



**Stanford** | GRADUATE SCHOOL OF  
**EDUCATION**



**Save the Children**

# **Literacy Boost Rwanda**

## **Reading Assessment Report**

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## **Executive Summary**

In the autumn of 2013, researchers from Stanford University led an assessment of current reading skills in the Gicumbi district, Rwanda. Coordinated by Save the Children staff, with approval from both the Rwanda National Ethics Committee (RNEC) and the Stanford University Ethics Review Board (referred to as the Stanford IRB), and with in partnership with the Rwanda Education Board (REB) and the Rwandan Ministry of Education (MiniEduc), the Stanford team and its partners designed, piloted, and conducted a survey and reading assessment for Primary 1 students.

The purpose of this assessment was to establish a baseline for the Literacy Boost randomized control trial. Literacy Boost is a holistic early grades reading program designed to help children learn to read better, both in-school through teacher training and support, and out-of-school through community and home activities.

Official expectations of competencies expected of end-of-Primary 1 students have been difficult to locate. There are anecdotal expectations gleaned from conversations with teachers, REB & MiniEduc staff, and others. Two of these are:

- 1) By the end of Primary 1, students should be able to identify all of the letters in Kinyarwanda.
- 2) By the end of Primary 1, students should be able to read a Primary 1 leveled text in Kinyarwanda.

For now, we use these informal, un-verified expectations to place results from the assessment in context.

In the original proposal for this project, one of the key research questions was, “What are the effects on children's early reading development of the (a) teacher training alone and (b) a combination of teacher training with home and community support for children's reading development in a developing world context such as Rwanda?” This report provides baseline data upon which changes in students’ reading development will be measured.

The key research questions that this report explores are:

1. What can the baseline tell us about learners’ emergent reading skills? What does this mean for Literacy Boost programming?
2. How do learners’ reading skills vary by student background, language spoken, and home literacy environment? What does this mean for targeting Literacy Boost’s two strands (teacher training only and teacher training plus community action) of intervention?

## **Data and Methods**

### *Sample*

The survey and reading assessment covered 2118 Primary 1 learners throughout 85 schools across all 21 sectors of the Gicumbi district in the Northern Province of Rwanda. The 85 schools were sampled from a pool of 102 schools in the Gicumbi district that were recruited to take part in the randomized control trial of Save the Children’s Literacy Boost program. While all 102 schools will be assigned to a treatment group or a control group, these randomly selected 85 schools will serve as the sample to track changes in reading development over time.

### *Personnel*

For the creation and piloting of the assessment, a team consisting of Stanford researchers, Save the Children Staff, and representatives from the REB and MiniEduc came together with hired assessors (all University students or recent graduates) to create an assessment that reflected the context of Gicumbi and that would accurately capture the range in reading skill levels of Primary 1 students.

### *Instrument*

Table 1 offers examples of background and home literacy indicators and a detailed description of reading indicators.

Table 1: Data Collected

<b>Student Background</b>	<b>Examples</b>
General	Sex, age, language spoken at home, work duties at home
School-related	Repetition history, ECCD attendance
Socioeconomic status	Type of home, household size, household amenities/possessions
<b>Home Literacy Environment</b>	
Access to print	Materials present in home, types of materials
Reading habits at home	Presence and percentage of family members who students see read, who read to students, who have conversations with students and who help/encourage students to study
<b>Reading &amp; Language Skills</b>	<b>Description</b>
Phonological Awareness	Composed of 5 separate sub tests: a) Similar beginning sounds (10 items total); b & c) Blending & Segmenting syllables (6 items each, 12 total), d & e) Blending & Segmenting Phonemes (12 items each, 24 total)
Alphabet knowledge	Identification of uppercase/lowercase letters in random order. Contains 29 letters representing all 24 letters of the Kinyarwanda alphabet, orthographic variations on “g” (i.e. g, G, & g), “t” (i.e. T, t & t), and “a” (i.e. a & a). Letters X and Q were not assessed but will be during follow-up assessments.
Individual Word Reading	Includes reading high frequency words (10 items) and reading pseudo words (10 items)
Writing	Includes dictation of high frequency words (10 items) and encoding of pseudo-words (10 items)
Reading Comprehension	Includes reading one-sentence statements and answering a simple question (6 separate items) and orally completing written cloze exercises (6 items)
Reading Fluency & Accuracy	N of words in a connected text read correctly in a minute and percentage of words read correctly on 2 separate passages, one approved by a Rwanda Education Board inspector as appropriate for Primary 1 (21 words total) and one appropriate for Primary 3 (60 words total)

These assessments were developed and pilot tested prior to baseline data collection. Participant observers from the Rwanda Education Board and the Rwanda Ministry of Education participated in this process, providing valuable insight and feedback into the creation of the tools.

### *Data Collection*

Assessors were grouped into teams and visited one to two schools per day over the course of four weeks in September and October 2013. Each team comprised of one team leader (a

representative of Save the Children Rwanda), and a team of 8 to 9 assessors. Prior to any assessment, permission to conduct the assessment was granted from district, sector, and cell authorities. In addition, the principal (also known as head teacher) or acting principal at each school signed a consent form approved by RNEC and the Stanford IRB. Each school was left with a copy of this consent while Save the Children M&E staff retained the official signed consent. The verbal assent of Primary 1 students was also sought in compliance with RNEC and Stanford IRB approved protocols, as well as Save the Children internal protocols.

### *Analysis*

To answer question #1, above, we used simple descriptive statistics and, where appropriate, correlations to understand the current reading skills students possess. To answer question #2, we used t-tests<sup>1</sup> and multivariate regression analyses, which control for relevant variables and cluster standard errors by school to account for the nested nature of the data. A third, more complicated piece of the analysis, testing for significant differences between treatment groups, is not of primary concern in the baseline report and will be conducted later in 2014.

### Findings

#### *Student Background*

Students, on average, were slightly under 8 years old. The vast majority of students speak Kinyarwanda at home. However, a sizeable portion of students (13 percent of the sample) speak a language other than Kinyarwanda at home. This indicates that teachers will need to be supported in helping second language learners to learn to read in Kinyarwanda.

Over half of the sample (55 percent) reported that that they had repeated Primary 1 at least one time. Note, this figure is based on the responses of Primary 1 students who were less than 8 years old on average, which may explain why it differs from official government statistics. Students did not report studying with nearly the same frequency as they reported doing work (such as fetching water, cleaning, etc.) at home. Nearly a quarter of students (23 percent) reported never studying at home, and only 15 percent reported studying at home everyday. While we recognize the daily challenges faced by these students and their families, we still encourage Literacy Boost to include advocacy messages highlighting the importance of regular attendance at school and providing children the opportunity both at school and at home to study and learn.

#### *Home Literacy Environment as reported by Primary 1 students*

Over three quarters (76 percent and above) of students report that someone reads to them, and 86 percent of students have a reader in the family. These are extremely valuable resources that Literacy Boost can tap to help students achieve their full learning potential. Also, students have a high amount of verbal interaction with family members, indicating that the potential for accelerating vocabulary growth and critical thinking skills growth is present. Providing family and community members with techniques and strategies to foster this growth is a goal for which Literacy Boost implementers should strive.

However, there is some concern about accuracy in these numbers. Given the fact that there are so few storybook and comics, it is not clear precisely what is being read to children when the child reports that someone at home reads to them.

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<sup>1</sup> A t-test is a statistical test that determines whether two groups are reliably (usually referred to as "significantly") different from each other on some variable of interest.

The most common type of reading material at home was reading material that students understood to be religious in nature (57 percent). They were not asked to specify what religion, simply that the books were religious. This was followed by textbooks (41 percent) and booklets (36 percent). Reading material for children was extremely scarce, with just over one in five students reporting that they had any stories (22 percent) or comics at home (21 percent). Finally, only 20% of students reported seeing newspapers at home.

### *Reading Skills*

The data on phonological awareness reveals that students are very comfortable separating words into syllables. The concept of phonemes (individual sounds within words, e.g. the three sounds comprising *cat* -- /k/ /a/ /t/), and the division of words into phonemes, proved a much more challenging task, but correlations indicate a strong relationship between phonemic awareness and reading achievement in Kinyarwanda. Although it is possible that phonemic awareness should be encouraged to help all children learn to read earlier and better, a causal link between phonemic awareness instruction and early literacy development in Kinyarwanda has not been established. Recent research has called into question the value of phonemic awareness instruction for learning to read in Spanish, which has a syllabically-based and highly regular orthography (spelling system), similar in some ways but not identical to Kinyarwanda.

On average, students could only identify 8.8 out of the 24 letters, or 36.7 percent of the letters in their alphabet. A mere 4 percent of students (85 total) could identify all the letters, and only 31.4 percent of students could identify 12 or more letters. This is far less than the expectation that at the end of Primary 1, students will know their alphabet.

On average, students could read between 12 and 19 percent of words in isolation. They could write, on average, 12 to 21 percent of words dictated to them. On the two measures of reading comprehension, the average score was between 9 and 10 percent. Given the fact that each of the skills tests was 6 items long, this means the average student could not answer even one question correctly. While we do not have anecdotal evidence for standards in writing, the anecdotal evidence for reading standards indicates that children are struggling to live up to expectations, as a large proportion of these words are covered in Primary 1.

Students were given two reading passages, one appropriate for Primary 1 learners, and a more difficult one intended for Primary 2 and 3 learners. On the first passage, students could on average read on 3 words per minute, and read with 17.5% accuracy. Only 5.1 percent of students could read 20 words per minute or greater and only 0.4 percent of students could read 40 words per minute or more. In terms of accuracy, only 18.7 percent of students could read the passage with 50 percent accuracy, and 14.4 percent of students read the passage with 90 percent accuracy or greater. On the second passage, students could on average read on 2.1 words per minute, and read with 10.1% accuracy.

In summary, students at the end of Grade 1 are struggling, both with the high order skills of fluency, accuracy, and comprehension, but also with the more basic skills of simple letter identification. Literacy Boost is a timely intervention that is clearly needed by program participants. It is a timely intervention as these findings suggest that children are not learning up to expectations set by the education system and clearly need better support in learning how to read.

### *Issues of Equity*

It is clear from the analyses that girls are gaining reading skills much faster and better than boys. In univariate analysis, it appeared that Kinyarwanda speakers outperformed non-Kinyarwanda speakers. However, when including control variables, the differences between these language groups disappear. No statistical difference was observed between children with larger and smaller amounts of chores to do at home.

For equity findings regarding HLE, we find that **a composite index that takes into account the dimensions of the HLE strongly and uniformly predicts every single reading skill outcome.** While not causal, this does indicate the central role that family and community member might play in children's reading development.

For equity findings regarding socioeconomic status (SES), we find significant relationships between a student's SES (represented in quintiles) and that student's reading achievement across a range of skills. While the vast majority of students need help in learning to read, it might be beneficial to turn to the community to see whether community action in the form of neighbors helping neighbors could support those children whose own family lack the means to provide that support. This does not necessarily mean financial support. Rather including a neighboring child during a storybook reading, or during games around reading could help promote literacy more broadly.

### Recommendations

The recommendations that arise from the findings in this report are displayed in Table 8a:

Table 8a: Findings and Recommendations

Finding	Recommendation
Significant portion of non-Kinyarwanda speakers in schools in Gicumbi	Provide teachers with research-proven tips and tools for engaging students who may not be fully comfortable in speaking or reading Kinyarwanda
Students report having a large number of chores or other work around the household	During community sensitization meetings, deliver advocacy messages on the importance of providing children with time to engage in reading and learning outside of the school. Help parents and family members to realize that a child's whole day can and should be filled with learning experiences.
Girls read significantly better than boys	During community sensitization meetings, deliver advocacy messages on the importance of providing all children with time to engage in reading and learning outside of the school. Educate them around the fact that girls seem to be learning more than boys, and support teachers and community member to provide all students opportunities to build their reading skills.
Few storybooks available in homes	Provide as many child-gearred reading materials as possible to as many children as possible. Both locally made stories based on Rwandan folklore or other familiar stories <i>as well as</i> books from outside Rwanda but translated into Kinyarwanda should be provided to allow for maximum variation to capture the potential interests of all readers.
Low performance on reading skills	Provide teachers, families, and communities with the knowledge and resources to support student's learning to read.
Students from lower SES struggle more with certain reading skills	Provide advocacy messages to communities around helping not only their own children but all students to learn to read, and particularly those whose parents may not be in a financial position to provide these opportunities to their own children.

### Conclusion

Primary 1 students in Gicumbi are clearly struggling to learn to read. The data collected for this report cannot definitively answer why students are struggling, but they do indicate that a better approach to supporting children learn to read is needed. The strongly predictive nature of the Home Literacy Environment index in relation to reading outcomes may indicate that providing structure and knowledge around reading development in the home and community could help all children learn better. Data collection in subsequent years during and after the randomized control trial will provide much greater insight into this and other methods for helping the children of Gicumbi learn to read better.

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## **1 Introduction**

This report examines the results of a learner background survey and reading assessment conducted from September to October 2013 as part of the baseline data collection for the randomized control trial of Literacy Boost in Rwanda.

### **1.1 Overview**

In the autumn of 2013, researchers from Stanford University led an assessment of reading skills in the Gicumbi district, Rwanda. Coordinated by Save the Children staff, with approval from both the Rwanda National Ethics Committee (RNEC) and the Stanford University Ethics Review Board (referred to as the Stanford IRB), and with in partnership with the Rwanda Education Board (REB) and the Rwandan Ministry of Education (MiniEduc), the Stanford team and its partners designed, piloted, and conducted a survey and reading assessment for Primary 1 students.

The purpose of this assessment was to establish a baseline for the Literacy Boost randomized control trial, which began implementation in January 2014. Literacy Boost is a holistic early grades reading program designed to help children learn to read better, both in-school through teacher training and support, and out-of-school through community and home activities.

While the research team is still searching for official published standards on what children at the end of Primary 1 are expected to know and be able to do, there are anecdotal expectations gleaned from conversations with teachers, REB & MiniEduc staff, and others. Two of these are:

- 1) By the end of Primary 1, students should be able to identify all of their letters.
- 2) By the end of Primary 1, students should be able to read a Primary 1 leveled text.

For now, we use these informal, un-verified expectations to place results from the assessment in context.

In the original proposal for this project, one of the key research questions was, “What are the effects on children's early reading development of the (a) teacher training alone and (b) a combination of teacher training with home and community support for children's reading development in a developing world context such as Rwanda?” This report provides baseline data upon which changes in students’ reading development will be measured.

### **1.2 Context<sup>2</sup>**

The literacy rate in Gicumbi is 70.5 percent which is similar to the national level 67.7 percent with at least 13 percent of men to 11.1 percent women having completed primary education.

Northern Province statistics show that 15.2 percent of the population has no education, while 70.2 percent have attained primary education and 13.2 percent have attained secondary education.

Completion of primary school enables individuals contribute largely in physical economic development activities like agriculture and animal husbandry, making traditional handcraft, carpentry, commerce and trade, motorcycle transport, some load carriers in town. Of recent,

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<sup>2</sup> Source of all the data in this section come from the Rwanda Demographic and Health Survey 2010

many people are involved in political responsibilities as well as all the above activities do not impede them from participating in different political activities like leadership for example. In this area you can find some people who are village leaders, local defenses, in charge of community policing, etc.

Individuals who have completed secondary studies in Gicumbi district are involved in a wide range of activities including those listed above. Many of them are able to do jobs that have slightly advanced skills than the primary leavers or those who didn't have a chance to complete primary. Often completion of secondary education gives individuals more chances of employment based on post-secondary education including technical and vocation responsibilities. Secondary leavers often get training in education and end up in primary school teaching. A number also take up local leadership responsibilities including becoming Executive Secretaries of cells, secretaries in various institutions as well as veterinary assistants and at the cells levels. Other characteristic jobs include being accountants, cashiers in Savings and Credit Cooperatives, nurses, working in the policemen, serving in restaurants and bars, ticket inspectors on buses etc. A significant number also remain unemployed due to a range of reasons including mainly low levels of education.

A significant proportion of the population of Gicumbi district live on agriculture with a majority of the people involved in crop production and others involved in small scale animal husbandry. The district is largely rural with a hilly landscape. A section of the population also works on tea plantations mainly in the low laying swampy valleys. The district has wide rice fields in different wetland valleys made up of small patches owned by individuals. This often enables rice producers to cultivate at the same time and sell collectively. Other sources of livelihood include stone quarry business and charcoal making.

### **1.3 Literacy Boost<sup>3</sup>**

Literacy Boost is Save the Children's innovative, evidence-based program to support the development of reading skills in young children. The program was Save the Children's response to data that revealed an emerging crisis in education – while children were attending school in ever greater numbers, fewer and fewer of them were reaching upper grades with the ability to read independently (Dowd et al., 2009; Friedlander et al., 2010; Gove & Cvelich, 2010; Guajardo et al., 2012). The program subscribes to Save the Children's Life-Wide Learning approach, which views the child's entire waking day as full of opportunities to learn and grow, as opposed to only focusing on the few hours that a child may attend school.

The Literacy Boost program is made up of three complementary components: a Teacher Training component to provide teachers with research-proven reading pedagogy skills, a Community Action component to provide children fun and motivating reading experiences as well as to provide parents and other community members more knowledge and activities with which to support children's learning, and an Assessment component to understand where children begin and how they grow through the course of the program. Each of these components was created based on existing research on children's reading acquisition conducted almost exclusively in the developed world.

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<sup>3</sup> Note: Section 1.3 is taken in its entirety from a book chapter submitted for publication in December 2013. The working citations is as follows.

Friedlander, E., Dowd, A.J., Guajardo, J., & Pisani, L. (submitted pending review). "Education for All or Literacy for All? Evaluating Student Outcomes from Save the Children's Literacy Boost Program in Sub-Saharan Africa". In Abubakar, A., & van de Vijver, F. (2014 – estimated) Handbook of Applied Developmental Science in Sub-Saharan Africa(working title). Springer Publishers.

The Teacher Training component engages teachers in monthly to bi-monthly training sessions where teachers learn a) about the five key skills identified in the research as important to children's reading growth, and b) pedagogical techniques to best teach those five skills. This content is primarily derived from developed world research (including, but not only: Adams, Foorman, Lundberg, & Beeler, 1998; Beck, McKewon, & Kucan, 2002; Block & Pressley, 2001; Kame'enui & Simmons, 2001; National Reading Panel, 2000; Pressley, Gaskins, & Fingeret, 2006; Snow, Burns, & Griffin, 1998). In addition, teachers also learn about formative assessment, the importance of the print environment, and strategies for teaching reading in multi-lingual classrooms, again all grounded in the research literature (including, but not only: Birdyshaw, 2001; Hudson, Lane, & Pullen, 2005; Pearson, Hibert, & Kamil, 2007; Scarborough, 2001). Teachers meet on a regular basis to learn manageable amounts of new skills and techniques, and then have the opportunity to go back into the classroom and practice these skills. When they return for the next training session, they first share about their successes and challenges from the previous month, another practice that is derived from the literature on successful teacher training (Elmore, 2002; International Reading Association, 2007).

The Community Action component provides a customizable menu of activities to take place outside of the school walls. Some of the activities included in this component are: Reading Awareness Workshops, where parents and other community members gather to learn about supporting children's reading development; Reading Buddies, where older, more competent readers are paired with beginning readers in order to read together; and Reading Camps, where children are led by a local volunteer in reading activities, including the reading and discussion of a story as well as a make-and-take activity where children create some sort of small book or drawing which they can then take home. These activities are all designed to encourage enjoyment during reading, to motivate children to read more and more often, and to provide scaffolding outside the school walls so that children understand that reading is not a skill that is only learned and used in school. Again, these activities and their underlying aims all arise from literature on supporting children's reading growth, much of which is from developed world settings (Goldenberg, Rueda, & August, 2006; Hess & Holloway, 1984; New, 2001; Muaka, Bernhardt & Kamil, 2003; Snow, Burns, & Griffin, 1998; Sylva, et al. 2011; Wagner, 1993).

Finally, the Assessment component provides guidance on the creation of baseline and endline assessments for the rigorous evaluation of the program, most often pursued through quasi-experimental evaluation approaches using treatment and control groups. While this component serves the purpose of evaluation, baseline results also feed into initial program design. This component as well draws on the existing literature (Birdyshaw, 2001; Chicago Public Schools Office of Accountability 2002; Hasbrouck & Tindal, 2006; Pearson et al., 2007). Children are assessed individually by one of a team of assessors at baseline in order to ascertain what reading skills they possess. At endline, usually a year after the baseline, the same children are assessed again to provide estimates on the value added of the Literacy Boost program versus a control group of children attending schools and living in communities not included in the program.

In each of the countries where Literacy Boost is implemented, a significant adaptation process is undertaken to ensure that the program meets the local needs of the community Save the Children serves. It also serves to enhance, and not replace, the existing government curriculum. Since the goal of Literacy Boost is to help all children learn to read, during the

baseline assessment children are asked a series of questions about themselves and daily life so that we can take a critical look at who precisely is achieving to what level prior to Literacy Boost. Through this information, we identify several possible sub-groups to monitor to ensure that equitable outcomes are achieved by all. These sub-groups include girls, students from the most economically impoverished homes, students from homes with low home literacy environments, and students who have large amounts of physical labor/work in addition to their school work.

## **2 Methods**

### **2.1 Sector Assignment to Treatment Group**

Sectors (with an average of 4 to 5 schools per sector) were assigned to one of two treatment groups or one control group (3 groups total) for the first 2 years of the project implementation. The treatment groups were as follows:

- 1) Literacy Boost Group (LB Group): Schools and communities in this group receive the entire LB programs, including teacher training and community activities around reading and literacy.
- 2) Teacher Training Only Group (TT Group): Schools in this group receive teacher training support, identical to the support schools receive in the LB group. However, communities do not receive community activities.
- 3) Control Group (C Group): Schools and communities do not receive any support from Save the Children in this group for the first two years.

All 21 sectors in Gicumbi was assigned to one of the three groups. Assignment was done on October 11, 2013, in the presence of 17 of the 21 Sector Education Officers assigned to the 21 sectors of Gicumbi from the Rwanda Education Board. For the sake of transparency, a video recording of the randomization process is available upon request.

### **2.2 School Selection**

The sample in this report contains between two and five schools from each sector, with an average of 4 schools per sector and a total of 85 schools overall. Schools assessed were randomly selected by sector by assigning each school within a sector a number between 1 and N (N being the number of schools within that sector) and then randomly drawing a number from a hat to select the individual schools within the sector. If two or more schools existed within one cell (a cell being the administrative unit just below the sector), then the other school(s) were excluded from the drawing during the second round of school selection to ensure maximum coverage of the sector. The 85 schools were sampled from a pool of 102 schools in the Gicumbi district that were recruited to take part in the randomized control trial of Save the Children's Literacy Boost program. While all 102 schools will be assigned to a treatment group or a control group, these randomly selected 85 schools will serve as the sample to track changes in reading development over time.

### **2.3 Student Selection**

A random sample of students from Primary 1 was assessed in each of the 85 schools<sup>4</sup>. To select the students, first the Primary 1 classroom was identified. If only one class of Primary 1 existed, students were sampled from that classroom. If more than one class of Primary 1

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<sup>4</sup> In the original project proposal, we intended to reach 102 schools. However, due to resource and time constraints, it was only possible to assess a random sample of 85 of the 102 existing schools. This has a negligible effect on the statistical power. All schools in Gicumbi are participating in the randomized control trial, but only 85 will be assessed.

existed, one of the classes was randomly selected, and students from that one stream were randomly sampled. In the event that less than the target number of students ( $n=25$ ) were present that day in one particular stream, additional students from another stream (where one existed) were sampled.

The selection was designed to sample boys and girls equally. To sample students, assessors first asked girls to stand up and randomly chose 13 students. They then asked that group to sit down, and then asked the boys to stand up and chose 12 names. At the next school, they would reverse the process and have the boys stand up first and then the girls and note down their names.

Given that students alternate between attending school in the morning shift one week and attending in the afternoon shift the following week, students were selected during both morning and afternoon shifts in school. This was to maximize the number of students and schools that we could assess.

## 2.3 Instruments

Table 2.3a offers examples of background and home literacy indicators and offers a detailed description of reading indicators.

Table 2.3a: Data Collected

<b>Student Background</b>	<b>Examples</b>
General	Sex, age, language spoken at home, work duties at home
School-related	Repetition history, ECCD attendance
Socioeconomic status	Type of home, household size, household amenities/possessions
<b>Home Literacy Environment</b>	
Access to print	Materials present in home, types of materials
Reading habits at home	Presence and percentage of family members who students see read, who read to students, who have conversations with students and who help/encourage students to study
<b>Reading &amp; Language Skills</b>	<b>Description</b>
Phonological Awareness	Composed of 5 separate sub tests: a) Similar beginning sounds (10 items total); b & c) Blending & Segmenting syllables (6 items each, 12 total), d & e) Blending & Segmenting Phonemes (12 items each, 24 total)
Alphabet knowledge	Identification of uppercase/lowercase letters in random order. Contains 29 letters representing all 24 letters of the Kinyarwanda alphabet, orthographic variations on “g” (i.e. g, G, & g), “t” (i.e. T, t & t), and “a” (i.e. a & a). Letters X and Q were not assessed but will be during follow-up assessments.
Individual Word Reading	Includes reading high frequency words (10 items) and reading pseudo words (10 items)
Writing	Includes dictation of high frequency words (10 items) and encoding of pseudo-words (10 items)
Reading Comprehension	Includes reading one-sentence statements and answering a simple question (6 separate items) and orally completing written cloze exercises (6 items)
Reading Fluency & Accuracy	N of words in a connected text read correctly in a minute and percentage of words read correctly on 2 separate passages, one approved by a Rwanda Education Board inspector as appropriate for Primary 1 (21 words total) and one appropriate for Primary 3 (60 words total)

These assessments were developed and pilot tested prior to baseline data collection. Participant observers from the Rwanda Education Board and the Rwanda Ministry of Education participated in this process, providing valuable insight and feedback into the creation of the tools.

In addition to the data specified above, school background information was collected, including resources present at the school, student attendance, and teacher-level data.

## 2.4 Personnel

To collect this data, 25 assessors all students or recent graduates from the Kigali Institute of Education and Byumba Polytechnic in Rwanda were hired and grouped into teams. Each team was composed of one team leader (a representative of Save the Children Rwanda), and a team of 8 to 9 assessors. As a part of capacity development, as well as to solicit and incorporate critical local input from interested authorities, members of the Rwanda Education Board and the Rwandan Ministry of Education actively participated in the creation and

piloting of the reading assessment tool. Team leaders collected school level data while the team of assessors collected student background and reading skill data.

Assessors and team leaders were trained in research ethics, including how to gain informed consent from principals and headteachers and informed assent from students. Assessors were also trained in how to assess children of a young age, how to put them at ease as best as possible to ensure that the data collected is the most reliable and valid data possible.

## **2.5 Data Collection and Entry**

Each assessment team visited one to two schools per day over the course of four weeks in September and October 2013. Prior to collecting any data, a consent form was signed by the school principal (also called head teacher) or by his/her representative in the event the principal was absent on the day of the assessment.

Once the reading assessment was concluded, four of the assessors were retained to enter the data into an excel database created by the Stanford team. For procedures concerning inter-rater reliability data collection, and for the inter-rater reliability results, as well as information on data entry accuracy, refer to Appendix B.

## **2.6 Analysis**

The central purpose of this report and analysis is to determine the skills and resources that Primary 1 students currently possess in Gicumbi, and how these skills correlate with one another, and to determine whether any sub-groups (girls, language minority speakers, students of low SES, etc.) within the sample display significant differences in regard to reading achievement.

The key research questions that this report explores are:

1. What can the baseline tell us about learners' emergent reading skills? What does this mean for Literacy Boost programming?
2. How do learners' reading skills vary by student background, language spoken, and home literacy environment? What does this mean for targeting Literacy Boost's two strands (teacher training only and teacher training plus community action) of intervention?

While the randomized control trial portion of this project lasts only 2 years (through December 2015, the project is designed to reach all students via teacher training and community activities in Gicumbi by the end of the project in 2017. As such, we analyze the baseline skills and characteristics of the group as a whole, and search for systematic differences between sub groups across the whole sample. When searching for significant differences between sub-groups, we cluster students by school to control for the between school variation in reading scores.

To answer purpose #1, above, we use simple descriptive statistics and, where appropriate, correlations to understand the skills students possess. To answer purpose #2, we use t-tests and multivariate regression analyses, which control for relevant variables and cluster standard errors by school to account for the nested nature of the data.

A third critical piece of this data analysis is to determine whether the treatment groups are statistically significantly equal in terms of background characteristics and reading abilities

prior to the commencement of the intervention. This complex analysis is not included here and will be provided in a separate report in 2014.

### **2.7 A Note about Student Reported Data**

All data in this report is collected directly from Primary 1 students. Questions were simplified to create the most reliable and valid data possible. Tools were pilot tested and adapted to fit the context of the Rwanda students in Gicumbi. If students do not know the answer to the questions, or reply to questions incorrectly, this error in the data should be evenly distributed throughout the sample. This error will be picked up in the descriptive statistics and may mean that reported averages are greater or less than the values represented in subsequent sections. In the later multivariate regressions, this student-report error might attenuate any observed relationships in the data. Unfortunately, there was no better cost-effective and reliable method for collecting these data. *All subsequent findings are presented with the caveat that all non-reading skill data are student-reported, and these students are young students, around 7 years old.*

### **3 Student Background Characteristics**

Before looking at the reading skills of the students within the sample, we describe relevant student variables, including demographic data and socioeconomic status (SES).

Table 3a reports descriptive statistics for a selection of items. Note that the number of students who answered each question varies as certain students did not know the answer to a specific question (e.g. age) or the assessor missed the item or did not record the item during the interview. For a complete list of descriptive statistics for the overall sample, including standard deviation, please refer to Table C1 in Appendix C. The following sub-sections in this section all refer to Table 3a, below.

Table 3a: Background Characteristics of the Sample

<b>Child Background Characteristics</b>	<b>N of Students<sup>†</sup></b>	<b>Mean or Sample %</b>
<i>General</i>		
% Female	2118	48%
Home Language: Kinyarwanda	2118	86%
Home Language: Non-Kinyarwanda	2118	13%
Age (years)	1949	7.75
Does Chores at Home	2114	99%
N of Chores Named	2118	2.94
Misses School to do Chores	2077	20%
Studies at Home: Never	2118	23%
Studies at Home: Sometimes	2118	61%
Studies at Home: Everyday	2118	15%
<i>School Related</i>		
Attended Early Childhood Care & Development Center	2115	71%
<i>Socioeconomic Status</i>		
Roof Made of Locally Made Tiles	2118	16%
Roof Made of Iron Sheets	2118	83%
Walls of Mud & Wood	2118	33%
Walls of Mud Bricks	2118	58%
Has Radio	2116	80%
Has Bicycle	2113	32%
Has an Outdoor Latrine	2109	98%
Outdoor Latrine: has both Walls & a Roof	2118	68%
Has Mobile Phone	2116	70%
Has Computer	2005	4%
Has Animals	2109	91%
Has Cows	2026	83%
N of Bedrooms	2061	3.0
Parent has Status in Community (works in cooperative, is a teacher, religious leader, or community leader)	2118	75%

<sup>†</sup>Sample sizes differ some items due to missing data. Data is missing because either the children did not know the answer (e.g. age), or the assessor skipped the question or did not record an answer.

### 3.1 Sex

Female students comprise 48 percent of the sample. This does not reflect an imbalance in the sex ratio in school. Rather, it was a quirk of the sampling frame where the target was to collect 25 students. Boys and girls names were recorded in an alternating fashion, but boys names always came first. In many instances, this meant that 12 girls and 13 boys were sampled.

### 3.2 Language at home

The vast majority of students speak Kinyarwanda at home. However, a sizeable portion of students (13 percent of the sample) speak a language other than Kinyarwanda at home. This has implications which are explored in greater detail in the recommendations section.

### 3.3 Age & School-Related Variables

At the time of the assessment, students were on average 7 years and 9 months of age. Approximately 71 percent of students reported attending an Early Childhood Care and Development (ECCD) center. However, it is unclear the quality of each ECCD center, and whether it was a formal ECCD center with trained caregivers. More research is necessary to understand where children attended ECCD.

### 3.4 Socioeconomic status

Students were asked a variety of questions concerning their home and the possessions they had at home. To gauge differences in material resources, students were asked about the type of roof they have at home and the type of walls.

A large majority (83 percent) of students reported having a roof made of iron sheets at home. This is likely the result of recent drives within the country to upgrade the roofs on all dwellings. As such, we set aside this indicator as an indicator of material resources because we do not believe it represents a family's individual socioeconomic status as they may have received subsidized materials and/or labor. There was greater variability in the type of walls from which students' homes were constructed.

The possibilities, from lowest to highest socioeconomic status indicator, are walls of mud and wood, of mud bricks, of baked or fired mud brick, of stones, and of concrete bricks. This ranking was created by individuals familiar with the local context of Rwanda and specifically Gicumbi. The majority of homes had walls of unbaked mud bricks (also called adobe bricks). Simple mud and wood were the second most common type of walls at 33 percent of the sample. Students were also asked the number of bedrooms, with the theory that more sleeping rooms would equate with more material resources/wealth. On average, students reported that there were 3 separate rooms for sleeping at home.

Students were also asked about a number of items they have in their home. Nearly all houses have radios (80 percent), outdoor latrines (98 percent), livestock (91 percent), and specifically cattle (83 percent). Mobile phones were also very common, with over two-thirds (70 percent) of children reporting that someone at home had a mobile phone. Fewer students reported having a bicycle at home (32 percent) and a handful of students (87 students total) reported having a computer at home. Only 11.9 percent of students reported having electricity (likely in the form of dry cell batteries, but this level of detail was not collected) at home.

As a different view of SES, students were asked whether their parents participated in a cooperative, worked as a teacher, worked as a religious leader, or worked on the village councils as a community leader. While these positions do not necessarily imply material resources, they may be associated with social status. 75 percent of children responded yes to at least one of these questions.

Correlations among the variables representing SES were low, and exploratory factor analysis failed to provide insight into underlying factors by which data reduction and index-building could be guided. As such, we will combine these variables along two theoretically-derived (as opposed to empirically derived) factors for later use in regression analysis. Those factors are home possessions and home construction. Also, due to low variance and unclear relationships with SES, parental status will be set aside for the remainder of the analysis.

### 3.5 Studying and Working at Home

Students were asked whether they worked or did chores at home. Unsurprisingly, 99 percent of students responded that they did indeed do work at home. Students were asked to list the different types of work, but specific tasks (e.g. do you wash clothes at home?) were not asked. On average, students named approximately 3 tasks (of a possible 10 separate items including a catchall ‘other’ response) that they regularly perform. The most common was fetching water (76 percent), followed by tending animals (57 percent) and cooking (48 percent). Forty percent of student reported performing these tasks everyday, while 58 percent reported only doing them ‘sometimes’. One fifth of the students reported that they had missed school to perform this work.

Students did not report studying with nearly the same frequency as they reported doing work. Nearly a quarter of students (23 percent) reported never studying at home, and only 15 percent reported studying everyday.

### 4 Home Literacy Environment

The Home Literacy Environment (HLE) has been shown in research in the developed world to be significantly associated with a child’s reading development. While most people instantly think of books in the home, the HLE is not only about books and other reading materials, but how people in the home interact with those books and how children are (or are not) actively engaged in reading those books. Hess and Holloway (1984) described five dimensions of the HLE that have been empirically shown to be related to reading achievement in children. Those dimensions are the *value placed on literacy*, *press for achievement*, *availability of reading materials*, *reading with children*, and *opportunities for verbal interaction*. To assess these dimensions, we first asked children about the different types of reading materials they had seen at home. We then asked them to list their family members (up to 8 individuals), and to tell us whether the student being assessed, within the last week, had seen that family member reading (the *value placed on literacy* dimension), whether that family member had helped or encouraged the student to study (the *press for achievement* dimension), whether that family member had read to them (the *reading for children* dimension), and whether that family member had had a conversation with the student (the *opportunities for verbal interaction* dimension). We also asked the students whether the student herself had lent any books to family members or neighbors in the last week, and whether the student herself had read to anyone in the last week. We first present findings on the reading materials at home, followed by the reading habits and interactions.

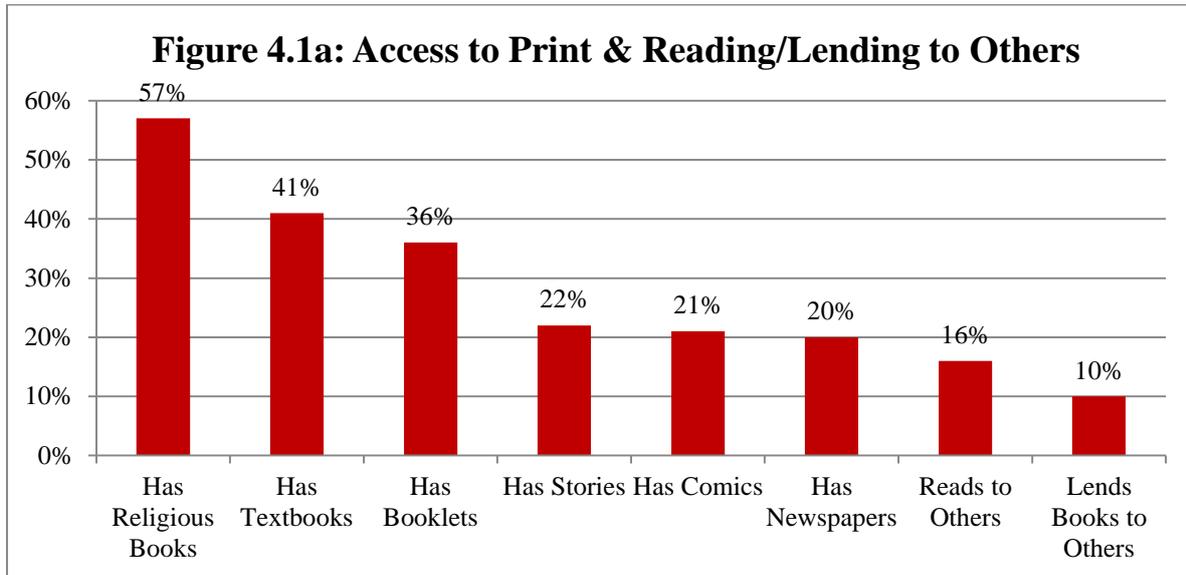
Table 4a: Dimensions and questions representing the Home Literacy Environment

<b>Theoretical Dimension of HLE</b>	<b>Question Linked to Dimension</b>
Value Placed on Literacy	<i>Do you see person ‘X’ reading at home in the last week?</i>
Press for Achievement	<i>Does person ‘X’ tell you to study or help you to study?</i>
Availability of Print Materials	<i>What type of reading materials do you have at home?</i>
Reading With Children	<i>Has person ‘X’ read to you in the last week at home?</i>
Opportunities for Verbal Interaction	<i>Has person ‘X’ had a discussion or conversation with you in the last week?</i>

#### 4.1 Access to Print

To assess what kinds of reading materials students had at home, students were asked whether they had textbooks, religious books, storybooks, comics, newspapers, and booklets at home. Students were asked simply whether they had seen any of these materials, but were not asked about the amounts of each type they had seen at home, as this could confound an indicator of

HLE with students' numeracy skills. Figure 4.1a shows the percent of students who responded affirmatively to each category.



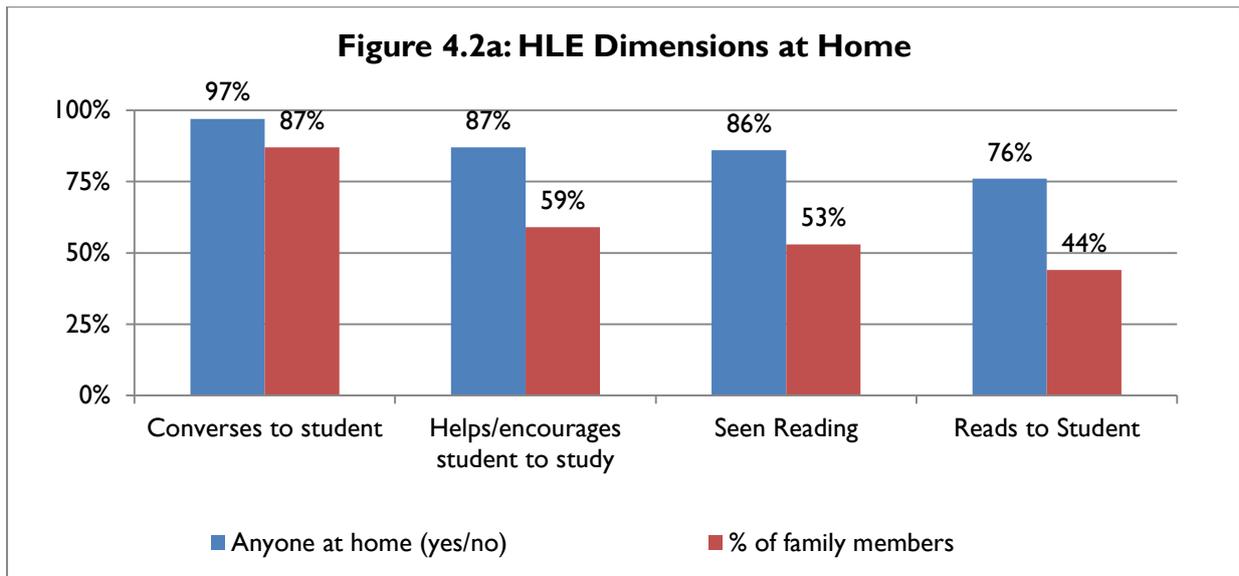
The most common type of reading material at home was reading material that students understood to be religious in nature (57 percent). They were not asked to specify what religion, simply that the books were religious. This was followed by textbooks (41 percent) and booklets (36 percent). Reading material for children was extremely scarce, with just over one in five students reporting that they had any stories (22 percent) or comics at home (21 percent). Lastly, only 20% of students reported seeing newspapers at home.

When we conducted exploratory factor analysis to identify common underlying factors that explain the variance in the data, we found that there was a common factor underlying the reading materials and the questions around whether the student had read to or lent books to other family or community members. As such, we present them with the reading materials at home. We can see in Figure 4.1a that both of these occurrences were rare, with only 16 percent of students reporting that they read to others in the last week and only 10 percent reporting that they had lent books to others.

As indicated by exploratory factor analysis, we combine all of these variables into an HLE sub index that we call the reading material index for the purposes of multivariate regression analysis. We now turn to indicators of the other four dimensions of the home literacy environment.

## 4.2 Home Literacy Environment Dimensions

As stated above, to measure the dimensions of the HLE, students were asked whether each family member had performed a specific activity within the past week to the student's knowledge. Figure 4.2a displays the average values for these four dimensions.



In Figure 4.2a, four sets of bars are displayed, made up of one red and one blue bar. Each set represents one of the four dimensions of the HLE as described above. On the right, in blue, is a binary variable indicating whether *anyone* at home was seen performing a specific activity. That is, the blue bar answers the question, “What percent of students have someone at home who does X?” On the right of each set, in red, is the percentage of family members seen performing a specific activity. That is, the red bar answers the question, “On average, what percentage of family members do X activity?”

As can be seen in this figure, the most common activity was conversing with the student, with 97 percent of students reporting that someone at home speaks with them, and on average 87 percent of all family members speaking with the student. Following this is whether anyone has helped or encouraged the student to study, with 87% of all children reporting that someone had done this, and on average 59% of family members encouraging students to study. The next most common activity was seeing a family member read (86 percent), and 53 percent of all family members, on average, were seen reading. Lastly, 76 percent of students replied that someone at home had read to them, and approximately 44 percent of family members read to the students, on average.

There is both encouraging and challenging information to be gleaned from this figure. We focus on the encouraging data first. Over three quarters (76 percent and above) of students report that someone reads to them, and 86 percent of students have a reader in the family. These are extremely valuable resources that Literacy Boost can tap to help students achieve their full learning potential. Also, students have a high amount of verbal interaction with family members, indicating that the potential for rapid vocabulary growth and critical thinking skills is present, and providing family and community members with techniques and strategies to foster this growth is a goal for which Literacy Boost implementers should strive.

However, there is some concern about accuracy in these numbers. Given the fact that there are so few storybook and comics, it is not clear precisely what is being read to children when the child reports that someone at home reads to them. Secondly, to our team, the fact that 87 percent of family members engage the student in conversation seems high to us. The question asked to students was: *Mwaba mwaragize umwanya wo kuganira mu cyumweru gishize?* In English, this best translates to “Did you (have time to) have a discussion/ a conversation with

this person in the past week?” The goal of the question was to measure how many content rich, authentic conversations the child experienced with how many family members. Due to the age of the child and translation issues, the child may have been responding whether anyone had simply talked to them. There is a very real distinction between simple exchanges like:

Mother: “Go and fetch water”  
 Child: “Yes Mama”

and other, content rich discussions such as:

Mother: “What did you learn at school today”  
 Child: “We learned addition, and about turtles, and we played a game”.  
 Mother: “What sort of game?...”

The first of these exchanges is merely a command that does not encourage the child to think and produce substantive vocabulary, and convey coherent information. The second of these exchanges does precisely that, allowing the child to provide details, embellishments, practice and retain vocabulary, and better engage with language. Whether the item “Have you conversed with anyone” measures the first type of exchange or the second is difficult to discern.

Nevertheless, all of these items are highly correlated with each other. During an exploratory factor analysis, these variables all loaded onto one factor, indicating that they have a common source of variance. As such, we place these four variables together in a sub-index we call the HLE dimensions index. Since the distribution and variance is best across the percentages of family members who exhibit the four dimensions, we use the percentages variables to construct the index for future analyses.

## **5 Reading & Language Skills**

This section will review the individual reading skills that Literacy Boost assessed. Each sub-skill (phonological awareness, letter knowledge, most used words, decoding, encoding, dictation, simple reading comprehension, cloze exercises, reading fluency, and reading accuracy) will be examined in depth. Implications of these findings will be presented at the end of this section following a graphic that sums up student skills. For complete group averages and significant differences, if any, refer to Appendix D.

### **5.1 Phonological Awareness**

An important precursor to learning to read is the development of phonological awareness. Phonological awareness is the knowledge that spoken words are made up of different parts, and can be divided and manipulated to create new sounds or words. There are many different ways to assess phonological awareness. During piloting, we attempted to create six different subtests to assess phonological awareness. Linguistic challenges made it impossible to create a rhyming subtest, as the syllables and tones used in Kinyarwanda prevented the assessment creation team from achieving agreement on what words rhyme. As such, we created and assessed students on 5 different phonological awareness tasks. For each of these tasks, students were given two to three practice items to ensure they understood what they were being asked to do. With the exception of the Similar Beginning Sounds sub-test, items started off at the easiest level and became more difficult. Assessors were instructed to stop the sub-test and move on to the subsequent subtest if students incorrectly answered four consecutive

items following the practice items. We refer to this rule as the stop-rule. If the stop-rule was used to discontinue a subtest because the student answered 4 consecutive items incorrectly, the student's score was the sum of items correctly answered.

Table 5.1a: Phonological Awareness Sub-test Performance

Sub-test	N	Average % Correct	% of sample scoring 50% or greater	% of sample scoring 100%
Similar Beginning Sounds	2118	8.5%	5.76%	0.6%
Blending Syllables	2118	79.8%	81.3%	59.0%
Segmenting Syllables	2118	84.7%	85.0%	67.4%
Blending Phonemes	2118	4.1%	2.27%	0.1%
Segmenting Phonemes	2118	9.2%	3.1%	0.9%

### 5.1.1 Similar Beginning Sounds

Assessors said three words orally, two of which began with the same initial sound; e.g. Iliza, inuma, amazi. Students were to identify words that began with the same initial sound. When presented with 3 words orally (not written), students struggled to identify words that began with the same initial sound. The average score across the 2118 students in the sample was only 1.3 items correct, or 13 percent correct. Nearly half of students (49.58 percent) could not answer even one of these questions correctly.

### 5.1.2 Blending Syllables

In comparison with the similar beginning sounds, students did remarkably well on the task of Blending Syllables. In this task, students were given distinct syllables and asked what word did the syllables make when they came together. For instance, the assessor would say, “mu...[pause for 3 seconds]...ra ...[pause again]...ho. What word does that make?” The child would receive 1 point for correctly saying “muraho”.

Out of six items, student on average answered correctly on 4.79 of the items, or 80 percent of all items. Out of 2118 students, only 10 percent (218 students) did not finish this assessment due to stop-rule invocation.

### 5.1.3 Blending Phonemes

Blending phonemes was a similar assessment to the Blending Syllables one, except in the place of syllables went phonemes, the smallest unit of oral speech. In the first items, students were given 2 phonemes and asked what word they made. For instance, the assessor would say “/n/...[pause for 3 seconds].../i/. What word does that make?”

Students struggled to correctly blend phonemes together. Out of 12 possible items, students answered correctly on average 1.1 items or just 9 percent of items correctly. Of 2118 students, only 114 (5 percent) of students reached the end of the sub-test before the stop rule was invoked.

### 5.1.4 Segmenting Syllables

In the Segmenting Syllables portion of the assessment students were asked to perform the reverse task of the Blending Syllables. Given a word, students were asked to separate out the syllables in the word, clapping for each syllable to make interpretation of correct answers easier. Students performed very well on this portion of the assessment, answering 5.1 out of 6

(85 percent) items correctly, on average. 1972 out of 2118 students reached the last item on this assessment sub-test.

### 5.1.5 Segmenting Phonemes

Lastly, students were given simple words and asked to segment the phonemes in the word. This was by far the hardest of the phonological tasks, with students answering only 0.5 items correctly out of 12, on average. Only 72 out of 2118 students reached the final item prior to the stop-rule coming into effect.

### 5.1.6 Correlations between Phonemic Awareness, Phonologic Awareness, and higher order Reading Skills

Table 5.1.6a is a partial correlation table that looks at the correlations between a phonemic composite score (Blending phonemes + Segmenting phonemes + Similar beginning sounds), a syllabic composite score (Blending Syllables + Segmenting Syllables), and the other reading scores.

Table 5.1.6a: Correlations between Phonologic Tests and other Reading Skills

	Syllabic Composite	Phonemic Composite
Dictation Total	0.3207	0.4921
Encoding Total	0.3251	0.4895
Most Used Words Total	0.3093	0.5081
Decoding Total	0.2916	0.5181
Reading Comprehension Total	0.2237	0.525
Cloze Total	0.2296	0.5429
P1 Fluency	0.2066	0.5034
P1 Accuracy	0.2384	0.4793
P2 Fluency	0.1922	0.4951
P2 Accuracy	0.2026	0.4898

Table 5.1.6a shows the correlations between the totals that children earned on the two phonologic composite items, and their other reading skill scores (which will be fully examined in the following sections. What is important to notice from this table is how much more highly correlated phonemic awareness is with later reading versus syllabic awareness. That is, students who did better on phonemic awareness were much more likely to do better on the other, higher-order reading skills, whereas the score students achieve on syllabic awareness was less predictive of higher order reading skill achievement.

What the data on phonological awareness tells us is that students are very comfortable separating words into syllables. Indeed, in informal observations conducted by the Stanford team and in discussion with teachers and other education personnel, the way children are taught in school to read is through an emphasis on reading syllable by syllable. On the other hand, even with the group of assessors and Save the Children staff who piloted the assessment, the concept of phonemes, and the division of words into phonemes proved a much more challenging task, especially given that it was not part of the Kinyarwanda Reading curriculum in 2013 or in previous years. What we do not know, and could be a topic for future investigation, is whether emphasizing either syllabic or phonemic awareness contributes to children's reading development.

## 5.2 Alphabet Knowledge

Students were presented a chart of 29 letters, a mixture of uppercase and lowercase, and asked to identify the letters. Since a new curriculum was in the process of being released, and the fonts / styles of the text were changing, there was some disagreement during piloting about which form of certain letters to use. Those letters were, specifically, the letter a ( ‘a’ versus ‘a’), the letter t ( ‘t’ versus ‘t’) and the letter g ( ‘g’ versus ‘g’). Using this chart with 29 letters, students only identified 9.89 letters correctly, or 34 percent of all the letters presented to them.

When take into account that some letters were duplicated, and we examine only the 24 letters of the Kinyarwanda alphabet, including only the version of the letter a, g, and t that students correctly identified most often, the average rises only slightly. On average, students could only identify 8.8 out of these 24 letters, or 36.7 percent of the letters in their alphabet. Statistics on Alphabet Knowledge are presented in Table 5.2a.

Table 5.2a: Alphabet Knowledge Sub-test Total Scores

Sub-test	N	Mean	% of sample scoring 50% or greater	% of sample scoring 100%
Total Score: Alphabet Knowledge	2118	33.7%	34.5%	4.1%

Table 5.2b contains the top 5 easiest and most difficult letter for the students to identify. This table disregards the letters a, g, and t, due to the ambiguity surrounding their proper orthography

Table 5.2b: Hardest and Easiest Letters to Identify

Hardest letters to identify		Easiest Letters to Identify	
L	10%	i	74%
J	17%	U	62%
p	18%	m	60%
R	20%	e	59%
H	20%	k	58%

Note: Students were given a chart with a mixture of uppercase and lowercase letters on it. Letters did not repeat.

Considering that over 50 percent of students are repeating Primary 1 this year, these data on letter identification illustrate that there is still significant work to be done to enabling all children to gain the necessary skills to become good readers.

## 5.3 Individual Word Reading

Students were presented with two separate charts of 10 words each, (1) high frequency words children were likely to have encountered in their school reading materials and (2) pseudo words that were made up and administered as a direct test of children's decoding skills. Assessors asked the students to read two practice items for each of the two subtests, and corrected students if they did not read the word correctly. Following these two items, students then proceeded to read the words. Words were ordered from easiest to most difficult. If students incorrectly read 4 items consecutively, a stop rule was invoked and the next sub-skill was assessed. Statistics for both sub-tests of Individual Word Reading are presented in Table 5.3a.

Table 5.3a: Individual Word Reading Sub-test Total Scores

Sub-test	N	Mean	% of sample scoring 50% or greater	% of sample scoring 100%
Total Score: Reading High Frequency Words	2118	18.9%	23.3%	1.23%
Total Score: Reading Pseudo-Words	2118	21.4%	13.0%	0.1%

### 5.3.1 High Frequency Words (aka Most Used Words).

The first item shown to children was the chart of 10 high frequency words that could be found commonly in textbooks. This assessment was designed to see whether students could read words that they were familiar with and had seen before. Out of 10 words, students only read on average 1.89 words correctly, or 19 percent of the words.

### 5.3.2 Pseudo Words / Nonsense Words / Decodable Words

Since it is impossible to assess whether students read the High Frequency Words from memory and sight recognition or if they are breaking the word apart into sounds, we also included a Decodable Word Reading sub-test. This assessment was conducted in the same manner as the Most Used Words test, but the words contained in this portion did not have any meaning in Kinyarwanda. That is, while the words followed the regular and common orthographic patterns of the language Kinyarwanda, there was little chance that the children had ever before seen them. In this way it is possible to measure the decoding abilities of children. It is important to measure this, as children need good decoding skills if they are to read more advanced books and be able to read and understand words that they have never encountered before.

One other notable difference is important for this sub-test. Rather than a simple zero for incorrect answers and one point for correct answers, students could score either a zero, one, or two. Students received two points if they read the decodable word correctly. Students received one point if they pronounced at least one *grapheme* correctly. That is, if the word was 'blag', and the student said "bet", they would receive one point. If the word was 'blag' and the student said "cat", he/she would still receive one point, because that grapheme /a/ is common to both.

On this portion of the assessment, students seemed to do better than they did on high frequency words. Out of a total of 20 possible points, students on average scored 4.28, or 21.4% correctly. However, if we consider only the full word as the correct answer, students scored only 1.2 out of 10, or 12 percent correctly. So while they were gaining points for correctly matching phonemes to specific words, they still struggled to decode the full words correctly.

In brief, students on average could accurately decode 12% of phonetically regular pseudowords. If given credit for at least partially correct reading, average student performance improves to 21.4%. In other words they are unable to read nearly 80% of words or parts of words containing decodable letters. We come away with the following conclusions: students, on average, could not read even a grapheme in 78.6 percent of the words. They were able to read at least one letter, but not the whole word, in another 9.4 percent of words they were presented. Finally, they could successfully read about 12 percent of the words they were presented with.

## 5.4 Writing

Similar to the reading of individual words, students were asked to write a list of 10 individual words spoken by the assessor on two subtests: one with high frequency words and the other with phonetically regular words. Both sets of words were the ones used for the single word reading tests described above. Assessors asked the students to write two practice items, and corrected students if they did not write the word correctly. Following these two items, students then proceeded to write the actual test items. Words were ordered from easiest to most difficult. If students incorrectly wrote 4 items consecutively, a stop rule was invoked and the next sub-skill was assessed. Statistics on Writing are presented in Table 5.4a.

Table 5.4a: Writing Sub-test Total Scores

Sub-test	N	Mean	% of sample scoring 50% or greater	% of sample scoring 100%
Total Score: Writing High Frequency Words	2118	22.8%	28.6%	0.8%
Total Score: Writing Pseudo-words	2118	11.8%	2.2%	0.1%

### 5.4.1 Dictation

Students were asked to write 10 words following a practice of two words. All these words were high frequency words to which they had been exposed in their textbooks and elsewhere. On average, students correctly wrote 2.28 words, or 22.8% of the words correctly. Only 751 out of 2118 students were able to continue writing past the second item due to the stop rule.

### 5.4.2 Encoding Pseudo-Words

Similar to reading pseudo-words, assessors read pseudo words to the student (without the student seeing the word) and asked the student to write this word that they had never heard before. This sub-test also followed the same scoring scheme as decodable words (see section 5.3.2, above).

The average score for the entire sample was 4.14 out of 20 items, or 20.7 percent. However, a deeper dive into the data finds that the average when not giving partial credit for writing the phonemes correctly is 1.18 out of 10, or 11.8 percent items written completely correctly, on average.

In brief, students on average could accurately write 1.2 word, or 11.8 percent of phonetically regular pseudo-words. If given credit for at least partially correct writing, average student performance improves to 20.7%. In other words they are unable to write nearly 80% of words or parts of phonetically regular pseudo words. We come away with the following conclusions: students, on average, could not write even one grapheme in 79.3 percent of the words. They were able to write at least one grapheme, but not the whole word, in another 8.9 percent of words they were presented. Finally, they could successfully write about 11.8 percent of the words they were presented with.

## 5.5 Reading Comprehension

Reading comprehension is a notoriously difficult skill to master, and there is no one clear definition as to what reading comprehension is. As such, for this assessment we measured comprehension in two separate ways. In each of the sub-assessments of reading comprehension, assessors presented students with two practice items, and gently gave

feedback and encouraged / corrected responses if students if they did not answer correctly. Following these two items, students then proceeded to the actual test items. Items were ordered from easiest to most difficult. If students incorrectly answered 4 items consecutively, a stop rule was invoked and the next sub-skill was assessed. Statistics for Reading Comprehension are presented in Table 5.5a.

Table 5.5a: Reading Comprehension Sub-test Total Scores

Sub-test	N	Mean	% of sample scoring 50% or greater	% of sample scoring 100%
Total Score: Reading Comprehension	2118	10.5%	13.8%	1.6%
Total Score: Cloze	2118	9.0%	11.4%	1.2%

#### 5.5.1 Simple Sentences & Questions

The first method was to present students with a simple sentence and ask them to read the sentence. Once the students had read the sentence, the assessor asked the students a simple, factual question based on the sentence and marked if they responded correctly. These sentences were presented in isolation to minimize any distractions for the student.

Students scored very low on this portion of the assessment, averaging only 0.63 items out of 6 correct, or 10% of the items assessed.

#### 5.5.2 Cloze Sentences

The second method to assess reading comprehension was to ask the child to complete cloze passages. In this sub-test, students are presented with a sentence with one word missing. Using their knowledge of reading and their background and inferential knowledge, students must correctly fill in a word or words to make the sentence meaningful.

Out of 6 possible items, students answered on average 0.54 (9 percent) correctly.

### 5.6 Reading Fluency and Accuracy

Students who could read some of the High Frequency Words and could read some of the simple sentences in Reading Comprehension were given 2 simple passages to read out loud to the assessor. Once the student began to read, the assessor would start a stop watch and time how fast the student read. The assessor would also mark the words the student read correctly.

If the child read fewer than 5 words correctly in the first 30 seconds, the student was stopped from reading to prevent undue stress. In the scoresheet, the student was marked as having read zero words correctly over all (accuracy) and as having read 0 words in a minute (fluency). Table 5.6a presents statistics on Reading Fluency and Reading Accuracy for two separate reading passages.

Table 5.6a: Reading Fluency and Accuracy Sub-test Total Scores

Sub-test	N	Mean	% of sample scoring 50% or greater	% of sample scoring 100%
Reading Passage 1: Fluency	2118	3.0	na	na
Reading Passage 1: Accuracy	2118	17.5%	18.7%	9.0%
Reading Passage 1: Fluency	2118	2.1	na	na
Reading Passage 1: Accuracy	2118	10.1	13.3%	0.2%

na = not applicable. These items measured the number of words read in a one minute, and hence there is no 'correct' score.

### 5.6.1 Reading Passage 1

The first passage was a Primary 1 leveled text of 21 words. Only 405 out of 2118 students were able to read 5 or more words in the first 30 seconds, and hence only these 405 have scores for the first reading passage. These 405 students read on average 15.9 words per minute, and read 92 percent of the Primary 1 passage correctly. If we look across the whole sample, students could on average read on 3 words per minute, and read with 17.5% accuracy.

### 5.6.2 Reading Passage 2

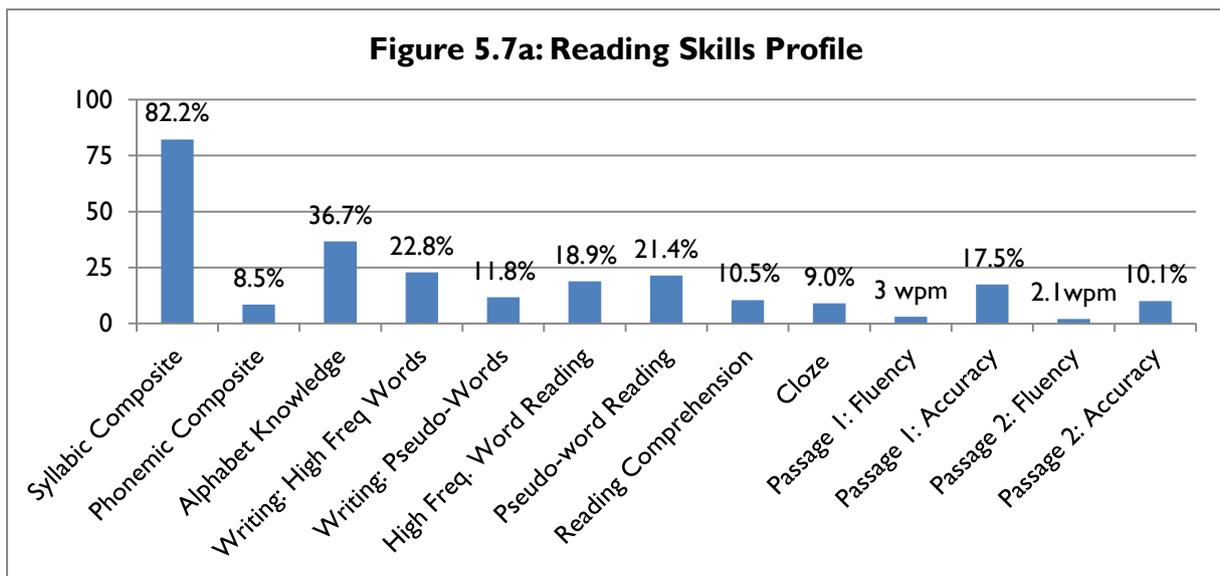
Students who read 10 or more words correctly in the first reading passage were given a second, more difficult passage to read. This passage, made up of 59 words and including words that contained double and triple consonant combinations, was leveled for a Primary 2 to Primary 3 reader. 296 of the original 2118 Primary 1 students were able to read this passage with varying levels of success. On average, this small group of students read 15.2 words per minute correctly, and read 73 percent of the passage correctly. If we look across the whole sample, students could on average read on 2.1 words per minute, and read with 10.1% accuracy.

## 5.7 Summary and Skills Profile

In this subsection we provide a summary of the skills above, as well as displaying graphically how the average skills measure up across Primary 1 student in Gicumbi. To simplify the measures and interpretation, we only display 2 composite phonologic measures, one measuring phonemic awareness and one measuring syllabic awareness.

Table 5.7a: Sub-test Total Scores

Sub-test	N	Mean	Standard Deviation
Total Score: Phonemic Composite	2118	8.5%	0.13
Total Score: Syllabic Composite	2118	82.2%	0.24
Total Score: Alphabet Knowledge	2118	33.7%	0.27
Total Score: Writing High Frequency Words	2118	22.8%	0.34
Total Score: Writing Pseudo-words	2118	11.8%	0.19
Total Score: Reading High Frequency Words	2118	18.9%	0.29
Total Score: Reading Pseudo-Words	2118	21.4%	0.30
Total Score: Reading Comprehension	2118	10.5%	0.24
Total Score: Cloze	2118	9.0%	0.22
Reading Passage 1: Fluency	2118	3.0 wpm	7.40 wpm
Reading Passage 1: Accuracy	2118	17.5%	0.37
Reading Passage 2: Fluency	2118	2.1 wpm	5.78 wpm
Reading Passage 2: Accuracy	2118	10.1%	0.26



All skills shown in this figure are percentages of percentage of total scores, with the exception of fluency scores, measured as words per minute correct.

Table 5.7a and Figure 5.7a show the average student scores across Gicumbi. What is important to take away from this figure is that, with the exception of syllabic awareness, the average score across every skill assessed was between 10% and 37% of all possible items. That is, students at the end of Primary 1 are struggling, both with the high order skills of fluency, accuracy, and comprehension, but also with the more basic skills of simple letter identification. Literacy Boost is a timely intervention that is clearly needed by program participants.

## **6 Equity Issues**

In this section, we assess whether any systematic differences exist in sample sub-groups—girls, students who speak a minority language, students with more work than others, students

from low HLE backgrounds, and students of low SES. For girls and boys, and Kinyarwanda speakers and non-Kinyarwanda speakers, we first use two tailed t-tests to determine whether significant differences exist between the two sets of subgroups. We then turn to multivariate regression analysis to examine whether students with heavier workloads, students from lower HLE homes, and students from lower SES homes experience systematic disadvantage.

### 6.1 The Relationship between Sex and Reading Achievement

Table 6.1a shows the results of a two tailed t-test for all variables collected in the sample. Only the variables where results from a two-tailed t-test indicated that significant differences existed among groups are included in the table.

Table 6.1a: Significant differences between boys and girls

Variable	Male N	Male Mean	Female N	Female Mean	Sig. Diff. in means
Age	1004	7.936	945	7.56	***
Repeated Primary 1	1094	58%	1013	52.3%	**
N of Bedrooms	1068	3.055	993	2.931	*
N of Chores reported	1100	2.783	1018	3.113	***
Tends Animals	1092	71.7%	1008	40.5%	***
Fetches Water	1094	79.2%	1008	71.8%	***
Sweeps	1095	9.7%	1008	32.9%	***
Never Studies	1100	25.7%	1018	20.9%	**
% of Family converses w/ student	1100	89.4%	1018	85.2%	**
Total Score: Alphabet Knowledge	1100	34.4%	1018	39.1%	***
Total Score: Reading High Frequency Words	1100	16.5%	1018	21.5%	***
Total Score: Reading Pseudo-words	1100	10.5%	1018	14.2%	***
Total Score: Writing High Frequency Words	1100	20.7%	1018	25.1%	**
Total Score: Writing Pseudo-Words	1100	10.9%	1018	12.8%	**
Total Score: Reading Comprehension	1100	8.2%	1018	12.9%	***
Total Score: Cloze	1100	7.6%	1018	10.4%	**
Passage 1: Fluency (words per minute)	1100	2.243	1018	3.886	**
Passage 1: Accuracy (% words read correctly)	1100	14.4%	1018	20.9%	**
Passage 2: Fluency (words per minute)	1100	1.507	1018	2.78	**
Passage 2: Accuracy (% words read correctly)	1100	7.5%	1018	13.0%	**

\*p<.05, \*\*p<.01, \*\*\* p<.001

There are three significant trends that can be seen from this table. The first is that girls are on average younger than boys, and repeat less often than boys do. As explained above, these two facts are undoubtedly linked, as grade repeaters will tend to be older. The second trend concerns the work that students do at home. On average, girls report doing more work than boys, but the types of tasks that boys and girls report doing are significantly different for 3 out of the 10 possible tasks. Boys tend to be responsible for tending animals and fetching water more often, while girls are responsible for sweeping.

The last significant trend in this data, and by far the most important to note, is girls' higher achievement in reading than boys. While none of the phonological assessment scores turned up significantly different, girls performed significantly better on nearly every other sub-test with the exception of accuracy. This conforms to developed world research findings that show that girls tend to pick up reading faster and at younger ages than boys. Although there is some debate, ample literature from the developed world suggests that girls actually are quicker to master reading than boys (Coley, 2001; Lummis & Stevenson, 1990; Phillips, Norris, Osmond & Maynard, 2002; Ready, LoGerfo, Burkam & Lee, 2005).

Using multivariate regression analysis that controls for age, grade repetition, SES, HLE, and work, girls continue to show statistically significant gains across a wide range of skills including the higher order skills of fluency, accuracy, and comprehension.

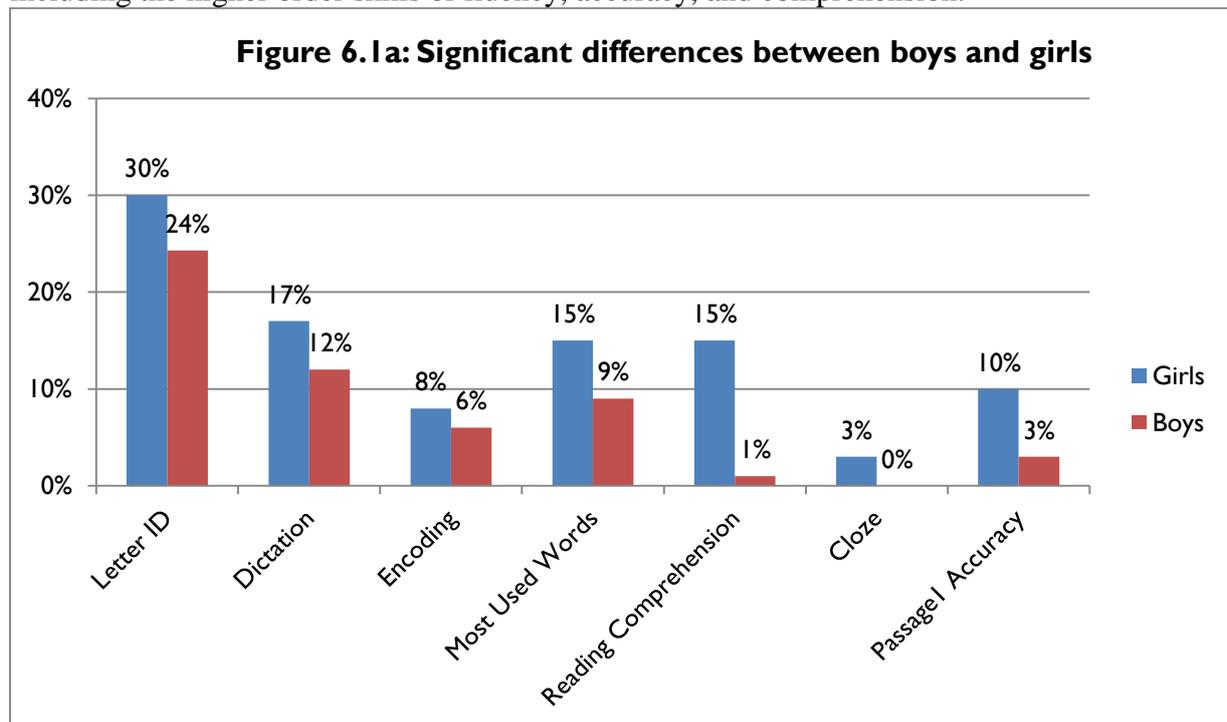


Figure 6.1a shows the significant difference between boys and girls when controlling for relevant variables. It is clear from this analysis that girls are gaining reading skills much faster and better than boys. For the full multivariate regression model, refer to Appendix E.

## 6.2 The Relationship between Language at Home and Reading Achievement

We use the phrase Kinyarwanda speakers and non-Kinyarwanda speakers to encompass the home language that is spoken by children. The vast majority of non-Kinyarwanda speakers are Rukiga speakers, but there are other students in the sample who report speaking a language other than Kinyarwanda or Rukiga at home. Table 6.2a shows the results of a two-tailed t-test for all variables collected in the sample. Only the variables where results from a two-tailed t-test indicated that significant differences existed among groups are included in the table.

Table 6.2a: Significant Differences between Kinyarwanda speakers and non-Kinyarwanda speakers

Variable	Non-Kinyarwanda N	Non-Kinyarwanda Mean	Kinyarwanda N	Kinyarwanda Mean	Sig. Diff.
Attended ECCD	291	56.7%	1824	73.5%	***
Index of Possessions	292	6.753	1826	6.372	**
Parental Status (out of 4)	292	0.952	1826	1.082	*
N of Types of Books	292	1.795	1826	2.008	*
Index of Reading Materials	292	3.188	1826	3.676	*
Has Storybooks	292	17.8%	1826	23%	*
Has Comics	292	16.8%	1826	22%	*
Has Booklets	292	29.8%	1826	37%	*
N of Chores	292	3.212	1826	2.898	***
Fetches Water	289	84.4%	1813	74.2%	***
Farms	289	23.5%	1813	11.6%	***
Misses School to Do Chores	282	25.9%	1795	18.9%	**
Total Score: Writing High Frequency Words	292	1.452	1826	1.959	**
Total Score: Writing Pseudo-Words	292	3.332	1826	4.435	**
Total Score: Writing High Frequency Words	292	1.568	1826	2.394	***
Total Score: Writing Pseudo-Words	292	3.253	1826	4.284	**
Total Score: Reading Comprehension	292	0.452	1826	0.656	*

\*p<.05, \*\*p<.01, \*\*\* p<.001

There are several important points to take away from Table 6.2a. The first is the marked difference in ECCD attendance. Kinyarwanda speakers attended ECCD centers much more frequently than non-speakers. A possible reason for this offered by Save the Children staff is that the campaign promoting attendance of ECCD is done in Kinyarwanda and is likely to succeed with native language speakers than non-Kinyarwanda. Additionally, non-Kinyarwanda speaker parents/guardians are likely to delay to free their children to participate in activities out of parents/guardians' sight for reasons related to a sense of belonging as well as security. Hence they will be of primary school going age or even older by the time they are sent to school – in this case straight to primary school.

The second point to note is the reduced presence of storybooks and comic books in the homes on non-Kinyarwanda speakers. One possible reason for this is that parents whose children first speak another language other than Kinyarwanda may not invest in these materials due to reduced or no availability of these child-gearred materials in that child's language. The last trend to take note of is the underperformance by non-Kinyarwanda speakers in comparison with Kinyarwanda speakers on the reading skills sections. In phonological awareness, subtests concerning phonemes were particularly challenging for these students. Non-Kinyarwanda speakers also struggled with writing and reading isolated words, as well as with the simple reading comprehension subtest.

As Literacy Boost is implemented, specific attention should be paid to the children who do not speak Kinyarwanda at home to ensure that they achieve at the same level as their Kinyarwanda-speaking peers.

When we investigated the effect that language spoken in the home had on reading outcomes through multivariate regression analysis, what we found was surprising. The significant differences we found in the t-tests above disappeared for every skill when we clustered the standard errors at the school level. That is, the schools that had high percentages of non-Kinyarwanda speakers also performed significantly worse in reading skills. However, it is impossible to say whether the language spoken at home, or some *other* factor is the cause of these low reading skills. All that we can say is that there is something different about these schools, and these schools on average demonstrate lower average reading skills. More research is required to see whether it is the effect of speaking a home language that is not Kinyarwanda or some other factor that might be negatively impacting children's reading growth.

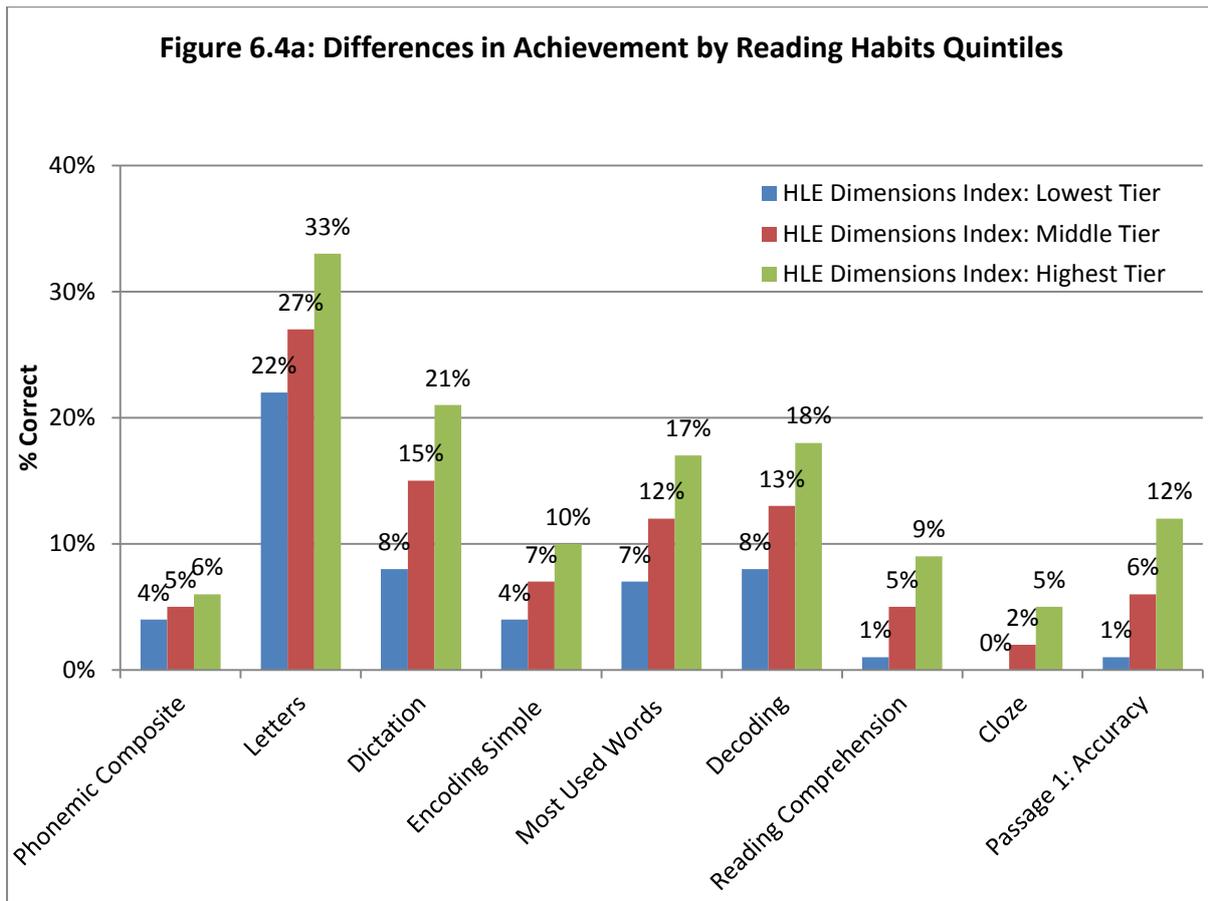
### **6.3 The Relationship between Work and Reading Achievement**

As above, we fit multivariate regression models to predict achievement based on the number of chores a child mentioned performing at home on a regular basis, while controlling for relevant variables (age, SES, sex, etc.) and clustering the standard errors by school to account for students nested in schools. We find that students who report doing more work do not have statistically significantly different reading achievement scores than students who do less work. This finding might indicate either that chores at home have no impact on early reading achievement or that our method of measuring a child's work at home is inadequate for capturing possible advantages and disadvantages of work loads at home.

### **6.4 The Relationship between HLE and Reading Achievement**

HLE is indicated by two sub-indices, a reading materials index, as well as an HLE dimensions index. These two indices were created following factor analysis results that described two underlying factors. The reading materials, in addition to whether the child read to or lent books to others in the family or community loaded onto one factor, while the other variables (family seen reading, family reads to students, family helps student to study, and family talks to student) loaded onto their own separate factor. As such, in the regression analysis, we include both indices to see if either significantly predicts achievement. To make the measures more easily comprehensible, we separate these sub indices into quintiles, so that we may compare those of the lowest, middle, and upper quintiles. That is, we rate all students on a scale from 1 to 5, with 1 being the homes with the lowest reading habit or reading materials environment and 5 being the highest.

As above, we fit multivariate regression models to predict achievement based on these two indices of the HLE, while controlling for relevant variables (age, SES, sex, etc.) and clustering the standard errors by school to account for students nested in schools.



All differences significant at a  $p < .01$  level or lower.

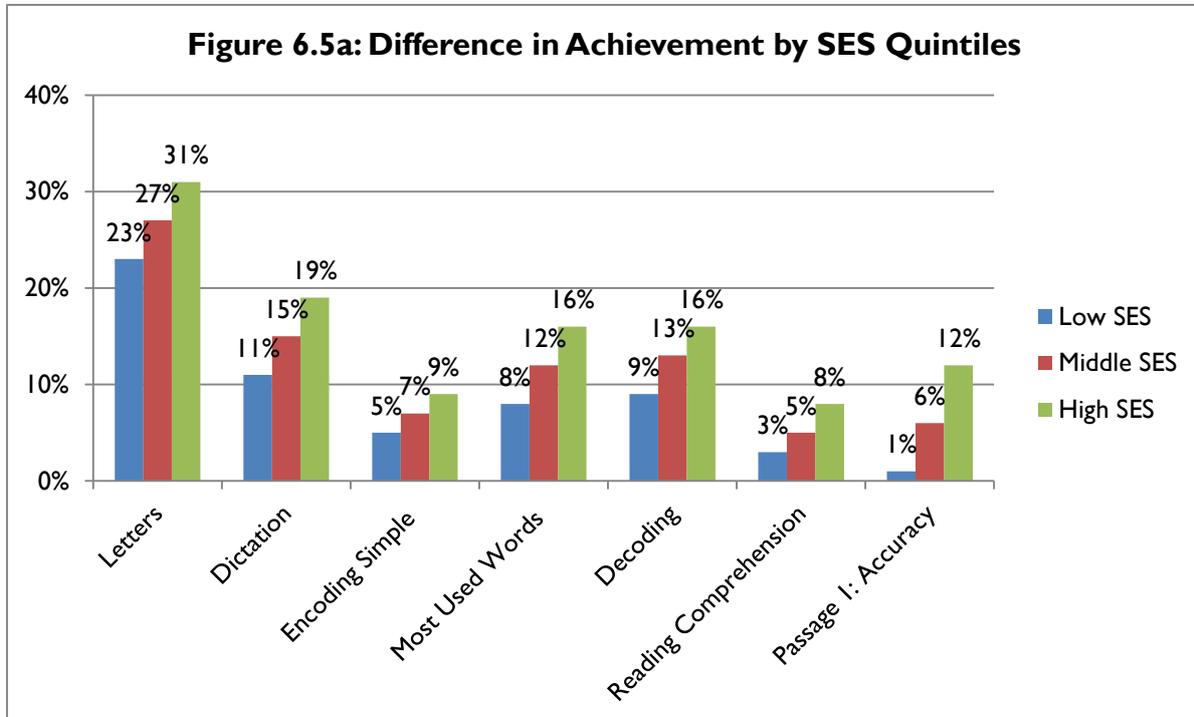
As seen in Figure 6.4a, the quintiles of the HLE Dimensions index strongly and consistently predict reading achievement. Not displayed are the results for predicting the Syllabic composite measure, Fluency scores, or Passage 2 accuracy. While the HLE dimensions are significantly associated with achievement in these areas, either the scale of the measure (for fluency, which is measured in words per minute) did not fit with the other measures, or the difference, while significant, was not of great enough magnitude to see on the graph. The findings displayed in Figure 6.4a echo findings from the developed world that show associations between a child's home literacy environment and his/her reading achievement. (De Jong & Lesemann, 2001; Griffin & Morrison\*, 1997; Payne, Whitehurst, & Angell, 1994)

While the measure of Reading habits did significantly predict achievement across all measures, the index of reading materials at home only predicted achievement in the phonemic composite score. What does this mean? There are several interpretations. Possibly at a relative young age, the interactions and habits that happen around literacy play a more critical role than materials. Another possible interpretation is that the materials that are in the students' homes are not of high enough quality or are not used to engage the students, so having more types of them at home is not associated with greater achievement.

### 6.5 The Relationship between SES and Reading Achievement

Like the HLE index, the SES index is a composite of several variables. After exploring the correlations and failing to turn up any underlying factors, these variables were put into two sub-indices: one indexed the possessions a family had, and one indexed the buildings on the family's property (including the type of walls as an indicator of SES and the rooms per

person in the family home). Z-scores were derived from these two separate indices (expressed in units of standard deviation), and the two indices were added together to create one unified SES index. This index was then divided into quintiles to facilitate the interpretation of the results.



All differences significant at  $p < .05$  or lower

Figure 6.5a displays the significant differences across a wide range of skills between students from low, medium, and high SES households. These figures are derived from multivariate regression models controlling for relevant variables and cluster standard errors by school to account for the nested nature of this data. Appendix E contains the full regression models from which this figure was derived.

As can be seen in Figure 6.5a, there is a clear association between SES and reading achievement. SES not only predicted these measures, but other measures not displayed, including the syllabic composite measure, fluency on both reading passages, and accuracy on reading passage 2. Significant attention should be paid to students from lower SES to ensure that they achieve equitable outcomes with their higher SES peers.

## **7 Recommendations**

The recommendations that arise from the findings in this report are displayed in Table 8a:

Table 8a: Findings and Recommendations

Finding	Recommendation
Significant portion of non-Kinyarwanda speakers in schools in Gicumbi	Provide teachers with research-proven tips and tools for engaging students who may not be fully comfortable in speaking or reading Kinyarwanda
Students report having a large number of chores or other work around the household	During community sensitization meetings, deliver advocacy messages on the importance of providing children with time to engage in reading and learning outside of the school. Help parents and family members to realize that a child's whole day can and should be filled with learning experiences.
Girls read significantly better than boys	During community sensitization meetings, deliver advocacy messages on the importance of providing all children with time to engage in reading and learning outside of the school. Educate them around the fact that girls seem to be learning more than boys, and support teachers and community member to provide all students opportunities to build their reading skills.
Few storybooks available in homes	Provide as many child-gearred reading materials as possible to as many children as possible. Both locally made stories based on Rwandan folklore or other familiar stories <i>as well as</i> books from outside Rwanda but translated into Kinyarwanda should be provided to allow for maximum variation to capture the potential interests of all readers.
Low performance on reading skills	Provide teachers, families, and communities with the knowledge and resources to support student's learning to read.
Students from lower SES struggle more with certain reading skills	Provide advocacy messages to communities around helping not only their own children but all students to learn to read, and particularly those whose parents may not be in a financial position to provide these opportunities to their own children.

One other interesting item to follow up on is the ECD centers that children report attending. A large majority of children reported attending some sort of ECD center, which does not align with government statistics on the capacity of formal ECD centers. Further research is necessary to understand what students consider ECD, and how accurate their reports of attending these centers.

## **8 Conclusion**

Primary 1 students in Gicumbi are clearly struggling to learn to read. The data collected for this report cannot definitively answer why students are struggling, but they do indicate that a better approach to supporting children learn to read is needed. The strongly predictive nature

of the Home Literacy Environment index in relation to reading outcomes may indicate that providing structure and knowledge around reading development in the home and community could help all children learn better. Data collection in subsequent years during and after the randomized control trial will provide much greater insight into this and other methods for helping the children of Gicumbi accelerate their early reading development, thereby laying a more solid foundation for continued literacy growth throughout their schooling years.

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**Appendix A. Glossary of Terms**

cloze	This is a test of reading comprehension. In the test, the reader is presented with a sentence or a passage with a word missing. The reader is asked to fill in an appropriate word to make a meaningful sentence/passage.
control group	Also called the counterfactual. Used in randomized control trials to describe the group(s) who do not receive a specific intervention.
correlation	Correlation is a measure of how well two variables are related or are dependent on one another. If two variables are highly and positively correlated, a rise in the value of one variable will mean a rise in the value of the other variable. A negative correlation indicates a rise in one variable will cause a drop in the other variable
decoding	This is the process by which a person uses his/her knowledge of the alphabetic principle to sound out and successfully read an unfamiliar word, or a word that he/she has never seen before.
encoding	This is the processing in which a word is heard by a student, and that student then writes the sounds that he/she hears. He/she 'encodes' the sounds into letters.
exploratory factor analysis	"In multivariate statistics, exploratory factor analysis (EFA) is a statistical method used to uncover the underlying structure of a relatively large set of variables. EFA is a technique within factor analysis whose overarching goal is to identify the underlying relationships between measured variables. It is commonly used by researchers when developing a scale (a scale is a collection of questions used to measure a particular research topic) and serves to identify a set of latent constructs underlying a battery of measured variables". Source: Wikipedia <a href="http://en.wikipedia.org/wiki/Exploratory_factor_analysis">http://en.wikipedia.org/wiki/Exploratory_factor_analysis</a>
high frequency words	These are words that appear very often in a learner's Primary 1 textbook or that are used very commonly. In English, good examples of high frequency words are "the", "and", "my", etc.
home literacy environment	Describes the amount and quality of interactions around reading, writing, and other literacy related activities in the home.
interrater reliability	This is a measure of how well different raters or assessors agree on what should be considered a correct or an incorrect answer.
mean	The mean (also called the average) is a measure that provides average value, or the middle value, of a set of numbers. To find the mean, you add up all the values in a group and then divide that by the number of values in a group.
multivariate regression analysis	A type of regression analysis using many variables to predict a variable of interest.
phonemic awareness	"Phonemic awareness is a subset of phonological awareness in which listeners are able to hear, identify and manipulate phonemes, the smallest

	units of sound that can differentiate meaning. Separating the spoken word "cat" into three distinct phonemes, /k/, /æ/, and /t/, requires phonemic awareness." -Sources: Wikipedia: <a href="http://en.wikipedia.org/wiki/Phonemic_awareness">http://en.wikipedia.org/wiki/Phonemic_awareness</a>
phonological awareness	"Phonological awareness refers to an individual's awareness of the phonological structure, or sound structure, of spoken words. Phonological awareness is an important and reliable predictor of later reading ability and has, therefore, been the focus of much research." Source: Wikipedia <a href="http://en.wikipedia.org/wiki/Phonological_awareness">http://en.wikipedia.org/wiki/Phonological_awareness</a>
print environment	The amount of printed words or other written text in the immediate environment
pseudo words	These are entirely made-up words that do not have any meaning, but that follow the regular orthographic patterns of a particular language.
randomization	The process through which all participants have equal chance to be included in any particular group of a study.
randomized control trial	An research method that examines the impact of different interventions with participants randomly assigned to different groups
reading accuracy	This is a measure of how correctly a students reads a text.
reading fluency	This is the rate at which a child reads, usually measured in words read correctly in one minute.
regression analysis	A type of statistical analysis that is used to establish a relationship between one variable and another (or a group of other) variables
sector	The administrative unit below the district level in Rwanda. In Gicumbi, there are 21 sectors
significant difference	In statistics, a significant difference indicates that an observed difference is greater than what one would expect by random chance. There are different techniques used to test for significant differences. For one of them, refer to the term "t-test"
socioeconomic index	This variable is an index indicating where individuals fall in relation to each other in terms of socioeconomic status. In this report, the socioeconomic index is separated into 5 groups: low socioeconomic status, low-middle, middle, high-middle, and high socioeconomic status.
socioeconomic status	This is a way of measuring a person or family's social and economic position based on a variety of factors. This study uses a measure of a family's assets to determine socioeconomic status. Other research may use family income, parental education level, or parental occupation (or some combination of the three) to measure socioeconomic status.
statistically significant difference	see "significant difference"
structural equation modelling	An advanced statistical technique that examines the relationship between different types of variables.

treatment group	Used in randomized control trials to describe the group(s) receiving a specified intervention
t-test	A t-test is a statistical test that determines whether two groups are reliably (usually referred to as "significantly") different from each other on some variable of interest.

## **Appendix B. Inter-rater Reliability & Data Entry Accuracy**

### **B.1 Inter-rater Reliability**

To test inter-rater reliability, 7 percent of learners (157 out of 2118 learners) were assessed by two enumerators simultaneously. Long one-way ANOVA techniques were used to calculate the intra-class correlation within pairs of assessors for a measure of reliability. Table 1 presents the results below. Using Fleiss' benchmarks for excellent ( $ICC > 0.75$ ), good or fair ( $0.75 \geq ICC > 0.4$ ), and poor ( $0.4 \geq ICC$ ); many of the literacy outcome variables exhibited excellent inter-rater reliability. Table A1 shows the percent of agreement between the raters.

**Table B1. Interrater Accuracy and Reliability**

Literacy Skill Sub-Test	Inter-rater Reliability	Rating
Beginning Sound	0.995	Excellent
Blending Syllables	0.977	Excellent
Blending Phonemes	0.935	Excellent
Segmenting Syllables	0.981	Excellent
Segmenting Phonemes	0.998	Excellent
Letter Knowledge	0.998	Excellent
Dictation	0.982	Excellent
Encoding	0.998	Excellent
Most Used Words	0.999	Excellent
Decoding	0.998	Excellent
Reading Comprehension: Simple Questions	0.997	Excellent
Reading Comprehension: Cloze	0.998	Excellent
Reading Passage 1: Fluency	0.994	Excellent
Reading Passage 1: Accuracy	0.998	Excellent
Reading Passage 2: Fluency	0.993	Excellent
Reading Passage 2: Accuracy	0.987	Excellent

There was excellent inter-rater reliability on every measure. **In general, inter-rater reliability was very high, and we can be confident that the internal validity of the scores is good.**

### **B.2 Data Entry Accuracy**

Out of 2280 total assessment collected, including students who were scored by two assessors at once for inter-rater reliability estimates, 246 of these assessments were entered two times by the 4 data entry specialists. This was done to assess the amount of error introduced into the data during the data entry process and the creation of the data base.

**Data entry specialists agreed on values 99.3% of the time. This is a more than acceptable rate of agreement for the data entry accuracy check**

**Appendix C. Descriptive Tables**

Table C1: Background, SES, and Work Descriptive Statistics for the Overall Sample

<b>Measure</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>
% Female	2118	48%	0.50
Home Language: Kinyarwanda	2118	86%	0.34
Home Language: Non-Kinyarwanda	2118	13%	0.34
Age (years)	1949	7.75	1.64
Attended ECD	2115	71%	0.45
Repeated Primary 1	2107	55%	0.50
Roof made of locally made tiles	2118	16%	0.36
Roof made of Iron Sheets	2118	83%	0.37
Roof made of Industrially-made Tiles	2118	1%	0.09
Walls of Mud & Wood	2118	33%	0.47
Walls of Mud Bricks	2118	58%	0.49
Walls of Fired/Baked Bricks	2118	4%	0.20
Walls of Stones	2118	1%	0.08
Walls of Concrete bricks	2118	0%	0.06
Has Radio	2117	80%	0.40
Has Electricity	2113	12%	0.32
Has Bicycles	2113	32%	0.47
Has an Outdoor Latrine	2109	98%	0.12
Outdoor Latrine: No Walls & No Roof	2118	3%	0.17
Outdoor Latrine: No Walls or No Roof	2118	28%	0.45
Outdoor Latrine: Wall & Roof	2118	68%	0.47
Has Mobile Phone	2116	70%	0.46
Has Computer	2005	4%	0.20
Has Motorcycle	2113	6%	0.25
Has Animals	2109	91%	0.29
Has Cows	2026	83%	0.37
Has Goats	2011	53%	0.50
Has Pigs	1999	17%	0.37
Has Sheep	2001	32%	0.47
N of Bedrooms	2061	3	1.19
Parent has Status in Community	2118	75%	0.43
Status of Parent (out of 4)	2118	1.06	0.86
Parent participates in Cooperative	2065	69%	0.46
Parent is a Teacher	2107	7%	0.26
Parents is a Religious Leader	2103	15%	0.36
Parent is a Village Leader	2091	17%	0.38
Does Chores at Home	2114	99%	0.11
N of Chores mentioned	2118	2.94	1.47
Collects Firewood	2103	43%	0.50
Washes Clothes	2101	7%	0.25
Cooks	2101	48%	0.50
Tends Animals	2100	57%	0.50
Takes Care of Children	2098	7%	0.25
Fetches Water	2102	76%	0.43
Cleans Dishes	2106	21%	0.41
Sweeps	2103	21%	0.41
Farms	2102	13%	0.34
Does Other Chores	2101	4%	0.2
Chores: Never	2118	0%	0.07
Chores: Sometimes	2118	58%	0.49
Chores: Everyday	2118	40%	0.49
Misses School to do Chores	2077	20%	0.40
Studies at Home: Never	2118	23%	0.42
Studies at Home: Sometimes	2118	61%	0.49
Studies at Home: Everyday	2118	15%	0.36

Table C2. Home Literacy Environment Descriptive Statistics

Measure	N	Mean	SD
N of Types of Books	2118	1.98	1.69
Has Textbooks	2118	41%	0.49
Has Religious Books	2118	57%	0.49
Has Newspapers	2118	20%	0.4
Has Stories	2118	22%	0.42
Has Comics	2118	21%	0.41
Has Booklets	2118	36%	0.48
Lends Books to others in Family/Community	2118	10%	0.3
Reads to other in Family/Community	2118	16%	0.37
N of Household	2114	4.97	1.6
Sees family member read (yes/no)	2118	86%	0.34
N of family members seen reading	2115	2.7	1.9
% of family members seen reading	2118	53%	0.33
Family member reads to student (yes/no)	2118	76%	0.43
N of family members who read to student	2115	2.25	1.94
% of family members who read to student	2118	44%	0.35
Family member helps student study (yes/no)	2118	87%	0.33
N of family members who help student study	2115	2.91	1.98
% of family members who help student study	2118	59%	0.35
Family member converses to student (yes/no)	2118	97%	0.16
N of family members who converse with student	2115	4.32	1.85
% of family members who converse with student	2118	87%	0.3

**Appendix D. Reading Skill Averages**

Table D1: Reading Items for Beginning Sounds, Blending Syllables, &amp; Blending Phonemes

Item	N	Mean	Standard Deviation
Beginning Sound 1	2111	0.27	0.44
Beginning Sound 2	2111	0.36	0.48
Beginning Sound 3	2109	0.09	0.29
Beginning Sound 4	2107	0.17	0.38
Beginning Sound 5	1069	0.07	0.26
Beginning Sound 6	930	0.29	0.45
Beginning Sound 7	517	0.19	0.39
Beginning Sound 8	476	0.28	0.45
Beginning Sound 9	358	0.3	0.46
Beginning Sound 10	346	0.6	0.49
Total Score: Beginning Sounds	2118	1.3	1.97
Blending Syllables 1	2115	0.73	0.45
Blending Syllables 2	2114	0.83	0.37
Blending Syllables 3	2114	0.84	0.37
Blending Syllables 4	2114	0.82	0.38
Blending Syllables 5	1923	0.88	0.33
Blending Syllables 6	1900	0.86	0.34
Total Score: Blending Syllables	2118	4.79	1.95
Blending Phonemes 1	2109	0.16	0.37
Blending Phonemes 2	2109	0.12	0.33
Blending Phonemes 3	2108	0.14	0.34
Blending Phonemes 4	2105	0.33	0.47
Blending Phonemes 5	875	0.37	0.48
Blending Phonemes 6	820	0.18	0.39
Blending Phonemes 7	778	0.1	0.3
Blending Phonemes 8	723	0.04	0.19
Blending Phonemes 9	396	0.16	0.37
Blending Phonemes 10	214	0.21	0.41
Blending Phonemes 11	132	0.46	0.5
Blending Phonemes 12	114	0.13	0.34
Total Score: Blending Phonemes	2118	1.1	1.82

Table D2: Reading Items for Segmenting Syllables and Segmenting Phonemes

Item	N	Mean	Standard Deviation
Segmenting Syllables 1	2114	0.94	0.24
Segmenting Syllables 2	2113	0.87	0.34
Segmenting Syllables 3	2114	0.83	0.38
Segmenting Syllables 4	2114	0.85	0.36
Segmenting Syllables 5	2031	0.84	0.37
Segmenting Syllables 6	1972	0.86	0.34
Total Score: Segmenting Syllables	2118	5.08	1.66
Segmenting Phonemes 1	2114	0.08	0.27
Segmenting Phonemes 2	2113	0.08	0.27
Segmenting Phonemes 3	2114	0.08	0.27
Segmenting Phonemes 4	2108	0.04	0.19
Segmenting Phonemes 5	210	0.33	0.47
Segmenting Phonemes 6	195	0.36	0.48
Segmenting Phonemes 7	175	0.33	0.47
Segmenting Phonemes 8	104	0.51	0.5
Segmenting Phonemes 9	86	0.72	0.45
Segmenting Phonemes 10	84	0.65	0.48
Segmenting Phonemes 11	75	0.71	0.46
Segmenting Phonemes 12	72	0.71	0.46
Total Score: Segmenting Phonemes	2118	0.5	1.91

Table D3: Reading Items for Letter Identification

Item	N	Mean	Standard Deviation
a	2118	0.249	0.432
a	2118	0.480	0.5
B	2118	0.249	0.433
C	2118	0.294	0.456
d	2118	0.232	0.422
e	2118	0.593	0.491
F	2118	0.221	0.415
G	2118	0.178	0.383
g	2118	0.345	0.475
g	2118	0.129	0.336
H	2118	0.203	0.402
i	2118	0.739	0.439
J	2118	0.167	0.373
k	2118	0.584	0.493
L	2118	0.103	0.305
m	2118	0.597	0.491
n	2118	0.354	0.478
O	2118	0.478	0.5
p	2118	0.175	0.38
R	2118	0.200	0.4
S	2118	0.445	0.497
T	2118	0.281	0.45
t	2118	0.251	0.434
t	2118	0.521	0.5
U	2118	0.616	0.487
v	2118	0.252	0.434
W	2118	0.291	0.454
Y	2118	0.282	0.45
z	2118	0.381	0.486
Total Score: Letter Identification	2118	9.891	8.936

Table D4: Reading Items for Dictation and Encoding

Item	N	Mean	Standard Deviation
Dictation 1	1783	0.36	0.48
Dictation 2	1782	0.37	0.48
Dictation 3	751	0.86	0.35
Dictation 4	744	0.81	0.39
Dictation 5	709	0.11	0.31
Dictation 6	697	0.88	0.32
Dictation 7	685	0.81	0.39
Dictation 8	670	0.05	0.21
Dictation 9	650	0.87	0.34
Dictation 10	647	0.7	0.46
Total Score: Dictation	2118	2.28	3.42
Encoding 1	834	1.58	0.63
Encoding 2	835	1.73	0.6
Encoding 3	780	1.42	0.71
Encoding 4	776	1.64	0.56
Encoding 5	777	1.21	0.7
Encoding 6	775	0.83	0.42
Encoding 7	764	0.71	0.48
Encoding 8	762	0.77	0.45
Encoding 9	750	0.74	0.45
Encoding 10	717	0.51	0.52
Total Score: Encoding	2118	4.14	5.76

Table D5: Reading Items for Most Used Words, Decoding, Reading Comprehension, Cloze, Reading Fluency and Reading Accuracy

Item	N	Mean	Standard Deviation
Most Used Words 1	1764	0.39	0.49
Most Used Words 2	1763	0.39	0.49
Most Used Words 3	775	0.79	0.41
Most Used Words 4	763	0.56	0.5
Most Used Words 5	750	0.66	0.47
Most Used Words 6	718	0.09	0.29
Most Used Words 7	655	0.77	0.42
Most Used Words 8	577	0.09	0.29
Most Used Words 9	566	0.7	0.46
Most Used Words 10	534	0.11	0.31
Total Score: Most Used Words	2118	1.89	2.91
Decoding 1	799	1.63	0.6
Decoding 2	798	1.68	0.61
Decoding 3	778	1.47	0.65
Decoding 4	775	1.63	0.58
Decoding 5	766	1.32	0.71
Decoding 6	760	0.92	0.42
Decoding 7	757	0.81	0.47
Decoding 8	752	0.77	0.5
Decoding 9	735	0.77	0.46
Decoding 10	709	0.78	0.5
Total Score: Decoding	2118	4.28	6.04
Reading Comprehension 1	790	0.39	0.49
Reading Comprehension 2	790	0.46	0.5
Reading Comprehension 3	429	0.74	0.44
Reading Comprehension 4	416	0.36	0.48
Reading Comprehension 5	384	0.34	0.47
Reading Comprehension 6	373	0.17	0.37
Total Score: Reading Comprehension	2118	0.63	1.46
Cloze 1	787	0.42	0.49
Cloze 2	788	0.33	0.47
Cloze 3	394	0.8	0.4
Cloze 4	385	0.34	0.47
Cloze 5	366	0.17	0.37
Cloze 6	340	0.13	0.34
Total Score: Cloze	2118	0.54	1.3
Reading Passage 1: Fluency	405	15.86	9.12
Reading Passage 1: Accuracy	405	0.92	0.13
Reading Passage 2: Fluency	296	15.16	6.4
Reading Passage 2: Accuracy	296	0.73	0.15

**Appendix E. Regression Models by Outcome**

Table E1: Multivariate Regression Models by Predicting Reading Outcomes

VARIABLES	(1) Phonemic Composite (% Correct)	(2) Syllabic Composite (% Correct)	(3) Letters (% Correct of 24)	(4) Dictation (% Correct)	(5) Encoding Simple (% Correct)	(6) Most Used Words (% Correct)	(7) Decoding (% Correct)
N of chores mentioned (unprompted)	0.002 (0.003)	0.000 (0.006)	0.008 (0.008)	0.001 (0.006)	0.003 (0.004)	0.003 (0.006)	0.003 (0.006)
Sex	0.009* (0.004)	0.012 (0.010)	0.056*** (0.013)	0.056** (0.015)	0.024** (0.008)	0.059*** (0.012)	0.055*** (0.011)
Child speaks Kinya at home	0.024 (0.016)	0.009 (0.022)	0.029 (0.062)	0.089 (0.056)	0.040 (0.033)	0.057 (0.053)	0.060 (0.057)
Quintiles of SES	0.004 (0.003)	0.009* (0.003)	0.020*** (0.005)	0.019** (0.005)	0.011** (0.003)	0.018** (0.005)	0.018** (0.005)
Age	0.004* (0.002)	0.014** (0.004)	0.022*** (0.004)	0.022*** (0.005)	0.012*** (0.003)	0.018*** (0.004)	0.022*** (0.005)
Student repeated Primary 1	0.008 (0.006)	0.002 (0.012)	0.051* (0.019)	0.044 (0.023)	0.015 (0.012)	0.037 (0.019)	0.035 (0.018)
Quintiles of HLE Dimensions Index	0.007* (0.002)	0.011* (0.004)	0.027** (0.008)	0.031** (0.008)	0.017** (0.005)	0.024** (0.008)	0.024** (0.007)
Quintiles of Reading Materials Index	0.008* (0.003)	0.007* (0.003)	0.008 (0.006)	0.000 (0.005)	-0.000 (0.003)	0.004 (0.005)	0.009 (0.006)
Constant	-0.036 (0.026)	0.620*** (0.039)	-0.067 (0.080)	-0.222** (0.074)	-0.121* (0.043)	-0.195** (0.064)	-0.211* (0.077)
Observations	2,118	2,118	2,118	2,118	2,118	2,118	2,118
R-squared	0.031	0.019	0.058	0.053	0.047	0.054	0.057
Adjusted R-squared	0.0273	0.0157	0.0548	0.0495	0.0429	0.0504	0.0530

Robust standard errors in parentheses. Standard errors clustered at sector level to account for nested nature of the data level.

\*\*\* p<0.001, \*\* p<0.01, \* p<0.05

Table E1: Multivariate Regression Models by Predicting Reading Outcomes (continued)

VARIABLES	(8) Reading Comprehension (% Correct)	(9) Cloze (% Correct)	(10) Passage 1 : Fluency	(11) Passage 1: Accuracy	(12) Passage 2: Fluency	(13) Passage 2: Accuracy
N of chores mentioned (unprompted)	0.002 (0.006)	-0.000 (0.005)	0.102 (0.156)	0.009 (0.007)	0.072 (0.134)	0.004 (0.005)
Sex	0.052*** (0.012)	0.034** (0.010)	1.803*** (0.347)	0.071*** (0.016)	1.375*** (0.282)	0.059*** (0.011)
Child speaks Kinya at home	0.039 (0.040)	0.029 (0.030)	0.930 (1.133)	0.061 (0.054)	0.765 (0.863)	0.041 (0.036)
Quintiles of SES	0.013* (0.005)	0.010* (0.005)	0.413* (0.146)	0.026** (0.007)	0.316* (0.129)	0.014* (0.006)
Age	0.011* (0.004)	0.008* (0.004)	0.257* (0.111)	0.016** (0.005)	0.122 (0.084)	0.006 (0.004)
Student repeated Primary 1	0.027 (0.014)	0.024* (0.011)	0.922 (0.447)	0.033 (0.023)	0.768* (0.309)	0.035* (0.013)
Quintiles of HLE Dimensions Index	0.021** (0.006)	0.018** (0.005)	0.589** (0.185)	0.028** (0.009)	0.390** (0.131)	0.016** (0.005)
Quintiles of Reading Materials Index	0.004 (0.005)	0.006 (0.004)	0.249 (0.175)	0.006 (0.008)	0.237 (0.140)	0.008 (0.006)
Constant	-0.177** (0.048)	-0.126* (0.047)	-5.132*** (1.290)	-0.258*** (0.066)	-3.560*** (0.915)	-0.149*** (0.038)
Observations	2,118	2,118	2,118	2,118	2,118	2,118
R-squared	0.048	0.039	0.051	0.048	0.046	0.042
Adjusted R-squared	0.044	0.035	0.047	0.045	0.043	0.039

Robust standard errors in parentheses. Standard errors clustered at sector level to account for nested nature of the data level.

\*\*\* p<0.001, \*\* p<0.01, \* p<0.05