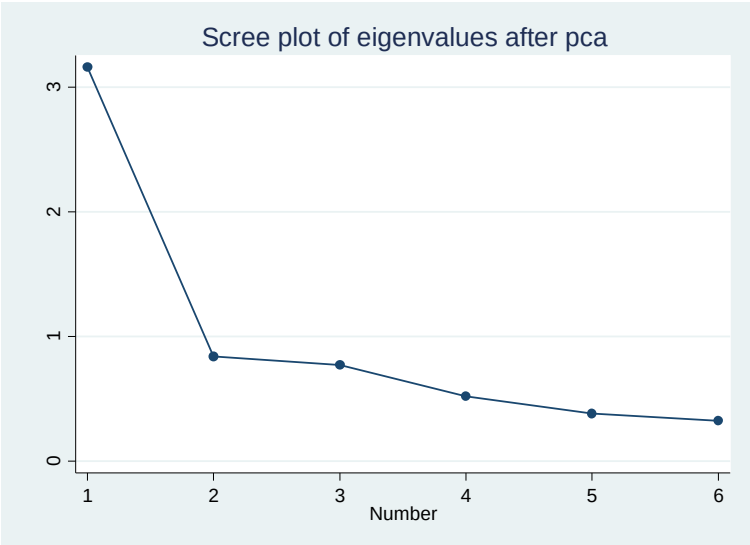
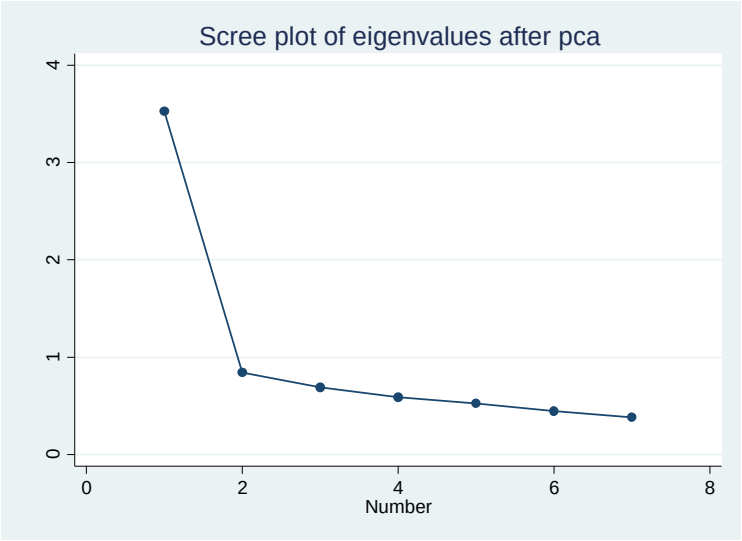


Figure B-4. Screeplot of Eigenvalues for Principal Components 1, "P6 Early Grade Mathematics Skill," and Other Potential Principal Components, All of Which Have Eigenvalues of Less Than 1



Annex C. Sample Items from EGRA and EGMA Instruments

Sample Items from English EGRA – P4:

Vocabulary sample items:

Ndakubwira amwe mu magambo agaragaza ibice byawe by'umubiri. Ujye unyereka icyo gice ku mubiri wawe iryo jambo rigaragaza. Nk'urugero ni : « izuru ryawe », « ijisho ryawe». Reka dutangire

your arm -	your foot -	your chin -	your knee –
your shoulder -	your elbow -	your face -	your hair

Amagambo ajyanye n'ahantu:

Put the pencil:

on the book-	behind you –	on the floor –
under the book -	in front of you -	beside the book

Listening Comprehension (also in P6 instrument):

(Enumerator reads out loud):

My name is Keza. I live with my mother. I've always wondered about the letters that I see painted on stores and signs. I asked myself what they mean. But I don't know how to read, and my mother could not teach me.

Then I started going to school. My teacher taught me how to read! I can go home now and teach my mother to read.

(Enumerator asks questions):

1. Who does Keza live with?
2. What is Keza's problem?
3. Why can't Keza's mother teach her to read?
4. Who taught Keza to read?
5. What will Keza do next?

Sample Items from English EGRA – P6:

Phonemic awareness sample items:

Ni irihe jwi rya mbere ry'ijambo "_____"? "_____"? *[Subiramo ijambo incuro ebyiri]*					
map	/mmmm/	○ Correct	○ Incorrect	○ Don't know	○ No Response
say	/ssssss/	○ Correct	○ Incorrect	○ Don't know	○ No Response
can	/k'/	○ Correct	○ Incorrect	○ Don't know	○ No Response
go	/g'/	○ Correct	○ Incorrect	○ Don't know	○ No Response

Letter sound knowledge sample items:

Examples: A v L

b	c	A	d	g	i	y	M	u	E
E	H	K	N	p	b	f	i	o	n
A	i	M	o	u	E	R	j	N	A

Familiar word reading sample items:

Example : cat	sick	made
go	sad	find
help	two	run
red	and	play
chair	man	when
please	like	soon

Unfamiliar, Nonword decoding sample items:

Example : ut	dif	mab
leb	lus	dit
huz	jod	kib
nom	rop	hig
tup	ral	wix
lut	yod	sim

Passage reading and comprehension:

Passage:

My name is Senga. I live on a farm with my mother, father, and sister Ana. Every year, the land gets very dry before the rains come. We watch the sky and wait. One afternoon as I sat outside, I saw dark clouds. Then something hit my head, lightly at first and then harder. I jumped up and ran towards the house. The rains had come at last.

Comprehension questions:

1. Where does Senga live?
2. Why does the land get dry?
3. Why do Senga and his family watch the sky?
4. What hit Senga on the head?
5. How do you think Senga felt when the rains came?

Sample Items from Kinyarwanda EGRA – P4/P6:

Phonemic awareness sample items:

Ni irihe jwi rya mbere mu ijambo "_____"? "_____"? *[Subiramo iryo jambo incuro ebyiri]*					
Kuki	/k'/	○ Nibyo	○ Sibyo	○ Simbizi	○ Nta gisubizo
Sibyo	/ssss/	○ Nibyo	○ Sibyo	○ Simbizi	○ Nta gisubizo
Papa	/p'/	○ Nibyo	○ Sibyo	○ Simbizi	○ Nta gisubizo

Letter sound knowledge sample items:

Ingero: Z A Y

1	2	3	4	5
b	cy	A	d	g
F	H	K	N	p
A	i	M	o	u
b	e	o	r	z

Syllable reading sample items:

Ingero : pa ko zu

1	2	3	4	5
su	ya	ka	umu	wa
ubu	to	yi	wu	do
so	a	wi	ta	bu
ku	da	ama	ka	tu

Familiar word reading sample items:

Ingero : **Bati** **Umwana** **mfite**

mu	afite	turi
abana	ku	abiri
umuntu	ishuri	neza
amazi	no	ibiti
ngo	ivomero	ko

Unfamiliar, nonword decoding sample items:

Ingero : **upi** **afo** **intu**

gini	nkunto	nwampe
bifo	pyino	numyi
kwipu	rwidwo	nyojwa
pudu	danko	mampi
vonki	risyo	fengo

Passage reading and comprehension:

Passage:

Umuhungu witwa Cyusa yari atwaye igare mu muhanda w'ibitaka yarangaye, noneho atera Sano ibiziba ku myenda ye y'ishuri. Sano agira ubwoba maze ararira cyane. Cyusa abwira Sano ati: "Mbabarira sinabishakaga. Sinari nabonye ibi biziba. Urira igare ngusubize iwanyu ujye guhindura imyenda y'ishuri. Hanyuma ndakwihutana nkugeze ku ishuri kugira ngo udakererwa." Sano arishima cyane kuko yari yungutse incuti!

Comprehension questions:

1. Ni iki cyabaye kuri Sano ubwo yari mu nzira ajya ku ishuri?
2. Kuki Sano yagize ubwoba?
3. Kuki Cyusa yahagaze agafasha Sano?
4. Ni gute ikibazo kigiye gukemuka?
5. Ni iki cyatumye Sano yumva yishimye ku iherezo ry'inkuru?

Sample Items from EGMA – P4/P6:

Number Identification items:

P4

4	10	28	58
94	368	30	106
9	39	14	711

P6

4 010	410	646	1 004
64	368	0.30	99 006
0.09	3 900	104	10 711

P4

6	8
63	54
381	279
79	80

P6

0.6	0.8
1 963	1 954
381	279
79.5	80.5

P4

2, _____, 6, 8
245, 250, 255, _____
_____, 40, 50, 60
_____, 90, 91, 92

P6

222, _____, 226, 228
245, 250, 255, _____
_____, 400, 500, 600
_____, 900, 910, 920

Addition sample items – P4 and P6:

4 + 2 =	8 + 2 =	8 + 6 =
16 + 4 =	7 + 1 =	5 + 4 =

10 + 3 =	10 + 10 =	2 + 2 =
5 + 7 =	6 + 6 =	3 + 4 =

Sample Items from EGMA – P4/P6:

Subtraction sample items – P4 and P6:

6 - 2 =	10 - 2 =	14 - 6 =	13 - 3 =	20 - 10 =	4 - 2 =
20 - 4 =	8 - 1 =	9 - 4 =	12 - 7 =	12 - 6 =	7 - 4 =

Word problem sample item – P4 and P6:

Yozefu afite amacunga 6. Yariyeho amacunga 3. Asigaranye amacunga angahe?

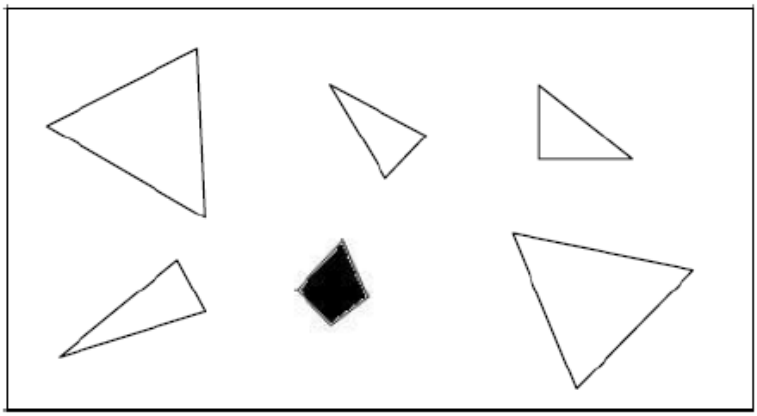
Correct answer: 3 [1] [0]

Multiplication sample items – P6:

2 x 3 =	8 x 6 =
3 x 4 =	9 x 7 =
4 x 7 =	5 x 6 =
6 x 9 =	8 x 9 =

Geometry – P4 and P6:

Reba kuri aya mashusho. Aya mashusho yose yakagombye kuba afite impande eshatu n'inguni eshatu. Erekana ishusho idafite impande eshatu n'inguni eshatu.



✓× [Did the child respond correctly] ? [1] [0]

🗣 Aya mashusho muyita ngo iki *[point to the triangles]* ? ✓× [1] [0]

Annex D. Detailed Statistical Results from EGRA and EGMA Instruments

Table D-1. Detailed Results – English EGRA P4 – Overall Results and Results by Gender

Subtask	Unit	Overall				By Gender					
		Mean	*Std. Err.*	*[95% Conf. Interval]*			*Mean*	*Std. Err.*	*[95% Conf. Interval]*		*P>|t|*
Concepts of print	Tot. Corr. (out of 6)	4.695	0.150	4.371	5.020	Male	4.798	0.165	4.440	5.155	0.082
						Female	4.599	0.172	4.228	4.970	
Vocabulary	Tot. Corr. (out of 20)	4.465	0.471	3.447	5.484	Male	4.425	0.408	3.544	5.307	0.860
						Female	4.503	0.605	3.196	5.810	
Phonemic awareness	Tot. Corr. (out of 10)	0.428	0.139	0.128	0.728	Male	0.437	0.145	0.123	0.750	0.811
						Female	0.420	0.145	0.106	0.734	
Listening comprehension	Tot. Corr. (out of 5)	0.298	0.058	0.173	0.423	Male	0.249	0.048	0.145	0.354	0.129
						Female	0.343	0.086	0.158	0.527	

Table D-2. Detailed Results – English EGRA P6 – Overall Results and Results by Gender

Subtask	Unit	Overall				By Gender					
		Mean	*Std. Err.*	*[95% Conf. Interval]*			*Mean*	*Std. Err.*	*[95% Conf. Interval]*		*P>|t|*
Phonemic awareness	% Correct	0.059	0.020	0.017	0.102	Male	0.050	0.017	0.014	0.087	0.034
						Female	0.067	0.023	0.018	0.117	
Letter-sound knowledge	Letters/min.	21.997	1.569	18.608	25.387	Male	21.298	1.809	17.389	25.206	0.109
						Female	22.657	1.489	19.441	25.874	
Familiar word reading	Words/min.	37.372	4.154	28.399	46.346	Male	37.677	4.260	28.474	46.880	0.710
						Female	37.085	4.320	27.752	46.417	
Unfamiliar nonword decoding	Words/min.	31.651	2.077	27.164	36.139	Male	31.302	2.770	25.317	37.287	0.687
						Female	31.981	1.881	27.918	36.044	
Oral passage reading	Words/min.	43.137	4.308	33.830	52.443	Male	42.755	4.436	33.172	52.338	0.747
						Female	43.497	4.677	33.392	53.601	
Reading comprehension	% Correct/ Attempted	0.111	0.016	0.078	0.145	Male	0.109	0.018	0.070	0.148	0.808
						Female	0.114	0.021	0.067	0.160	
Listening comprehension	% Correct	0.728	0.148	0.407	1.048	Male	0.726	0.128	0.449	1.002	0.951
						Female	0.730	0.176	0.349	1.111	

Table D-3. Detailed Results – Kinyarwanda EGRA P4 – Overall Results and Results by Gender

Subtask	Unit	Overall				By Gender					
		Mean	*Std. Err.*	*[95% Conf. Interval]*			*Mean*	*Std. Err.*	*[95% Conf. Interval]*		*P>|t|*
Phonemic awareness	% correct	0.244	0.017	0.208	0.281	Male	0.231	0.022	0.184	0.278	0.038
						Female	0.257	0.014	0.226	0.287	
Letter-sound knowledge	Letters/min.	18.006	0.938	15.979	20.033	Male	18.272	0.899	16.331	20.213	0.469
						Female	17.757	1.186	15.195	20.319	
Syllables	Syllables/min.	47.854	3.041	41.283	54.424	Male	46.439	2.970	40.022	52.857	0.200
						Female	49.178	3.716	41.151	57.205	
Familiar word reading	Words/min.	28.878	2.357	23.785	33.970	Male	28.278	2.441	23.005	33.551	0.376
						Female	29.440	2.602	23.819	35.061	
Unfamiliar nonword decoding	Words/min.	14.740	1.207	12.133	17.347	Male	14.690	1.373	11.723	17.656	0.907
						Female	14.788	1.320	11.935	17.641	
Oral passage reading	Words/min.	26.101	2.409	20.896	31.306	Male	25.549	2.832	19.432	31.667	0.432
						Female	26.621	2.289	21.675	31.567	
Reading comprehension	% Correct/ Attempted	0.405	0.033	0.335	0.476	Male	0.379	0.040	0.292	0.466	0.133
						Female	0.430	0.043	0.336	0.523	
Listening comprehension	% Correct	0.700	0.025	0.646	0.754	Male	0.693	0.026	0.636	0.751	0.638
						Female	0.706	0.030	0.642	0.770	

Table D-4. Detailed Results – Kinyarwanda EGRA P6 – Overall Results and Results by Gender

		Overall				By Gender					
Subtask	*Unit*	*Mean*	*Std. Err.*	*[95% Conf. Interval]*			*Mean*	*Std. Err.*	*[95% Conf. Interval]*		*P>|t|*
Phonemic awareness	% correct	0.288	0.015	0.257	0.320	Male	0.277	0.021	0.231	0.322	0.066
						Female	0.299	0.011	0.275	0.323	
Letter-sound knowledge	Letters/min.	26.404	1.455	23.259	29.548	Male	25.668	1.460	22.515	28.821	0.055
						Female	27.097	1.575	23.696	30.499	
Syllables	Syllables/min.	78.709	2.688	72.902	84.515	Male	77.732	3.301	70.600	84.864	0.337
						Female	79.630	2.450	74.336	84.924	
Familiar word reading	Words/min.	51.259	2.476	45.910	56.607	Male	49.705	2.345	44.639	54.771	0.053
						Female	52.724	2.851	46.566	58.883	
Unfamiliar nonword decoding	Words/min.	27.871	1.578	24.461	31.281	Male	26.492	1.866	22.462	30.523	0.021
						Female	29.179	1.515	25.907	32.452	
Oral passage reading	Words/min.	48.473	2.432	43.218	53.728	Male	46.101	2.206	41.335	50.866	0.016
						Female	50.710	2.944	44.349	57.071	
Reading comprehension	% Correct/ Attempted	0.664	0.025	0.611	0.717	Male	0.709	0.035	0.634	0.784	0.017
						Female	0.622	0.028	0.561	0.683	
Listening comprehension	% Correct	0.779	0.023	0.730	0.829	Male	0.796	0.026	0.739	0.852	0.181
						Female	0.764	0.025	0.710	0.819	

Table D-5. Detailed Results – EGMA P4 – Overall Results and Results by Gender

Subtask	Unit	Overall				By Gender					
		Mean	*Std. Err.*	*[95% Conf. Interval]*			*Mean*	*Std. Err.*	*[95% Conf. Interval]*		*P>|t|*
Number identification	Items/min.	18.932	0.995	16.783	21.081	Male	19.524	1.159	17.020	22.027	0.144
						Female	18.377	1.051	16.106	20.649	
Quantity discrimination	Tot. Corr. (out of 10)	7.787	0.258	7.229	8.345	Male	7.877	0.309	7.210	8.545	0.323
						Female	7.702	0.262	7.137	8.267	
Missing number	Tot. Corr. (out of 10)	2.673	0.394	1.822	3.525	Male	2.878	0.453	1.899	3.857	0.096
						Female	2.482	0.390	1.638	3.325	
Word problems	Tot.Corr. (out of 5)	3.516	0.078	3.347	3.684	Male	3.695	0.097	3.486	3.904	0.002
						Female	3.348	0.102	3.126	3.569	
Addition	Items/min.	10.693	0.653	9.281	12.105	Male	11.273	0.715	9.728	12.818	0.014
						Female	10.150	0.698	8.642	11.657	
Subtraction	Items/min.	7.863	0.530	6.717	9.009	Male	8.389	0.553	7.195	9.583	0.005
						Female	7.371	0.580	6.118	8.623	
Geometry	Tot. Corr. (out of 8)	3.276	0.225	2.789	3.763	Male	3.564	0.233	3.060	4.067	0.003
						Female	3.006	0.246	2.474	3.538	

Table D-6. Detailed Results - EGMA P6 – Overall Results and Results by Gender

Subtask	Unit	Overall				By Gender					
		Mean	*Std. Err.*	*[95% Conf. Interval]*			*Mean*	*Std. Err.*	*[95% Conf. Interval]*		*P>|t|*
Number identification	Items/min.	10.815	0.571	9.582	12.048	Male	11.167	0.562	9.952	12.382	0.149
						Female	10.483	0.702	8.966	12.001	
Quantity discrimination	Tot. Corr. (out of 10)	6.315	0.222	5.836	6.795	Male	6.571	0.240	6.052	7.090	0.002
						Female	6.074	0.241	5.555	6.594	
Missing number	Tot. Corr. (out of 10)	4.004	0.436	3.063	4.946	Male	4.382	0.437	3.438	5.325	0.000
						Female	3.648	0.466	2.643	4.654	
Word problems	Tot. Corr. (out of 6)	4.150	0.149	3.828	4.473	Male	4.363	0.197	3.937	4.788	0.001
						Female	3.950	0.129	3.672	4.228	
Addition	Items/min.	19.090	0.792	17.378	20.802	Male	20.709	1.019	18.508	22.910	0.000
						Female	17.573	0.785	15.878	19.269	
Subtraction	Items/min.	15.511	0.646	14.115	16.907	Male	16.447	0.794	14.731	18.163	0.005
						Female	14.628	0.725	13.061	16.195	
Multiplication	Tot. Corr. (out of 8)	4.129	0.158	3.788	4.470	Male	4.309	0.182	3.916	4.702	0.105
						Female	3.959	0.221	3.481	4.436	
Geometry	Tot. Corr. (out of 8)	5.195	0.161	4.848	5.543	Male	5.497	0.215	5.034	5.961	0.007
						Female	4.910	0.177	4.528	5.293	
Written exercises	Tot. Corr. (out of 16)	8.565	0.486	7.515	9.616	Male	9.087	0.467	8.077	10.097	0.032
						Female	8.073	0.590	6.798	9.349	

Table D-7. Detailed Results – Factors Showing Correlation with Kinyarwanda Oral Reading Fluency

Factor	Response	Mean	Std. Err.	[95% Conf. Interval]		P>|t|
Repetition	No	37.203	2.606	31.573	42.834	0.043
	Yes	31.623	2.527	26.163	37.083	
Comments in book	No	33.271	1.979	28.996	37.545	0.039
	Yes	42.044	4.309	32.735	51.353	
Meal today	No	34.495	2.183	29.780	39.211	0.012
	Yes	38.002	2.698	32.174	43.830	
Absent last week	No	32.155	2.198	27.406	36.903	0.003
	Yes	38.192	2.740	32.273	44.110	
Someone can read	No	28.059	2.748	22.121	33.997	0.002
	Yes	37.606	2.502	32.201	43.011	
Reading materials at home	No	34.744	2.079	30.253	39.235	0.003
	Yes	40.031	3.084	33.369	46.692	
Feels safe at school	No	29.613	2.170	24.924	34.301	0.001
	Yes	38.934	2.454	33.631	44.236	
Teacher has professional qualifications	No	21.694	4.974	10.949	32.440	0.001
	Yes	39.903	3.476	32.394	47.412	