



Learning in Liberia: Literacy and Numeracy Gains in Year 1

A Study on Bridge Partnership Schools for Liberia (PSL)



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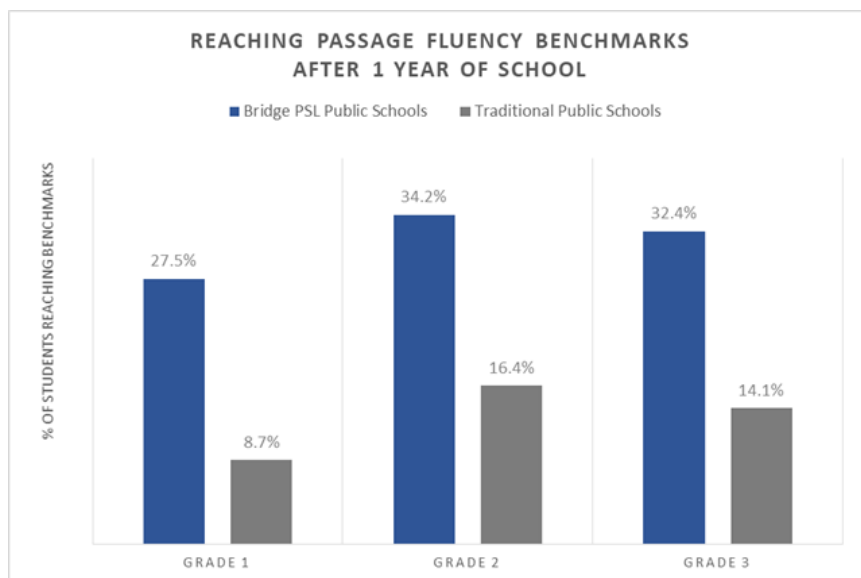
Executive Summary

Bridge International Academies opened 25 PSL public schools in eight different counties across Liberia in September 2016. To better understand how Bridge PSL public schools can drive educational gains, the Ministry of Education, Pencils of Promise, Worldreader, University of Liberia, and Bridge embarked upon “The Bridge PSL Public School Study.” This study compares performance for students attending Bridge PSL public schools with those in comparable traditional public schools.

Over the school year, we observed clear performance differences. Bridge PSL public school students in the early grades show demonstrably superior reading and math skills compared to their counterparts in traditional public schools. Bridge PSL public school students read faster and with greater accuracy. Bridge PSL public school students also solve basic math problems faster. The learning gains made at Bridge PSL public schools in a single academic year are equivalent to almost 3 years of English instruction and nearly 2 years of math instruction at traditional public schools. An independent impact study of the PSL program, led by the Center for Global Development and Innovations for Poverty Action, confirms the large learning gains driven by Bridge PSL.

Non-readers were transformed into emergent readers. At Bridge PSL public schools, almost 80% of non-readers made this transition compared to less than 50% for traditional public schools.

The number of proficient early grade readers doubled; more than twice the number of Bridge PSL public school students met reading fluency benchmarks compared to traditional public school students. In fact, the average Bridge PSL 1st grader will begin 2nd grade reading more than twice as fast as last year’s incoming 3rd graders.



It will be some time before we will know the full impact of Bridge support of public school education in Liberia, but these initial findings suggest that students in Bridge PSL public schools are learning better and faster than their peers. If this trend continues, it will mean that Bridge PSL public school students will be much better equipped to face the increasing demands of secondary school and college than their traditional public school peers.

The full report provides all relevant technical details, but a brief overview of the study and its measures will be helpful. The study measured performance with standard, widely used reading and math tests, suitable for assessing progress in the earliest years of formal education. The analysis focuses on student learning growth and compares the gains made by students in Bridge PSL and traditional public schools. Bridge PSL public schools in this study were randomly selected from those six counties in Liberia hosting both Bridge PSL and traditional public schools. Comparison schools were selected based on similarity and proximity to the Bridge PSL public schools. Students at all schools were randomly chosen to participate.

It is important to note that the goal of this study is to provide some indication of the relative benefits that accrue to Bridge PSL public school students. This study favors rapid response, which provides Bridge with information to drive improvements, and is not meant to definitively determine the impact of Bridge PSL public schooling. The trade-offs that impair precision and certainty, such as its small sample size, the use of a nonrandom comparison group of schools, and a sizable student attrition rate, are also the features of this study that reduce time and cost and make it possible to produce a rapid, if incomplete, performance comparison.

Despite these limitations, we are encouraged by this early positive signal of impact on learning outcomes, particularly as significant learning gains have also been found by the independent randomized evaluation. The Ministry of Education and Bridge PSL public schools look forward to continuing this partnership in working to improve learning and the opportunity that brings for the students of Liberia.

1. Introduction

The Partnership Schools for Liberia (PSL) program is a bold initiative developed in 2016 by the Government of Liberia to increase the quality of pre-primary and primary education in the country. Specifically, the Ministry of Education (MoE) invited Bridge and seven other non-state operators to bring their management and operational models to existing public schools nationwide.¹ Operators are responsible for the daily management of the schools and are held accountable to the Government of Liberia for their performance across several indicators.²

PSL public schools do not charge fees and students are enrolled on a first-come, first-served basis. The school buildings remain under the ownership of the Government of Liberia, and teachers in PSL public schools are employed by the government. Each operator is given limited autonomy to run schools and improve upon student achievement, as long as they do so in keeping with the regulations of the MoE and the Liberian national curriculum. Teachers remain civil servants, cannot have their employment terminated by operators, and continue to be paid through the MoE. Operators are encouraged to supplement the curriculum with remedial programs, a focus on literacy and numeracy, longer school days, and non-academic activities.

Bridge was assigned 25 public schools to operate across eight counties: Bomi, Bong, Grand Bassa, Grand Cape Mount, Margibi, Montserrado, Nimba, and River Cess. As part of its Memorandum of Understanding with the Government of Liberia, Bridge embarked on a collaborative study with the MoE of the Government of Liberia, Pencils of Promise, Worldreader, and University of Liberia to measure the effect of Bridge PSL public schools upon its students – the educational gains made by students attending Bridge

¹ These schools were randomly selected and assigned to the operators by a team of independent researchers, with each operator supplying feasibility criteria ex-ante. For the discussion of their randomization, see Romero (2017).

² Operators are to receive funding on a per-student basis, but can supplement their budget through individual fundraising.

PSL public schools, above their academic peers at traditional public schools – and the goal of this study is to provide some indication of the relative benefits that accrue to Bridge PSL public school students.

This report describes the learning gains of students in the program’s inaugural year. The learning gains made at Bridge PSL public schools in a single academic year are equivalent to almost 3 years of English instruction and nearly 2 years of math instruction at traditional public schools. Non-readers were transformed into emergent readers, and the number of proficient early grade readers doubled. More than twice the number of Bridge PSL public school students met reading fluency benchmarks compared to traditional public school students. In fact, the average Bridge PSL 1st grader now reads more than twice as fast as an incoming 3rd grader.

2. Bridge PSL Public Schools

2.1 The Bridge Approach

Bridge has developed systems and processes integrated with innovations in technology to provide each student with a high-quality education. Bridge believes that this relies on dedicated and trained teachers, engaging lessons paired with effective learning materials, and monitoring and support designed to create a safe environment for learning. Bridge describes its method as treating education as a science, where decisions rely on data to drive continuous improvements in training, materials, timetabling, and management.

In Table 1 below, we identify components of Bridge’s approach to public school support in this pilot year of the Partnership Schools for Liberia program and compare it with the status quo in typical Liberian schools, derived from a compilation of interviews with MoE officials, traditional public school staff, and Bridge PSL public school and central office staff, as well as observations from nearly 50 school visits conducted in March-July 2016.

Table 1. Features of Bridge PSL Public Schools vs. Traditional Public Schools

Category	Bridge PSL Public Schools	Typical Traditional Public School
Length of School Day	<ul style="list-style-type: none"> • 8:00 am – 3:15 pm for students. • 7:30 am – 3:30 pm for teachers. 	<ul style="list-style-type: none"> • 8:00 am – 12:30 pm for students and teachers.
Class Organization	<ul style="list-style-type: none"> • Grades not combined. • Maximum class size of 55. • Early childhood is designed for younger students aged 3-6. • Over-age children are placed into classes that are as age-appropriate as possible, with well targeted lessons to allow for quicker mastery of grade level content. 	<ul style="list-style-type: none"> • Grades often combined due to staffing shortage. • No maximum size.² • Over-age children (older than 6) are often placed in early childhood classes.

School Location & Building Characteristics	<ul style="list-style-type: none"> • Required data signal (2G access), proximity to a road. 	<ul style="list-style-type: none"> • Doesn't necessarily have data signal; not necessarily close to a road.
Instructional Materials, Guides, Teacher Technology	<ul style="list-style-type: none"> • Follows national curriculum (all materials approved by the MoE Department of Instruction). • Every teacher uses a Teacher Computer that contains a detailed teacher guide for every lesson.³ • Lessons designed to provide independent and group practice, emphasizing a “productive struggle.” 	<ul style="list-style-type: none"> • Follows national curriculum. • No teacher guides. • Lessons usually involve rote lecture, or students copying content off the board.
Selection of Administrators & Teachers	<ul style="list-style-type: none"> • Teachers vetted by Bridge for presence, literacy, competence, buy-in, and reputation in their community. • 1 teacher for each grade offered. • 2 administrators—a Principal and a Vice Principal for Instruction, per MoE standards. • 15% of teachers are community teachers who were already teaching at that Bridge PSL public school in previous years; the remainder of teachers are civil service employees who have graduated from a government teacher training institute. 	<ul style="list-style-type: none"> • Teachers not usually assessed for presence, literacy, competence or diligence, though a recent MoE initiative is seeking to change this by testing all teachers for basic literacy and enacting biometric checks on presence.⁴ • Most schools lack an assigned teacher for one or more grade levels; some schools have one or more assigned teachers who have absconded from their posting. • No uniform numbers of administrators or standardized job functions. Some administrators serve as full-time teachers; some have absconded from their posting. • Most teachers are civil service employees who have graduated from a government teacher training institute.

³ Teacher Computers are customized electronic reader tablets, which allow for two-way information transfer. The teacher guides empower the teachers with all the timing details, examples, practice questions, activities, and content knowledge necessary to teach the lesson.

⁴ Liberia Teacher Training Program II (LTTP II). Retrieved online at <https://www.fhi360.org/projects/liberia-teacher-training-program-ii-ltpp-ii>.

Teacher Training	<ul style="list-style-type: none"> • 13-day pre-service training in addition to government teacher training institute coursework. Topics covered include: mastering core content, use of classroom management techniques, teaching practice using Teacher Computer. • Teachers receive continuing support during the school year: daily messages about how to improve practice, daily observations from their Vice Principals of Instruction, and regular feedback on how to improve from regional supervisors. 	<ul style="list-style-type: none"> • Most teachers received the government teacher-training institutes' year-long training, which focuses on how to create lesson plans. Training also includes a practicum in actual schools, but with little oversight. Some teachers—including most of the teaching staff at some rural schools—are community teachers who were never formally trained. • No continuing training after initial certificate.
Teacher Attendance	<ul style="list-style-type: none"> • Teacher attendance is closely monitored, with warning letters sent to teachers for absenteeism. 	<ul style="list-style-type: none"> • Teacher attendance is rarely monitored and typically low.⁵
Teacher Monitoring	<ul style="list-style-type: none"> • Teacher attendance tracked via time stamps of the use of teacher support software. • School administrators are present to take school inventory, communicate with Bridge central office staff, and provide general support to teachers.⁶ • Teachers recognized for success through celebratory notes sent to staff, personal acknowledgement by school administrators and visiting central office staff, and other methods to recognize and incentivize performance. • Liberian law used to transfer teachers out of a Bridge PSL public school if repeatedly absent or repeatedly neglectful of duties as is allowed according to the Civil Service Administration. 	<ul style="list-style-type: none"> • Teacher attendance rarely monitored, although the MoE biometric program is starting to change this by matching biometrics to payroll. • Schools are visited by regional MoE staff occasionally. • Methods of teacher recognition unknown, likely vary from school to school. • Liberian law is infrequently or never used to remove and replace consistently absent or underperforming teachers.

⁵ See Mulkeen, A. (2009), p. 123 – 125.

⁶ Bridge is currently implementing a program whereby school administrators conduct 2 daily observations of teachers to provide coaching feedback, and monitor whether that feedback is implemented in practice.

<p>Administrator Roles & Responsibilities</p>	<ul style="list-style-type: none"> • Defined roles for two administrators: Principal and Vice Principal of Instruction. • Principal in charge of parent and student engagement, building maintenance, and all personnel; accountable for total management and performance of school, including instructional leadership. • Vice Principal reports to the principal; supports teachers through instructional coaching and ensuring presence of Academic materials. 	<ul style="list-style-type: none"> • Principal and Vice Principal role unclear. • Other Vice Principal roles also present. • A daily “sign in book” is used to help monitor staff.
<p>Administrator Attendance</p>	<ul style="list-style-type: none"> • Both administrators generally present.⁷ • Vice Principal is a full-time role with specific trained duties. 	<ul style="list-style-type: none"> • Principal commonly absent. • Vice Principal usually present – but teaching (due to staff shortage).
<p>School Materials</p>	<ul style="list-style-type: none"> • All textbooks, homework and classwork books provided to students free of charge. • Parents supply exercise books for notetaking and pencils. • In pilot year 2016-17, one free uniform was provided to every enrolled child. 	<ul style="list-style-type: none"> • In some schools, certain English and Math textbooks for some grades purchased through MoE GPE funds are available. At schools without GPE textbooks or for other subjects, textbooks are purchased by parents, or child does may not have access. There are no homework and classwork books. • Parents supply exercise books for notetaking and pencils. • Parents purchase a mandatory uniform for each child.
<p>School Culture</p>	<ul style="list-style-type: none"> • School administration trained to focus on positive discipline and student safety throughout the school. • All schools start the day with a student-led devotion in which all children line up and prepare for classes. • Positive school culture reinforced through grand opening ceremonies, PTA meetings, Liberia-created energizing “cheers” and songs in each class, character boards, and student leaders. 	<ul style="list-style-type: none"> • School culture is inconsistently defined; some schools have stronger school culture thanks to a strong principal, some do not. • Some sort of devotion is often a part of school culture.

⁷ Attendance has averaged ~90% across all Bridge PSL public schools.

<p>Student Body and Placement</p>	<ul style="list-style-type: none"> • No selection for students. • All previous students had priority; Bridge PSL public schools took any additional interested students from the community. • All students evaluated for literacy; placed in appropriate grades by competency and age. 	<ul style="list-style-type: none"> • No selection for students. • No systematic evaluation; children placed based on Principal perception.
<p>Student Attendance</p>	<ul style="list-style-type: none"> • Attendance tracked through school information management software. • Attendance also confirmed through calls to principals twice a week. • Teachers and principals encourage students to attend school, and hold PTA meetings to address challenges to student attendance. 	<ul style="list-style-type: none"> • Attendance is rarely tracked in a systematic way.
<p>Monitoring & Operational Support from Central Office</p>	<ul style="list-style-type: none"> • Support provided on Academics, Community Engagement, IT, HR, Supply Chain by central office. • Academic Field Team visits multiple schools daily, with the typical school receiving a visitor once every one to two weeks. • Regional Instructional Managers and Academic Field Officers visit three times per month: Observe lessons, support Vice Principals for Instruction, and coach teachers. • School and Community Support Team visits two times per month: Support principals and engage in proactive outreach to communities and PTAs. • IT Support Team Visits once per month, or whenever needed: Ensure that technology at schools is functioning, and fix any problems that arise. 	<ul style="list-style-type: none"> • Monitoring provided by District Education Officers. • Anecdotally, monitoring is low. • The typical DEO is assigned on average 44 schools to monitor across their district.

Special Programs & Partnerships	<ul style="list-style-type: none"> • Some schools receive school feeding from NGOs Mary’s Meals or the World Food Program, in accord with longstanding arrangements at those schools. • Worldreader and Pencils of Promise Partnership: 18 e-readers for 55 children (each 1st Grade through 6th Grade student gets 45 minutes of reading per day⁸). Each e-reader was filled with 222 digital titles, including English-language storybooks, levelled readers, and other materials to support literacy acquisition and make reading fun. 	<ul style="list-style-type: none"> • Some schools receive school feeding from NGOs Mary’s Meals or the World Food Program, in accord with longstanding arrangements at those schools. • Some schools have other partnerships with local NGOs, including libraries or other learning interventions.
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2.2 Operations and Challenges in Year 1

Bridge was assigned 24 public schools to manage and operate on July 15th, one month prior to the start of enrollment. The Bridge team proceeded full-speed ahead, supplying schools with everything from Teacher Computers to books to desks, training over 300 teachers and principals, and enrolling thousands of students.

The first day of school was September 5th. Teachers and principals started utilizing the skills they developed in training to ensure that learning in classrooms began in earnest. Members from three Bridge central office “teams” – academics, school and community engagement, and information technology – visited schools for ongoing monitoring and support. They observed lessons and teaching, engaged community members and Parent-Teacher Associations, coached teachers and principals on their roles, and ensured that the Bridge systems functioned at every school.

By the second semester, the Bridge central office in Liberia became more consistent and effective in implementing its academic program. By this time, Bridge had built-out its in-country permanent staff, and in particular strengthened its supply chain, inventory, auditing, and “Customer Care” call center functions. Bridge also implemented several pilots to explore improvements, such as more efficient Teacher Computer charging and better breakage prevention. One example was an internal randomized controlled trial to determine whether a particular type of Teacher Computer cover would improve the durability of the devices. The answer, an overwhelming yes, resulted in a data-driven decision to adopt these covers at scale and significant long-term cost savings.

Meanwhile, other teams within Bridge worked to improve the rigor of students’ academic experience. The academics team observed classrooms to understand the efficacy of lessons, and then developed and deployed new teacher guides to schools, resulting in lessons that were even better attuned to students’ academic levels. The academic team also made new textbooks for the students in preparation for Semester 2. Unlike the generic market textbooks used during the first semester, these textbooks were specifically designed by Bridge to include “at level” reading for the majority of students in each class. Based on evidence

⁸ During this period, students read independently in groups of three, for up to 40 minutes of the reading period. The students are given three or four books to read each lesson (three for Grades 1-3, and four for Grades 4-6), and students are free to choose which book they read from the given titles. Once they finish the book, they read another from the given titles, and so on for the duration of the lesson. The goal is that these periods are a dedicated reading period.

that students had more success on practice problems when they could follow a worked out example, the new Math textbooks also added example problems at the beginning of practice problem sets. The result of these efforts came through in daily field observations, which showed that the rigor and efficacy of lessons improved steadily during the academic year. See the “A Look into Developing Teacher Guides in Liberia” to understand the inner workings of the Bridge approach to improving learning materials.

Bridge also faced its fair share of challenges, ones in addition to the expected challenges of embarking on a school management public partnership in a new country. Some were solvable relatively quickly, but resulted in unanticipated expenditures. For example, upgrades to ceilings, walls, and doors at the public schools were required to ensure safety for students and staff. Blackboards and desks were also added to improve conditions for learning.

Other challenges were more persistent. The biggest was ensuring that teachers received their salary. Nearly two-thirds of the teachers (150 out of 237) were not on payroll at the start of the school year. Twenty of these teachers were existing community teachers, and 130 were recent RTTI graduates. Bridge engaged the staff of the MoE, Civil Service Administration, and Ministry of Finance daily to ensure that teachers were added to the payroll.

Table 2. Timeline of Payroll Challenges

Month	% Remaining Unpaid	% Not on Payroll
Sept 2016	63%	63%
Feb 2017	32%	19%
May 2017	9%	3%

Over the course of the year, more and more teachers were successfully established in the payroll system. However, the prolonged payroll issues also made it increasingly difficult for Bridge to manage and motivate teachers effectively. This in turn had other consequences: schools experiencing difficulties with teacher attendance also started to see dips in student attendance.

Another persistent challenge came from working against heavily entrenched norms around school attendance. Student attendance waned at the end of each week and just before or after holidays, and it also dropped significantly in the final weeks of the academic year.⁹ To help address this issue, the school and community engagement team at Bridge made calls to parents, encouraging them to send their children to school. Bridge also made radio announcements and used town criers in remote areas, creating awareness of the benefits of school and asking parents to help ensure that their children remain in school.

Finally, getting Bridge technology systems working to collect teacher and student level information was difficult from both a hardware and teacher compliance standpoint. The low availability of electricity in some of the communities hosting Bridge PSL public schools meant that school staff needed to make trips to the nearest market center to charge technology used at the school, which also increased operating costs.¹⁰ In addition, using Bridge technology to input student data also required a significant shift in behavior for

⁹ Bridge PSL public schools adhered to the full academic calendar set out by the MoE, which stipulated that classes were to end July 20. Unfortunately, very few Liberian schools actually honor this calendar, so Bridge PSL public schools were alone in remaining open for most of July.

¹⁰ This was the case for roughly 1/3 of the Bridge PSL public schools. When staff did have to travel outside of the community for charging, Bridge covered the costs for motorcycle transport and the costs for the charging itself.

teachers, moving away from paper notebooks to Teacher Computers instead. Many teachers struggled to consistently enter all student scores into their Teacher Computer within the time allotted for score entry.

Fortunately, the Bridge approach does not rely solely on technology. When Bridge's central office staff faced incomplete data regarding the day-to-day operations of schools, the team developed and enacted additional support strategies. Two Bridge measurement & evaluation officers, for example, led targeted call campaigns to teachers with missing student assessment scores. These officers would seek to understand and help trouble-shoot any issues teachers had, leading to a 43% improvement in the flow of student achievement information.

A Look into Developing Teacher Guides in Liberia

By gathering both student-level assessment data and classroom observations throughout the school year, Bridge sought to keep its lesson development team well-informed of any necessary changes to lesson design. This feedback loop resulted in improvements throughout Year 1.

In order to quickly assess the progress of the lessons in the new Bridge PSL public schools, the Bridge academic field team observed several lessons at the beginning of the school year, identifying seven core issues that required improvement:

- The content of initial lessons was too difficult.
- The initial lessons were taking too long to complete.
- Teachers found some teacher instructions to be unclear.
- Not all teachers knew how to properly use teaching manipulatives.
- Students did not organize their exercise books productively.
- Teacher guide formatting made some guides difficult to read.
- Students in all grades were still struggling with phonics.



These seven challenges then became the focal point for the lesson development team's work beginning in October. They spent days in schools observing over 180 lessons and testing revamped lessons until they figured how to fix the issues.

The most pressing issue was the excessive difficulty of the lessons given the incoming level of students in each grade level. The lesson development team made several adjustments across various subjects and grades. For early grade Writing and English lessons, additional teacher modeling was added so that students could see the correct procedure on the board before practicing themselves.

For upper grades, reading comprehension questions were rewritten to test basic understanding of the story before testing higher level inference. In lower primary math, new teacher guides called for more focus on the problem solving process rather than the mathematical concept to ease students into new types of problems.

The remaining core issues were resolved with improved teacher guide formatting and editing processes, as well as the standardization of certain teacher and student instructions (i.e. directions for setting up student exercise books). The team was able to implement 44 types of changes to the remaining 6,750 teacher guides to be taught in Semester 1, as well as apply similar edits to the 10,000+ teacher guides to be taught in Semester 2.

3. Data Collection & Instruments

3.1 The Field Team

To complete our baseline, midline, and endline assessments, Bridge and Pencils of Promise collaborated to hire assessors, train the assessors on the instruments, coordinate fieldwork, and provide oversight of field teams.¹¹ To streamline the data collection process of EGRA/EGMA results, assessors were provided with tablets and used the Tangerine¹² platform to conduct surveys and assess students.

3.1.1 Recruiting and Hiring

Pencils of Promise and Bridge received over 180 applications for 12 temporary measurement and evaluation (M&E) field officer positions for baselines. After initial resume reviews, members of each organization's M&E global team completed phone screens with 50 candidates and then narrowed the group down to 32 for in-person interviews and exercises. To choose final team members, reference checks were conducted on the top 18 applicants.

Nine of the baseline field officers returned to assist with our endline evaluations. A similar process was followed to hire three new officers to maintain a team of 12, with two officers joining for midlines and one joining for endlines.

3.1.2 Training

The original 12 officers participated in a six-day intensive baseline training.¹³ The team learned how to administer EGRA/EGMA using both tablets and hard-copies. All 12 candidates passed training, with each candidate scoring 92% or better on the final test.

Prior to our endline assessments, Bridge and Pencils of Promise completed a three-day intensive re-training session, including a field practicum. All new officers also completed a two-day overview of EGRA/EGMA key skills prior to the intensive.

In addition to the field officer training, Pencils of Promise and Bridge developed a capacity building workshop for representatives from the University of Liberia and the MoE. This workshop included three participants from the MoE's Monrovia office and six county M&E officers. Details regarding this workshop can be found in Appendix A1. Details on the MoE Training.

3.1.3 Monitoring

Pencils of Promise and Bridge established processes to ensure data integrity by monitoring each field team's daily progress. These efforts were enabled by electronic data collection with Tangerine. Field teams uploaded completed assessments daily so that the study team could react to the data in real time and communicate with the field teams to address issues quickly. Pencils of Promise and Bridge also conducted surprise field visits throughout the assessments to ensure that all team-members were administering

¹¹ This oversight included confirming that schools were visited and that students were assessed. It also included ensuring that the data were saved and uploaded on a daily basis.

¹² Developed by RTI, Tangerine is a software application that allows the programming of tailored EGRA/EGMA instruments online, which then can be downloaded onto tablets and used to collect field data in real time. <http://www.tangerinecentral.org/>

¹³ Length of training is generally five days for EGRA/EGMA, but may vary depending on the number of subtasks and additional survey questions. Research Triangle Institute (RTI) generally conducts five-day trainings, including field practicum days. In Kenya, Decisions Management Consulting also conducts five-day EGRA/EGMA trainings with field practicum.

EGRA/EGMA consistently and complying with all daily procedures. For more details, see Appendix A2. Field Work Monitoring.

All fieldwork was coordinated with the MoE, whose representatives were present at visits to both Bridge PSL public schools and traditional public schools throughout the study. During our endline assessments, graduate students from the University of Liberia accompanied the study team on three school visits, to provide monitoring assistance and to learn more about real-world data collection.



“The training was understandable, practical, and participatory. I have learned a number of new things, particularly how to choose a random sample, that will be practiced in my county as an M&E Officer.”

*~ Anonymous Feedback
from Ministry of Education
M&E Officer*

3.2 Timeline

Data was collected at three points during the school year, which we refer to throughout the report as baselines, midlines, and endlines. Baselines were conducted in the first weeks of school from mid-September through early October. Midlines were conducted just before the end of the first semester, mid-January through early February. Endlines were conducted in June, just before the end of the school year.

3.3 Instruments

3.3.1 EGRA / EGMA

To assess literacy and numeracy levels of the Kindergarten through Grade 3 students in our study, we used the Early Grade Reading Assessment and Early Grade Mathematics Assessment (EGRA/EGMA). Both EGRA and EGMA were developed by RTI International in conjunction with USAID.

EGRA is an oral student assessment designed to measure foundational skills for literacy in the early grades. EGMA is also an oral assessment, designed to measure students’ foundational skills in numeracy and mathematics in the early grades. Each foundational skill is tested with a different “subtask.” Both EGRA and EGMA are administered one-on-one with students.

Bridge, Pencils of Promise, and Worldreader use EGRA/EGMA globally because it provides detailed data at the item-level that is particularly helpful in driving programmatic improvements. In addition, these assessments are open source and supported with very effective knowledge sharing forums and infrastructure provided by RTI. The standardized use of EGRA/EGMA also allows for the comparison of

data across Bridge’s different operating countries, and for comparison with results from other organizations that use EGRA/EGMA.¹⁴

Pencils of Promise, Worldreader, and Bridge selected the specific bundle of subtasks that would be appropriate for each grade level, taking into consideration tasks that have been conducted in Liberia on past USAID projects. The subtasks we used in the study for each grade level are displayed below in Table 3 and are described in detail in the results section of this report.

Table 3. Subtasks Administered by Grade Level

EGRA	KG	G1	G2	G3	EGMA	KG	G1	G2	G3
Letter Sound Knowledge	X	X	X		One-to-One Correspondence	X			
Identify Onset Sounds	X	X	X		Number Identification	X	X		
Non-word Reading	X	X	X	X	Quantity Discrimination	X	X	X	
Familiar Word Reading	X	X	X	X	Addition Level I	X	X	X	X
Passage Fluency		X	X	X	Addition Level II			X	X
Reading Comprehension		X	X	X	Subtraction Level I		X	X	X
					Subtraction Level II			X	X
					Word Problems		X	X	X

3.3.2 Student Characteristics

We collected detailed background information for each student, including student demographics (gender, age), education (ECE attendance, grade level), household characteristics (ownership of a cell phone, radio or television, whether the student had electricity), activities at home (listening to the radio, watching television, reading, doing homework, and with whom), and meals consumed within a day of the assessment (number of meals).¹⁵ The demographic information collected is further detailed in Appendix A3.1 Description of Information Collected.



University of Liberia graduate student monitoring assessment quality.

We collected this information to test for balance in our sample between students at Bridge PSL public schools and traditional public schools. These observables provide clarity on whether any systematic differences between the groups receiving and not receiving the Bridge “treatment” exist, and if so, how they may influence results. It also allows for additional analysis by sub-groups within the sample.

¹⁴ Other organizations that use EGRA/EGMA include, but are not limited to: Save the Children, World Vision, FHI 360, Research Triangle Institute (RTI), and Creative Associates. See <http://www.tangerinecentral.org/in-the-field-1> for more examples of projects that use this early grade reading and math measurement tool.

¹⁵ Demographic questions were included at the beginning and end of the EGRA/EGMA survey instrument. We selected these questions based on RTI’s instrument, consultations with researchers, and piloting on Bridge PSL public school students. The questions included could all be reasonably and accurately answered by young students.

4. Study Sample

4.1 School Selection

4.1.1 Sampling Six Bridge PSL Public Schools

Bridge worked with the Ministry of Education to develop a list of 47 public school locations with conditions necessary for Bridge operations, particularly the sufficient 2G data connection needed to support use of Bridge technology. The Center for Global Development / Innovations for Poverty Action independent evaluation team then randomly selected the schools to be operated by Bridge. The remaining schools served as controls for the larger PSL evaluation, to allow for a matched-pair design.

Initially, we expected to conduct our study using the same matched-pair locations, just with a more limited scope of research. Our objective was to select Bridge PSL public/traditional public school pairs that were geographically representative of Bridge's presence in Liberia and had similar school-level characteristics. The random assignment of schools to Bridge by the independent evaluation team presented an opportunity for this study to have a first-best set of control schools.

To ensure that each of the schools in a pair were comparable, the pair had to be in the same district. Therefore, we eliminated from consideration two counties in which Bridge operates schools, because these counties did not have any districts with at least one PSL public school and one traditional public school included in the independent evaluation. Thus, while Bridge is operating in eight different counties, we chose to include only six school pairs in our study.

From each of the remaining six counties, we randomly selected one district. Within each of those districts, we selected the pair of schools in that district that had the most similar school-level characteristics (grade levels, number of classrooms, number of teachers, etc.).

However, after we shared the list of selected schools with the independent evaluation team to coordinate fieldwork, concerns were raised about study contamination, test fatigue, and overexposure of their control schools to Bridge personnel. It was then agreed that the independent evaluation team would use our list of six Bridge PSL public schools to identify a new group of six comparison schools that are not also included in their randomized controlled trial. Thus, this study does not contaminate the independent evaluation being conducted by the Center for Global Development / Innovations for Poverty Action team about the overall PSL program.

4.1.2 Assignment of Six Matched Comparison Schools

The independent evaluation team determined the final matched pairs by taking the six previously-selected Bridge PSL public schools and conducting a principal component analysis (PCA) to evaluate which other traditional public schools could serve as good comparison schools.

Variables analyzed in the PCA included factors such as teachers per student, classrooms per student, and chairs per student. See Appendix A4. School Selection - Principal Component Analysis for a list of components used in their analysis. While there may be differences between a matched pair on specific characteristics, the index derived from the PCA ensures that the pair is the best match across the set of all characteristics. Because these schools were selected independently and also selected in much the same way as the traditional public schools included in the overall PSL program study, we are confident that they are a reasonable counterfactual for Bridge PSL public schools.

Following our guidance, Bridge did its best to ensure that these comparison schools remained as “status quo” as possible. For example, Bridge did not actively attract teachers from these schools (any vacancies were recruited through RTTI graduates), nor actively recommend that deselected teachers from the PSL public schools be transferred to these schools (the MoE handled all teacher transfers). This prevented a strong source of selection bias from occurring in this study.

4.1.3 Study Geography

A total of 12 schools participated in our study from six different districts in six different counties.¹⁶ See Table 4 as follows.

Table 4. Counties and Districts of Participating Schools

Pair #	County – District
1	Bomi – Senjeh
2	Bong – Salala
3	Grand Cape Mount - Garwula
4	Margibi - Kakata
5	Montserrado - Careysburg
6	Nimba - Saclepea 2

4.2 Students in Sample

4.2.1 Random Selection & Follow-up

During the baseline study, our assessors randomly selected 20 students per grade level in Kindergarten through Grade 3, stratified by gender, to assess one-on-one in early grade literacy and numeracy. By stratifying by gender, the randomization process ensures that the sample has the same gender breakdown as the actual class. For more details on this on-the-spot randomization procedure, see Appendix A6. Randomization Strategy.

When we returned to the 12 schools for the midlines and endlines, we sought to re-assess as many as possible of the 20 baseline students in each grade. We visited each school at least three times, and during every visit we checked for students who may have been absent on days prior.^{17 18}

4.2.2 Student Counts by Grade Level

Table 5 below shows the by grade counts of students assessed during each survey round.

¹⁶ School names are not presented in this paper in order to minimize behavioral change targeted at these specific schools, which may undermine the generalizability of the study.

¹⁷ If we could not find and assess all of the original 20 students, we randomly selected students from the rest of the grade to get back to 20 assessments. However, these “replacement” students are not analyzed in this study because we do not have information on them from baseline. The purpose of conducting these assessments was two-fold. First, it allowed Bridge to understand the spread of learning levels at any given point in time. Second, it gives the pilot study team the option to conduct a cross-sectional analyses with a larger sample, should sample attrition increase.

¹⁸ If a student was absent during all school visits, we asked school staff if the student had withdrawn.

Table 5. Student Counts by Grade¹⁹

	Bridge PSL Public Schools			Traditional Public Schools		
	Baseline	Baseline & Midline	Baseline & Endline	Baseline	Baseline & Midline	Baseline & Endline
Kindergarten	80	62	53	126	103	91
Grade 1	99	83	69	117	99	92
Grade 2	110	97	79	94	75	67
Grade 3	117	95	74	101	77	71
Total	406	337	275	438	354	321

The decline in counts indicates that not all of the students assessed at the baselines were available for the midline assessments, and even fewer were also available for the endline assessments. The implications of this sample attrition are discussed further in Section 9.

5. Comparability of Schools and Students

5.1 School Characteristics

Recall that the team of independent evaluators assigned us these comparison schools by applying the Principal Component Analysis technique to the MoE’s Education Management Information System (EMIS) data. As EMIS data could sometimes be outdated, we believed conducting a survey on site was a worthwhile addition to our student assessments. During midlines and endlines, assessors completed two surveys at each school - one survey based on an interview with the principal and another survey based on their own direct observations.²⁰

While these survey results help to better understand some of the differences and similarities between the schools in our study, they may not be representative of the schools over the course of the year, as the information comes from a single day for each school in each semester. Furthermore, though each comparison traditional public school may look different than its corresponding Bridge PSL public school on any given observable characteristic, the hope is that it is the best comparison school balancing *across* characteristics.

5.1.1 Principal Reported Characteristics

Table 6 below shows self-reported information on school staff and school features. A key difference worth noting is that the number of grade levels offered at Bridge PSL public schools corresponds to exactly the same number of teachers. At traditional public schools, the number of grade levels offered may be higher than the number of teachers, because classes may be combined. It is unclear how grade-specific curriculum is taught in combined classrooms. Further research is required to understand this practice and its effects on learning in traditional public schools.²¹

¹⁹ Note that there are some students who were assessed at baselines and endlines, but were not present for midlines. There are 37 such students, making up 6.2% of the sample assessed at both the baselines and endlines.

²⁰ Unfortunately, we do not have this information from baselines.

²¹ For example, are differentiated learning materials provided to students in combined classrooms? How do schools with combined classrooms ensure that grade-level specific curriculum is taught for students of different grades? Or, is teaching directed towards one grade level?

Table 6. Principal Reported Characteristics (Midlines)

	Bridge PSL Public Schools	Traditional Public Schools
School Staff		
Principal Gender	5 of 6 M	5 of 6 M
Years of Experience as Principal	1.6	16.6
# of ECE Teachers	9	14
# of Primary Teachers	35	32
Total # of Teachers	44	46
Average # per School	7.3	7.7
% Teachers Female	23%	33%
Grades Offered		
# of ECE Grade Levels Offered	1.5	2.8
# of Primary Grade Levels Offered	5.8	6.0
School Features		
Length of School Day (hrs)	7.9	5.3
Has Free Lunch Program	33%	50%
Had a PTA Meeting in 1st Semester	83%	83%

Number of ECE Grade Levels Offered: All traditional public schools in the study offer Beginner, Nursery, and Kindergarten class, with the exception of the school in Margibi County (which does not offer Beginner). Two Bridge PSL public schools offer all three ECE grades, three offer Kindergarten only, and one doesn't offer any ECE classes. This is due to physical infrastructure constraints; there are not enough classrooms in some of the Bridge PSL public schools to offer three years of ECE and six years of Primary.

Number of Primary Grade Levels Offered: All schools in the study offer 1st through 6th grade, with the exception of the Bridge PSL public school in Margibi (which doesn't offer 1st grade due to only having five classrooms; not offering 1st grade was the decision made jointly by PTA, DEO, MoE and Bridge PSL management).²²

Student Enrollment: The average reported enrollment per classroom at Bridge PSL public schools is 45.5 students vs. 32.7 students at traditional public schools. With the exception of Beginner class, there were higher levels of enrollment at Bridge PSL public schools than traditional public schools.

Principal Gender: Bridge PSL public schools and traditional public schools have the same number of male and female principals.

Principals' Years of Experience: Bridge PSL public school principals have less experience than their peers at traditional public schools. The Bridge PSL program often brought in new principals from the MoE-approved pool of recent RTTI graduates to its schools. This resulted in the average years of experience for Bridge principals being 1.5 years vs. 16.6 years for traditional public school principals.

Number of Teachers: Bridge PSL public schools generally have one fewer teacher than traditional public schools. It should be noted that Bridge PSL public schools always have a unique teacher for every grade

²² The community wanted to build a new annex room. This is currently in progress.

offered. At the traditional public schools, grades are often combined due to lack of teachers. Principals reported combined classes at 3 out of 6 traditional public schools in our study.²³

Percent of Female Teachers: Traditional public schools have more female teachers (33% or 15 out of 46) than Bridge PSL public schools (23% or 10 out of 44).²⁴

Length of School Day: Most Bridge PSL public school principals report a school day beginning at 7:30 am and lasting until 3:30 pm; official hours are 8 am to 3:15 pm for students. Traditional public school principals generally report the school day beginning at 7:30 am and lasting until 1 pm; official hours are broadly 8 am to 1 pm for students. On average, Bridge PSL public schools are open 2.6 additional hours per day according to principal reports.

Free Lunch Program: Two Bridge PSL public schools and three traditional public schools in our study offer free lunch supported by separate NGOs.

PTA Meetings: Most schools had at least one PTA meeting in the first semester.

5.1.2 Observed Characteristics

Accessibility: All schools in the study are accessible by foot or motorbike, even during heavy rain. Most schools are a short walk from the main road and accessible by car. The only exception is the traditional public school in Bomi County.

Electricity & Water: None of the schools in the study have electricity. All schools in the study have access to water.

Number of Classrooms: Bridge PSL public schools typically have two fewer classrooms than traditional public schools. Essentially all classrooms at both school types are in active use.

Number of Bathrooms: Bridge PSL public schools and traditional public schools both generally have 7 bathrooms on campus, but the number in active use differs. Traditional public schools typically have 5.5 bathrooms open, while Bridge PSL public schools have 3.5.

Has a Library: Two Bridge PSL public schools and three traditional public schools in our study have libraries.

Teacher Attendance: During school visits, 89% of teachers were present at Bridge PSL public schools, compared to 57% at traditional public schools.

Students Present in Classroom: On average, there were 27.3 students present in each grade level at Bridge PSL public schools compared to 22.9 at traditional public schools.

²³ 1st and 2nd Grade have the same teacher at the traditional public school in Bomi. Beginner and Nursery are combined and 5th and 6th Grade are combined at the traditional public school in Grand Cape Mount. All ECE grades are taught by the same teacher at the traditional public school in Montserrado. This school also only reported two teachers for Grades 3-6.

²⁴ This school staffing gender imbalance at Bridge PSL public schools reflects both an inherited gender bias towards male school staff at the schools prior to Bridge management and also an inherent gender bias in the qualified pool of teachers that Bridge was allowed to select from for additional school staff. At the Bridge PSL public schools in this study, women originally made up 24.5% of the teachers (16 women, 49 men). After the approved MoE teacher selection process, Bridge requested the transfer out 36 men and 11 women. Bridge requested the placement of 27 men and 8 women from the government-approved RTTI training pool, resulting in the final pool of teachers with 24.5% women on staff – equal to the ratio of female staff members before Bridge engaged in management.

5.2 Student Characteristics at Baselines

5.2.1 Demographics and Home Life

We compared student background data collected during baselines across school types in order to uncover any fundamental differences between the population of Bridge PSL public school students and the population of traditional public school students. See Appendix A3.2 Baseline Student Characteristics for a detailed description of each of the demographic variables.

Table 7 below shows the average values of each student background characteristic from the sample of students present at both baselines and endlines,²⁵ across grades. Differences between the student sample at Bridge PSL public schools and the traditional public schools are indicated through t-tests.²⁶

²⁵ This table is replicated for the full sample of baseline students (regardless of whether or not they were assessed during endlines), and the results are essentially the same. See Appendix A3.2 Baseline Student Characteristics.

²⁶ Note that corrections for multiple hypothesis testing have been left out, as such corrections would only adjust to make statistical significance less likely.

Table 7. Student Characteristics at Baselines

	Bridge PSL Public Schools	Traditional Public Schools	Difference
Count	275	321	
Demographics			
Mean Age	10.78	11.33	-0.55*
% Female	47%	46%	1%
Grade Level Breakdown			
Kindergarten	19%	28%	-9%*
Grade 1	25%	29%	-4%
Grade 2	29%	21%	8%*
Grade 3	27%	22%	5%
Education History			
Attended School Last Year	92%	93%	-1%
% Attended Any ECE	98%	100%	-2%+
Years of ECE	2.46	2.73	-0.27**
% Attended Beginner	84%	88%	-4%
% Attended Nursery	77%	88%	-11%**
% Attended Kindergarten	87%	96%	-9%**
Meals			
% With No Meals	1%	1%	0%
Average # of Meals	2.24	2.20	0.04
% Who Had Breakfast	67%	59%	8%+
% Who Had Lunch	95%	94%	1%
% Who Had Dinner	63%	67%	-4%
Assets			
% Has Radio	66%	69%	-3%
% Has Television	25%	29%	-4%
% Has Electricity	25%	27%	-2%
% Has Cellphone	85%	87%	-2%
Language Exposure			
% Speaks English at Home	65%	70%	-5%
% Listens to Radio	55%	58%	-3%
% Watches TV	46%	53%	-7%+
Parent Involvement			
% Receive Homework Help	64%	76%	-12%**
If Give Help, % by Parent	20%	18%	2%
% Reads Out Loud with Parent	40%	45%	-5%
% Are Read To	49%	54%	-5%
If Read To, % by Parent	14%	17%	-3%
If Listens to Radio, % with Parent	40%	46%	-6%
If Watches TV, % with Parent	19%	25%	-6%

** p<0.01, * p<0.05, + p<0.1

Statistically significant differences occur for five demographic variables: Age, Years of ECE, Attendance of Nursery Class, Attendance of Kindergarten, and Homework Help.

The average Bridge PSL public school student is about 0.5 years younger than the average traditional public school student and has fewer years of ECE. This age difference likely stems from the Bridge approach to

student placement in Year 1, which encouraged a balance of both age-appropriateness and academic readiness, resulting in over-age students being placed into higher primary grade levels.

Homework help also differs between school types. The percentage of students receiving help on their homework is larger at traditional public schools than at Bridge PSL public schools.

Note that the smaller percentage of kindergarteners in Bridge PSL public schools than in traditional public schools results from the fact that two of the Bridge PSL public schools included in the study did not have Kindergarten classes at the beginning of the year.²⁷

5.2.2 Incoming Literacy & Numeracy

The baseline EGRA and EGMA scores themselves serve as the best indicators of comparability of the students attending Bridge PSL public schools versus traditional public schools. Table 8 below presents the average performance on each subtask by school type, and includes the statistical significance of the differences.²⁸ This table includes all students with both baseline and endline scores.²⁹

As the table shows, there are no statistically significant differences on EGRA subtasks. The only EGMA subtask with such a difference is One-to-One Correspondence, on which Bridge PSL public school students averaged 12 fewer correctly counted circles. In addition, this subtask was only administered to Kindergarteners.

Table 8. Baseline EGRA/EGMA Scores

	Bridge PSL Public Schools	Traditional Public Schools	Difference
Count	275	321	
EGRA			
Letter Sounds	1.78	2.13	-0.35
Onset Sounds	25%	23%	2%
Non-Word Reading	0.30	0.24	0.06
Familiar Word Reading	4.95	4.32	0.63
Passage Fluency	6.00	5.08	0.92
Reading Comprehension	3%	3%	0%
EGMA			
One-to-One Correspondence	37.38	49.65	-12.27*
Number Identification	10.03	12.09	-2.06
Quantity Discrimination	41%	42%	-1%
Addition Level 1	5.17	5.40	-0.23
Addition Level 2	37%	40%	-3%
Subtraction Level 1	4.78	5.10	-0.32
Subtraction Level 2	25%	28%	-3%
Word Problems	46%	44%	2%

** p<0.01, * p<0.05, + p<0.1

²⁷ Note that school selection for the study occurred prior to and independently of each school's decision on which grades to offer.

²⁸ Once again, we did not correct for multiple hypothesis testing, as this would only make statistical significance less likely.

²⁹ See Appendix A13. Baseline EGRA/EGMA Results for a table including all students at baseline. The results are essentially the same.

6. Improvements in Academic Achievement

6.1 Overview of Literacy and Numeracy Measurements

The study team chose the EGRA/EGMA instrument as our tool to measure student learning. The subtasks used and the method of calculating a student’s score on each subtask are detailed below.

Table 9. Understanding EGRA Subtasks³⁰

Subtask	The subtask shows...	...which measures...	...which is an important building block towards literacy because...
Onset Sounds	Words arranged in random order (read out loud to the student by the assessor)	A student’s ability to identify the initial sounds of each word	It tests phonemic awareness, or “the understanding that speech is comprised of individual sounds.” ³¹ This is fundamental for later linking sounds to letters and then words.
Letter Sounds	Upper and lower case letters, arranged in random order	A student’s knowledge of individual sounds associated with each letter	It is a prerequisite for being able to combine the sounds of multiple letters into words.
Non-Word Reading	A set of made-up words, which are words that follow the basic rules of the language of assessment but have no meaning	A student’s ability to decode (“sound out”) unfamiliar words	To be proficient readers, children must learn to both recognize sight words (common words that children are encouraged to memorize) and to decode unfamiliar words by linking sounds of the letters together. Reading from a list of non-words tests the latter without the possibility of sight word recognition.
Familiar Word Reading	A set of familiar, grade-level words selected from early grade reading texts	A student’s ability to decode unfamiliar words as well as her/his recognition of sight words	The ability to recognize and decode individual words is a prerequisite for linking the words together to read an entire passage of text fluently.
Passage Fluency	A short passage of grade-level text	A student’s ability to read age appropriate text aloud accurately, at sufficient speed	Reading with sufficient speed and accuracy is a necessary precursor for reading comprehension. Students must link words together fast enough for their working memories to be able to retain the information conveyed by the text. When students are not yet reading with automaticity, their brains must focus on decoding words, which takes more time and results in slower reading. Once students are able to read with sufficient speed and accuracy, their brains can focus on deriving meaning from the content of the reading.
Reading Comprehension	Five questions about the text read in the Passage Fluency subtest	A student’s ability to understand and communicate the meaning of text	Reading comprehension is a prerequisite for children to use reading as a tool to receive information. It is a necessary precursor for later academic and vocational success.

³⁰ This table draws on material in Gove and Wetterberg (2011).

³¹ Yopp, H.K. (1992).

Table 10. Understanding EGMA Subtasks

Subtask	The subtask shows...	...which measures...	...which is an important building block towards numeracy because...
One to One Correspondence	Ten rows of ten circles	A student’s ability to 1) recognize the items they need to count and 2) recognize and mentally flag the items that have already been counted	Counting strategies are an essential precursor to further and deeper mathematical knowledge and skills.
Number Identification	A set of numbers increasing in complexity from single digit to triple digit	A student’s ability to identify the number-words associated with each written number with sufficient speed	Clear communication about numbers is essential for math learning. Understanding the number words contributes to place value awareness, which is a critical component of successful computation.
Quantity Discrimination	Ten pairs of numbers increasing in complexity from single to triple digit	A student’s ability to judge which number is larger	Quantity discrimination demonstrates a critical link to an effective and efficient counting strategy for problem solving. ³²
Addition 1	A set of 20 addition problems that increase in complexity to require carrying and involving two digit numbers	A student’s ability to solve simple addition problems with sufficient speed	Addition I and Subtraction I reveal a student's fact fluency - how quickly and accurately they can recall basic facts. Performing well on fact fluency shows that the student has the building blocks to tackle increasingly complex computations.
Subtraction 1	A set of 20 subtraction problems that increase in complexity to require borrowing and involving two digit numbers	A student’s ability to solve simple subtraction problems with sufficient speed	
Addition 2	A set of five addition problems that increase in complexity from adding a single and a double digit number together to adding two double digit numbers together	A student’s ability to solve more complex addition problems	Addition II and Subtraction II reveal a student’s understanding of the computation algorithm - if they can align face values and carry or borrow correctly. The understanding of computation and integration of methods, and practice with both, leads to “computational fluency.” ³³
Subtraction 2	A set of five subtraction problems that increase in complexity from subtracting a single digit number from a double digit number to subtracting a double digit number from another double digit number	A student’s ability to solve more complex subtraction problems	
Word Problems	Five word problems involving basic addition and subtraction (read out loud to the student by the assessor)	A student’s ability to select operations, and their ability to accurately solve the problem using the operation they selected.	The ability to correctly select an operation for a real world situation demonstrates a basic understanding of the meaning of the operation. This understanding is essential for more complicated applications as well as for basic algebraic thinking.

³² Clarke et al. (2008)

³³ Fuson, K.C. (2004)

Table 11. Scoring Equations for Each Subtask Administered³⁴

Subtask	Scoring Formula	Total # of Questions
Letter Sounds	$(\# \text{ Correct Sounds}) / ((60 - \text{remaining seconds}) / 60)$	100
Onset Sounds	$(\# \text{ Correctly Answered Questions}) / (\# \text{ of Questions Asked})$	10
Non-Word Reading	$(\# \text{ Correct Words}) / ((60 - \text{remaining seconds}) / 60)$	50
Familiar Word Reading	$(\# \text{ Correct Words}) / ((60 - \text{remaining seconds}) / 60)$	50
Passage Fluency	$(\# \text{ Correct Words}) / ((60 - \text{remaining seconds}) / 60)$	61
Reading Comprehension	$(\# \text{ Correctly Answered Questions}) / (\# \text{ of Questions Asked})$	5
One to One Correspondence	$(\# \text{ Correctly Counted Circles})$	100
Number Identification	$(\# \text{ Correctly Answered Questions}) / ((60 - \text{remaining seconds}) / 60)$	20
Quantity Discrimination	$(\# \text{ Correctly Answered Questions}) / (\# \text{ of Questions Asked})$	10
Addition I	$(\# \text{ Correctly Answered Questions}) / ((60 - \text{remaining seconds}) / 60)$	20
Addition II	$(\# \text{ Correctly Answered Questions}) / (\# \text{ of Questions Asked})$	5
Subtraction I	$(\# \text{ Correctly Answered Questions}) / ((60 - \text{remaining seconds}) / 60)$	20
Subtraction II	$(\# \text{ Correctly Answered Questions}) / (\# \text{ of Questions Asked})$	5
Word Problems	$(\# \text{ Correctly Answered Questions}) / (\# \text{ of Questions Asked})$	5

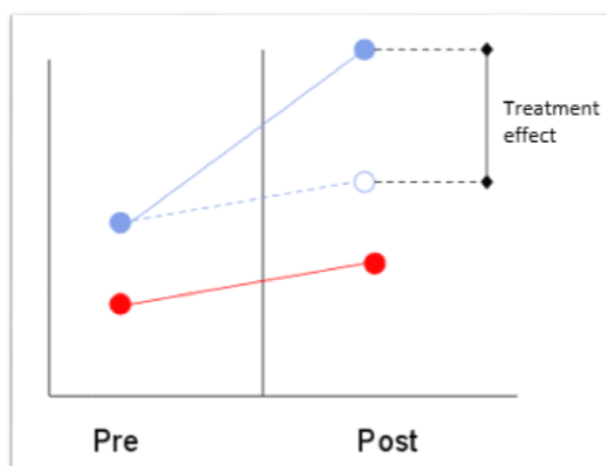
6.2 Differential Learning Gains for Year 1

6.2.1 Concept

The difference-in-differences (DiD) methodology allows us to estimate the “Bridge PSL effect” – the change in student academic performance as a direct result of attending a PSL public school operated by Bridge – without requiring a randomized experiment.³⁵

DiD isolates treatment effects by comparing the difference in outcome measures at two points in time for the treatment (Bridge PSL public schools) and control (traditional public schools) groups, as shown in Figure 1 below.

Figure 1. Difference in Difference Estimation



³⁴ Timed subtasks allot 60 seconds each.

³⁵ Again, note that when we say “Bridge PSL effect,” it is not intended to imply that this is an impact evaluation.

DiD essentially ensures that any unobserved variables that remain constant over time and that are associated with the outcome will not bias our estimation of the treatment effect. However, it is important to note a few assumptions we are making to employ this methodology. First, the model assumes that the unobserved constant variables would affect both the treatment and control groups equally. Second, it also assumes that there are no unobserved time-varying variables that differentially affect treatment and control schools.³⁶ Third, it assumes that both groups are following the same growth trajectory across time. In other words, it assumes that if the treatment group had not received the treatment at all, its average change from baselines would be the same as the average change of the control group.³⁷

6.2.2 Application of Concept

We can estimate treatment effects using a DiD model via either a simple difference of within-group differences or a regression framework. In its simplest form, the average Bridge PSL treatment effect can be calculated by taking the difference in gains achieved by the two groups of students, as shown in Figure 2 below.

Figure 2. Calculation of Simple Difference-in-Differences

	Baseline	Endline	Difference 1: Growth Between Baseline and Endline	Difference 2: Difference Between Growth at Bridge PSL Public and Traditional Public Schools
Bridge PSL Public Schools	A	B	B - A	(B - A) - (D - C)
Traditional Public Schools	C	D	D - C	

We can take the DiD methodology a step further by applying a regression framework, which provides us with the added benefit of including extra explanatory (control) variables in our model.³⁸ By taking into account other factors that may have an impact on learning outcomes, the analysis becomes more rigorous than the simplest application of DiD because it better isolates the treatment effect.³⁹

As both applications of the model offer valuable insights, we adopt the following specifications to examine the Bridge PSL effect:

1. Simple DiD. This tells us the overall difference in gains between the two groups, without examining how or how much various factors contribute to this difference.
2. Regression DiD, controlling baseline scores. This tells us the contribution of Bridge to increases in endline test scores, by separating out the effect of the incoming skill level of the child.
3. Regression DiD, controlling for baseline assessment scores and student characteristics. This is the same as #2, but considers even more factors that may contribute to differences in endline test scores.

Each specification is executed using both raw and standardized scores. Standardizing scores allows us to interpret the results in terms of effect sizes and compare results across subtasks.⁴⁰ We also pool the data

³⁶ For instance, our model cannot control for circumstances such as neighborhoods with treatment schools gaining access to electricity more quickly than neighborhoods with control schools, which could potentially bias our results. However, because of our set of baseline, midline and endline demographic variables, we will be able to test whether observed characteristics differentially change in treatment and control neighborhoods, which should provide some indication about the size of any potential bias.

³⁷ Buckley et al. (2003).

³⁸ Without control variables added into the framework, the estimation of treatment effects using either method is the same.

³⁹ Buckley et al. (2003).

⁴⁰ Details of how we standardized each score can be found in Appendix A14. Standardization of Scores.

for each subtask across grades, which allows us to estimate the overall effect of Bridge PSL while also increasing statistical power in our analyses.

6.2.3 Simple DiD Results

Bridge PSL Public Schools had positive differential gains in every subtask assessed. Table 12 and Table 13 show summary statistics for students in the baselines and endlines sample as well as the simple DiD results.

Table 12. Pooled Simple Difference-in-Differences – Raw Scores

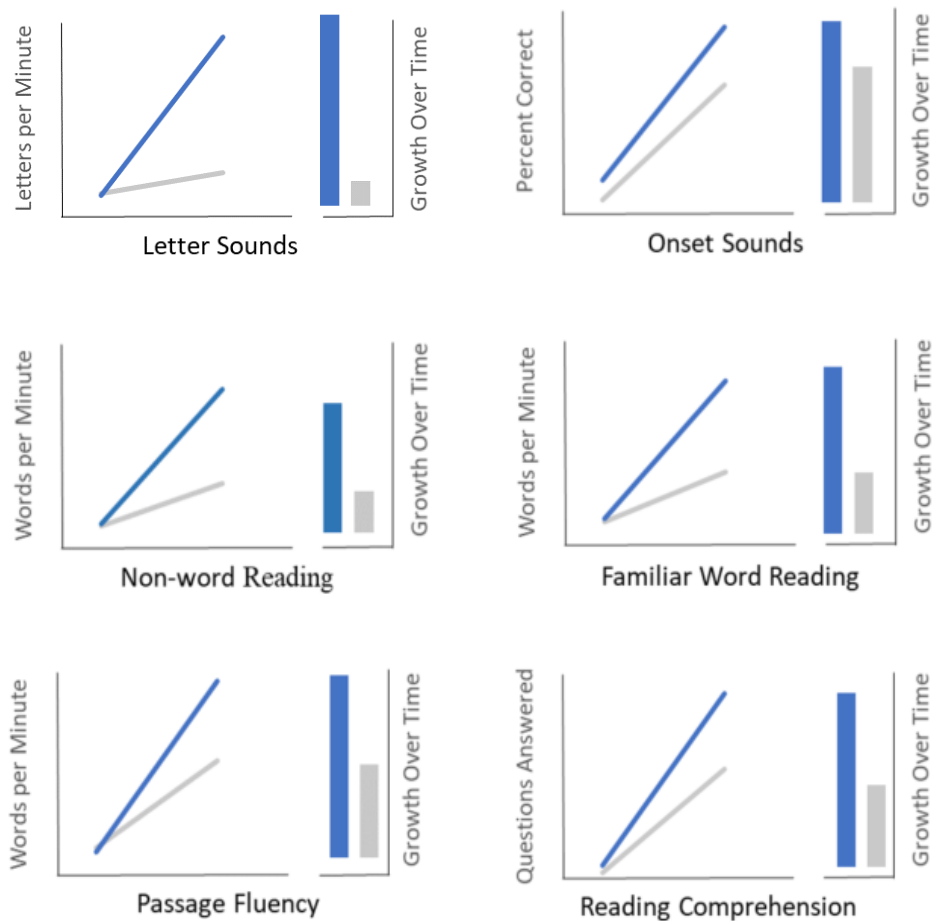
Subtask	Grades	Bridge PSL Public Schools						Traditional Public Schools						Diff-n-Diff
		Count	Baseline		Endline		Diff	Count	Baseline		Endline		Diff	
			Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Letter Sounds	KG-G2	198	1.8	4.0	25.0	17.1	23.3	247	2.1	7.6	5.1	12.4	3.1	20.2
Onset Sounds	KG-G2	198	25%	23%	45%	23%	20%	247	22%	22%	38%	23%	15%	5%
Non-Word Reading	KG-G3	275	0.3	1.3	2.8	4.9	2.5	319	0.2	1.2	1.0	3.1	0.8	1.7
Familiar Word Reading	KG-G3	270	4.6	5.9	18.9	15.5	14.3	319	4.3	6.7	9.4	11.2	5.2	9.1
Passage Fluency	G1-G3	222	6.0	8.6	29.8	27.7	23.8	229	5.1	8.8	15.2	17.5	10.1	13.7
Reading Comprehension	G1-G3	222	3%	10%	22%	25%	18%	230	3%	8%	10%	18%	8%	11%
One to One Correspondence	KG	53	37.4	30.9	53.2	31.0	15.9	90	49.7	34.0	52.0	32.7	2.4	13.5
Number Identification	KG-G1	122	10.0	23.7	19.8	10.1	9.7	183	12.1	17.1	17.1	9.0	5.0	4.7
Quantity Discrimination	KG-G2	198	40%	32%	71%	31%	30%	247	41%	30%	61%	30%	20%	10%
Addition 1	KG-G3	275	5.2	4.6	11.8	6.8	6.6	318	5.4	4.1	8.4	5.2	3.0	3.6
Addition 2	G2-G3	152	37%	29%	59%	32%	22%	136	39%	30%	51%	31%	12%	10%
Subtraction 1	G1-G3	222	4.8	4.8	8.9	4.3	4.1	227	5.1	3.8	7.5	7.2	2.5	1.6
Subtraction 2	G2-G3	152	25%	27%	43%	34%	18%	135	28%	26%	39%	33%	11%	7%
Word Problems	G1-G3	222	46%	27%	59%	25%	13%	228	44%	25%	53%	24%	9%	4%

Table 13. Pooled Simple Difference-in-Differences – Standardized Scores

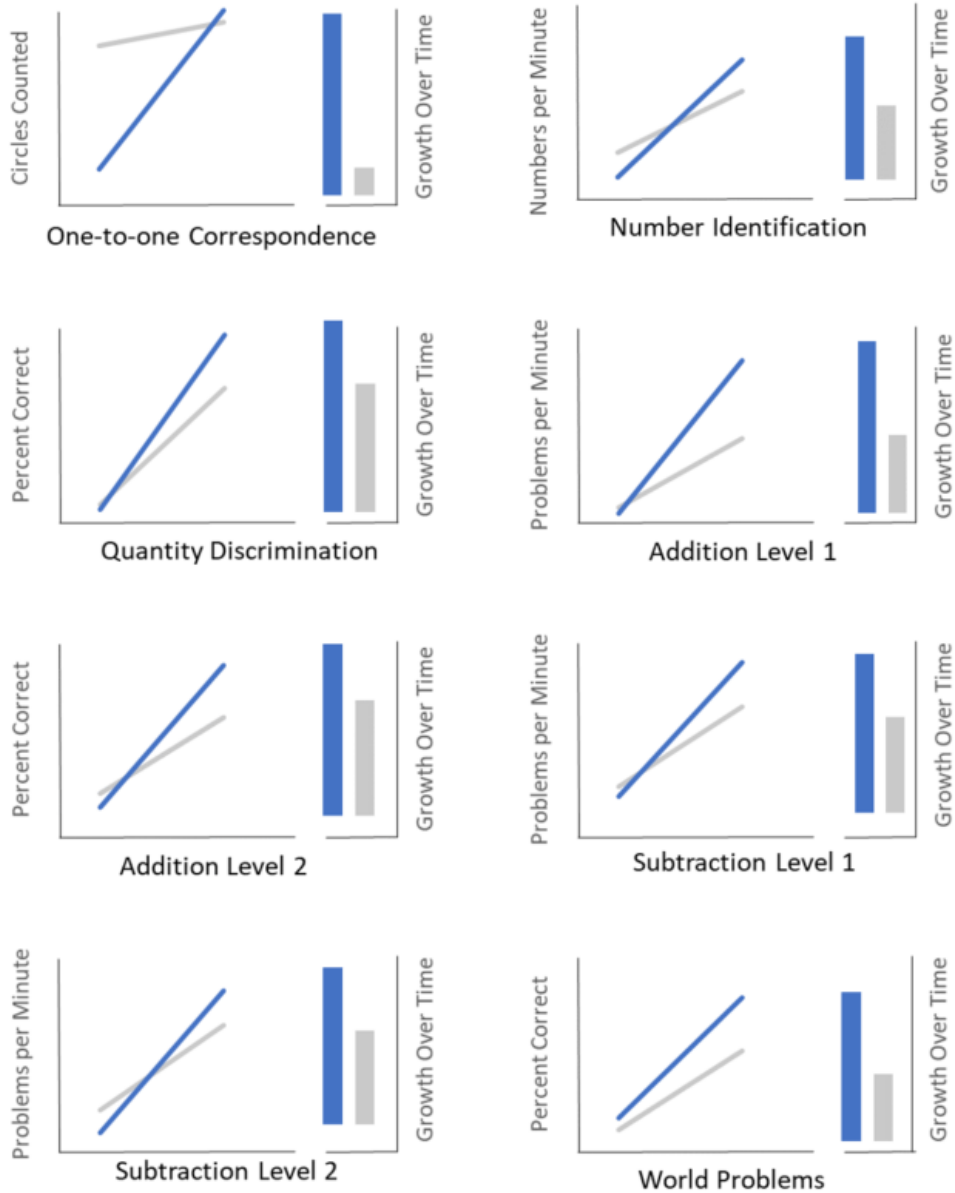
Subtask	Grades	Bridge PSL Public School					Traditional Public School				Diff-n-Diff
		Count	Baseline	Endline	Diff	Count	Baseline	Endline	Diff		
			Mean	Mean			Mean	Mean			
Letter Sounds	KG-G2	198	0.0	3.6	3.6	247	0.0	0.5	0.5	3.13	
Onset Sounds	KG-G2	198	0.1	1.0	0.9	247	0.0	0.6	0.7	0.23	
Non-Word Reading	KG-G3	275	0.0	2.1	2.1	319	0.0	0.7	0.7	1.42	
Familiar Word Reading	KG-G3	270	0.0	2.1	2.1	319	-0.1	0.7	0.8	1.34	
Passage Fluency	G1-G3	222	0.1	2.8	2.8	229	0.0	1.1	1.2	1.58	
Reading Comprehension	G1-G3	222	0.1	2.2	2.1	230	0.0	0.9	0.9	1.24	
One to One Correspondence	KG	53	-0.2	0.3	0.5	90	0.2	0.3	0.1	0.41	
Number Identification	KG-G1	122	0.0	0.6	0.6	183	0.1	0.4	0.3	0.27	
Quantity Discrimination	KG-G2	198	0.1	1.0	1.0	247	0.1	0.7	0.7	0.32	
Addition 1	KG-G3	275	0.0	1.5	1.5	318	0.1	0.7	0.7	0.82	
Addition 2	G2-G3	152	0.0	0.7	0.7	136	0.1	0.5	0.4	0.34	
Subtraction 1	G1-G3	222	0.0	1.0	1.0	227	0.1	0.7	0.6	0.39	
Subtraction 2	G2-G3	152	0.0	0.7	0.7	135	0.1	0.5	0.4	0.28	
Word Problems	G1-G3	222	0.0	0.5	0.5	228	0.0	0.3	0.3	0.17	

Figure 3 and Figure 4 shows this graphically for EGRA and EGMA respectively. Bridge PSL public school results are in blue, with traditional public school results in grey. Each chart contains two graphs: (1) a line graph showing student achievement levels at baselines and endlines and (2) a bar graph showing absolute growth between the beginning and end of the year. Each subtask's underlying scale can be found on the left-hand y-axis, but note that each scale has been adjusted for ease of interpretation.

**Figure 3. Learning Gains on EGRA Subtask in 2016-17 School Year
Bridge PSL Public Schools vs. Traditional Public Schools**



**Figure 4. Learning Gains on EGMA Subtask in 2016-17 School Year
Bridge PSL Public Schools vs. Traditional Public Schools**



Learning More, Learning More Quickly

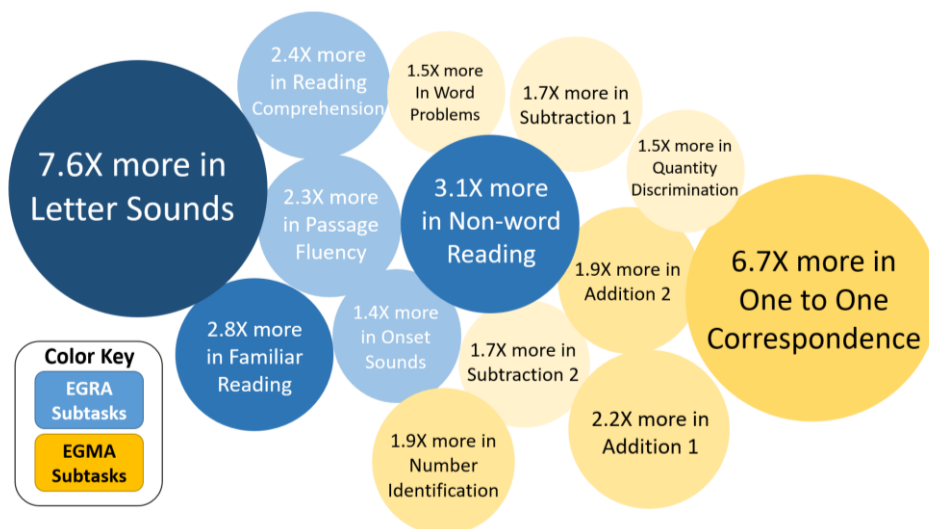
Bridge PSL public school students had greater rates of learning across all subtasks. By looking at the simple average growth at Bridge PSL public schools relative to traditional public schools, we can estimate how much faster more Bridge PSL public school students learned than their counterparts in the same amount of time. Table 14 shows the relative rates of learning across each subtask. This rate ranges from 1.3 times faster in Onset Sounds to 7.6 times faster in Letter Sounds.

Table 14. Relative Gains of Bridge PSL Public Schools vs. Traditional Public Schools

	Bridge PSL Public Schools	Traditional Public Schools	Relative Rate of Learning
Letter Sounds	23.3	3.1	7.6X
Onset Sounds	20.3%	15.2%	1.3X
Non-word Reading	2.5	0.8	3.1X
Familiar Word Reading	14.3	5.2	2.8X
Passage Fluency	23.8	10.1	2.3X
Reading Comprehension	18.1%	7.6%	2.4X
One-to-One Correspondence	15.9	2.4	6.7X
Number Identification	9.7	5.0	1.9X
Quantity Discrimination	30%	20%	1.5X
Addition 1	6.6	3.0	2.2X
Addition 2	22%	12%	1.9X
Subtraction 1	4.1	2.5	1.7X
Subtraction 2	18%	11%	1.7X
Word Problems	13%	9%	1.5X

On average, Bridge PSL public school students progressed 2.7 times faster than students at traditional public schools across subtasks.

Figure 5. Bridge PSL Public School Students Learned...



6.2.3 Regression DiD Results, Controlling for Baseline Test Scores

For non-experimental studies, a baseline test score is a critical data point to collect and factor in when conducting non-experimental studies. The first regression specification is therefore as follows:

$$\text{endline subtask score} = \beta_0 + \beta_1(\text{Bridge PSL treatment}) + \beta_2(\text{grade 1}) + \beta_3(\text{grade 2}) + \beta_4(\text{grade 3}) + \beta_5(\text{baseline subtask score}) + \beta_6(\text{baseline subtask score}^2) + \beta_7(\text{baseline subtask score}^3) + \varepsilon$$

β_1 will quantify the Bridge PSL effect. $\beta_1, \beta_2,$ and β_3 represents differences in scores by grade levels on average, as generally students in upper grades tend to do better on the same subtask. $\beta_5, \beta_6,$ and β_7 tells us how (linearly, non-linearly) and how much baseline scores affect endline scores.

For EGRA, the Bridge PSL effect is positive on all six subtasks and statistically significant on five of the six. For EGMA, the Bridge PSL effect is also positive on all eight subtasks. Out of these eight EGMA subtasks, it is only appropriate to conduct statistical testing on four due to minimum cluster requirements.⁴¹ Out of these subtasks, all four are statistically significant. See Appendix A7.1 DiD Regressions Controlling for Baseline Scores Only for the full regression results.

6.2.4 Regression DiD Results, Controlling for Baseline Test Scores and Student Characteristics

We then apply a second regression specification, this time also factoring in baseline student characteristics, which can lead us towards a more precise estimate of the Bridge PSL effect:

$$\text{endline subtask score} = \beta_0 + \beta_1(\text{Bridge PSL treatment}) + \beta_2(\text{grade 1}) + \beta_3(\text{grade 2}) + \beta_4(\text{grade 3}) + \beta_5(\text{baseline subtask score}) + \beta_6(\text{baseline subtask score}^2) + \beta_7(\text{baseline subtask score}^3) + \beta_8(\text{age}) + \beta_9(\text{female}) + \beta_{10}(\text{attended school last year}) + \beta_{11}(\text{has electricity}) + \beta_{12}(\text{\# of years of ECE}) + \beta_{13}(\text{\# of meals}) + \beta_{14}(\text{reads to someone at home}) + \beta_{15}(\text{asset index}) + \beta_{16}(\text{school activities w/parents index}) + \beta_{17}(\text{other activities w/parents index}) + \beta_{18}(\text{speaks Eng at home}) + \varepsilon$$

β_8 through β_{18} factor in the following information:

- **Demographics:** Age and gender;
- **Educational History:** Whether the child attended school last year and years of ECE attended (if any);
- **Meals:** Number of meals the child had in the past day; and
- **Home Life Indicators:** Whether the child has electricity at home, whether the child reads out loud at home, and whether the child speaks English at home.
- **Assets:** Whether the child has a cellphone, TV, and radio at home.
- **School Activities with Parents:** Whether the child does homework and reads aloud with parents at home.
- **Other Activities with Parents:** Whether the child watches TV and listens to the radio with parents.

For six literacy and three numeracy subtasks, the “Bridge PSL effect” was positive, large, and statistically significant. Note that minimum cluster requirements also apply to this regression, meaning that statistical significance can once again only be determined for four of the eight EGMA subtasks. See Appendix A7.2 DiD Regressions Controlling for Baseline Scores and Student Characteristics for the full regression results.

⁴¹ The required number of clusters to make the appropriate corrections for standard errors is around 30. As we have 12 participating schools and each school-grade represents a cluster, we can make this correction for the majority of the subtasks. However, the following four EGMA subtasks were not administered to at least three grades, and therefore do not meet the minimum cluster requirement: One-to-One Correspondence (KG only), Number Identification (KG & G1), Addition 2 (G2 & G3), and Subtraction 2 (G2 & G3). See Ozler (2012) for an explanation of issues faced when using data from a limited number of clusters.

6.2.5 Summary of Pooled DiD Results

Early Grade Reading

Table 15 and Table 16 below display a summary of raw and standardized EGRA results from our three specifications.

Table 15. Summary of EGRA Results - Raw Scores

Subtask	Applicable Grades	Simple DiD [1]	Regression w/ Baseline Scores Only [2]	Regression w/ Baseline Scores & Characteristics [3]
Letter Sounds	KG-G2	20.2	20.3	21.5
Onset Sounds	KG-G2	5%	6%	7%
Non-Word Reading	KG-G3	1.7	1.6	1.5
Familiar Word Reading	KG-G3	9.1	8.6	9.1
Passage Fluency	G1-G3	13.7	12.1	12.6
Reading Comprehension	G1-G3	11%	10%	10%

Table 16. Summary of EGRA Results - Standardized Scores⁴²

Subtask	Applicable Grades	Simple DiD [1]	Regression w/ Baseline Scores Only [2]	Regression w/ Baseline Scores & Characteristics [3]	Statistical Significance of [3]
Letter Sounds	KG-G2	3.13	3.14	3.34	**
Onset Sounds	KG-G2	0.23	0.25	0.29	*
Non-Word Reading	KG-G3	1.42	1.32	1.34	**
Familiar Word Reading	KG-G3	1.34	1.26	1.34	**
Passage Fluency	G1-G3	1.58	1.40	1.46	**
Reading Comprehension	G1-G3	1.24	1.16	1.19	**
Average Effect Size		1.49	1.42	1.49	1.49

Bridge PSL Public school students achieved large differential gains in all six EGRA subtasks, representing a large amount of learning. The results are stable across all three specifications. Given specification 3 is most comprehensive in its inclusion of student baseline characteristics and likely provides the most precise estimate of the Bridge PSL effect, we highlight its results in more depth here.

On average, students at Bridge PSL public schools pronounced an additional 21.5 letter sounds, read an additional 9.1 familiar words per minute, and read an additional 12.6 story words per minute beyond their peers at traditional public schools, when controlling for baseline ability and other student characteristics. They also learned to answer 10% more reading comprehension questions correctly.

⁴² The statistical significance column shows two asterisks (**) for 99% confidence level and one asterisk (*) for 95% confidence level. The average effect size under this column is designed to count insignificant coefficients as 0, although this adjustment is not needed here because all coefficients are significant.

Among EGRA subtasks, effect sizes were very large: 1.49 SDs on average.⁴³ While this is driven in part by the large number of zero scores on baseline assessments,⁴⁴ it still represents a substantial movement of students from having zero measurable literacy skills to progressing steadily on the path towards literacy.

Student-level characteristics do not contribute directly to endline EGRA assessment scores. The inclusion of baseline test scores likely absorbs much of the information these additional observables provide. However, we do see that female students learned less on Non-word Reading holding all else constant. Additional years of early childhood education are associated with less progress on the Letter Sound subtask. Older students in the study had lower growth on Passage Fluency and Reading Comprehension.

Early Grade Math

Table 17 and Table 18 below display a summary of raw and standardized EGMA results from our three specifications.

Table 17. Summary of EGMA Results - Raw Scores

Subtask	Applicable Grades	Simple DiD [1]	Regression w/ Baseline Scores Only [2]	Regression w/ Baseline Scores & Characteristics [3]
One to One Correspondence	KG	13.5	4.5	9.4
Number Identification	KG-G1	4.7	5.0	4.5
Quantity Discrimination	KG-G2	10%	11%	11%
Addition 1	KG-G3	3.6	3.4	3.7
Addition 2	G2-G3	10%	9%	8%
Subtraction 1	G1-G3	1.6	1.6	2.1
Subtraction 2	G2-G3	7%	7%	7%
Word Problems	G1-G3	4%	5%	4%

⁴³ An alternative to clustering at the school-grade level is to collapse data at the school level. The resulting summary effect size for EGRA would be 0.96 standard deviations considering only coefficients significant at the 95% confidence level or better, or 1.28 standard deviations considering only coefficients significant at the 90% confidence level or better. See Appendix A7.3 Standardized Difference-in-Differences, Data Collapsed at School Level, Table 43 for these regression results.

⁴⁴ A large number of zero scores narrows the distribution of baseline scores, lowering the standard deviation. Standardized scores (using z-score methodology) are calculated as $(Individual\ Score - Average\ Score) / Standard\ Deviation$. Consequently, a small standard deviation results in large standardized scores, and hence a larger effect size.

Table 18. Summary of EGMA Results - Standardized Scores⁴⁵

Subtask	Applicable Grades	Simple	Regression	Regression	Statistical
		DiD	w/ Baseline	w/ Baseline	
		[1]	Scores Only	Scores & Characteristics	Significance of
			[2]	[3]	[3]
One to One Correspondence	KG	0.41	0.34	0.29	N/A
Number Identification	KG-G1	0.27	0.76	0.26	N/A
Quantity Discrimination	KG-G2	0.32	0.34	0.37	**
Addition 1	KG-G3	0.82	0.76	0.84	**
Addition 2	G2-G3	0.34	0.30	0.29	N/A
Subtraction 1	G1-G3	0.39	0.39	0.51	**
Subtraction 2	G2-G3	0.28	0.26	0.26	N/A
Word Problems	G1-G3	0.17	0.18	0.15	-
Average Effect Size		0.38	0.42	0.37	0.43

N/A under statistical significance signifies that these subtasks do not have enough grade levels to allow for statistical significance testing.

Differential gains are positive across all EGMA subtasks. Results are again fairly stable across specifications. Again, we turn to specification three to review the results in more detail.

In three out of the four EGMA subtasks where statistically significance testing was appropriate, the “Bridge PSL effect” was large and statistically significant, with an average effect size of 0.43.⁴⁶ The relative gains of Bridge PSL public school students are meaningful. On average, students at Bridge PSL public schools correctly answered 3.7 more Addition 1 problems and 2.1 more Subtraction 1 problems per minute than their peers at traditional public schools, when controlling for baseline ability and other student characteristics. They also learned to solve 11.3% more Quantity Discrimination problems.

Student-level characteristics contribute to endline scores differently for numeracy than literacy. Again, the inclusion of baseline test scores likely absorbs much of the information these additional observables provide. Attending school last year correlates with lower growth on Subtraction 1. Girls had less growth on Quantity Discrimination and Addition 1. Older students in the study learned more on Addition 1 and Subtraction 1.

6.3 Making Meaning of Effect Sizes

The effect sizes we have detected in one academic year are quite promising. The standard benchmark for educational interventions in one year is 0.2 SDs. 0.2 SDs is often the go-to measure used to conduct power calculations for education interventions; in other words, researchers will make sure that the sample size in their study is large enough to detect an effect size of 0.2 SD. In addition, a guide to charter school studies notes “Although there is some debate, researchers generally consider an effect size of .1 of a standard deviation as slight, .2 or .3 as moderate, and .5 as large.”⁴⁷

⁴⁵ As in the table for EGMA above, two asterisks (**) indicates 99% confidence level, and one asterisk (*) indicates 95% confidence level. The calculation of the average effect size counts insignificant coefficients as 0. The subtasks marked as “N/A” are simply omitted from the calculation entirely.

⁴⁶ An alternative to clustering at the school-grade level is to collapse data at the school level. The resulting summary effect size for EGMA would be 0.36 standard deviations considering only coefficients significant at the 95% confidence level or better. See Appendix A7.3 Standardized Difference-in-Differences, Data Collapsed at School Level, Table 44 for these regression results.

⁴⁷ Rainey (2015).

It is important to recognize that “...standard deviations are merely a measure of dispersion – and this is not constant across samples. So an intervention delivering the same absolute increment in learning would look less effective in a context with high variance in test scores than in another with low variance.”⁴⁸ Low variance can be caused by a high proportion of zero scores, as is the case of this study. In addition, one year gains as measured in standard deviations also tend to be larger in early grades.⁴⁹ As such, it is useful to examine gains from this study in the context of other early grade studies, particularly in Liberia. The effect sizes detected for Bridge PSL public schools in the first year of the school are laudable (1.49 SD over 8 months in reading); an early grade reading intervention lasting 18 months in Liberia, using similar measures, yielded an overall effect size of 0.79 SD.⁵⁰ The “Bridge PSL effect” in reading was twice as large in less than half the time.

We also find it useful to interpret our results in terms of additional schooling. One approach to estimate additional schooling is to compare differential gains achieved relative to the status quo.⁵¹

Bridge’s differential gains for English are close to double the annual gains achieved by traditional public schools, while differential gains for math approach an additional school year.⁵² This translates to an *additional* 335 days of schooling for early grade literacy skills and 114 days of schooling for early grade numeracy skills. In other words, the learning gains made at Bridge PSL public schools in a single academic year are equivalent to almost 3 years of English instruction and nearly 2 years of math instruction at traditional public schools.

Table 19. The Bridge PSL Effect Converted to Additional Schooling⁵³

	EGRA	EGMA
Bridge Effect- Above and Beyond Gains	1.49	0.43
"Business-as-Usual" Yearly Growth	0.77	0.57
Percent Additional Schooling	192.7%	75.9%
Additional Days of Schooling	335	132

For additional context, we compare student performance at endlines relative to their performance at baselines, across grades. Grade-by-grade growth on the Passage Fluency and Familiar Word Reading subtask are shown in Figure 6 below. When looking at Passage Fluency, for example, the average Bridge PSL 1st grader now reads more than twice as fast as last year’s incoming 3rd graders. With Familiar Word Reading, which was also assessed for students in Kindergarten, Bridge PSL Kindergarteners are able to read 9 sight words per minute at the end of the year. That is more than the number of words an average third-grader at a Bridge PSL public school read at the beginning of the year.⁵⁴ For the grade-by-grade growth on the other EGRA/EGMA subtasks, see Appendix A8. Yearly Growth in Subtasks by Grade.

⁴⁸ Singh (2015).

⁴⁹ For example, 0.2 SDs is approximately the average 1 year gain in English and math in upper grades in the United States, but ranges from .36 to 1.52 SDs in early grades. See Hill et al. (2008)

⁵⁰ These results are from the EGRA Plus project, with Research Triangle Institute (RTI) and FHI360. See Piper et al. (2010).

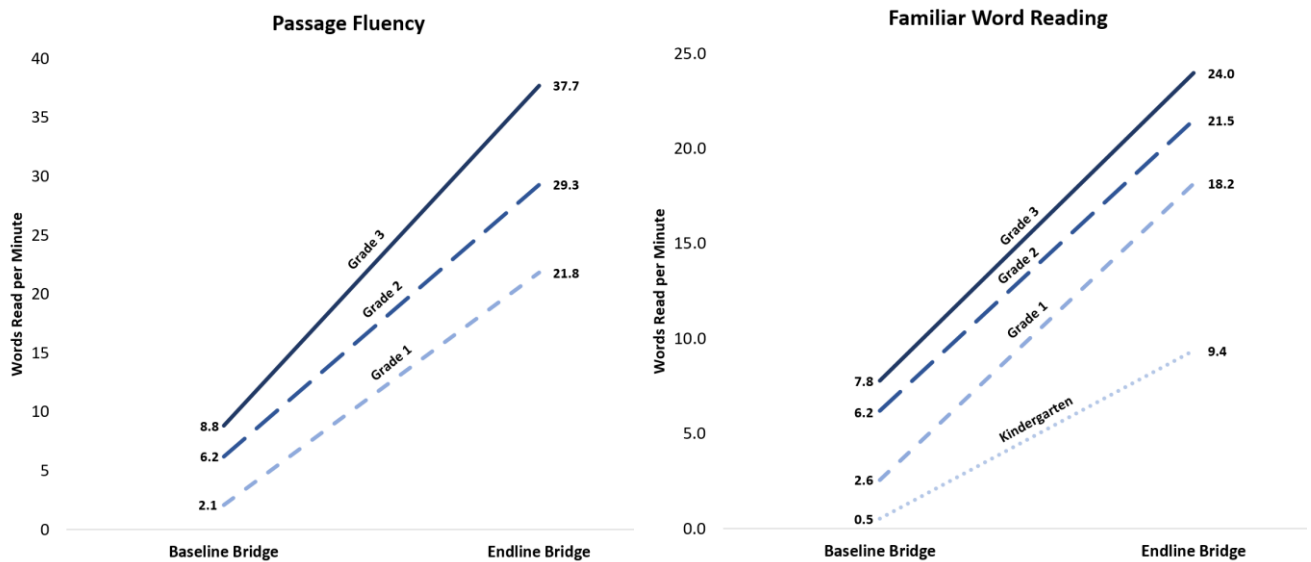
⁵¹ Students at the traditional public schools in our study saw absolute (not “above and beyond”) gains ranging from 0.5 to 1.2 SDs during the academic year on EGRA subtasks, which averages 0.77 SD. For EGMA, the range is 0.1 to 0.7 SDs, and averages to 0.57 SDs. Averages across subtasks included in our effect size estimate can be seen in in the Appendix [A15. Standardized Annual Gains Baselines to Endlines at Bridge PSL Public Schools and Traditional Public Schools](#).

⁵² See Appendix A15. Standardized Annual Gains Baselines to Endlines at Traditional Public Schools for the by subtask breakdown of the standardized annual gains achieved by traditional public schools.

⁵³ Percent Additional Schooling was calculated by dividing the Bridge Effect by “Business-as-Usual” yearly growth.

⁵⁴ This is a remarkable result even considering summer slide for the third-graders at the beginning of the year. Summer slide is the phenomenon where students lose some of the learning they have achieved during summer break.

Figure 6. Yearly Growth by Grade Level at Bridge PSL Public Schools



6.4 Setting the Stage for Meeting Global Literacy Standards

6.4.1 Reaching Literacy Benchmarks for Liberia

A useful indicator for comparing the performance of different student groups is the set of literacy benchmarks for Grade 1 - Grade 3 established at a workshop organized in 2014 by Liberian Ministry of Education officials and USAID.⁵⁵ These benchmarks were developed for three specific literacy skills - non-word reading, reading fluency, and reading comprehension - all of which are measured by EGRA subtasks.

Table 20 below shows the benchmark values for each literacy skill and grade, and the percentages of assessed students who are meeting these benchmarks based on their baseline and endline EGRA scores. The difference between the baseline percentage and endline percentage shows the progress toward these benchmarks achieved by each school type.

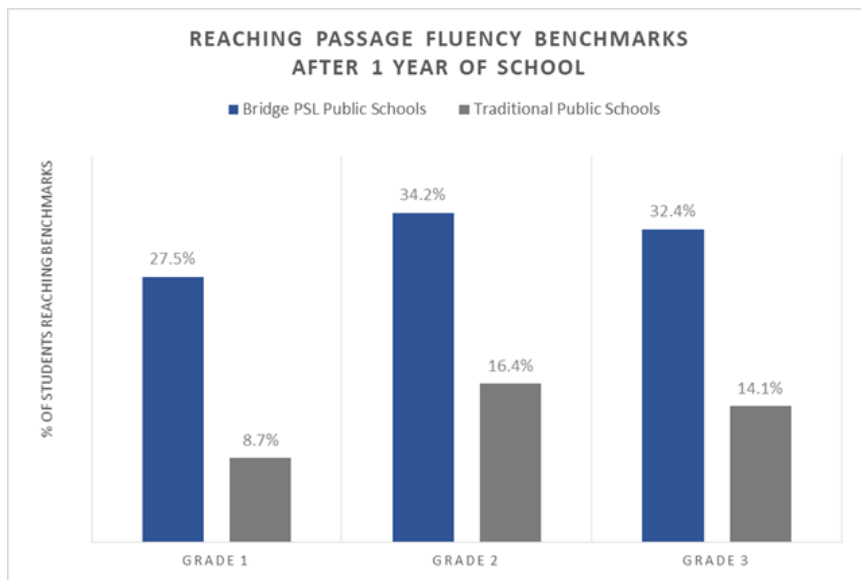
⁵⁵ RTI International (March 2014), "Proposing Benchmarks for Early Grade Reading Skills in Liberia," <https://globalreadingnetwork.net/eddata/proposing-benchmarks-early-grade-reading-skills-liberia>.

Table 20. Literacy Skills Performance Benchmarks

Benchmark	Bridge PSL Public School			Traditional Public School			Diff-in-Diff	
	Criteria by Subtask	% Met at Baseline	% Met at Endline	Diff	% Met at Baseline	% Met at Endline		Diff
Grade 1								
Non-Word Reading	8 wpm	0%	6%	6%	0%	7%	7%	-1%
Passage Fluency	30 wpm	0%	28%	28%	0%	9%	9%	19%
Reading Comprehension	40%	0%	19%	19%	0%	1%	1%	18%
Grade 2								
Non-Word Reading	10 wpm	1%	11%	10%	3%	3%	0%	10%
Passage Fluency	35 wpm	1%	34%	33%	0%	16%	16%	16%
Reading Comprehension	50%	0%	20%	20%	0%	4%	4%	16%
Grade 3								
Non-Word Reading	15 wpm	0%	1%	1%	0%	1%	1%	0%
Passage Fluency	50 wpm	3%	32%	30%	1%	14%	13%	17%
Reading Comprehension	75%	1%	4%	3%	0%	3%	3%	0%

A greater proportion of Bridge PSL public school students reached reading benchmarks in one year than traditional public school students on the majority of measures, most noticeably on Passage Fluency. Approximately one in three Bridge PSL public school students in the early grades met fluency benchmarks, compared to one in six at best at the traditional public schools.

Figure 7. Relative Performance on Passage Fluency Benchmarks



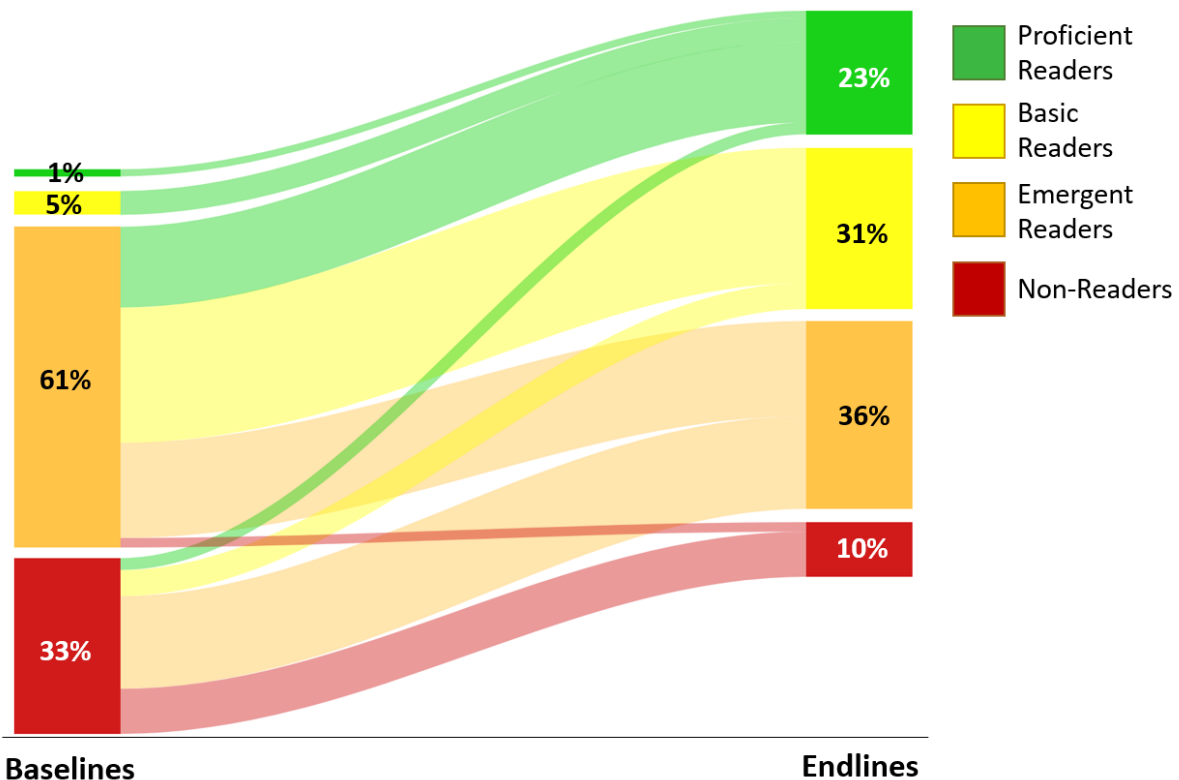
6.4.2 The Path and Progress toward Literacy

Another way to assess progress towards literacy is to examine the movement of students across four literacy categories: Proficient Readers, Basic Readers, Emergent Readers, and Non-Readers.⁵⁶ Non-Readers are students who score 0 on the Passage Fluency subtask, Emergent Readers read 1-19 words per minute, Basic Readers read 20-44 words per minute, and Proficient Readers read 45 or more words per minute. Figure 8 below shows the percentage of Bridge PSL public school students in Grades 1 – 3 who fall into in each of

⁵⁶ These four literacy categories and their words-per-minute cutoffs were suggested in a benchmark setting workshop with USAID in 2015. See http://www.urc-chs.com/sites/default/files/Setting%20Benchmarks%20for%20Early%20Grade%20Reading_10-1-2015.pdf.

these categories at baselines and at endlines. The connecting lines in the graphic also indicate the volume of students moving between different categories over the course of the school year.

Figure 8. RTI Literacy Categories: Paths from Baselines to Endlines at Bridge PSL Public Schools*



*Categories proposed by RTI. Non-readers = 0 wpm; Emerging readers = 1-19 wpm; Basic readers = 20-44 wpm; Proficient readers 45+ wpm.

Almost half the students became either basic or proficient readers over the course of the school year. The proportion of proficient readers has increased from 1% to 23% over the school year, while the number of non-readers has fallen from 33% to 10%.

While this progress is encouraging, it also highlights the continuing challenge Bridge PSL will face as it strives to ensure that every child becomes literate. Approximately 30% of Emergent Readers and Non-Readers failed to move up a reading category. Bridge’s goal is for students to leave the lower primary grades fully equipped with the skills they need to succeed in upper primary and beyond; this includes basic reading fluency. The high percentage of zero scores at baseline means that students are starting from scratch – getting many of these students to fluency is going to take more than one school year. As such, Bridge and its partners will have more work to do in Year 2 and beyond, but the results indicate that the approach is effective and can be built upon to move more students towards fluency in the future.

6.5 Moving Away from Zero Scores

As discussed earlier, a significant proportion of students scored zero on one or more subtasks during the baselines, especially on EGRA. This was true at both Bridge PSL public schools and traditional public schools. For example, on the Non-word Reading subtask at the baseline, 91% and 93% of students scored zero at Bridge PSL public and traditional public schools respectively. A score of zero is particularly alarming

because it indicates that the student is a non-reader, meaning the student has minimal foundational literacy skills required to build from to become a successful reader. In contrast, a student who scores non-zero is able to apply basic literacy skills.

6.5.1 Reduction in % of Students with Zero Scores

At the end of the school year, the number of zero scores dropped, and dropped more dramatically for students attending Bridge PSL public schools. Table 21 shows that Bridge had a larger percentage point reduction in the number of students with zero scores across all subtasks, with the exception of Passage Fluency, One-to-One Correspondence, and Addition 2.

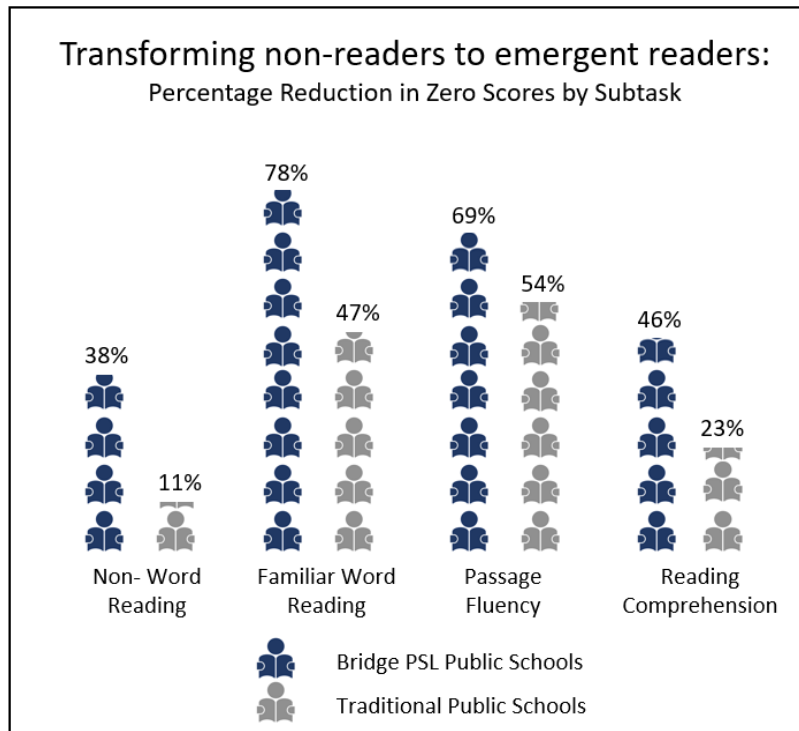
Table 21. Difference in Proportion of Students with Zero Scores

Subtask	Grades	Bridge PSL Public School			Traditional Public School				Diff-n-Diff	
		Total # of Students	% of Zeros at Baseline	% of Zeros at Endline	Diff	Total # of Students	% of Zeros at Baseline	% of Zeros at Endline		Diff
Letter Sounds	KG-G2	198	73%	8%	-66%	247	88%	71%	-17%	-49%
Onset Sounds	KG-G2	198	35%	5%	-31%	247	38%	13%	-26%	-5%
Non-Word Reading	KG-G3	275	91%	56%	-35%	319	93%	82%	-11%	-24%
Familiar Word Reading	KG-G3	270	39%	9%	-30%	319	50%	27%	-23%	-7%
Passage Fluency	G1-G3	222	33%	10%	-23%	229	51%	24%	-28%	5%
Reading Comprehension	G1-G3	222	86%	46%	-40%	230	89%	69%	-20%	-19%
One-to-One Correspondence	KG	53	0%	0%	0%	90	0%	0%	0%	0%
Number Identification	KG-G1	122	13%	2%	-11%	183	0%	1%	1%	-12%
Quantity Discrimination	KG-G2	198	17%	3%	-14%	247	9%	3%	-6%	-7%
Addition 1	KG-G3	275	23%	5%	-18%	318	15%	6%	-9%	-9%
Addition 2	G2-G3	152	21%	10%	-11%	136	20%	7%	-12%	1%
Subtraction 1	G1-G3	222	27%	7%	-20%	227	22%	10%	-12%	-8%
Subtraction 2	G2-G3	152	44%	24%	-20%	135	33%	26%	-7%	-13%
Word Problems	G1-G3	222	12%	3%	-9%	228	11%	4%	-7%	-2%

Differences in percentage points may, however, mask the reduction in the proportion of students who went from zero to non-zero scores. In Passage Fluency, for example, fewer Bridge PSL public school students scored zero on baselines than traditional public school students.⁵⁷ However, of these students, 69% of them at Bridge PSL public schools scored at least one point during endlines, compared to 54% at traditional public schools. See Figure below.

⁵⁷ Part of the reason zero scores are lower on Familiar Word Reading and Passage Fluency could be attributable to Bridge PSL impacting learning in the weeks before the baseline assessments began.

Figure 9. Reduction in Zero Scores by Subtask



Bridge PSL public schools had a particularly large impact on developing non-readers into emergent readers. For every ten students who could not read a single familiar word at the beginning of the year, eight Bridge PSL public school students were able to read at least one word by the end of the year, compared to only five traditional public school students. In fact, for all subtasks except for Addition Level 2, Bridge PSL public schools had a higher percent reduction of zero scores across Year 1. The detailed difference-in-difference estimates and charts for percent reduction of zero scores can be seen in Appendix A9. Zero Score Reduction Tables.

6.5.2 Likelihood of Moving Away from a Zero Score

While the above results are compelling, it may be that the reductions in zero scores are due to chance rather than as a result of the Bridge PSL intervention. We can use a statistical model to estimate this particular outcome - the likelihood that a student moves from a zero score to a non-zero score. As this outcome is binary, rather than the continuous outcomes of student achievement that we analyzed in section 6, we adopt a linear probability model to isolate the impact of attending a Bridge PSL public school on the probability of moving from a zero to a non-zero score.⁵⁸

While this approach allows us to factor in the same baseline characteristics that were present when determining the size of the “Bridge PSL effect,” we only include grade dummies for the sake of simplicity. This translates into the following model specification:

$$\text{Zero to Non-zero Change} = \beta_0 + \beta_1(\text{treatment}) + \beta_2(\text{grade 1}) + \beta_3(\text{grade 2}) + \beta_4(\text{grade 3}) + \varepsilon$$

⁵⁸ There are two main choices here: a logistic regression or a linear probability model (LPM) which uses simple ordinary least squares to estimate marginal impacts. Because our treatment is a binary variable, the LPM can be used. As the coefficient estimates are easier to interpret than the logistic regressions, the LPM is our preferred model.

See Table 22 below. We find that attending Bridge PSL public schools resulted in a higher probability of a student moving from a zero to non-zero score across all EGRA subtasks. These results are statistically significant at the 95% confidence level, with the exception of Passage Fluency. On Familiar Word Reading, for example, attending a Bridge PSL public school increases the probability for a student who scored zero to score at least one by 27 percentage points, relative to traditional public schools.

Table 22. EGRA Reduction in Zero Scores: Linear Probability Model

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	0.67** (0.00)	0.10* (0.03)	0.26** (0.00)	0.27** (0.00)	0.10 (0.36)	0.22** (0.00)
Grade 1	0.18* (0.04)	0.09 (0.12)	0.06 (0.27)	0.26** (0.00)	0.01 (0.97)	-0.19* (0.01)
Grade 2	0.10 (0.17)	0.11* (0.04)	0.17* (0.02)	0.16 (0.10)		
Grade 3			0.12* (0.04)	0.16 (0.19)	0.16 (0.28)	0.08 (0.45)
Constant	0.13** (0.00)	0.78** (0.00)	0.06+ (0.07)	0.40** (0.00)	0.61** (0.00)	0.31** (0.00)
Count	362	164	546	264	191	396
R-squared	0.46	0.05	0.12	0.13	0.03	0.12

Across EGMA,⁵⁹ the probability that Bridge PSL public school students would move from zero to non-zero is positive across all subtasks except Addition Level 2; however, no EGMA results are statistically significant. This is likely a reflection of both greater differential gains achieved by Bridge PSL public schools on literacy and fewer zero scores on numeracy to begin with.

⁵⁹ Because no students scored zero on the baseline for One-to-one Correspondence and only 16 students scored zero on Number Identification, these subtasks were excluded from this analysis.

Table 23. EGMA Reduction in Zero Scores: Linear Probability Model

	(9) Quantity Disc. KG-G2	(10) Addition 1 KG-G3	(11) Addition 2 G2-G3	(12) Subtraction 1 G1-G3	(13) Subtraction 2 G2-G3	(14) Word Problems G1-G3
Bridge	0.02 (0.87)	0.04 (0.55)	-0.12 (0.42)	0.12 (0.27)	0.07 (0.52)	0.08 (0.55)
Grade 1	0.07 (0.57)	0.14 (0.12)		-0.07 (0.62)		-0.20* (0.03)
Grade 2	0.13 (0.42)	0.18+ (0.08)				-0.32* (0.02)
Grade 3		0.17 (0.18)	0.18 (0.17)	-0.05 (0.75)	-0.02 (0.84)	
Constant	0.75** (0.00)	0.68** (0.00)	0.74** (0.00)	0.71** (0.00)	0.55** (0.00)	0.96** (0.00)
Count	56	112	59	109	111	52
R-squared	0.02	0.04	0.06	0.03	0.01	0.04

6.5.3 Benchmarks for Reducing Zero Scores

The benchmarking workshop that set literacy benchmarks by grade also set goals for reducing the percentage of students who score zero on non-word reading, passage fluency, and reading comprehension. These recommended percentages, described as “ambitious,”⁶⁰ are shown in Table 24 below along with the progress of students at each school type towards these goals.

Table 24. Reducing Zero Score Benchmarks

	Benchmark % Scoring Zero	Bridge PSL Public Schools % Scoring Zero	Benchmark Achieved?	Traditional Public Schools % Scoring Zero	Benchmark Achieved?
Grade 1					
Non-Word Reading	25%	62%	X	85%	X
Passage Fluency	15%	13%	✓	40%	X
Reading Comprehension	20%	57%	X	92%	X
Grade 2					
Non-Word Reading	20%	48%	X	69%	X
Passage Fluency	15%	14%	✓	19%	X
Reading Comprehension	20%	46%	X	64%	X
Grade 3					
Non-Word Reading	15%	54%	X	72%	X
Passage Fluency	5%	4%	✓	6%	X
Reading Comprehension	15%	38%	X	42%	X

As with the performance benchmarks discussed in the previous section, Bridge PSL public schools made noticeably more progress toward these goals, as the percentage of zero scores is lower at Bridge PSL public schools on all literacy skills in all grades. In fact, on Passage Fluency, Bridge PSL public schools actually

⁶⁰ RTI International (2014).

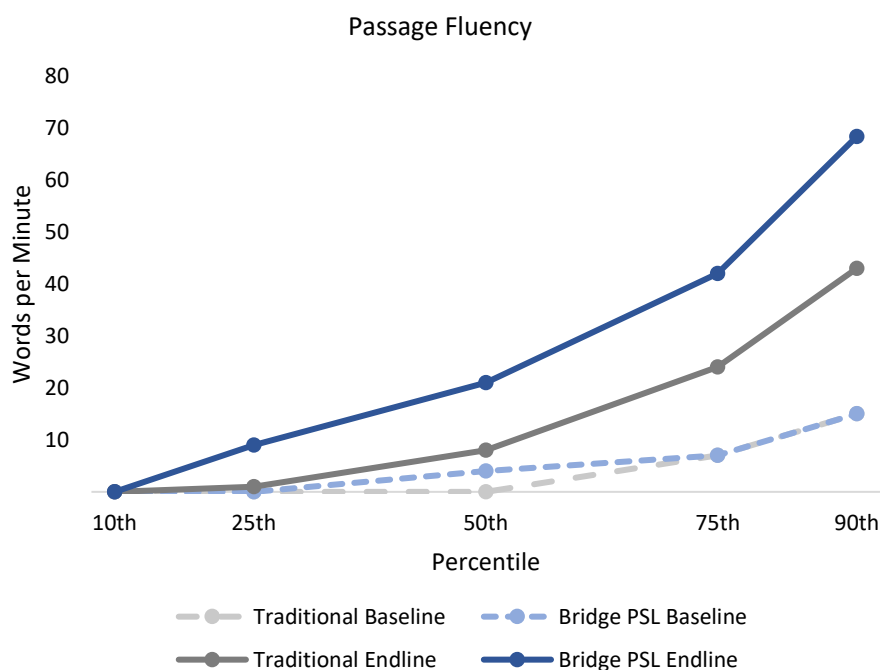
achieved the reduction in zero scores goals in all three grades. This is particularly notable for Grade 3, for which the benchmark requires a zero score percentage of less than 5%.

7. Exploring Heterogeneous Impacts

7.1 Gains for Students by Percentile

Although the results provide a strong signal that Bridge PSL has a differential impact on student outcomes overall, it is critical that every child is learning regardless of their incoming ability level. To investigate whether gains achieved vary by students' baseline literacy and numeracy levels (heterogeneous impact), we can look at the performance of students across different percentiles across the academic year. Figure 10 shows student baseline and endline performance for the 10th, 25th, 50th, 75th, and 90th percentile at both Bridge PSL public and traditional public schools on Passage Fluency.

Figure 10. Passage Fluency Performance of Students by Percentile



On some subtasks such as Passage Fluency, many students starting at the 10th percentile did not realize the gains of students with higher incoming skill levels. However, on the majority of subtasks, particularly on EGMA, gains were fairly evenly distributed across the entire spectrum of scores. In other words, students at Bridge PSL exhibit strong learning gains irrespective of baseline performance.

Figure 15 and Figure 16 in Appendix A10. Heterogeneity of the Treatment show the heterogeneous impact of Bridge PSL across subtasks.

Formal testing for equality of treatment effects at different points of score distributions can be seen in Table 50 and Table 51 in Appendix A10. Heterogeneity of the Treatment.⁶¹ Students were divided into terciles (low, medium, and high) based on their performance at baselines. We then tested to see whether

⁶¹ Methodology for testing heterogeneity of the treatment comes from Muralidharan et al. (2017).

there was a differential impact on student outcomes at Bridge PSL public schools relative to traditional public schools depending on their original performance.

While the coefficient on the treatment dummy remains statistically significant, interactions between the treatment and terciles at baselines are generally not significant. Only on the Familiar Word Reading and Passage Fluency subtasks are the interactions with Bridge and certain terciles significant, indicating that Bridge PSL students who perform higher at baselines do experience even more growth than students at traditional public schools who also perform higher at baselines.

For the most part, we do not see systematic differences between Bridge PSL public schools and traditional public schools in the impact on student performance across the distribution of baseline performance, though this may be due to limitations of sample size. Directionally, it appears that Bridge PSL is having a larger impact on students in the second tercile (students performing in the middle).

7.2 Results by Grade Level

Although we cannot conduct regression analysis at the grade level due to the limited number of schools in our study, we can conduct simple DiD to see how the “Bridge PSL effect” varied across grades. Through this simplified analysis, we see that our results were similar across grade levels in EGRA except letter sounds. Bridge PSL public school Kindergarteners learned the most letter sounds by far, able to pronounce 25.6 more letter sounds than their peers at traditional public schools. Put another way, Bridge PSL public school Kindergarteners could produce sounds associated with nearly every letter of the English alphabet, whereas students in the traditional public schools could barely produce one.

EGMA results were less consistent across grade levels. Students in 2nd Grade and 3rd Grade made minimal differential gains in word problems compared to 1st graders. Kindergartners made double the differential gains of 1st graders. See the tables below for the simple DiD results by grade level.⁶²

Table 25. Kindergarten Simple Difference-in-Differences, Raw Scores

Subtask	Count	Bridge PSL Public Schools						Traditional Public Schools						Diff-n-Diff
		Baseline			Endline			Baseline			Endline			
		Mean	SD	Diff	Mean	SD	Diff	Count	Mean	SD	Mean	SD	Diff	
Letter Sounds	53	0.4	1.6	26.5	16.2	26.1	91	0.2	0.8	0.7	2.4	0.5	25.6	
Onset Sounds	53	17%	20%	35%	21%	18%	91	17%	20%	31%	21%	14%	4%	
Non-Word Reading	53	0.0	0.0	2.1	3.8	2.1	91	0.1	0.7	0.1	0.6	0.0	2.1	
Familiar Word Reading	53	0.5	1.3	9.4	9.0	8.8	91	0.8	2.3	1.9	4.3	1.1	7.8	
One to One Correspondence	53	37.4	30.9	53.2	31.0	15.9	90	49.7	34.0	52.0	32.7	2.4	13.5	
Number Identification	53	3.8	4.1	13.5	8.5	9.7	91	10.9	23.0	14.3	8.2	3.4	6.3	
Quantity Discrimination	53	13%	16%	46%	29%	34%	91	26%	25%	50%	29%	24%	10%	
Addition 1	53	0.7	1.4	6.1	4.3	5.4	90	3.2	3.2	5.4	4.1	2.2	3.2	

⁶² Standardized results by grade level can be found in Appendix section A7.4 Standardized Difference-in-Differences by Grade.

Table 26. Grade 1 Simple Difference-in-Differences, Raw Scores

Subtask	Bridge PSL Public Schools						Traditional Public Schools						Diff-n-Diff
	Count	Baseline		Endline		Diff	Count	Baseline		Endline		Diff	
		Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Letter Sounds	69	1.3	3.3	22.4	13.6	21.0	92	1.5	6.3	7.0	14.0	5.5	15.6
Onset Sounds	69	27%	22%	46%	22%	19%	92	21%	20%	38%	21%	16%	3%
Non-Word Reading	69	0.0	0.3	2.2	3.9	2.2	92	0.0	0.2	1.1	3.3	1.1	1.1
Familiar Word Reading	69	2.6	3.7	18.2	13.6	15.6	92	1.9	3.7	7.0	7.4	5.1	10.5
Passage Fluency	69	2.1	3.3	21.8	21.2	19.7	92	1.2	2.9	6.9	9.8	5.7	14.0
Reading Comprehension	69	1%	4%	14%	19%	13%	92	1%	4%	2%	6%	1%	12%
Number Identification	69	14.8	30.6	24.6	8.5	9.8	92	13.3	7.8	19.9	8.9	6.7	3.1
Quantity Discrimination	69	44%	29%	80%	24%	36%	92	46%	31%	64%	29%	18%	18%
Addition 1	69	4.1	3.3	10.4	4.5	6.2	92	5.0	3.8	7.4	4.2	2.5	3.8
Subtraction 1	69	2.8	3.2	7.8	3.8	5.0	92	3.3	3.4	6.2	10.2	2.8	2.2
Word Problems	69	32%	24%	50%	24%	18%	92	36%	25%	44%	23%	8%	10%

Table 27. Grade 2 Simple Difference-in-Differences, Raw Scores

Subtask	Bridge PSL Public Schools						Traditional Public Schools						Diff-n-Diff
	Count	Baseline		Endline		Diff	Count	Baseline		Endline		Diff	
		Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Letter Sounds	76	3.1	5.1	26.4	20.2	23.3	64	5.6	12.2	8.9	16.2	3.3	20.1
Onset Sounds	76	28%	26%	52%	23%	23%	64	32%	25%	47%	27%	15%	8%
Non-Word Reading	79	0.5	1.7	4.4	7.0	3.9	67	0.6	2.2	1.9	3.5	1.2	2.6
Familiar Word Reading	76	6.2	6.7	21.5	17.0	15.3	67	6.4	6.6	13.5	10.1	7.1	8.1
Passage Fluency	79	6.8	8.1	29.3	28.1	22.5	67	3.8	5.4	16.3	15.2	12.5	10.0
Reading Comprehension	79	3%	8%	24%	26%	21%	67	1%	4%	11%	17%	10%	11%
Quantity Discrimination	76	56%	31%	79%	29%	23%	64	55%	28%	74%	28%	19%	3%
Addition 1	79	6.7	5.3	13.3	6.9	6.6	67	6.4	4.0	9.9	5.0	3.5	3.1
Addition 2	78	33%	28%	55%	33%	22%	67	37%	29%	46%	29%	0.1	13%
Subtraction 1	79	4.5	3.9	9.2	4.7	4.7	67	5.6	3.5	7.5	3.8	1.9	2.7
Subtraction 2	78	19%	25%	37%	31%	18%	67	25%	26%	32%	31%	0.1	12%
Word Problems	79	49%	27%	62%	27%	13%	67	47%	23%	59%	24%	12%	2%

Table 28. Grade 3 Simple Difference-in-Differences, Raw Scores

Subtask	Bridge PSL Public Schools						Traditional Public Schools						Diff-n-Diff
	Count	Baseline		Endline		Diff	Count	Baseline		Endline		Diff	
		Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Non-Word Reading	74	0.5	1.6	2.1	3.3	1.6	69	0.3	1.2	1.4	4.0	1.1	0.5
Familiar Word Reading	72	7.8	6.3	24.0	16.5	16.2	69	9.9	9.0	18.7	14.2	8.8	7.4
Passage Fluency	74	8.8	10.9	37.7	30.7	29.0	70	11.5	12.4	25.2	21.7	13.7	15.2
Reading Comprehension	74	6%	14%	26%	26%	20%	71	6%	12%	20%	22%	13%	7%
Addition 1	74	7.6	3.8	15.7	6.9	8.0	69	7.9	4.1	12.4	5.1	4.5	3.6
Addition 2	74	42%	30%	64%	31%	22%	69	42%	30%	56%	32%	14%	7%
Subtraction 1	74	6.9	5.9	9.5	4.1	2.6	68	6.9	3.7	9.3	3.8	2.4	0.2
Subtraction 2	74	31%	28%	50%	35%	18%	68	31%	27%	46%	33%	15%	3%
Word Problems	74	55%	25%	63%	23%	8%	69	52%	22%	59%	23%	7%	1%

8. Changes in School Level Characteristics

8.1 Student Enrollment and Presence

As previously mentioned, assessors completed in-person surveys at each school during midlines and endlines. During the surveys, assessors asked Principals for their current enrollment by grade level and also counted the number of students physically present that day. When principals were asked to report enrollment, those at traditional public schools usually referred to student names written on a paper roster – names are generally added, but not removed. Principals at Bridge PSL public schools pulled up their roster via their smartphone, where enrollment is electronically maintained. Separately, to determine presence we conducted a count of the number of physical student bodies in the classrooms on survey day. The difference between the roster and count of students present is therefore a combination of both withdrawn and absent students.

By the end of the year, the average number of physically present students in each grade was 25 at Bridge PSL public schools and 19 at traditional public schools. Table 29 below displays the change between midlines and endlines by grade level.

Table 29. Average Number of Students Enrolled vs. Present on Visit Day

Grade	Bridge PSL Public Schools						Traditional Public Schools					
	Principal Reported Enrollment			Number of Students Physically Present			Principal Reported Enrollment			Number of Students Physically Present		
	Midline	Endline	Diff	Midline	Endline	Diff	Midline	Endline	Diff	Midline	Endline	Diff
Beginner Class	57	37	-21	30	24	-6	73	50	-23	47	24	-23
Nursery Class	43	42	-1	27	25	-2	25	55	30	19	25	6
Kindergarten	53	54	1	37	35	-3	28	34	6	22	27	5
1st Grade	58	53	-6	39	35	-4	39	45	6	30	23	-7
2nd Grade	47	41	-6	28	28	0	30	29	-1	20	18	-3
3rd Grade	46	37	-8	29	25	-4	28	34	5	21	18	-3
4th Grade	36	29	-7	21	19	-1	30	34	4	22	15	-8
5th Grade	31	22	-9	16	14	-2	19	27	7	14	10	-4
6th Grade	40	31	-9	19	20	2	23	27	4	13	12	-1
Average	45	38	-7	27	25	-2	33	37	4	23	19	-4

At Bridge PSL public schools, enrollment since January declined by an average of 7 students per grade, based on principal records. The number of students physically present as verified by the assessor fell by an average of 2 students per grade.

At traditional public schools, enrollment increased by an average of 4 students per grade according to principals. Although enrollment reportedly increased, the number of students physically present in classrooms did not. In fact, the number of students present fell by an average of 4 students per grade.

Again, traditional public schools principals tend to add students to their roster, but not necessarily remove names when students have withdrawn. Given different standards of maintaining a student roster, we refrain here from calculating average attendance rates as they would not be comparable.

8.2 Teacher Attendance

During the surveys, assessors visited each classroom and recorded whether or not a teacher was present. The results were consistent across both assessment periods. Bridge PSL public schools had 89% of teachers

present during school survey visits while traditional public schools had 57%. Table 30 below displays the change in teacher attendance between the midlines and endlines by grade level.

Table 30. % of Teachers Present⁶³

	Bridge PSL Public Schools			Traditional Public Schools		
	Midline	Endline	Diff	Midline	Endline	Diff
Beginner Class	100%	100%	0%	100%	40%	-60%
Nursery Class	100%	100%	0%	50%	75%	25%
Kindergarten	100%	100%	0%	83%	50%	-33%
1st Grade	100%	80%	-20%	50%	50%	0%
2nd Grade	83%	83%	0%	50%	67%	17%
3rd Grade	83%	83%	0%	50%	83%	33%
4th Grade	83%	100%	17%	50%	50%	0%
5th Grade	83%	67%	-17%	50%	50%	0%
6th Grade	67%	83%	16%	33%	50%	17%
Average	89%	89%	0%	57%	57%	0%

8.3 Changes in Other School Characteristics

There were a few other minor changes in school characteristics:

- Traditional public schools increased their total number of teachers by two.⁶⁴
- Both Bridge PSL public schools and traditional public schools slightly increased their proportion of female teachers (Bridge PSL +7%, Traditional +6%)
- Assessors reported a longer walk time to the majority of schools in the study from the main road during the endlines. The difference was driven due to the rainy conditions experienced during endlines.
- One additional Bridge PSL public school and one additional traditional public school became inaccessible by car during the endline assessments due to rain.
- Two traditional public schools removed partitions from several classrooms, driving the average number of classrooms at traditional public schools down from 9.3 to 8.2.
- The water pumps at two Bridge PSL public schools broke down, removing the schools’ access to drinking water.

“Unlike the Bridge [PSL public] school, which was well organized and managed, the traditional [public] school in Margibi suffered a deficiency in school management. Some of the biggest differences between Bridge schools and the traditional schools in the study are time duration, teacher’s commitment to instructions, and classroom management. Finally, the traditional school [I visited] is similar to other traditional schools in terms of infrastructure, poor sitting capacities, etc.”

~ Emmanuel Stevens, MoE Planning Officer of Margibi County

⁶³ All schools in the study offer Grade 2 through Grade 6. Two of the six Bridge PSL public schools offer Beginner and Nursery class and five of the six Bridge PSL Public schools offer Kindergarten and Grade 1. Only one traditional public school doesn’t offer Beginner.

⁶⁴ The traditional public school in Montserrado county reported adding a new Kindergarten teacher and a new 5th Grade teacher between midlines and endlines

“I noticed three main differences between Bridge [PSL public schools] and traditional public schools. First, the traditional schools did not have sufficient desks for students, but Bridge PSL schools had. Second, traditional schools did not have full instructional staff on campus, but Bridge PSL schools had. Third, Bridge PSL students had textbooks and could read them.”

~ *Daowomah Bono, Graduate Student in Education Administration, University of Liberia*

9. Limitations

One of our main concerns is attrition; 29% of students in our study sample were not in school during endline assessments, making it impossible to collect data on their outcomes. Unfortunately, tracking students outside of their baseline school is cost-prohibitive for the scope of this study, so we were therefore constrained by the schedules of comparison schools and whether students happened to be absent during assessment days. Where students moved grade levels, however, we did our best to locate them within their baseline school, and their results are analyzed per their starting grade level.

9.1 Attrition

Sample attrition rates at midlines and endlines by Bridge PSL public and traditional public schools can be seen in Table 31. The overall average sample attrition rate was slightly lower for Bridge PSL public schools than traditional public schools at midlines, but higher at endlines.

Table 31. Sample Attrition at Midlines vs. Endlines

	Bridge PSL Public Schools		Traditional Public Schools		All Schools	
	Midline	Endline	Midline	Endline	Midline	Endline
Kindergarten	23%	34%	18%	28%	20%	30%
Grade 1	16%	30%	15%	21%	16%	25%
Grade 2	12%	28%	20%	29%	16%	28%
Grade 3	19%	37%	24%	30%	21%	33%
Total	17%	32%	19%	27%	18%	29%

Sample attrition is not the same as attrition from schools. Reasons for attrition from the sample can be seen in Table 32. As of the date of this report, endline analysis shows that around 16% of students were not assessed because they have withdrawn. While about 4% of students have moved, 12% have withdrawn for other reasons⁶⁵. About 8% of the students were not assessed because they were absent. Note that a larger percentage of Bridge PSL public school students were absent compared to traditional public school students. Given that the majority of assessments at Bridge PSL public schools was conducted in the afternoon during the extended day periods, there is a possible bias toward absenteeism at Bridge PSL public schools.

⁶⁵ The “other” withdrawal reasons reported for Bridge PSL public schools included: farming/selling (9 students), transferred to a traditional public school (7 students), pregnancy (4 student), the length of the PSL school day (3 students), lack of feeding (2 students), and being demoted (1 student). The “other” withdrawal reasons reported for traditional public schools included: farming/selling (21 students), pregnancy (3 students), and playing soccer (1 student).

Table 32. Endline Status of Students from Baseline Sample

Status	Bridge PSL Public Schools		Traditional Public Schools		All Schools	
	Count	%	Count	%	Count	%
Present	275	68%	321	73%	596	71%
Absent	46	11%	25	6%	71	8%
Withdrawn (Moved)	10	2%	25	6%	35	4%
Withdrawn (Other)	61	15%	43	10%	104	12%
Unknown	14	3%	24	5%	38	5%
Total	406	100%	438	100%	844	100%

Sample attrition can greatly impact results if the reasons for the attrition are different across school types. To ensure our estimates of the Bridge effect are not biased, we test for differential attrition below. An explanation of why sample attrition, and particularly differential attrition, is a concern can be found in Appendix A11. Why Sample Attrition is a Concern.

9.2 Differential Attrition

Attrition only biases our results if it differentially impacts students who received the treatment. For example, let's assume that students who performed poorly at baselines had less gains than students who performed well. If students who were performing poorly left School A but those types of students stayed at School B, it would appear that School A had differential gains when in actuality the final sample of students is not comparable.

In the following two sections, we explore the possibility of differential attrition in our sample. First, we look at differential attrition by baseline characteristics, then we review differential attrition by mid-year growth differences.

9.2.1 Differential Attrition by Baseline Characteristics

Using the baseline sample, we created an indicator on whether the student attrited from the sample by endlines. We then used a regression framework to examine whether particular types of students attending Bridge PSL public schools were more likely to attrite than their counterparts attending traditional public schools. The key factors we worry about are incoming levels of literacy and numeracy (the EGRA and EGMA subtask scores). For the ease of interpretation, we created a composite variable for EGRA and EGMA subtasks.⁶⁶

We ran three different sets of specifications in order to balance between including all baseline information and losing statistical power due to too many interaction effects. On the whole, we do not see systematic differences in attrition rates by school type, but do see some differences by student type.

While students' EGRA scores do not correlate with attrition, students with higher EGMA scores at baselines were less likely to attrite. Older students or those who did not attend school the previous year were also more likely to attrite. Again, this is the case for both Bridge PSL public schools and traditional public schools.

⁶⁶ Composite EGRA/EGMA scores were created by taking the standardized baseline score for each subtask and averaging this score across subtasks. We used a unit weight, which suggests each outcome is equally important. For a discussion on composites, see Schochet (2008).

The only differential attrition by school system concerned meals: Students who reported eating more meals were less likely to leave Bridge PSL schools relative to students at traditional public schools. While further research is required to determine why this is true, one hypothesis relates to the longer school days at Bridge PSL public schools, a key feature of the overall PSL program.

The results are detailed in Table 52 in Appendix A12. Differential Attrition.

9.2.2 Differential Attrition by Mid-Year Growth

Attrition could also impact the estimates of our results if attritors at Bridge PSL public schools were on different growth trajectories than attritors at traditional public schools. Because we assessed students half way through the year, we can estimate growth trajectories for students at midlines and see if different types of students were more likely to attrite by endlines.

We again use a regression framework to determine if there is differential attrition, this time using composite growth scores for EGRA and EGMA.⁶⁷ See Table 53 in Appendix A12. Differential Attrition for more details.

Students with lower growth rates are more likely to attrite in both groups, particularly when the student has lower numeracy growth between baselines and midlines. It may be that students who are already planning on attending school less frequently or leaving school put in less effort, and therefore see less gains.

While it appears that this issue applies equally to both Bridge PSL public schools and traditional public schools, we also acknowledge that there may be insufficient statistical power to detect this differential. As such, we explore how this type of attrition may bias our results.

A simple comparison of the average midline growth of attritors and non-attritors demonstrate that the relative gains of Bridge PSL public school students are larger amongst non-attritors (the students who stay to endlines). Table 33 below shows these relative growth averages and the differences between attritors and non-attritors (students who stay to endlines) for each subtask.⁶⁸

⁶⁷ These analyses were conducted on a sub-sample of students who were present at baselines, midlines, and endlines, which includes x% fewer students than the endline results section as some students who were present at endlines were not present for assessments during midlines.

⁶⁸ For the same table showing standardized scores, see Table in Appendix A16. Differential Relative Gains between Attritors and Non-Attritors.

Table 33. Differential Relative Midline Growth between Attritors and Non-Attritors

	Stayers - Students who Stay to Endline			Attritors - Students who Leave by Endline			Difference-in-Differences
	Bridge PSL Public Schools	Traditional Public Schools	Difference	Bridge PSL Public Schools	Traditional Public Schools	Difference	
Count	264	295		73	59		
	Midline Growth	Midline Growth		Midline Growth	Midline Growth		
EGRA							
Letter Sounds	14.8	2.3	12.5	10.6	1.6	9.0	3.5
Onset Sounds	12 %	9 %	3 %	13 %	13 %	0 %	3 %
Non-Word Reading	1.5	0.5	1.0	0.6	0.2	0.4	0.6
Familiar Word Reading	7.3	3.5	3.8	5.7	2.6	3.1	0.7
Passage Fluency	11.6	4.4	7.2	8.6	2.3	6.3	0.9
Reading Comprehension	9 %	3 %	6 %	5 %	3 %	2 %	4 %
EGMA							
One-to-One Correspondence	9.9	11.2	-1.3	8.7	21.3	-12.6	11.3
Number Identification	3.9	2.5	1.4	5.7	4.1	1.6	-0.2
Quantity Discrimination	15 %	13 %	2 %	18 %	19 %	-1 %	3 %
Addition Level 1	4.5	1.9	2.6	3.6	1.7	1.9	0.7
Addition Level 2	18 %	7 %	11 %	6 %	5 %	1 %	10 %
Subtraction Level 1	3.4	1.1	2.3	3.1	1.4	1.7	0.6
Subtraction Level 2	18 %	10 %	8 %	3 %	-1 %	4 %	4 %
Word Problems	10 %	6 %	4 %	5 %	-6 %	11 %	-7 %

The positive difference-in-difference-in-differences signal that midline relative gains of Bridge PSL public schools are typically smaller for attriting students than they are for students who stayed to the endline assessments. Bridge PSL public school attritors still improved more than traditional public school attritors in almost all subtasks, but their differential improvement was typically less than that of non-attritors.⁶⁹ It is likely that these attritors would also have exhibited less relative growth during endlines, had they still been present. Hence, the absence of these students from the endlines could upwardly bias the estimated “Bridge PSL effect.” We suggest that our estimated effect sizes are best thought of as upper bounds, rather than exact estimates of the impact Bridge PSL public schools.

⁶⁹ We also examine this in a DiD regression framework, controlling for baseline characteristics. See Table 54 and Table 55 in A12. Differential Attrition. This is the same methodology we apply to our endline results in Section 6, but with one additional consideration – students’ attrition status by endlines. The estimate on “the Bridge effect” generally remains positive and large in magnitude, but would be reduced when looking solely at the sample of students who later attrited.

Example: Differential Attrition by Mid-Year Growth

Mary and Precious, both 2nd graders, read 10 words correctly on the passage fluency subtask during the baseline assessments. Mary attends a Bridge PSL public school and reads 30 words correctly during the midlines. Precious attends a traditional public school and reads 20 words at midlines. Both girls are learning, but Mary learned 10 words more.

Emmanuel and Andrew, also 2nd graders read 5 words correctly during the baselines. Emmanuel attends a Bridge PSL public school and reads 15 words correctly during the midlines. Andrew attends a traditional public school and reads 10 words at midlines. Both boys are learning, but Emmanuel learned 5 words more.

At this point we see the following simple difference in difference estimate:

$$\text{Average Mid-Year Difference in Difference} = (10+5) / 2 = 7.5$$

Mary learned 10 words more than Precious and Emmanuel learned 5 words more than Andrew.

If we assume that all students in the study learn at the same rate, we would have seen the following difference-in-difference estimate at the end of the year:

$$\text{Estimated Average Full-Year Difference in Difference} = (20+10) / 2 = 15$$

Mary will learn 20 words more than Precious and Emmanuel will learn 10 words more than Andrew.

However, between the midlines and the endlines, Emmanuel and Andrew both drop out of school. This means that Emmanuel and Andrew are not assessed in our endlines. We call them “attritors.” Mary and Precious are still attending and we give them the endline assessment, so we call them “stayers”.

In our study, we only report the results for the stayers because the true result of the attritors cannot be known. Because only Mary and Precious are stayers in this example the reported DiD for the year becomes 20, 5 more than our estimated full-year difference that included the full sample.

9.3 Comparability of Effect Sizes

The Center for Global Development (CGD) and Innovations for Poverty Action (IPA) is conducting a randomized controlled trial (RCT) to determine the impact of the PSL program across all eight partner providers. As part of this effort, it also examined the specific impact of Bridge PSL on learning outcomes. Recently published midline results from the RCT show that learning at Bridge PSL public schools in a single year is equivalent to over 2 years of schooling at traditional public schools. This corroborates the findings in our study, which point to learning gains equivalent to almost 3 years of English instruction and nearly 2 years of math instruction at traditional public schools.

While both studies provide strong evidence that Bridge PSL is driving large learning gains in Liberia, the magnitude of the estimated effect sizes differ. This is to be expected given the differences in the studies' main purpose and research design.

First, the RCT had a better control group. The best counterfactual for the 6 Bridge PSL public schools would have been their matched control schools in the randomized evaluation. However, to avoid possible contamination of the randomized study, we used counterfactual schools assigned to us by the same team at CGD and IPA using principal component analysis.

Second, we only assessed students who were at the school on the days of our visit. While sample attrition appears to be similar between Bridge and traditional schools, our estimate focuses on students in the same school, for the full year. Due to time and financial constraints, we did not attempt to locate or assess students who were not present on our assessment day. The RCT on the other hand, tracked students to another school or home if they were not found at the school they attended the previous year.⁷⁰

Finally, the student assessment tools and grade levels differ. The RCT assesses students from the 1st through the 6th grade. Our study assesses students in Kindergarten through the 3rd grade. The RCT assessments examine a wider range of skills. On English, for example, the RCT assessments also measured object identification, letter name identification, and listening comprehension. The RCT math assessments included concepts such as fractions, multiplication, and division. Finally, item difficulty on the RCT assessments was not constant, but increased or decreased depending upon whether the student answered the previous items correctly.

Even with these differences, the results are roughly comparable: According to the RCT, one year at Bridge PSL is equivalent to over two years at traditional public schools.⁷¹ In our study, one year at Bridge PSL is equivalent to almost two years of math and three years of English at traditional public schools.

⁷⁰ This study starts with a sample of students attending each school in the first few weeks of class. The RCT study starts by sampling students from each school's enrolment roster from the previous year, regardless of if the student actually attends the school this year. They do this in order to perform an "Intention-to-Treat" (ITT) analysis, which ensures that the selection of students moving in or out of PSL schools in response to the program does not drive differences in learning outcomes between the treatment and control schools. However, this means that the ITT results combine outcomes for both those students who benefited from Bridge PSL and those that never attended, which can reduce the magnitude of an effective intervention. As such, the RCT also presents the "Treatment-on-the-Treated" (ToT) results, which focuses in on students who attended Bridge PSL. As expected, the magnitude of the ToT estimate is larger, and can be thought of the impact of Bridge PSL for students who actually attended Bridge PSL.

⁷¹ In the RCT, the Bridge PSL treatment-on-the-treated impact estimate, which considers only those students who attended Bridge PSL and is therefore closer to what our study measures, is approximately 0.37 standard deviations. An effect size of 0.18 standard deviations is equivalent to 60% more schooling in the RCT. The effect size of 0.37 standard deviations is therefore equivalent to 123% more schooling. Put differently, one year at Bridge PSL is the same as 2.23 years at a traditional public school.

10. Reflections and the Road Forward

The results from this study are encouraging. Learning is happening across Bridge PSL public schools in Liberia – gains made in a single academic year are equivalent to almost 3 years of English instruction and nearly 2 years of math instruction at traditional public schools. Non-readers were transformed into emergent readers. The number of proficient early grade readers doubled.

Yet, there is more work to do.

For Bridge, it means continuing to equip every student with the skills they need to succeed in upper primary and beyond, starting with reading fluency. With many of its students lacking even the most basic building blocks towards literacy, getting these students to fluency is going to take continuous innovation and more than one school year.

For the PSL program more broadly, it means staying bold in its reform movement while simultaneously adapting the program to ensure sustainability and success. Providers were asked to institute several evidence-based reforms to drive improvements in student learning, such as longer school days⁷², data-driven instruction and student tracking⁷³, and the implementation of performance management systems via the monitoring and support of teachers.⁷⁴

These reforms have had some early successes. Students spend more hours every day in school. Data collected is utilized to track student performance, ensure lessons are taught at the right level, and hold operators accountable to results. Management systems are increasing the probability that a teacher is present in the classroom, teaching, and teaching well. The successful implementation of these features has led to a large impact on student learning outcomes.⁷⁵ Many aspects of the Bridge approach align closely with the policy reforms of the PSL program, and this study has demonstrated the positive results.

Of course, such ambitious shifts in policy do not come without significant challenges as well. We must do our part to learn from these challenges and turn them into opportunities for policy change.

The longer school day alone surfaced two critical issues. Government supported lunch programs, for example, may encourage attendance throughout the day, and ensure students can more fully reap the

“Public private partnership in education holds a strong promise for sustainable development in Liberia. Within a relatively short period, the Partnership Schools for Liberia – a unique example of public private partnership – has made significant gains in the way public education is managed and is poised to narrow the gap in access to quality education across Liberia.”

~ Marcus Wleh
Bridge PSL Country Director

⁷² A study analyzing effective policies of the most successful New York City charter schools found that higher achieving charter schools had both longer school days and a longer instructional year (Dobbie et al. 2012). Similarly, a quasi-experimental study found that students exposed to full school days had higher test scores than students who attended schools for a half a day, particularly in poorer and more remote schools (Hincapie 2016).

⁷³ As part of the agreement with the Ministry of Education, PSL partners also worked toward consistently updating the Ministry of Education with status on student outcomes and key performance indicators related to school operations. Numerous studies have shown how teaching at the right level can have large impacts on student performance. And, it has been shown that higher achieving schools use data more intensely, precisely because this data helps inform instruction (Dobbie et al. 2012).

⁷⁴ Liberia’s teacher absenteeism is estimated to be as high as 60%. Through the PSL system, private operators gained limited authority to reassign teachers and generate accountability through monitoring and support. (Romero et al. 2017). Increased monitoring of teachers has been shown to ensure teachers show up to school and increase the chance that learning is happening in the classroom. Duflo et al. (2012) found that increased monitoring of teachers using video cameras and incentives related to teacher pay was able to decrease teacher absenteeism by 21%. This decrease in absenteeism led to an increase in student test scores by 0.17 standard deviations. This coupled with a management shifts that identifies struggling teachers and provides feedback could lead to increases in performance. Dobbie et al. (2012) find that teachers at high achieving charter elementary schools receive around 50% more feedback than teachers at lower performing charter elementary schools.

⁷⁵ See “Ministry of Education Welcomes Publication of PSL Providers’ Mid-Line Assessments,” 3rd July 2017. <http://moe.gov.lr/news/page/3/>.

benefits of a longer school day.⁷⁶ And, a strong school culture and effective management become even more critical when teachers are asked to teach longer hours without a change in compensation. A difficulty for Bridge PSL public schools throughout the year was that while the PSL program encouraged a longer day, and Bridge PSL delivered on this policy recommendation, the MoE has not called for this change in public school timetables more widely across the country. Consequently, while the Civil Service Administration states that all CSA employees, of which teachers are one category, will work 8 hours per day, teachers in practice have been allowed to work only half that while collecting full pay. Changing teacher behavior both in the PSL public school program and in traditional public schools across the country will require stronger MoE leadership.

Data on student performance can be both more informative and more efficient through the development of standardized exams and a common assessment system. Each PSL operator worked to use student assessments to inform instruction, but there was no standardized set of tools that all providers could use to measure student progress. Even as four operators in the PSL program voluntarily used EGRA and EGMA, the selection of subtasks and even the exact assessment varied, limiting comparisons. Furthermore, as learning builds upon learning, these tools to measure basic literacy and numeracy will be insufficient to understand progress towards higher order skills and content knowledge of subjects such as Social Studies and Science. This demonstrates the need for a common assessment system, which can jointly hold both PSL public schools (and therefore providers) and traditional public schools accountable on learning outcomes.

System level improvements are also critical on the teacher side. Current performance management systems fall short on measuring teacher quality in a rigorous manner, and therefore limit further learning and policy prescriptions. These systems can do even more to drive learning outcomes when teacher value-added estimates are developed. These measures offer a way to quantify teachers' contributions to learning, and variations in teacher quality can be explored to learn from the best and support those who are struggling. Teacher quality measures are a perfect complement to both a common assessment system and the Ministry's existing initiative to revamp payroll and remove ghost teachers. This information will provide the Ministry with the evidence it needs to make good on its commitment to the children of Liberia: employ truly qualified, not just certified, teachers to help them learn, and ensure teaching continues day-after-day, starting with payroll verification upon assignment.

Finally, we call upon donors to support the Ministry's goals of increasing enrollment while ensuring that learning is still happening in each classroom. Bridge PSL public schools were required to cap enrollment at 55 students per grade level; other operators were encouraged but not mandated to limit enrollment to 65 students per grade level. Unfortunately, over-demand for Bridge PSL public schools coupled with insufficient numbers of classrooms resulted in some students not being able to benefit from the program. Going forward, we hope that donors will partner with the Ministry and PSL operators to build more classrooms in areas with high-demand. That will allow Bridge PSL to continue implementing an important Ministry reform and ensure a productive learning environment for all students in the community. Until then, Bridge is faced with two bad options – operate a public school and make learning happen, but in some cases, not for all students it wishes to serve, or, do not operate a public school and leave all students in an ineffective system.

As the PSL program embarks on its second year, we hope to draw from our varied experiences in the education sector and support the path towards reform. As Minister Werner says, “We hold the dreams and aspirations of this new generation in our hands, and it is our responsibility to ensure that they have every opportunity to succeed.”

⁷⁶ Further research is warranted on the impact of free-lunch programs on student attendance. Within the 25 Bridge PSL public schools, there was no difference in student attendance rates at schools with feeding programs compared to those without. On the other hand, our attrition analysis for this study shows that students who had more meals were less likely to be absent on the day of assessments.

Appendix

A1. Details on the MoE Training

On June 6, 2017, the M&E team led a capacity building workshop with six Regional M&E Officers, two Central M&E Officers, and a Central Instructional Design Officer. These sessions provided detailed information on our assessments and how we utilize collected data to measure our impact. Specifically, the training session covered:

- The design of our study and difference-in-difference methodology
- The importance of randomization and how to select students in an unbiased manner
- Detailed information on EGRA/EGMA subtasks and importance of each subtask
- School surveys and electronic data collection

A2. Field Work Monitoring

To ensure that data collection occurred as scheduled and that the field team was conducting enough assessments in each of the 12 schools, the M&E team established a number of processes to monitor daily progress.

Student Assessment Lists

The M&E team created student assessment lists for each school and grade. Field team leaders were responsible for completing these during their visits to each school. The assessment lists aimed to capture information such as: date of the assessment, beginning and end times of the assessment, student's unique randomly generated Tangerine ID, assessor's name, student's full name, and student's gender. This information was then used to a) cross-check that data have not been falsified, b) match students, and c) identify schools that the field team needed to re-visit.

Daily Data Downloads

Data was downloaded from Tangerine each day during data collection in the evening. These downloads were also backed up. The M&E team used this data to check on which schools had or had not yet been visited.

Student Counts

Using the daily data downloads, the M&E team calculated the number of completed assessments at each school to determine student counts. Once these student counts had been tallied, short reports were sent to each field team to identify outstanding issues (i.e. missing data in Tangerine – schools scheduled to be visited had no assessments, student shortfalls in schools already visited, etc.).

A3. Student Characteristics

A3.1 Description of Information Collected

Age

Each student was asked how old he or she is. Self-reported ages ranged from 0 to 24. We also included an “answer extremely unlikely” option for students whose stated ages were unlikely to be correct. 10% of ages were noted as unlikely by our assessors.

Gender

Each assessor was asked to record the gender of the student being assessed.

School Attended Last Year

Each student was asked if he or she went to “this school last year”. If the student responded no, the assessor asked “did you go to school last year?” and recorded the name of the school down if the student said yes and could provide it.

ECE Attendance

Depending on the grade of the student being tested, students were asked if (1) they had attended Beginner class, (2) if they had attended Nursery class, and (3) if they had attended Kindergarten. Students in Nursery class, for instance, were not asked if they had attended Kindergarten.

- *% Attended 1+ Year of ECE*: If students attended Beginner, Nursery, or Kindergarten (or any combination of these), they were counted as having attended at least one year of ECE and included in this percentage.
- *If Attended ECE, # of Years*: Recorded as one year per ECE grade level the student reported to have attended.

An important caveat is that there may be errors in self-reported information (rather than actual differences between groups). Students may not remember whether they attended a particular ECE class the further away they are from that time period in their lives. Alternatively, older students may be more likely to state that they attended ECE even when they did not, due to their interest in providing a socially desirable response.

Language Spoken at Home

Students were asked to specify the languages that they speak at home. We provided a list of languages most commonly spoken in Liberia, as well as English. From these responses, we were able to calculate the following:

- % Speak English at Home

Meals

Students were asked three different questions about the meals that they had eaten both the day prior to and the day on which they were assessed. We then measured the following:

- % Ate Lunch Day Before
- % Ate Dinner Day Before
- % Ate Breakfast Morning of Assessment

Reading at Home

Students were asked if someone read with them at home, and if so, who (e.g., mother, father, grandparent, etc.). We used student responses to calculate the following:

- % Someone Reads at Home
- If Someone Reads, % Mother or Father

Homework Assistance

Students were asked if someone assisted them with their homework, and if so, whom (e.g., mother, father, grandparent, etc.). Student responses were used to calculate the following:

- % Someone Helps with Homework
- If Someone Helps, % Mother or Father

Cellphone

Students were asked if anyone has a cellphone in his or her home. Student responses were used to calculate the variable “% Has Cellphone”

Radio

Students were asked a series of questions about radios: (1) did the student have a radio in his or her home, (2) did the student listen to the radio, and (3) if so, who did the student listen to the radio with (e.g., mother, father, uncle, grandparent, and/or friend). Student responses were used to calculate the following:

- % Has Radio
- % Listens to Radio
- % Listens to Radio, % with Mother or Father

Television

Students were asked a series of questions about televisions, including the following: (1) did the student have a TV in his or her home, (2) did the student watch TV, and (3) if so, who did the student listen to the TV with (e.g., mother, father, uncle, grandparent, and/or friend).

- % Has TV
- % Watches TV
- If Watches TV, % with Mother or Father

Electricity

Students were asked if they have electricity in their homes (this was then used to calculate the variable “% Has Electricity”).

Asset Index

We calculated an “asset” index by adding the “has cellphone,” “has radio,” and “has television” at home variables together and dividing by three.

School Activities with Parents Index

We calculated a “school activity with parents” index by adding the “does homework with parents” and “reads with parents” variables together and dividing by two.

Other Activities with Parents Index

We calculated the “other activity with parents” index by adding the “watches TV with parent” and “listens to radio with parents” variables together and dividing by two.

A3.2 Baseline Student Characteristics

The following table shows the demographic data by school type with data from all students assessed at baseline.

Table 34. Student Characteristics at Baselines, All Baseline Students

	Bridge PSL Public Schools	Traditional Public Schools	Difference
Count	406	438	
Demographics			
Mean Age	10.87	11.53	-0.66**
% Female	48%	46%	2%
Grade Level Breakdown			
Kindergarten	20%	29%	-9%**
Grade 1	24%	27%	-3%
Grade 2	27%	21%	6%+
Grade 3	29%	23%	6%+
Education History			
Attended School Last Year	90%	89%	1%
% Attended Any ECE	98%	100%	-2%*
Years of ECE	2.39	2.70	-0.31**
% Attended Beginner	81%	87%	-6%*
% Attended Nursery	74%	87%	-13%**
% Attended Kindergarten	85%	96%	-11%**
Meals			
% With No Meals	2%	1%	1%
Average # of Meals	2.17	2.22	-0.05
% Who Had Breakfast	64%	60%	4%
% Who Had Lunch	92%	94%	-2%
% Who Had Dinner	62%	68%	-6%*
Assets			
% Has Radio	67%	69%	-2%
% Has Television	28%	27%	1%
% Has Electricity	30%	26%	4%
% Has Cellphone	85%	87%	-2%
Language Exposure			
% Speaks English at Home	66%	68%	-2%
% Listens to Radio	55%	58%	-3%
% Watches TV	48%	52%	-4%
Parent Involvement			
% Receive Homework Help	62%	74%	-12%**
If Give Help, % by Parent	18%	16%	2%
% Reads Out Loud with Parent	41%	43%	-2%
% Are Read To	48%	52%	-4%
If Read To, % by Parent	14%	16%	-2%
If Listens to Radio, % with Parent	37%	43%	-6%+
If Watches TV, % with Parent	20%	24%	-4%

** p<0.01, * p<0.05, + p<0.1

A4. School Selection - Principal Component Analysis

The independent evaluation team used the following variables from the MoE’s EMIS dataset to determine appropriate control schools for each of the Bridge PSL public schools in our study. Bridge does not currently have access to this information by school. We have made a formal request for the data and plan to include it in following reports should the request be approved.

Variables Analyzed:

- Teachers per student
- Classrooms per student
- Chairs per student
- Desks per student
- Benches per student
- Chalkboards per student
- Books per student
- A dummy for "solid building"
- A dummy for "piped water"
- A dummy for "well"
- A dummy for "toilet"
- A dummy for "staff room"
- A dummy for generator
- Number of students

A5. Becoming Bridge PSL Public Schools

The process of Bridge's entry into Liberia schools spanned 6 months, from April 2016 to September 2016.

1. **School Visits:** Developing the Bridge model in Liberia began in April 2016, when Bridge staff members with the support of Ministry officials visited over 140 schools across 9 counties to meet teachers and identify plausible sites to begin operations.
2. **Vetting School Personnel:** In June and July 2016, Bridge staff deployed Ministry-approved vetting tools to identify which teachers were present at schools, which were absent, and which were likely to struggle with teaching students due to limited literacy and numeracy skills.
3. **Talent Identification:** Bridge staff also deployed the same vetting tools to identify young graduates of the Rural Teacher Training Institutes (RTTIs) in Liberia, who could take the place of absent teachers in Bridge PSL public schools.
4. **School Selection:** The MoE authorized the independent evaluation team of the greater PSL public schools program to randomly select 23 public schools to become Bridge PSL public schools across 8 counties in mid July 2016 (and therefore in the treatment group of the PSL public schools Randomized Control Trial), and one additional school to serve as a "demonstration school" in Monrovia for a total of 24 Bridge PSL public schools.[1] At the request of the Chair of the Senate Education Committee, one additional Bridge PSL public school opened in mid-November, also outside of the treatment group, bringing the total count of Bridge PSL public schools to 25.
5. **Training:** In August 2016, Bridge conducted a 13-day pre-service training of over 330 teachers who had passed these vetting tests. Bridge training is based more on practice and data-driven interventions than on pedagogical theory; Bridge focuses how to use its specific resources and to focus on its "Big 4 ideas about Bridge Teaching." Those ideas are:
 - a. Follow the lessons and sequence developed by Bridge's resource development team.
 - b. Check on every student's performance.
 - c. Respond with clear written feedback, every time.
 - d. Motivate all students to behave and try hard.

6. **Assets to Support Learning:** Bridge delivered over 29,000 textbooks, 435 student e-readers, 259 teacher computers, and 9,000 student uniforms to schools.

7. **Placement Tests:** The most rigorous research in education to date has shown that teaching at the right level produces the largest gains in learning outcomes for students.⁷⁷ In keeping with this research, in late August 2016, teachers returned to schools and welcomed back students from previous years with placement assessments. These assessments were designed to identify the correct grade level for each child, based on their reading ability and their age. In accordance with Bridge’s agreement with the Ministry of Education (and also with Bridge’s own strong beliefs), placement tests are never used to reject children from school, but rather to place them in a grade that will serve them best.

8. **First Day and Onward:** On September 5, 2016, Bridge PSL public schools in Liberia opened their doors to students for the first day of lessons.

a. In all 25 Bridge PSL public schools, lessons are to run from 8:00-3:15 pm, with teachers arriving by 7:30 am to “sync” their Teacher Computers and prepare their classrooms and lessons for the day ahead.

b. The Bridge PSL public school is a place of focused, happy learning. Teacher guides and textbooks, developed in tandem for every instructional period of every day for every grade, are designed to shift away from rote lecture (the status quo in most Liberian schools, and schools across much of Africa) and towards opportunities for students to engage in independent and group practice, and to do the “heavy lifting” that generates thinking and learning.

A6. Randomization Strategy

To ensure that our samples are randomized in a way that takes into account gender proportions for given classes, field team leaders followed the six steps detailed below.

The most important numbers to keep in mind for this sampling strategy are the **interval** by which students will be selected and the **percentages of girls and boys**.

1. **Separate Students by Gender:** Ask students to form two lines – one line for boys and one line for girls. If there are multiple streams for a class, collect *all* students and separate them out by boys and girls.

2. **Determine the Total Number of Students for the Class:** Count the number of girls and the number of boys to find the total number of students. Example:

Number of Girls = 5

Number of Boys = 10

Number of Girls + Number of Boys = 5 + 10 = 15

We have a total of 15 students in the class we are assessing.

3. **Calculate the Target Interval Number:** Take the **total number of students** and divide it by the target number of students. Example:

⁷⁷ Two examples are: Banerjee et al. (2013) and Duflo et al. (2011).

Total number of students = 15

Target sample number = 5

$$\frac{\text{Total Number of Students}}{\text{Target Sample Number}} = \frac{15}{5} = 3$$

Based on the equation above, we find that our **target interval number** is 3.

4. **Calculate the Gender Ratios:** Calculate the ratio of girls to the total number of students and the ratio of boys to the total number of students in the class being assessed. To determine the ratio of girls, divide the number of girls in the class by the total number of students.

$$\frac{\text{Number of Girls}}{\text{Total Number of Students}} = \frac{5}{15} = \frac{1}{3} \rightarrow \text{Ratio of Girls} = \frac{1}{3}$$

$$\frac{\text{Number of Boys}}{\text{Total Number of Students}} = \frac{10}{15} = \frac{2}{3} \rightarrow \text{Ratio of Boys} = \frac{2}{3}$$

5. **Calculate Number of Boys and Girls Required for the Sample:** Multiply the ratios found in step 4 by the target sample number to determine exactly how many girls and how many boys should be in the final sample. If the calculation yields a decimal, keep the following in mind: if the decimal is less than 0.5, round down. If the decimal is 0.5 or higher, round up. Example:

Girls: Multiply the ratio of girls ($\frac{1}{3}$) by the target sample number (5).

So: $(\frac{1}{3}) * 5 = 1.7$. We should have 2 girls in our final sample.

Boys: Multiply the ratio of boys ($\frac{2}{3}$), by the target sample number (5).

So: $(\frac{2}{3}) * 5 = 3.3$. We should have 3 boys in our sample.

6. **Identify the Students for the Sample:** Use the interval to separately identify the girls and boys who will be in the sample and be assessed. See the tables below for which students would be selected, based on our calculations in steps 1 through 5. Our interval number was 3, so count every third girl and third boy. For the girls, once you've reached the fifth girl (who would be 2), start back at the top.

Random Selection - Example

Girls

G	2nd Selected Girl
G	
G	1st Selected Girl
G	
G	

Boys

B	
B	
B	1st Selected Boy
B	
B	
B	2nd Selected Boy
B	
B	
B	3rd Selected Boy
B	

A7. Difference-in-Differences Regressions

A7.1 DiD Regressions Controlling for Baseline Scores Only

Table 35. EGRA Raw Scores Baseline Controls

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	20.29** (2.68)	0.06+ (0.03)	1.58** (0.39)	8.62** (1.10)	12.07** (2.47)	0.10** (0.03)
Student in Grade 1	0.44 (2.77)	0.08+ (0.04)	0.63 (0.48)	4.27** (1.12)		
Student in Grade 2	-0.92 (3.07)	0.14** (0.03)	1.36* (0.53)	3.06+ (1.61)	0.02 (2.65)	0.09** (0.03)
Student in Grade 3			0.02 (0.40)	3.11* (1.45)	0.17 (4.17)	0.11** (0.03)
Baseline Task Score	1.26* (0.61)	0.09 (0.32)	3.71** (0.90)	1.78** (0.32)	2.97** (0.55)	0.79+ (0.45)
Baseline Task Score ^2	0.03 (0.03)	-0.20 (1.25)	-0.71** (0.24)	-0.02 (0.03)	-0.05 (0.03)	-0.62 (1.84)
Baseline Task Score ^3	0.00+ (0.00)	0.53 (1.18)	0.05* (0.02)	0.00 (0.00)	0.00 (0.00)	1.00 (1.64)
Constant	2.34 (1.41)	0.28** (0.03)	0.18 (0.26)	0.30 (0.70)	3.87** (1.38)	0.02 (0.01)
Count	445	445	594	589	451	452
R-squared	0.54	0.13	0.25	0.60	0.50	0.24

Table 36. EGRA Standardized Scores Baseline Controls

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	3.14** (0.42)	0.25+ (0.12)	1.32** (0.33)	1.26** (0.16)	1.40** (0.29)	1.16** (0.31)
Student in Grade 1	0.07 (0.43)	0.33+ (0.18)	0.53 (0.40)	0.63** (0.16)		
Student in Grade 2	-0.14 (0.48)	0.60** (0.13)	1.14* (0.44)	0.45+ (0.24)	0.00 (0.31)	1.10** (0.34)
Student in Grade 3			0.01 (0.34)	0.46* (0.21)	0.02 (0.48)	1.33** (0.40)
Baseline Task Score	1.37** (0.49)	0.09 (0.10)	3.70** (0.90)	1.59** (0.16)	2.50** (0.31)	0.76* (0.36)
Baseline Task Score ^2	0.17 (0.20)	0.04 (0.10)	-0.85** (0.29)	-0.12 (0.14)	-0.36+ (0.21)	-0.05 (0.15)
Baseline Task Score ^3	-0.03+ (0.02)	0.03 (0.06)	0.06* (0.02)	0.02 (0.03)	0.02 (0.03)	0.01 (0.01)
Constant	0.46 (0.28)	0.31+ (0.16)	0.16 (0.21)	0.50** (0.16)	1.51** (0.33)	0.17 (0.21)
Count	445	445	594	589	451	452
R-squared	0.54	0.13	0.25	0.60	0.50	0.24

Table 37. EGMA Raw Scores Baseline Controls⁷⁸

	(7) One to One Corresp.* KG	(8) Number Id.* KG-G1	(9) Quantity Disc. KG-G2	(10) Addition 1 KG-G3	(11) Addition 2* G2-G3	(12) Subtraction 1 G1-G3	(13) Subtraction 2* G2-G3	(14) Word Problems G1-G3
Bridge	4.54 (5.04)	5.00** (0.85)	0.11** (0.02)	3.36** (0.34)	0.09* (0.04)	1.63** (0.46)	0.07 (0.04)	0.05* (0.02)
Student in Grade 1		2.69** (0.74)	0.04 (0.03)	0.91+ (0.45)				
Student in Grade 2			0.03 (0.04)	2.13** (0.55)		0.20 (0.62)		0.07* (0.03)
Student in Grade 3				3.42** (0.69)	0.07+ (0.04)	0.27 (0.46)	0.09* (0.04)	0.04+ (0.02)
Baseline Task Score	0.55 (1.06)	1.08** (0.09)	1.53** (0.42)	0.80** (0.25)	1.03** (0.36)	0.64* (0.27)	1.26** (0.40)	0.77** (0.21)
Baseline Task Score ^2	0.00 (0.03)	-0.01** (0.00)	-1.37 (0.95)	0.01 (0.03)	-1.16 (0.89)	0.00 (0.03)	-2.41* (1.09)	-0.52 (0.50)
Baseline Task Score ^3	0.00 (0.00)	0.00** (0.00)	0.48 (0.57)	0.00 (0.00)	0.51 (0.60)	0.00 (0.00)	1.57+ (0.76)	0.24 (0.36)
Constant	34.21* (10.91)	5.60** (0.90)	0.23** (0.04)	2.47** (0.42)	0.27** (0.05)	4.19** (0.75)	0.20** (0.05)	0.25** (0.03)
Count	143	305	445	593	288	449	287	450
R-squared	0.08	0.52	0.52	0.53	0.19	0.18	0.15	0.32

Table 38. EGMA Standardized Scores Baseline Controls⁷⁹

	(7) One to One Corresp.* KG	(8) Number Id.* KG-G1	(9) Quantity Disc. KG-G2	(10) Addition 1 KG-G3	(11) Addition 2* G2-G3	(12) Subtraction 1 G1-G3	(13) Subtraction 2* G2-G3	(14) Word Problems G1-G3
Bridge	0.14 (0.15)	0.29** (0.05)	0.34** (0.08)	0.76** (0.08)	0.30* (0.13)	0.39** (0.11)	0.26 (0.16)	0.18* (0.08)
Student in Grade 1		0.15** (0.04)	0.14 (0.11)	0.21+ (0.10)				
Student in Grade 2			0.09 (0.13)	0.48** (0.13)		0.05 (0.15)		0.25* (0.10)
Student in Grade 3				0.77** (0.16)	0.23+ (0.13)	0.07 (0.11)	0.35* (0.17)	0.16+ (0.09)
Baseline Task Score	0.34 (0.31)	0.89** (0.08)	0.68** (0.09)	0.86** (0.08)	0.37** (0.11)	0.63** (0.07)	0.32** (0.07)	0.45** (0.07)
Baseline Task Score ^2	-0.09 (0.18)	-0.16** (0.02)	-0.25** (0.09)	0.00 (0.09)	-0.17* (0.07)	-0.01 (0.10)	-0.31* (0.14)	-0.05 (0.03)
Baseline Task Score ^3	-0.01 (0.19)	0.01** (0.00)	0.05 (0.05)	-0.02 (0.01)	0.04 (0.05)	-0.01 (0.01)	0.11+ (0.05)	0.02 (0.02)
Constant	0.33+ (0.17)	0.31** (0.04)	0.82** (0.11)	0.37** (0.10)	0.47** (0.13)	0.60** (0.13)	0.50* (0.24)	0.23* (0.09)
Count	143	305	445	593	288	449	287	450
R-squared	0.08	0.52	0.52	0.53	0.19	0.18	0.15	0.32

⁷⁸ Note that we cannot actually detect accurate statistical significance on the One-to-One Correspondence, Number Identification, Addition 2, and Subtraction 2 subtasks because not enough grade levels took these assessments.

⁷⁹ Note that we cannot actually detect accurate statistical significance on the One-to-One Correspondence, Number Identification, Addition 2, and Subtraction 2 subtasks because not enough grade levels took these assessments.

A7.2 DiD Regressions Controlling for Baseline Scores and Student Characteristics

Table 39. EGRA Raw Scores Baseline Controls and Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	21.51** (2.45)	0.07* (0.03)	1.49** (0.41)	9.14** (1.17)	12.64** (2.56)	0.10** (0.03)
Student in Grade 1	-1.64 (2.31)	0.07 (0.04)	0.76 (0.53)	3.73** (1.31)		
Student in Grade 2	-3.29 (3.21)	0.12** (0.04)	1.76* (0.69)	2.77 (1.87)	0.53 (2.93)	0.09** (0.03)
Student in Grade 3			0.30 (0.56)	2.44 (1.53)	1.98 (3.39)	0.14** (0.03)
Baseline Task Score	0.90 (0.60)	-0.08 (0.36)	3.44** (0.95)	1.90** (0.32)	2.86** (0.58)	0.60 (0.45)
Baseline Task Score ^2	0.05 (0.03)	0.31 (1.40)	-0.65** (0.23)	-0.04 (0.03)	-0.04 (0.03)	0.35 (1.81)
Baseline Task Score ^3	0.00* (0.00)	0.11 (1.32)	0.04* (0.02)	0.00 (0.00)	0.00 (0.00)	0.01 (1.63)
Age	0.65+ (0.38)	0.01 (0.01)	-0.04 (0.08)	-0.16 (0.19)	-0.84* (0.39)	-0.01* (0.01)
Female	-1.50 (1.34)	0.00 (0.02)	-0.63* (0.31)	-0.25 (0.98)	-1.00 (1.79)	-0.04* (0.02)
Attended School Last Year	-0.20 (2.00)	-0.07+ (0.04)	0.26 (0.70)	-0.20 (1.82)	-1.48 (3.31)	-0.03 (0.05)
Has Electricity	0.44 (1.41)	0.03 (0.02)	-0.09 (0.30)	-0.93 (0.96)	-4.74+ (2.45)	-0.02 (0.02)
Years of ECE	2.00* (0.98)	0.00 (0.02)	0.08 (0.20)	0.86+ (0.45)	1.69 (1.40)	0.03+ (0.02)
Meal Count	0.43 (0.82)	0.01 (0.01)	0.22 (0.19)	0.63 (0.47)	1.89 (1.23)	0.01 (0.01)
Reads Aloud at Home	0.21 (1.00)	0.01 (0.02)	-0.36 (0.29)	0.48 (0.75)	1.55 (1.65)	-0.02 (0.02)
Asset Index	-5.31 (3.39)	-0.02 (0.05)	-0.30 (0.75)	-0.71 (1.93)	2.87 (4.16)	0.06 (0.04)
School Activity with Parent Index	1.97 (2.05)	0.05 (0.04)	0.49 (0.61)	-1.21 (1.13)	-0.51 (2.30)	0.04 (0.03)
Other Activity with Parent Index	0.32 (1.36)	0.00 (0.04)	-0.08 (0.58)	0.92 (1.31)	-0.82 (3.69)	-0.01 (0.04)
Speaks English at Home	-3.75+ (1.93)	-0.02 (0.02)	-0.55 (0.43)	0.38 (0.96)	0.04 (1.80)	-0.01 (0.02)
Constant	-3.11 (4.26)	0.28** (0.09)	0.61 (1.36)	-0.54 (3.26)	6.00 (8.46)	0.11 (0.12)
Count	417	417	564	559	437	438
R-squared	0.58	0.15	0.27	0.60	0.52	0.28

Table 40. EGRA Standardized Scores Baseline Controls and Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	3.34** (0.38)	0.29* (0.13)	1.34** (0.32)	1.34** (0.17)	1.46** (0.30)	1.19** (0.35)
Student in Grade 1	-0.26 (0.36)	0.31 (0.20)	0.46 (0.42)	0.55** (0.19)		
Student in Grade 2	-0.51 (0.50)	0.53** (0.19)	1.21* (0.52)	0.41 (0.27)	0.06 (0.34)	1.09** (0.33)
Student in Grade 3			0.06 (0.43)	0.36 (0.22)	0.23 (0.39)	1.65** (0.38)
Baseline Task Score	1.07* (0.49)	0.09 (0.11)	3.07** (0.87)	1.60** (0.16)	2.41** (0.31)	0.62+ (0.36)
Baseline Task Score ^2	0.28 (0.20)	0.09 (0.12)	-0.74* (0.29)	-0.18 (0.14)	-0.35 (0.22)	0.03 (0.14)
Baseline Task Score ^3	-0.04* (0.02)	0.01 (0.07)	0.06* (0.03)	0.03 (0.03)	0.02 (0.03)	0.00 (0.01)
Age	0.10+ (0.06)	0.03 (0.03)	0.01 (0.06)	-0.02 (0.03)	-0.10* (0.05)	-0.16* (0.07)
Female	-0.23 (0.21)	0.01 (0.11)	-0.51+ (0.26)	-0.04 (0.14)	-0.12 (0.21)	-0.50* (0.21)
Attended School Last Year	-0.03 (0.31)	-0.31+ (0.18)	0.24 (0.60)	-0.03 (0.27)	-0.17 (0.38)	-0.34 (0.59)
Has Electricity	0.07 (0.22)	0.11 (0.10)	-0.08 (0.27)	-0.14 (0.14)	-0.55+ (0.28)	-0.29 (0.25)
Years of ECE	0.31* (0.15)	-0.01 (0.09)	0.06 (0.17)	0.13+ (0.07)	0.20 (0.16)	0.36+ (0.18)
Meal Count	0.07 (0.13)	0.04 (0.06)	0.15 (0.15)	0.09 (0.07)	0.22 (0.14)	0.07 (0.14)
Reads Aloud at Home	0.03 (0.16)	0.05 (0.09)	-0.28 (0.24)	0.07 (0.11)	0.18 (0.19)	-0.18 (0.22)
Asset Index	-0.82 (0.53)	-0.10 (0.24)	-0.12 (0.58)	-0.11 (0.28)	0.33 (0.48)	0.75 (0.48)
School Activity with Parent Index	0.31 (0.32)	0.21 (0.16)	0.51 (0.53)	-0.18 (0.17)	-0.06 (0.27)	0.42 (0.31)
Other Activity with Parent Index	0.05 (0.21)	0.00 (0.18)	-0.05 (0.49)	0.14 (0.19)	-0.09 (0.43)	-0.17 (0.45)
Speaks English at Home	-0.58+ (0.30)	-0.09 (0.09)	-0.46 (0.37)	0.06 (0.14)	0.00 (0.21)	-0.14 (0.27)
Constant	-0.49 (0.62)	0.21 (0.46)	0.48 (1.02)	0.42 (0.50)	1.70 (1.07)	1.15 (1.45)
Count	417	417	564	559	437	438
R-squared	0.58	0.15	0.27	0.60	0.52	0.28

Table 41. EGMA Raw Scores Baseline Controls and Characteristics ⁸⁰

	(7) One to One Corresp.* KG	(8) Number Id.* KG-G1	(9) Quantity Disc. KG-G2	(10) Addition 1 KG-G3	(11) Addition 2* G2-G3	(12) Subtraction 1 G1-G3	(13) Subtraction 2* G2-G3	(14) Word Problems G1-G3
Bridge	9.40+ (4.85)	4.54** (0.96)	0.11** (0.02)	3.70** (0.35)	0.08+ (0.04)	2.10** (0.41)	0.07 (0.05)	0.04 (0.02)
Student in Grade 1		3.54** (1.10)	0.04 (0.03)	0.40 (0.52)				
Student in Grade 2			0.03 (0.04)	1.27* (0.62)		-0.07 (0.63)		0.08** (0.03)
Student in Grade 3				2.73** (0.70)	0.08+ (0.04)	-0.25 (0.53)	0.12* (0.04)	0.06** (0.02)
Baseline Task Score	0.01 (1.18)	1.06** (0.10)	1.50** (0.45)	0.65* (0.25)	0.95** (0.31)	0.65* (0.28)	1.13** (0.40)	0.66** (0.21)
Baseline Task Score ^2	0.01 (0.03)	-0.01** (0.00)	-1.46 (1.02)	0.02 (0.03)	-1.15 (0.83)	0.00 (0.04)	-2.17+ (1.13)	-0.30 (0.49)
Baseline Task Score ^3	0.00 (0.00)	0.00** (0.00)	0.57 (0.61)	0.00 (0.00)	0.56 (0.60)	0.00 (0.00)	1.45+ (0.82)	0.13 (0.34)
Age	2.34+ (1.11)	-0.13 (0.23)	0.01+ (0.01)	0.21* (0.08)	-0.02 (0.01)	0.26* (0.09)	-0.01 (0.02)	-0.01 (0.01)
Female	4.21 (4.49)	-1.06 (0.81)	-0.06** (0.02)	-1.28** (0.40)	-0.03 (0.03)	-0.09 (0.61)	-0.03 (0.03)	-0.03 (0.02)
Attended School Last Year	6.00 (8.77)	-2.65 (1.90)	-0.05 (0.04)	-0.78 (0.86)	-0.09 (0.09)	-1.45* (0.53)	-0.13 (0.09)	-0.02 (0.05)
Has Electricity	11.42+ (5.24)	0.39 (1.12)	-0.02 (0.03)	-0.79 (0.51)	0.00 (0.05)	0.73 (0.88)	0.04 (0.04)	0.00 (0.03)
Years of ECE	-8.99 (6.37)	-0.55 (0.60)	0.00 (0.02)	0.21 (0.30)	0.01 (0.02)	0.18 (0.31)	0.01 (0.03)	-0.01 (0.01)
Meal Count	-0.25 (3.07)	0.03 (0.54)	-0.01 (0.01)	0.16 (0.19)	0.01 (0.03)	0.18 (0.27)	0.02 (0.03)	0.01 (0.01)
Reads Aloud at Home	-11.15 (7.57)	-0.82 (0.74)	-0.03 (0.02)	0.25 (0.31)	-0.02 (0.04)	0.34 (0.63)	0.01 (0.04)	-0.03 (0.02)
Asset Index	-11.04 (15.22)	-1.03 (1.90)	-0.03 (0.06)	0.67 (0.87)	0.24* (0.09)	-0.30 (0.96)	0.10 (0.09)	0.02 (0.04)
School Activity with Parent Index	6.17 (11.69)	1.38 (1.41)	0.04 (0.03)	0.48 (0.59)	-0.04 (0.05)	0.82 (0.89)	0.02 (0.07)	-0.01 (0.03)
Other Activity with Parent Index	-7.69 (7.83)	1.18 (1.35)	0.01 (0.03)	-0.52 (0.66)	-0.12+ (0.07)	0.28 (0.66)	-0.10 (0.07)	-0.01 (0.04)
Speaks English at Home	4.91 (4.56)	0.32 (0.86)	0.01 (0.03)	0.77+ (0.41)	-0.01 (0.05)	0.95+ (0.47)	0.01 (0.05)	0.03 (0.02)
Constant	33.94 (22.99)	10.90** (3.06)	0.24** (0.07)	0.61 (1.62)	0.46 (0.28)	0.56 (2.02)	0.25 (0.32)	0.36** (0.12)
Count	125	282	417	563	281	437	280	438
R-squared	0.15	0.53	0.54	0.55	0.22	0.20	0.18	0.32

⁸⁰ Note that we cannot actually detect accurate statistical significance on the One-to-One Correspondence, Number Identification, Addition 2, and Subtraction 2 subtasks because not enough grade levels took these assessments.

Table 42. EGMA Standardized Scores Baseline Controls and Characteristics⁸¹

	(7) One to One Corresp.* KG	(8) Number Id.* KG-G1	(9) Quantity Disc. KG-G2	(10) Addition 1 KG-G3	(11) Addition 2* G2-G3	(12) Subtraction 1 G1-G3	(13) Subtraction 2* G2-G3	(14) Word Problems G1-G3
Bridge	0.29+ (0.15)	0.26** (0.05)	0.37** (0.08)	0.84** (0.08)	0.29+ (0.15)	0.51** (0.10)	0.26 (0.21)	0.15 (0.09)
Student in Grade 1		0.20** (0.06)	0.13 (0.11)	0.09 (0.12)				
Student in Grade 2			0.08 (0.14)	0.29* (0.14)		-0.02 (0.15)		0.32** (0.10)
Student in Grade 3				0.62** (0.16)	0.26+ (0.13)	-0.06 (0.13)	0.44* (0.17)	0.24** (0.08)
Baseline Task Score	0.28 (0.34)	0.88** (0.09)	0.63** (0.09)	0.78** (0.06)	0.32** (0.11)	0.62** (0.06)	0.30** (0.08)	0.46** (0.06)
Baseline Task Score ^2	0.03 (0.18)	-0.15** (0.02)	-0.25* (0.10)	0.02 (0.09)	-0.15* (0.06)	-0.02 (0.11)	-0.27+ (0.14)	-0.03 (0.03)
Baseline Task Score ^3	-0.04 (0.21)	0.01** (0.00)	0.05 (0.06)	-0.02 (0.01)	0.05 (0.05)	-0.01 (0.01)	0.10+ (0.06)	0.01 (0.02)
Age	0.07+ (0.03)	-0.01 (0.01)	0.03+ (0.02)	0.05* (0.02)	-0.06 (0.05)	0.06* (0.02)	-0.02 (0.07)	-0.03 (0.02)
Female	0.13 (0.14)	-0.06 (0.05)	-0.19** (0.07)	-0.29** (0.09)	-0.11 (0.11)	-0.02 (0.15)	-0.11 (0.11)	-0.10 (0.08)
Attended School Last Year	0.18 (0.27)	-0.15 (0.11)	-0.16 (0.14)	-0.18 (0.19)	-0.30 (0.30)	-0.35* (0.13)	-0.51 (0.34)	-0.08 (0.18)
Has Electricity	0.35+ (0.16)	0.02 (0.06)	-0.06 (0.08)	-0.18 (0.12)	-0.01 (0.16)	0.18 (0.21)	0.16 (0.16)	0.01 (0.11)
Years of ECE	-0.27 (0.19)	-0.03 (0.03)	0.00 (0.06)	0.05 (0.07)	0.04 (0.07)	0.04 (0.08)	0.06 (0.11)	-0.03 (0.06)
Meal Count	-0.01 (0.09)	0.00 (0.03)	-0.02 (0.04)	0.04 (0.04)	0.05 (0.09)	0.04 (0.07)	0.08 (0.11)	0.04 (0.05)
Reads Aloud at Home	-0.34 (0.23)	-0.05 (0.04)	-0.09 (0.07)	0.06 (0.07)	-0.07 (0.13)	0.08 (0.15)	0.05 (0.16)	-0.11 (0.07)
Asset Index	-0.34 (0.46)	-0.06 (0.11)	-0.09 (0.19)	0.15 (0.20)	0.81* (0.29)	-0.07 (0.23)	0.39 (0.34)	0.06 (0.16)
School Activity with Parent Index	0.19 (0.36)	0.08 (0.08)	0.13 (0.11)	0.11 (0.13)	-0.13 (0.18)	0.20 (0.21)	0.09 (0.27)	-0.03 (0.12)
Other Activity with Parent Index	-0.24 (0.24)	0.07 (0.08)	0.02 (0.10)	-0.12 (0.15)	-0.40+ (0.23)	0.07 (0.16)	-0.40 (0.26)	-0.03 (0.15)
Speaks English at Home	0.15 (0.14)	0.02 (0.05)	0.04 (0.09)	0.17+ (0.09)	-0.03 (0.16)	0.23+ (0.12)	0.05 (0.21)	0.11 (0.08)
Constant	-0.03 (0.54)	0.61** (0.19)	0.81** (0.27)	-0.18 (0.43)	1.05 (0.93)	-0.28 (0.60)	0.64 (1.28)	0.58 (0.45)
Count	125	282	417	563	281	437	280	438
R-squared	0.15	0.53	0.54	0.55	0.22	0.20	0.18	0.32

⁸¹ Note that we cannot actually detect accurate statistical significance on the One-to-One Correspondence, Number Identification, Addition 2, and Subtraction 2 subtasks because not enough grade levels took these assessments.

A7.3 Standardized Difference-in-Differences, Data Collapsed at School Level

Table 43. EGRA School Level Difference-in-Differences, Standardized Scores

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	3.77** (0.66)	0.29+ (0.15)	1.04* (0.37)	0.94* (0.35)	0.86+ (0.45)	0.80+ (0.41)
Baseline Task Score	5.48 (9.41)	-0.45 (0.75)	13.42+ (6.89)	3.67* (1.11)	5.38* (1.70)	0.94 (2.86)
Baseline Task Score ^2	-5.86 (9.83)	-0.80 (0.84)	-2.10 (2.04)	-0.12 (1.90)	-1.80 (1.21)	0.50 (1.73)
Baseline Task Score ^3	0.92 (1.37)	0.66 (0.54)	0.06 (0.15)	-0.29 (0.55)	0.23 (0.20)	0.05 (0.17)
Constant	1.75 (3.34)	1.10 (0.59)	-0.05 (0.44)	1.51 (0.99)	2.51* (0.88)	0.34 (1.14)
Count	12	12	12	12	12	12
R-squared	0.89	0.62	0.79	0.85	0.85	0.77

Table 44. EGMA School Level Difference-in-Differences, Standardized Scores

	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	One to One Corresp.*	Number Id.*	Quantity Disc.	Addition 1	Addition 2*	Subtraction 1	Subtraction 2*	Word Problems
	KG	KG-G1	KG-G2	KG-G3	G2-G3	G1-G3	G2-G3	G1-G3
Bridge	0.29 (0.17)	0.41** (0.09)	0.34** (0.10)	0.85** (0.10)	0.27* (0.11)	0.26 (0.16)	0.10 (0.17)	0.25* (0.10)
Baseline Task Score	2.31* (0.87)	1.65** (0.37)	1.82* (0.70)	1.05** (0.24)	0.24 (0.38)	0.07 (0.30)	2.12* (0.69)	0.87 (0.74)
Baseline Task Score ^2	-0.89 (0.82)	-0.23+ (0.11)	-0.30 (0.36)	-0.47 (0.36)	-0.76* (0.27)	0.29 (0.49)	1.25 (0.84)	-0.40* (0.16)
Baseline Task Score ^3	-0.66 (0.53)	0.01 (0.01)	-0.40 (0.38)	0.09 (0.05)	0.07 (0.23)	-0.02 (0.05)	-1.04+ (0.45)	-0.05 (0.25)
Constant	1.49+ (0.61)	0.36** (0.06)	1.13** (0.28)	1.04** (0.30)	1.17** (0.24)	0.45 (0.42)	0.04 (0.53)	0.69** (0.16)
Count	10	11	12	12	12	12	12	12
R-squared	0.67	0.95	0.93	0.94	0.75	0.49	0.66	0.77

A7.4 Standardized Difference-in-Differences by Grade

Table 45. Kindergarten Simple Difference-in-Differences, Standardized Scores

Subtask	Bridge PSL Public School				Traditional Public School				Diff-n-Diff
	Count	Baseline	Endline	Diff	Count	Baseline	Endline	Diff	
		Mean	Mean			Mean	Mean		
Letter Sounds	53	-0.23	3.82	4.05	91	-0.26	-0.19	0.07	3.97
Onset Sounds	53	-0.26	0.53	0.79	91	-0.30	0.33	0.62	0.17
Non-Word Reading	53	-0.22	1.56	1.79	91	-0.15	-0.16	-0.01	1.79
Familiar Word Reading	53	-0.60	0.70	1.30	91	-0.56	-0.40	0.16	1.14
One to One Correspondence	53	-0.15	0.33	0.48	90	0.22	0.29	0.07	0.41
Number Identification	53	-0.36	0.20	0.55	91	0.05	0.24	0.19	0.36
Quantity Discrimination	53	-0.84	0.25	1.09	91	-0.40	0.37	0.76	0.33
Addition 1	53	-1.00	0.21	1.21	90	-0.44	0.04	0.49	0.72

Table 46. Grade 1 Simple Difference-in-Differences, Standardized Scores

Subtask	Bridge PSL Public School				Traditional Public School				Diff-n-Diff
	Count	Baseline	Endline	Diff	Count	Baseline	Endline	Diff	
		Mean	Mean			Mean	Mean		
Letter Sounds	69	-0.08	3.17	3.26	92	-0.05	0.80	0.85	2.41
Onset Sounds	69	0.16	1.00	0.84	92	-0.08	0.64	0.72	0.12
Non-Word Reading	69	-0.19	1.62	1.81	92	-0.20	0.70	0.90	0.91
Familiar Word Reading	69	-0.30	1.99	2.28	92	-0.40	0.36	0.75	1.53
Passage Fluency	69	-0.37	1.91	2.28	92	-0.48	0.18	0.65	1.62
Reading Comprehension	69	-0.22	1.28	1.50	92	-0.24	-0.12	0.13	1.37
Number Identification	69	0.27	0.83	0.56	92	0.18	0.56	0.38	0.18
Quantity Discrimination	69	0.18	1.34	1.16	92	0.25	0.82	0.58	0.59
Addition 1	69	-0.23	1.17	1.40	92	-0.05	0.50	0.55	0.85
Subtraction 1	69	-0.47	0.73	1.21	92	-0.34	0.34	0.69	0.52
Word Problems	69	-0.50	0.20	0.70	92	-0.36	-0.06	0.30	0.40

Table 47. Grade 2 Simple Difference-in-Differences, Standardized Scores

Subtask	Bridge PSL Public School				Traditional Public School				Diff-n-Diff
	Count	Baseline	Endline	Diff	Count	Baseline	Endline	Diff	
		Mean	Mean			Mean	Mean		
Letter Sounds	76	0.19	3.80	3.62	64	0.58	1.08	0.50	3.11
Onset Sounds	76	0.23	1.25	1.03	64	0.38	1.06	0.68	0.35
Non-Word Reading	79	0.20	3.45	3.24	67	0.31	1.35	1.04	2.21
Familiar Word Reading	76	0.24	2.48	2.24	67	0.27	1.31	1.05	1.19
Passage Fluency	79	0.17	2.77	2.60	67	-0.18	1.27	1.45	1.16
Reading Comprehension	79	0.04	2.51	2.47	67	-0.22	1.01	1.23	1.24
Quantity Discrimination	76	0.58	1.31	0.73	64	0.54	1.16	0.62	0.11
Addition 1	79	0.35	1.83	1.48	67	0.27	1.06	0.79	0.69
Addition 2	78	-0.16	0.57	0.74	67	-0.03	0.27	0.30	0.44
Subtraction 1	79	-0.04	1.08	1.13	67	0.21	0.68	0.47	0.66
Subtraction 2	78	-0.27	0.43	0.70	67	-0.04	0.22	0.26	0.44
Word Problems	79	0.13	0.65	0.52	67	0.09	0.53	0.45	0.07

Table 48. Grade 3 Simple Difference-in-Differences, Standardized Scores

Subtask	Bridge PSL Public School				Traditional Public School				Diff-n-Diff
	Count	Baseline	Endline	Diff	Count	Baseline	Endline	Diff	
		Mean	Mean			Mean	Mean		
Non-Word Reading	74	0.22	1.55	1.33	69	0.07	0.96	0.90	0.44
Familiar Word Reading	72	0.47	2.84	2.37	69	0.77	2.07	1.29	1.08
Passage Fluency	74	0.40	3.75	3.35	70	0.71	2.30	1.59	1.76
Reading Comprehension	74	0.41	2.76	2.35	71	0.44	2.00	1.56	0.80
Addition 1	74	0.55	2.37	1.82	69	0.62	1.63	1.01	0.80
Addition 2	74	0.14	0.88	0.74	69	0.13	0.63	0.50	0.24
Subtraction 1	74	0.53	1.16	0.63	68	0.53	1.12	0.59	0.04
Subtraction 2	74	0.21	0.91	0.70	68	0.19	0.76	0.57	0.13
Word Problems	74	0.37	0.67	0.30	69	0.28	0.54	0.26	0.05

A8. Yearly Growth in Subtasks by Grade

Figure 11. Yearly Growth on EGRA Subtasks by Grade

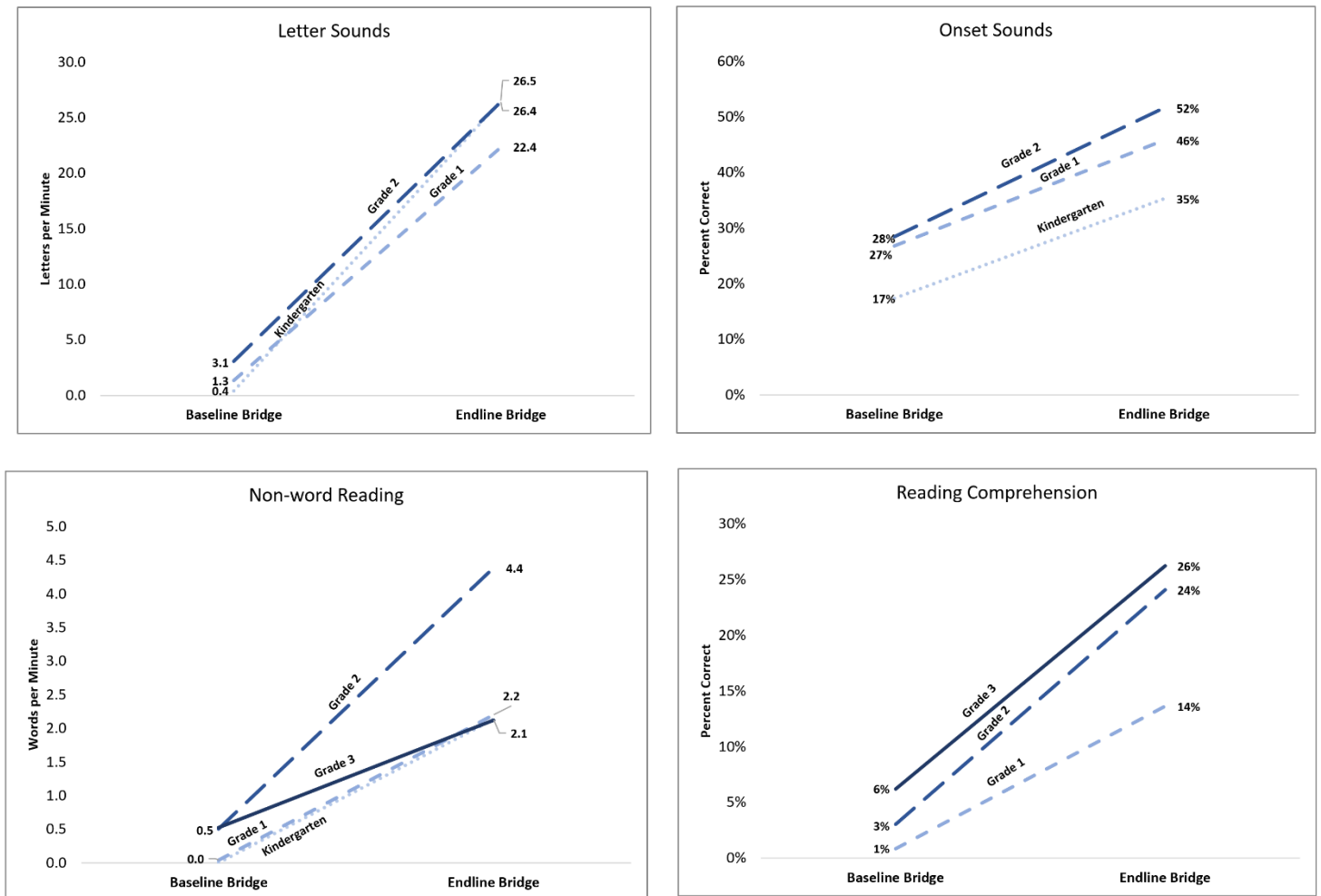
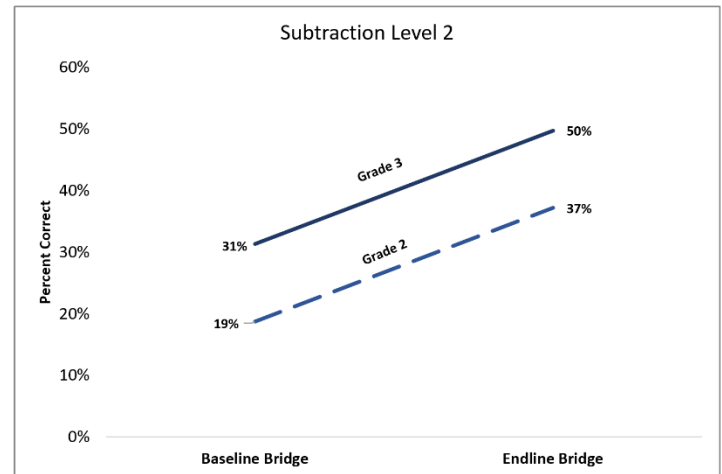
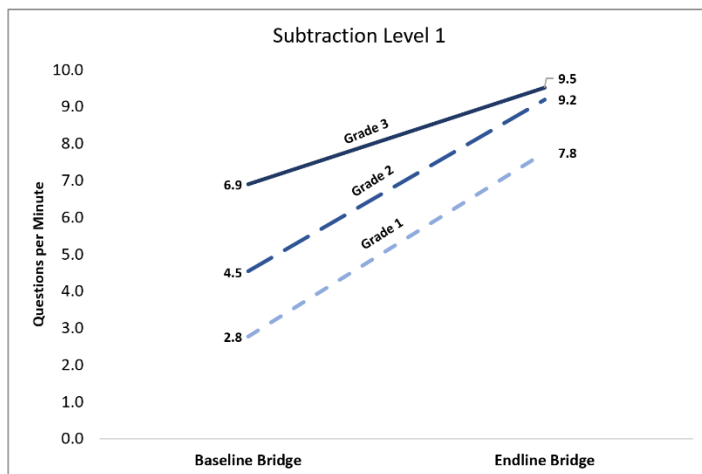
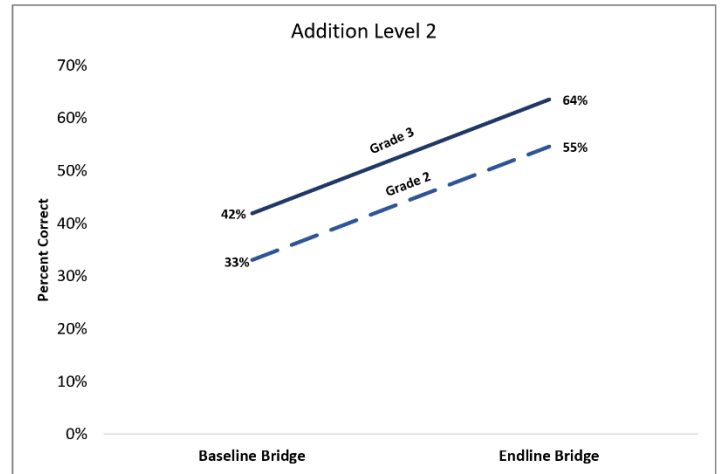
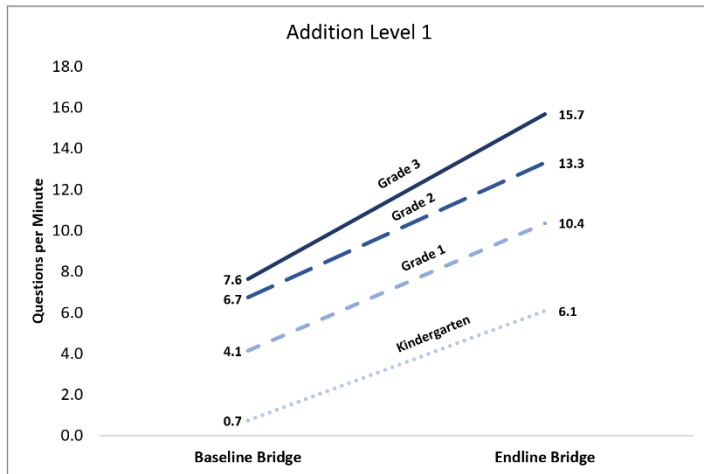
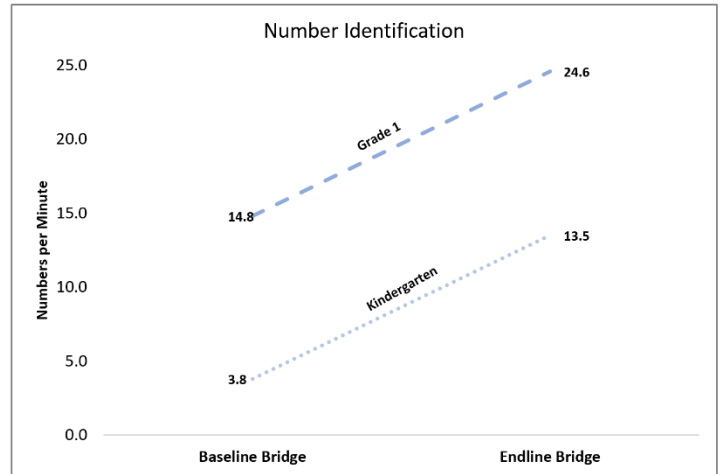
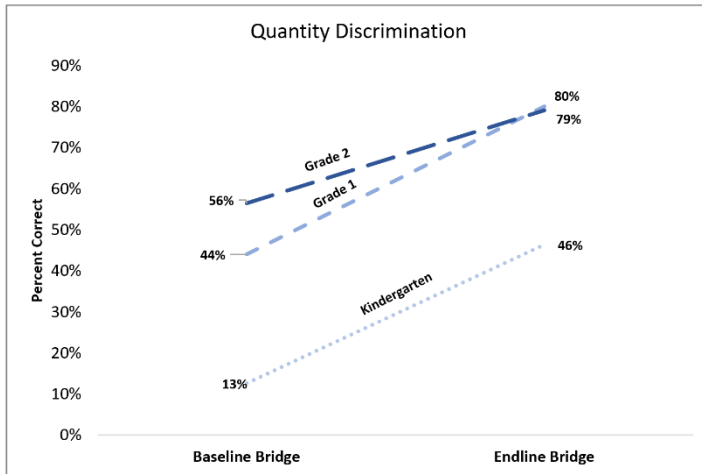
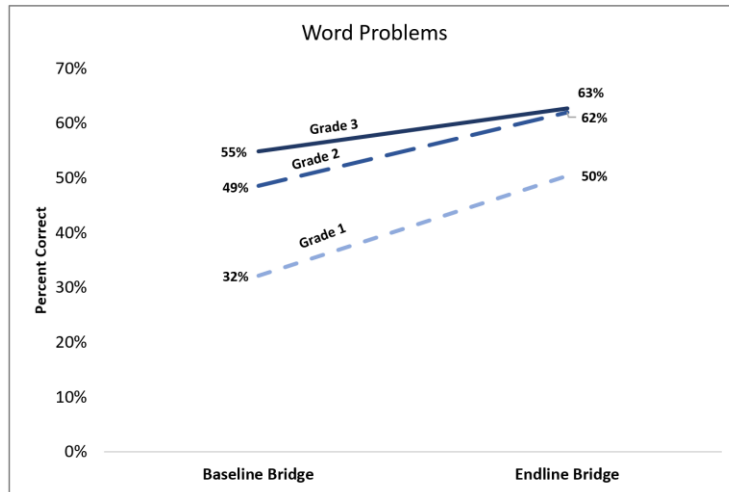


Figure 12. Yearly Growth on EGMA Subtasks by Grade





A9. Zero Score Reduction Tables

Table 49. Zero Score Reduction by Subtask

Subtask	Grades	Bridge PSL Public School				Traditional Public School				Diff-n-Diff
		Total # of Students	# of Zeros at Baseline	# of Zeros at Endline	% Reduction	Total # of Students	# of Zeros at Baseline	# of Zeros at Endline	% Reduction	
Letter Sounds	KG-G2	198	145	15	90%	247	217	176	19%	71%
Onset Sounds	KG-G2	198	70	9	87%	247	94	31	67%	20%
Non-Word Reading	KG-G3	275	249	154	38%	319	297	263	11%	27%
Familiar Word Reading	KG-G3	270	105	23	78%	319	159	85	47%	32%
Passage Fluency	G1-G3	222	74	23	69%	229	117	54	54%	15%
Reading Comprehension	G1-G3	222	191	103	46%	230	205	158	23%	23%
One-to-One Correspondence	KG	53	0	0	-	90	0	0	-	-
Number Identification	KG-G1	122	16	2	88%	183	0	1	-	-
Quantity Discrimination	KG-G2	198	33	6	82%	247	23	7	70%	12%
Addition 1	KG-G3	275	63	14	78%	318	49	20	59%	19%
Addition 2	G2-G3	152	32	15	53%	136	27	10	63%	-10%
Subtraction 1	G1-G3	222	59	15	75%	227	50	23	54%	21%
Subtraction 2	G2-G3	152	67	37	45%	135	44	35	20%	24%
Word Problems	G1-G3	222	27	6	78%	228	25	8	68%	10%

Figure 13. Zero Score Reduction on EGRA

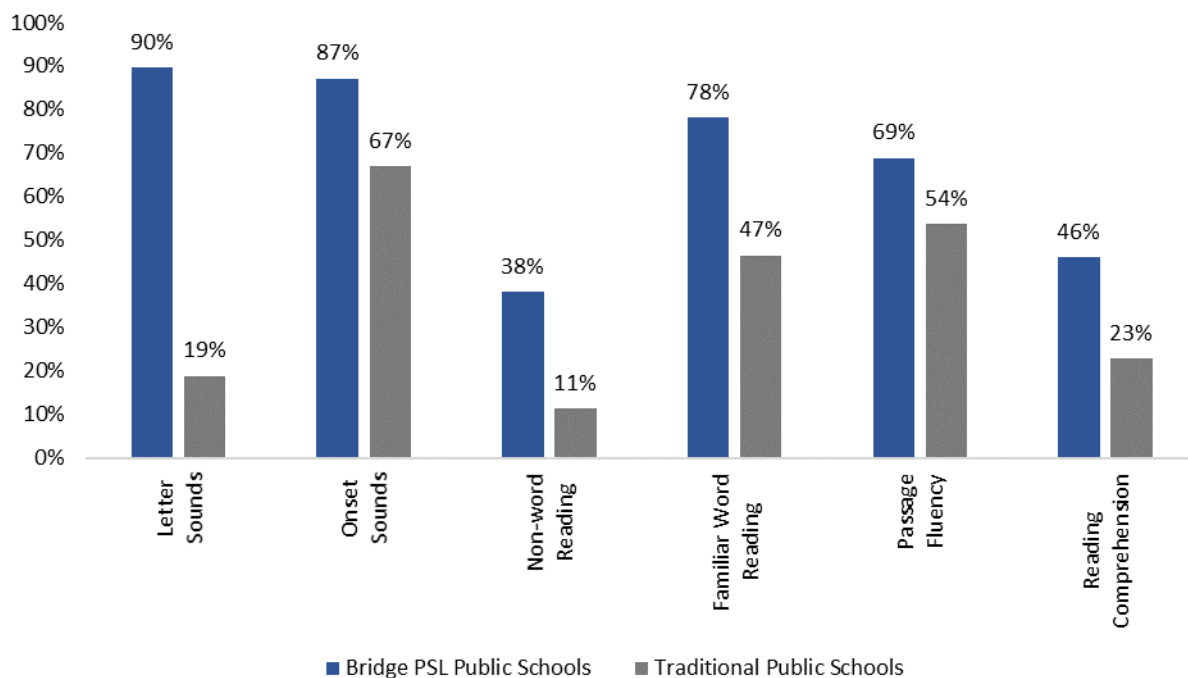
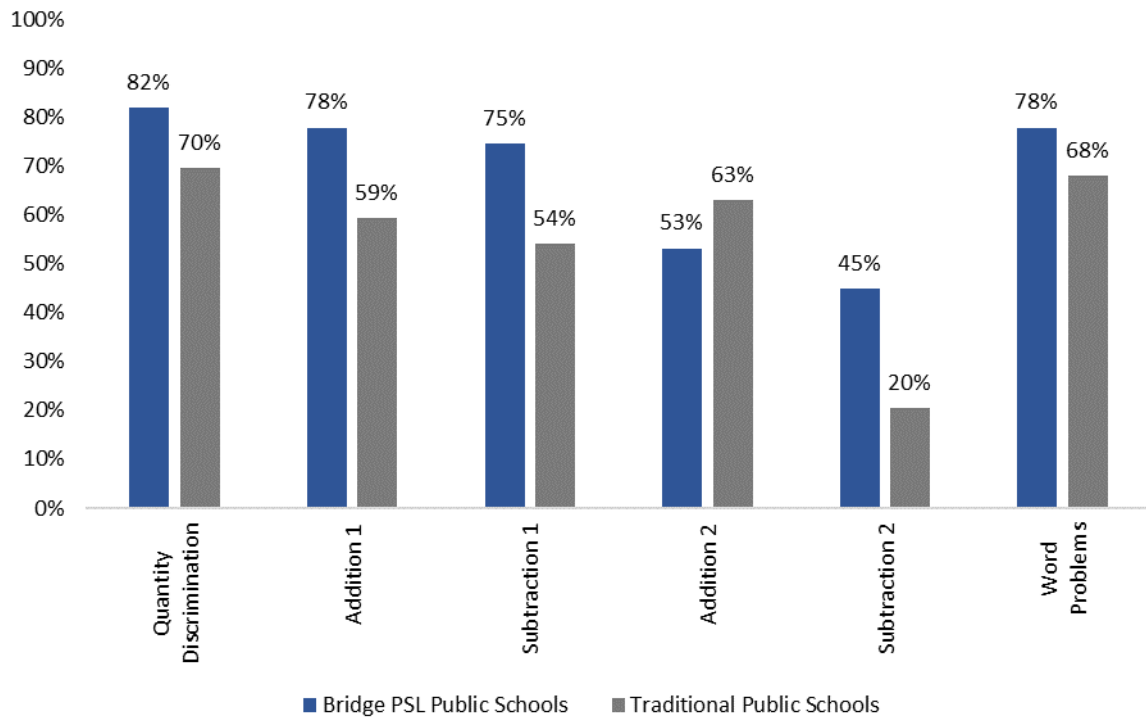


Figure 14. Zero Score Reduction on EGMA



A10. Heterogeneity of the Treatment

Table 50. Heterogeneous Treatment Effects on EGRA

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	19.68** (0.00)	0.07+ (0.08)	1.48** (0.00)	6.69** (0.00)	7.35* (0.01)	0.10** (0.00)
Bridge X Tercile 2		-0.02 (0.73)		0.99 (0.55)	3.51 (0.41)	
Bridge X Tercile 3	4.47 (0.25)	-0.02 (0.60)	1.05 (0.71)	5.56* (0.04)	12.75** (0.00)	-0.05 (0.42)
Tercile 2		0.24* (0.04)		0.32 (0.87)	-9.65* (0.04)	
Tercile 3	-3.57 (0.41)	0.29* (0.01)	2.10 (0.66)	1.30 (0.73)	-14.84+ (0.07)	-0.43 (0.13)
Grade 1	0.44 (0.88)	0.07+ (0.08)	0.62 (0.21)	4.37** (0.00)		
Grade 2	-0.98 (0.75)	0.13** (0.00)	1.32* (0.01)	3.20* (0.05)	0.26 (0.92)	0.09** (0.00)
Grade 3			-0.02 (0.97)	3.14* (0.03)	0.86 (0.84)	0.11** (0.00)
Baseline	1.28 (0.22)	-1.68 (0.13)	1.56 (0.74)	1.19 (0.12)	4.30** (0.00)	4.67* (0.03)
Baseline Squared	0.04 (0.46)	3.60 (0.28)	-0.30 (0.75)	0.00 (0.98)	-0.10+ (0.06)	-10.10* (0.03)
Baseline Cubed	-0.00 (0.17)	-2.04 (0.44)	0.02 (0.63)	0.00 (0.92)	0.00 (0.17)	7.75** (0.01)
Constant	2.62+ (0.07)	0.27** (0.00)	0.22 (0.37)	1.13* (0.04)	6.72** (0.00)	0.02 (0.20)
Count	445	445	594	589	451	452
R-squared	0.54	0.14	0.25	0.60	0.52	0.24

Table 51. Heterogeneous Treatment Effects on EGMA

	(7) One to One Corresp.* KG	(8) Number Id.* KG-G1	(9) Quantity Disc. KG-G2	(10) Addition 1 KG-G3	(11) Addition 2* G2-G3	(12) Subtraction 1 G1-G3	(13) Subtraction 2* G2-G3	(14) Word Problems G1-G3
Bridge	5.58 (0.42)	5.60** (0.00)	0.09* (0.05)	2.55** (0.00)	0.06 (0.34)	1.45 (0.16)	0.05 (0.38)	0.04* (0.04)
Bridge X Tercile 2	4.62 (0.64)	-0.61 (0.72)	0.05 (0.39)	1.55+ (0.09)	0.04 (0.65)	0.74 (0.54)	0.05 (0.53)	-0.02 (0.70)
Bridge X Tercile 3	-8.60 (0.21)	-1.13 (0.64)	-0.02 (0.72)	1.15 (0.30)	0.05 (0.56)	-0.35 (0.76)	-0.02 (0.87)	0.05 (0.49)
Tercile 2	-22.81 (0.11)	4.82* (0.03)	0.03 (0.64)	-1.06 (0.24)	0.06 (0.63)	-0.71 (0.57)	-0.18 (0.67)	0.10 (0.14)
Tercile 3	-27.41 (0.27)	7.65+ (0.05)	0.13 (0.21)	-2.40 (0.14)	0.09 (0.64)	-0.27 (0.87)	0.09 (0.73)	0.10 (0.41)
Grade 1		2.52** (0.00)	0.04 (0.23)	0.78+ (0.10)				
Grade 2			0.03 (0.51)	2.03** (0.00)		0.20 (0.75)		0.06* (0.01)
Grade 3				3.28** (0.00)	0.07+ (0.07)	0.26 (0.58)	0.09+ (0.06)	0.04 (0.11)
Baseline	1.70 (0.31)	0.64* (0.02)	1.50** (0.01)	0.88* (0.01)	0.97* (0.03)	0.74+ (0.09)	2.96 (0.40)	1.16** (0.00)
Baseline Squared	-0.01 (0.73)	-0.01** (0.00)	-1.65 (0.13)	0.02 (0.51)	-1.49 (0.16)	-0.00 (0.93)	-7.17 (0.39)	-1.88+ (0.06)
Baseline Cubed	0.00 (0.90)	0.00** (0.00)	0.66 (0.30)	-0.00 (0.14)	0.78 (0.26)	-0.00 (0.72)	4.56 (0.36)	1.09+ (0.09)
Constant	23.83 (0.13)	5.34** (0.00)	0.24** (0.00)	2.81** (0.00)	0.28** (0.00)	4.27** (0.00)	0.21** (0.00)	0.24** (0.00)
Count	143	305	445	593	288	449	287	450
R-squared	0.10	0.54	0.53	0.53	0.19	0.18	0.16	0.33

Figure 15. Growth on EGRA Subtasks by Percentile

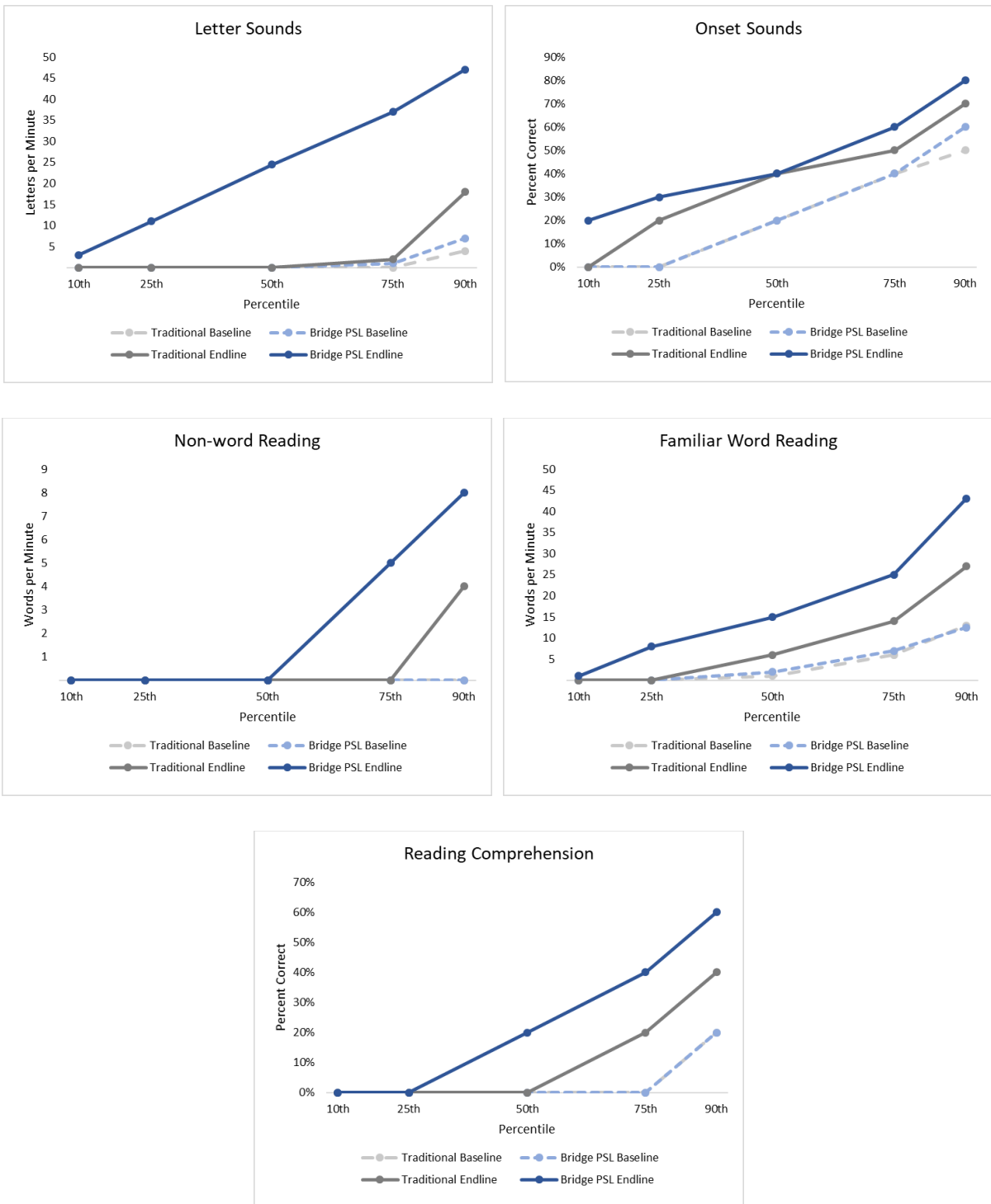
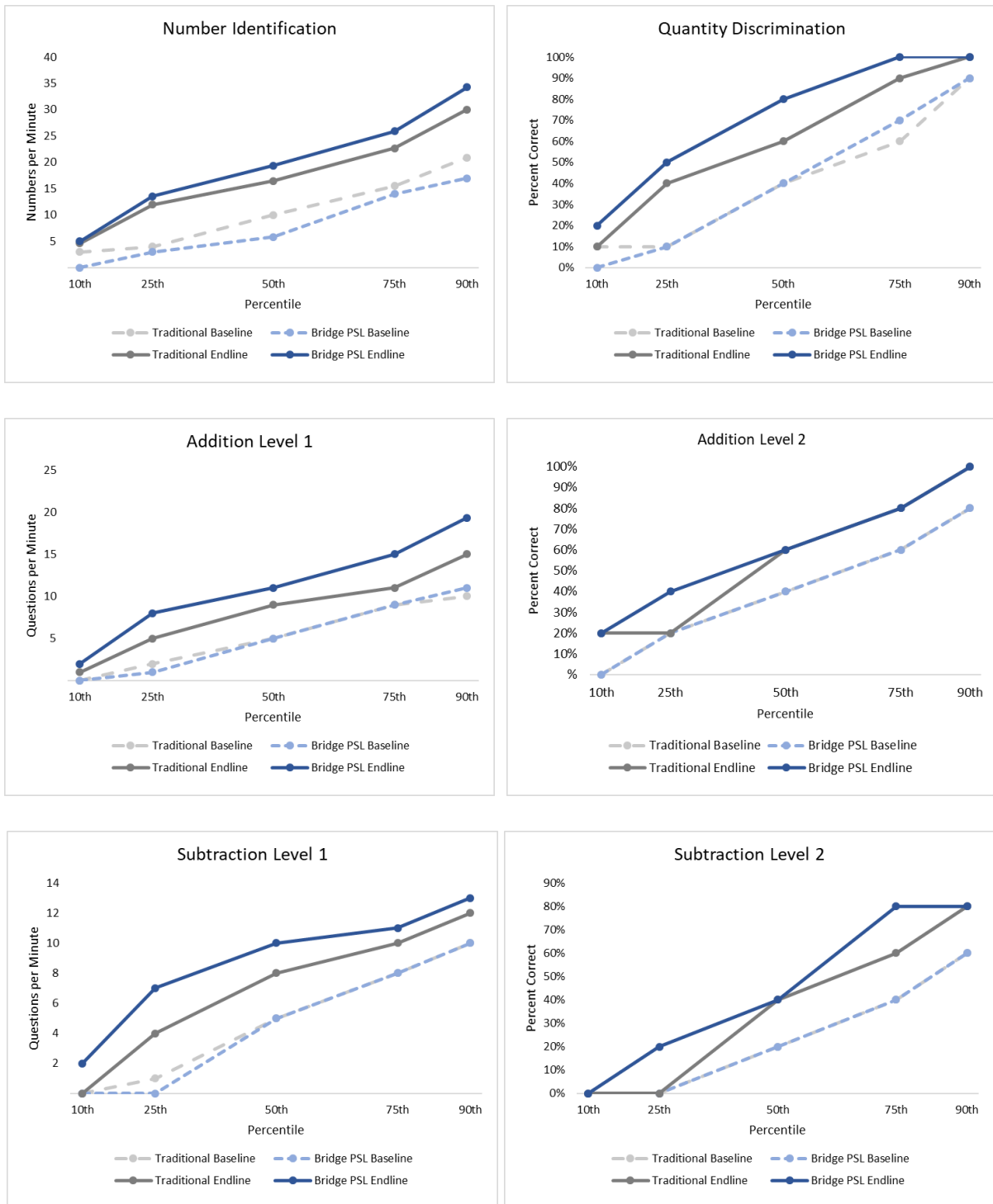
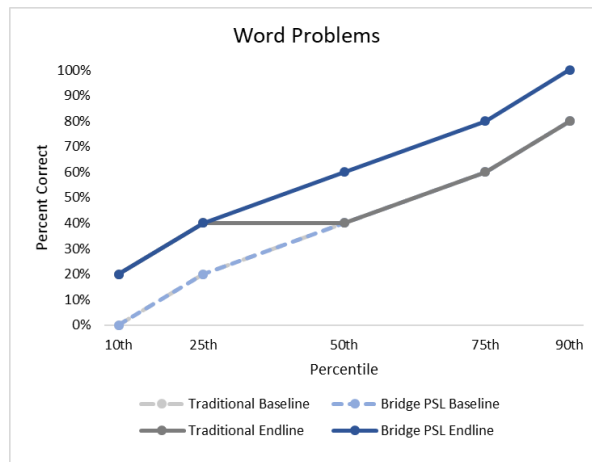


Figure 16. Growth on EGMA Subtasks by Percentile





A11. Why Sample Attrition is a Concern

Two types of attrition can occur in a study: equivalent attrition and differential attrition. Equivalent attrition occurs when individuals from the groups being compared attrite, but each group’s composition remains the same. Differential attrition occurs when attrition patterns are different for a particular type of student or vary across comparison groups.

A study in the American Journal of Public Health points out that the real concern is not necessarily high attrition itself, which frequently happens in highly mobile populations, but differential attrition. Why? Differential attrition has critical implications for how analyses and results are examined. Both forms of differential attrition, if they exist, pose serious limitations to what we should take away from this study:

1. If a particular type of student is more likely to leave the study sample, this is a concern because it results in inaccurate measure of the magnitude of an intervention’s effect, which ultimately can lead to biased estimates of results. Furthermore, it means that the sample now looks different from the population it was meant to represent, and the results may no longer be generalizable to the larger context.
2. If a particular type of student is more likely to leave a Bridge PSL public school or traditional public school, this is a concern because now there are systematic differences between comparison groups. This means that the results may be just as much of a function of the student composition as of the actual treatment effect.

The question therefore becomes whether there is differential attrition and, if there is, what we can do about it to make our findings more robust.

A12. Differential Attrition

Table 52. Probit Regressions for Differential Attrition by Baseline Characteristics

	Basic Model		With Interactions		Including Demographics	
	(1) Attrite (EGRA)	(2) Attrite (EGMA)	(3) Attrite (EGRA)	(4) Attrite (EGMA)	(5) Attrite (EGRA)	(6) Attrite (EGMA)
Bridge	0.14 (0.26)	0.11 (0.39)	0.11 (0.64)	0.08 (0.75)	0.17 (0.80)	-0.08 (0.91)
EGRA Composite	-0.08 (0.28)		-0.01 (0.91)		0.09 (0.25)	
EGMA Composite		-0.21** (0.01)		-0.17* (0.05)		-0.13+ (0.09)
Grade 1	-0.14 (0.49)	-0.11 (0.60)	-0.20 (0.37)	-0.18 (0.46)	-0.03 (0.92)	0.04 (0.90)
Grade 2	-0.03 (0.84)	0.04 (0.81)	0.03 (0.85)	0.11 (0.53)	0.06 (0.79)	0.17 (0.49)
Grade 3	0.16 (0.29)	0.24 (0.12)	0.12 (0.54)	0.21 (0.29)	0.13 (0.64)	0.29 (0.37)
Grade 1 * Bridge			0.13 (0.75)	0.14 (0.74)	-0.10 (0.81)	-0.19 (0.66)
Grade 2 * Bridge			-0.11 (0.73)	-0.12 (0.71)	-0.17 (0.57)	-0.32 (0.34)
Grade 3 * Bridge			0.07 (0.80)	0.07 (0.84)	-0.16 (0.66)	-0.35 (0.39)
EGRA Composite * Bridge			-0.16 (0.28)		-0.24 (0.12)	
EGMA Composite * Bridge				-0.07 (0.65)		-0.13 (0.36)
Age					0.06* (0.03)	0.06* (0.03)
Age * Bridge					-0.03 (0.50)	-0.01 (0.79)
Female					-0.13 (0.29)	-0.18 (0.15)
Female * Bridge					0.19 (0.33)	0.21 (0.29)
Attended School Last Year					-0.58** (0.00)	-0.52** (0.01)
Attended School Last Year * Bridge					0.34 (0.28)	0.27 (0.41)
Has Electricity					0.20 (0.25)	0.17 (0.33)
Has Electricity * Bridge					0.15 (0.52)	0.17 (0.47)
Years of ECE					-0.12 (0.31)	-0.15 (0.26)
Years of ECE * Bridge					0.01 (0.93)	0.07 (0.65)
Meals					0.10 (0.24)	0.09 (0.28)
Meals * Bridge					-0.29* (0.02)	-0.28* (0.03)
Reads Aloud at Home					-0.16 (0.28)	-0.11 (0.50)
Reads Aloud at Home * Bridge					0.20 (0.34)	0.19 (0.40)
Asset Index					-0.13 (0.74)	-0.07 (0.84)
Asset Index * Bridge					0.62 (0.22)	0.60 (0.22)
School Activity with Parent Index					-0.39+ (0.09)	-0.36 (0.13)
School Activity with Parent Index * Bridge					0.37 (0.28)	0.28 (0.40)
Other Activity with Parent Index					-0.25 (0.26)	-0.27 (0.22)
Other Activity Index * Bridge					-0.32 (0.31)	-0.31 (0.32)
Speaks English at Home					-0.21 (0.11)	-0.23+ (0.09)
Speaks English at Home * Bridge					0.34 (0.11)	0.36+ (0.10)
Constant	-0.60** (0.00)	-0.65** (0.00)	-0.59** (0.00)	-0.64** (0.00)	-0.33 (0.46)	-0.37 (0.40)
Count	844	844	844	844	774	774

Table 53. Probit Regressions for Differential Attrition by Mid-Year Growth

	With Interactions	
	(1) Attrite (EGRA)	(2) Attrite (EGMA)
Bridge	0.13 (0.49)	-0.01 (0.97)
EGRA Growth * Bridge	0.00 (0.95)	
EGMA Growth * Bridge		-0.14 (0.46)
EGRA Growth	-0.13* (0.02)	
EGMA Growth		-0.18 (0.20)
EGRA Composite	0.03 (0.46)	
EGMA Composite		-0.22+ (0.06)
EGRA Composite * Bridge	0.03 (0.58)	
EGMA Composite * Bridge		-0.01 (0.97)
Grade 1	-0.42 (0.17)	-0.20 (0.54)
Grade 2	-0.37* (0.02)	-0.10 (0.61)
Grade 3	-0.03 (0.82)	0.26 (0.17)
Grade 1 * Bridge	0.32 (0.45)	0.49 (0.31)
Grade 2 * Bridge	0.24 (0.40)	0.39 (0.30)
Grade 3 * Bridge	0.01 (0.98)	0.21 (0.52)
Constant	-0.67** (0.00)	-0.90** (0.00)
Count	1,043	690

Table 54. EGRA Midline Results Factoring in Endline Attrition Status

	(1)	(2)	(3)	(4)	(5)	(6)
	Letter Sounds	Onset Sounds	Non-word Reading	Familiar Word Reading	Passage Fluency	Reading Comp.
	KG-G2	KG-G2	KG-G3	KG-G3	G1-G3	G1-G3
Bridge	2.14** (0.32)	0.21 (0.16)	0.75** (0.24)	0.55** (0.13)	0.75** (0.17)	0.72** (0.20)
Attritor	-0.13 (0.14)	0.05 (0.13)	-0.21 (0.23)	-0.13 (0.12)	-0.25* (0.12)	0.01 (0.24)
Bridge * Attritor	-0.41 (0.37)	-0.19 (0.22)	-0.44 (0.30)	-0.12 (0.20)	0.10 (0.29)	-0.38 (0.29)
Student in Grade 1	-0.28 (0.28)	-0.06 (0.22)	0.39 (0.27)	0.09 (0.14)		
Student in Grade 2	-0.18 (0.38)	0.39+ (0.22)	1.05** (0.22)	0.26 (0.18)	0.30* (0.15)	0.78** (0.20)
Student in Grade 3			0.59+ (0.34)	0.17 (0.14)	0.29 (0.20)	1.07** (0.29)
Baseline Task Score	1.45** (0.36)	0.19+ (0.11)	2.37* (1.05)	1.34** (0.12)	1.73** (0.18)	-0.10 (0.34)
Baseline Task Score ^2	-0.09 (0.18)	0.12 (0.11)	-0.24 (0.39)	-0.03 (0.08)	-0.03 (0.12)	0.43** (0.16)
Baseline Task Score ^3	0.00 (0.02)	-0.05 (0.07)	0.01 (0.03)	0.00 (0.01)	-0.01 (0.02)	-0.03* (0.01)
Age	0.10* (0.05)	0.03 (0.02)	-0.02 (0.04)	0.00 (0.02)	-0.06* (0.03)	-0.08* (0.04)
Female	-0.12 (0.14)	0.03 (0.11)	-0.62** (0.19)	-0.05 (0.10)	-0.10 (0.10)	-0.43** (0.14)
Attended School Last Year	-0.08 (0.25)	0.01 (0.16)	0.48** (0.17)	0.08 (0.15)	0.18 (0.20)	-0.02 (0.28)
Has Electricity	-0.05 (0.16)	0.06 (0.13)	-0.46* (0.19)	0.01 (0.08)	-0.18 (0.13)	-0.33 (0.20)
Years of ECE	0.22+ (0.11)	0.01 (0.08)	0.02 (0.12)	0.05 (0.06)	0.26* (0.11)	0.14 (0.12)
Meal Count	-0.04 (0.09)	0.03 (0.06)	0.01 (0.08)	-0.04 (0.05)	-0.04 (0.06)	-0.02 (0.11)
Reads Aloud at Home	0.16 (0.17)	0.21+ (0.12)	0.04 (0.16)	0.05 (0.09)	0.16+ (0.09)	0.10 (0.12)
Asset Index	-0.11 (0.29)	0.07 (0.19)	0.09 (0.34)	0.09 (0.20)	0.18 (0.26)	0.06 (0.39)
School Activity with Parent Index	0.37 (0.25)	-0.14 (0.16)	0.29 (0.40)	-0.04 (0.12)	-0.09 (0.16)	0.26 (0.21)
Other Activity with Parent Index	0.20 (0.21)	-0.15 (0.16)	-0.10 (0.27)	-0.13 (0.16)	0.00 (0.28)	-0.02 (0.37)
Speaks English at Home	-0.22 (0.22)	0.05 (0.09)	0.02 (0.21)	0.14 (0.10)	0.05 (0.12)	0.23 (0.20)
Constant	-0.81 (0.51)	-0.29 (0.22)	-0.08 (0.58)	0.25 (0.39)	0.18 (0.60)	0.10 (0.68)
Count	476	476	642	642	503	503
R-squared	0.54	0.12	0.34	0.68	0.65	0.33

Table 55. EGMA Midline Results Factoring in Endline Attrition Status

	(7) One to One Corresp.* KG	(8) Number Id.* KG-G1	(9) Quantity Disc. KG-G2	(10) Addition 1 KG-G3	(11) Addition 2* G2-G3	(12) Subtraction 1 G1-G3	(13) Subtraction 2* G2-G3	(14) Word Problems G1-G3
Bridge	-0.21 (0.17)	0.13+ (0.20)	0.11 (0.20)	0.63** (0.06)	0.36* (0.08)	0.59** (0.08)	0.38+ (0.14)	0.20+ (0.07)
Attritor	-0.08 (0.12)	0.03 (0.24)	0.10 (0.12)	-0.10 (0.08)	-0.01 (0.15)	0.08 (0.15)	-0.20 (0.12)	-0.16 (0.25)
Bridge * Attritor	-0.05 (0.29)	-0.03 (0.29)	-0.09 (0.27)	-0.20 (0.10)	-0.33 (0.19)	-0.29 (0.18)	-0.34 (0.23)	-0.08 (0.27)
Student in Grade 1		-0.01 (0.05)	-0.04 (0.11)	0.09 (0.05)				
Student in Grade 2			0.23+ (0.12)	0.29* (0.14)		0.23* (0.14)		0.40** (0.11)
Student in Grade 3				0.42** (0.13)	0.13 (0.141)	0.33** (0.13)	-0.06 (0.14)	0.33** (0.10)
Baseline Task Score	0.45+ (0.18)	0.88** (0.34)	0.75** (0.20)	0.71** (0.09)	0.33** (0.08)	0.64** (0.05)	0.21* (0.10)	0.48** (0.05)
Baseline Task Score ^2	-0.09 (0.12)	-0.15** (0.16)	-0.23** (0.23)	-0.01 (0.02)	-0.08 (0.06)	-0.14 (0.07)	-0.45** (0.08)	-0.02 (0.08)
Baseline Task Score ^3	-0.03 (0.02)	0.01** (0.01)	0.05 (0.17)	-0.01 (0.00)	0.02 (0.04)	0.01 (0.01)	0.18** (0.06)	-0.02 (0.01)
Age	0.02 (0.03)	0.00 (0.04)	0.03* (0.04)	0.06** (0.01)	-0.04 (0.01)	0.02 (0.01)	-0.01 (0.04)	0.01 (0.02)
Female	-0.08 (0.10)	-0.05 (0.14)	-0.12* (0.23)	-0.23** (0.04)	-0.03 (0.05)	-0.29** (0.07)	-0.16 (0.17)	-0.16* (0.06)
Attended School Last Year	0.24 (0.20)	-0.07 (0.28)	-0.12 (0.27)	0.04 (0.07)	0.00 (0.13)	-0.05 (0.10)	0.08 (0.22)	0.18 (0.13)
Has Electricity	-0.13 (0.13)	0.05 (0.20)	-0.02 (0.21)	-0.04 (0.05)	-0.06 (0.08)	0.05 (0.07)	0.13 (0.13)	0.00 (0.08)
Years of ECE	-0.16 (0.11)	0.07* (0.12)	0.07 (0.12)	0.08+ (0.03)	-0.03 (0.05)	0.00 (0.04)	0.12 (0.07)	0.00 (0.06)
Meal Count	-0.07 (0.06)	0.00 (0.11)	-0.04 (0.11)	0.02 (0.02)	0.04 (0.03)	0.02 (0.04)	-0.23* (0.08)	0.02 (0.04)
Reads Aloud at Home	-0.24 (0.09)	0.00 (0.12)	-0.08 (0.18)	0.07 (0.04)	0.17 (0.06)	-0.05 (0.08)	0.10 (0.11)	0.00 (0.08)
Asset Index	0.11 (0.26)	-0.02 (0.39)	-0.06 (0.41)	0.17 (0.09)	0.00 (0.15)	0.05 (0.16)	-0.06 (0.24)	0.20 (0.18)
School Activity with Parent Index	0.02 (0.16)	0.09 (0.21)	0.17+ (0.20)	0.04 (0.11)	0.13 (0.10)	0.14 (0.10)	0.46* (0.21)	0.11 (0.11)
Other Activity with Parent Index	-0.20 (0.28)	-0.05 (0.37)	-0.06 (0.33)	-0.22+ (0.06)	-0.07 (0.07)	-0.16 (0.12)	-0.26 (0.13)	-0.22 (0.11)
Speaks English at Home	0.12 (0.12)	0.05 (0.20)	0.07 (0.20)	0.14+ (0.03)	0.14 (0.08)	0.17* (0.08)	0.23 (0.13)	0.14 (0.08)
Constant	0.74 (0.60)	0.18 (0.68)	0.38 (0.67)	-0.77** (0.18)	0.57 (0.26)	0.02 (0.23)	0.84 (0.68)	-0.35 (0.34)
Count	139	310	476	641	331	503	331	503
R-squared	0.18	0.53	0.63	0.58	0.17	0.46	0.20	0.32

* While we can take the co-efficient of (7), (8), (11), and (13), we cannot correctly test for statistical significance for these two subtasks due to the limited number of grades administered these subtasks (and therefore clusters).

A13. Baseline EGRA/EGMA Results

The following table shows the subtask averages by school type with scores from all students assessed at baseline.

Table 56. Baseline EGRA/EGMA Scores, All Baseline Students

	Bridge PSL Public Schools	Traditional Public Schools	Difference
Count	406	438	
EGRA			
Letter Sounds	1.61	2.1	-0.49
Onset Sounds	24%	22%	2%
Non-Word Reading	0.27	0.26	0.01
Familiar Word Reading	4.81	4.39	0.42
Passage Fluency	5.55	5.08	0.47
Reading Comprehension	3%	3%	0%
EGMA			
One-to-One Correspondence	36.04	46.50	-10.46*
Number Identification	8.71	11.08	-2.37
Quantity Discrimination	37%	40%	-3%
Addition Level 1	5.01	5.35	-0.34
Addition Level 2	37%	39%	-2%
Subtraction Level 1	4.37	5.11	-0.74*
Subtraction Level 2	25%	27%	-2%
Word Problems	44%	46%	-2%

** p<0.01, * p<0.05, + p<0.1

A14. Standardization of Scores

To standardize the raw subtask scores in our study, we first calculated the means and standard deviations from our baseline sample of students. We included all baseline scores in this calculation, regardless of whether the student attrited or not.

After calculating the baseline means and standard deviations, we used those numbers to standardize both the baseline and midline results by student using the following formula:

$$\text{Standardized Score} = \frac{\text{student's raw score (subtask 1)} - \text{baseline mean (subtask 1)}}{\text{baseline standard deviation (subtask 1)}}$$

The table below lists the means and standard deviations calculated by sub-task.

Table 57. Baseline Means and Standard Deviations

	Subtask	Baseline Mean	Baseline Standard Deviation
EGRA	Letter Sounds	1.87	6.45
	Onset Sounds	0.23	0.23
	Non-word Reading	0.27	1.19
	Familiar Word Reading	4.59	6.82
	Passage Fluency	5.32	8.64
	Reading Comprehension	0.03	0.09
EGMA	One to One Correspondence	42.44	32.77
	Number Identification	10.07	17.49
	Quantity Discrimination	0.39	0.31
	Addition 1	5.18	4.43
	Addition 2	0.38	0.29
	Subtraction 1	4.73	4.13
	Subtraction 2	0.26	0.26
	Word Problems	0.45	0.26

A15. Standardized Annual Gains Baselines to Endlines at Traditional Public Schools

Table 58. Annual Standardized Gains

	Standardized Gains	Average
Letter Sounds	0.47	
Onset Sounds	0.67	
Non-Word Reading	0.67	0.77
Familiar Word Reading	0.76	
Passage Fluency	1.17	
Reading Comprehension	0.89	
Quantity Discrimination	0.66	
Addition 1	0.68	0.57
Subtraction 1	0.59	
Word Problems	0.33	

A16. Differential Relative Gains between Attritors and Non-Attritors

Table 59. Differential Relative Gains between Attritors and Non-Attritors (Standardized)

	Stayers - Students who Stay to Endline			Attritors - Students who Leave by Endline			Difference-in-Difference-in-Differences
	Bridge PSL Public Schools	Traditional Public Schools	Difference	Bridge PSL Public Schools	Traditional Public Schools	Difference	
Count	264	295		73	59		
	Midline Growth	Midline Growth		Midline Growth	Midline Growth		
EGRA							
Letter Sounds	2.29	0.35	1.94	1.64	0.25	1.39	0.55
Onset Sounds	0.54	0.41	0.13	0.56	0.59	-0.03	0.16
Non-Word Reading	1.26	0.43	0.83	0.52	0.17	0.35	0.48
Familiar Word Reading	1.08	0.52	0.56	0.84	0.37	0.47	0.09
Passage Fluency	1.34	0.51	0.83	0.99	0.27	0.72	0.11
Reading Comprehension	1.06	0.32	0.74	0.61	0.29	0.32	0.42
EGMA							
One-to-One Correspondence	0.30	0.34	-0.04	0.27	0.65	-0.38	0.34
Number Identification	0.22	0.14	0.08	0.33	0.24	0.09	-0.01
Quantity Discrimination	0.49	0.42	0.07	0.60	0.60	0.00	0.07
Addition Level 1	1.02	0.44	0.58	0.82	0.39	0.43	0.15
Addition Level 2	0.62	0.23	0.39	0.19	0.18	0.01	0.38
Subtraction Level 1	0.83	0.27	0.56	0.76	0.34	0.42	0.14
Subtraction Level 2	0.67	0.39	0.28	0.11	-0.06	0.17	0.11
Word Problems	0.40	0.23	0.17	0.21	-0.23	0.44	-0.27

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