Ethiopia West Showa Numeracy Boost Endline

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With special thanks to our team of assessors!

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List of Acronyms and Definitions

ELM	Emergent Literacy and Math
ES	Effect size. The effect size is a measure of the magnitude of an observed difference, expressed in standard deviations in order to compare across different types of measures.
HNE	Home Numeracy Environment
LB	Literacy Boost
NB	Numeracy Boost
SES	Socioeconomic Status

Executive Summary

This report examines the results of a learner background survey and numeracy assessment conducted in West Showa, Ethiopia prior to beginning the Numeracy Boost (NB) intervention and again after nine months of implementation. The baseline survey and numeracy assessment covered 660 grade 2 learners throughout 30 schools (10 NB, 5 NB+ELM, 5 NB+ELM+LB, and 10 comparison schools) and was administered in October 2014. The follow-up gathered data again from 529 of these children. The learner background survey covered student socio-economic status and home numeracy environment questions amongst others. The numeracy assessment covered three constructs: numbers and operations, geometry and measurement. Also, three time identification questions were included in the assessment.

The results show a similar Home Numeracy Environment of students in NB and intervention schools with very low access to child friendly materials at home. In terms of impact, the results show that the overall impact of the Numeracy Boost program in the region has been high. Over the period of eight months children in Numeracy Boost schools had significant higher gains as compared to students in comparison schools in 14 out of the 17 numeracy skills assessed after controlling for background characteristics and baseline scores. The three skills were statistically equal gains between intervention and comparison groups were found were counting, one-to-one correspondence and measurement, with the first two being skills that students had already mastered so the no difference in gains is not practically significant.

The evaluation was also meant to provide a sense of the difference in achievement amongst subgroups (those children that had been exposed to ELM programming and LB programming before) but the results are limited in this front as we did not have a reliable source of information to determine whether the students in the sample were exposed to these programs. They show modest higher gains for children in LB programming schools in three out of 17 skills and modest higher gains for the "zero subtest" and a lower gain for number identification for students in districts with ELM programming.

Finally, in terms of learning equity there are a few skills where boys' scores outperform girls' at endline (magnitude, missing value, and time) and where high numeracy environments at endline are predictive of higher endline scores (ordering numbers, shape patterns, and shapes).

I. Introduction

This report examines the results of a learner background survey and numeracy assessment conducted in West Showa, Ethiopia prior to beginning the Numeracy Boost (NB) intervention and again after nine months of implementation. The baseline survey and numeracy assessment covered 660 grade 2 learners throughout 30 schools and was administered in October 2014. The follow-up gathered data again from 529 of these children. The 30 schools are split into 20 primary schools designated to receive Numeracy Boost (split into five that had received ELM and LB programming in the past, five that had received ELM programming, and 10 that had not received any previous Save the Children programming) and 10 comparison primary schools receiving no intervention. This report explores: the comparability of the learners in Numeracy Boost and comparison schools, the skills profiles at baseline and endline, and equity in learning by gender, poverty, home literacy and other characteristics. These results will inform targeting of further interventions.

The Numeracy Boost program includes teacher training, community math activities, and age-appropriate local language materials creation to support emergent math skills among early-grade children. These skills include numbers and operations, geometry and measurement. As part of Numeracy Boost, learners are periodically assessed in each of these skills through an adaptable assessment tool to inform programming and estimate program impact.

The key research questions to be explored in this report include:

1. How has the sample of learners changed over time?
    - Are the learners who were able to be found at endline different than those who were not able to be found? If so, how?
    - Did the attrition rate differ between Numeracy Boost and comparison learners?

2. Of the students who were able to be found at endline, how comparable are baseline background characteristics and numeracy skills among Numeracy Boost learners versus comparison learners?

3. What can the endline assessment tell us about students' math skills?
    - What does this mean for continuing Numeracy Boost programming in this area?

4. Did the Numeracy Boost program exhibit impact on learners' numeracy skills?
    - For which types of learners was impact the greatest/least?
    - Does this impact result in more equitable outcomes for traditionally disadvantaged groups?
    - Did this impact vary between children that had received previous Save the Children programming and those who had not?

5. How does learners' development of numeracy skills vary over time by learner background and community literacy environment?
    - What does this mean for targeting Numeracy Boost's various intervention components?

To investigate these questions, this report first describes the context and implementation history of Numeracy Boost in West Showa. Next, this report gives an overview of the research methods used; including sampling, measurement, and analysis. The report will then analyze the attrition of the sample over time and how intervention and comparison groups have or have not remained statistically similar. The report will then present results from impact analysis investigating the extent to which Numeracy Boost appears to have improved learners' numeracy skills. After this, learners' endline scores for each of the numeracy skills will be analyzed to determine which skills learners have mastered and which require additional improvement. Finally, the report will investigate any correlations between baseline-endline numeracy skill development and student background or community numeracy environment variables using multivariate regression analysis.

II. Context

The West Showa Impact Area is one of Save the Children's Sponsorship core programs intervention areas since 2009. The West Showa zone covers 18 districts with about 824 primary schools. Save the Children's Sponsorship program is currently under implementation in four of these districts- Dendi, Ejere, Toke Kutaye and Ambo-where there are 203 primary schools.

The Numeracy Boost pilot project covers Dendi and Ambo districts which have had LB programming in primary schools and ELM programs in ECCD centers since 2011 and 2012 respectively. For this evaluation, schools in districts were purposely selected to assess the contribution of LB and ELM on children's Numeracy Skills. For this reason, five primary schools with LB and NB interventions and five others with ELM and NB interventions were chosen as part of the evaluation sample. Besides these two districts, Toke Kutaye, a newly enrolled district for Save the Children's Sponsorship program and that has 10 primary schools with only NB programming was selected to measure the impact of exclusive NB programming on children's numeracy skills. To be able to have a valid comparison, 10 schools from Cheliya, a district with no Save the Children interventions, were selected as comparison schools. With this, a total of 30 schools were identified for the NB assessment.

III. Implementation History

The Numeracy Boost program in the West Shewa region of Ethiopia started towards de end of 2014. Baseline data was collected in October 2014 and actual implementation started in November of the same year with the teacher training activities. By April 2015 teacher trainings and follow-ups had happened and 53 math camps had been celebrated in 20 intervention schools. Complete details of implementation can be found on Table 1.

Table 1. Implementation Timeline and Outputs

Date	Activity	Output
Oct 2014	Baseline assessment	- 656 students assessed, 219 from Comparison and 437 from NB schools (

	Grade 2 students assessed on numeracy concepts	ELM+NB: 109, ELM+LB+NB:109, NB only: 219)
Nov.& Dec. 2014	Teacher Training: Basic training to math teachers on NB components(Numbers & operation, Measurement and Geometry)	-69 math teachers from grade 1 and 2 of the intervention schools took the training
Dec and mid Jan 2015	School Supply: Math supporting materials(manipulatives) and math reference books were provided	-20 intervention schools got different manipulatives and four types of math reference books
Feb 2015	Supportive Supervision: School-based coaching and supportive supervision was conducted by NB team	-20 schools got supportive supervision and coaching
March 2015	Follow-up Training: Based on the reflections from supportive monitoring and coaching, a follow-up training to teachers were given	-69 teachers from intervention schools were refreshed on key math components
April 2015	-Math Camp Activity: Math camp was established around the intervention schools, math camp facilitators were trained	-53 math camp around 20 intervention schools(3 on average) was established, 60 math camp facilitators were trained
May 2015	Supportive Supervision and Follow-up: School-based and community-level math activity was supervised and monitored	-20 intervention schools and established math camps continuously got monitoring supports from NB team
June 2014	Endline assessment Grade 2 students tested on numeracy concepts	- 529 students assessed, 165 from Comparison and 365 from NB schools (ELM+NB:85, ELM+LB+NB:90, NB only: 189)

IV. Methods

Sampling

The sample for the baseline assessment encompassed 656 grade 2 learners, divided between 20 schools set to receive the Numeracy Boost intervention (n of learners = 437) and 10 comparison schools (n of learners = 219). Ten of the schools sampled within the Numeracy Boost intervention schools had received either ELM or ELM+LB interventions before. The split at baseline of learners sampled is presented in Table 1.

Table 1. Baseline Sample

Group	Subsample	Female	Male	Total
Comparison	Comparison	110	109	219
NB	ELM+NB	54	55	109
	ELM+LB+NB	54	55	109
	NB only	110	109	219
Total		328	328	656

At each of the Numeracy Boost and comparison schools where data was collected, 22 children-11 girls and 11 boys- in grade 2 were sampled. If there was more than one section of grade 2 at a given school, one section was randomly selected. At endline, data was collected from as many students of those that participated in the baseline assessment as could be found. The resulting sample can be found on Table 2.

Table 2. Endline sample

Group	Subsample	Female	Male	Total
Comparison	Comparison	73	92	165
NB	ELM+NB	44	41	85
	ELM+LB+NB	44	46	90
	NB only	94	95	189
Total		255	274	529

Measurement

For the student assessment, all learners in the sample were asked about their background characteristics (age, household possessions, household building materials, etc.). Learners also were asked about their family members and numeracy habits in their home (who they had seen doing math in the week prior to the assessment, who had ask them to help doing something that required math, etc). Table 3 offers examples of school survey items, background, and home literacy indicators.

Table 3. Student Background and Home Numeracy Environment Data Collected

Type of Data Collected	Examples
Student Background	
General	Sex, age, language spoken at home
School-related	Distance to school, repetition history, previous ECD attendance
Socioeconomic status	Household possessions, house building materials and access to public

	services, livestock
Children's Time	Type of chores, amount of time spent on chores, amount of time spent studying
Home Numeracy Environment	
Access to print	Types of materials present in home
Math at home	Presence and percentage of family members who children see using numbers, who ask children to do math, and who play math games with the child

All students were also given a numeracy assessment covering three conceptual areas: numbers and operations, geometry, and measurement. Although specific learning outcomes for children in the early grades vary from country to country, these conceptual areas are universal areas within mathematics that children in the first few years of school learn. Each of these conceptual areas was broken down into a number of sub-tests: for number and operations, students were tested on counting aloud to 100, one to one correspondence of items up to 22, three patterns subtests (two skip counting and one figures pattern), zero concept interpretation, number identification of six numbers between 1-19 and six numbers between 20-100, tens and ones identification of three numbers, ordering of five sets of numbers, number discrimination among five sets of four numbers 1-100, identification of five missing numbers between 1-100, 10 timed addition problems, 10 timed subtraction problems, and three word problems.

To test geometry, students were asked five questions about identifying shapes and items from their lives that resembled certain shapes. To test measurement, students were asked four questions about measuring different items and measurement interpretation. Finally, students were asked three questions on identifying and presenting different times on a clock. All sub-tests and assessment instructions were given in Afaan Oromo. Table 4 below outlines the different components of the numeracy assessment.

Table 4. Numeracy Assessment Constructs and Measures

Construct	Measure	Scoring (# correct of ...)
Number Sense and Operations	Counting aloud to 100	100
	One to one correspondence	22
	Skip counting by 2s to 20	7
	Skip counting by 5s to 50	7
	Shape patterns (2 patterns)	2
	Problem Solving (3 problems)	3
	Zero concept	1
	Number identification (12 numbers)	12
	Tens and ones identification (3 numbers)	3
	Ordering numbers (5 sets of 3 numbers)	5
	Number discrimination (5 sets of 4 numbers)	5

	Missing numbers identification (8 numbers)	8
	Timed addition (10 problems)	10
	Timed subtraction (10 problems)	10
Geometry	Shape identification (5 questions)	5
Measurement	Measuring items (4 questions)	4
	Time identification (3 questions)	3

Analysis

The critical purpose of this analysis is to estimate the impact of Numeracy Boost programs on children's reading and math skills, as well as to perform an in-depth analysis of each skill to inform future programming. Summary statistics will be used to analyze students' performance in each of the reading and math sub-tests. To test the comparability of students in the samples, this report will use comparison of means through t-tests, with clustered standard errors to account for the grouping of student-level data within schools. Finally, this report will look to multilevel regression models to explore relationships between literacy skills and student background characteristics, school environment, and home numeracy environment.

V. Student Descriptive Statistics

Presence at Endline

Of the 656 students surveyed at baseline, 529 were found at endline (80.1%). Student attrition was more likely amongst students that were not part of the numeracy program (the probability of attrition for Numeracy Boost students was 16.7% vs. 25% of the comparison students), and those with less household members.

Schools with a particular high number of students not present at endline were: Barkume Uko (47% of students missing), Sire Silase (41% of students missing), and Rafiso Kortu (40% of students missing). The main reason for students missing at endline was the timing of the data collection. June was the end of academic year for Ethiopia and some students were not attending school. In addition, the month of June is a rainy and busy month in which the rural community is cultivating and some children are supporting their family in farms. Also, crossing rivers to attend school is difficult for children at this time of the year.

Student Background Characteristics

At endline, students are 10 years old in average, 48% of them are female and 99% speak Afaan Oroomo at home. About 34% of them have attended an ECD/preschool program before, they have been in school for an average of 2.6 years and 21% repeated grade 1. In terms of socioeconomic characteristics 84% of them live in a house with an iron sheets roof and only 20% have access to electricity. Appendix A1 contains further details on the characteristics of students at endline divided by group.

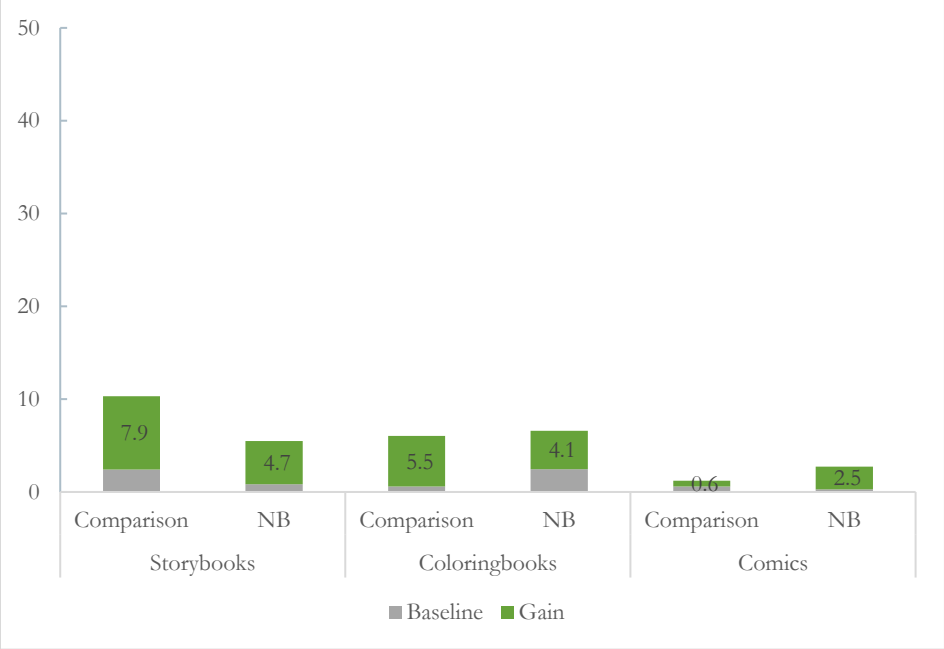
There are a few characteristics at endline that are different between NB and Comparison students and that need to be taken into account for impact analysis. These are: age, ECD, time in school,

household members, grade 1 repetition, iron sheets roof, and to a lesser extent the presence of a bicycle and electricity at home. **Controlling for these variables that are different at endline will be important to understand the real extent of the program's effect in children's skills.**

Home Numeracy Environment

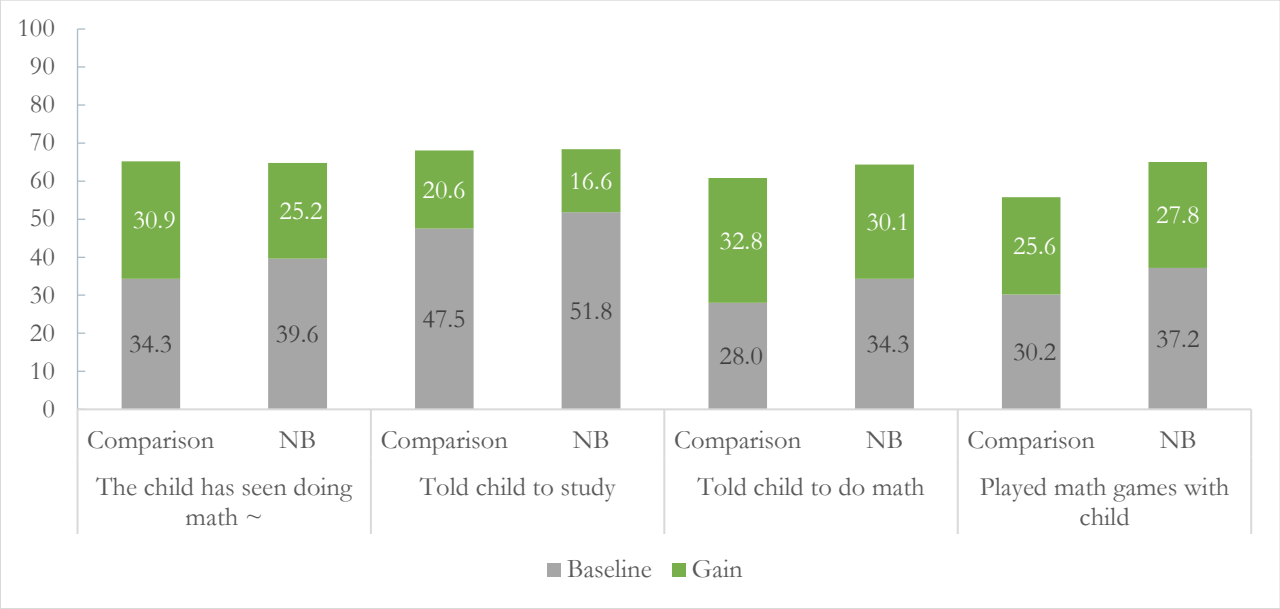
In terms of the Home Numeracy Environment (HNE), gains of students from comparison schools are larger for the majority of child friendly materials and numeracy habits. However, the only statistical significant difference in gains comes from children seeing someone doing math at home. Further information on the students' home numeracy environment can be found in Appendix A2.

Figure 1. Reading Materials.
Percentage of children that report having child-friendly reading materials at home. Baseline scores and gains



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%.

Figure 2. Numeracy Habits
Percentage of family members that…



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%.

VI. Endline Results

Overall Impact

Over the period of eight months children in Numeracy Boost schools had significant higher gains as compared to students in comparison schools in 14 out of the 17 numeracy skills assessed after controlling for background characteristics and baseline scores. The average effect size across subtest gains differences was of 0.5 (which is considered a medium effect size).[1] Details on baseline score, endline scores, gains can be found on Table 5.

[1] Widely cited statistician Jacob Cohen describes effect sizes of .2 as small, .5 as medium, and .8 as large. Cohen, J.: *Statistical Power Analysis for the Behavioral Sciences*. (2nd ed.) 1988.

Table 5. Numeracy scores (%) at baseline/endline, significance and effect sizes

Skill	Sample group	Baseline score	Endline score	Gain from baseline to endline	Sig difference in gain between groups[2]	SD Effect Size
Counting items	NB	88	98	10		0.05
	Comparison	92	98	6		
One to one corr	NB	99	100	1		-
	Comparison	100	100	0		
Zero concept	NB	35	91	56	***	0.28
	Comparison	53	79	26		
Number ID	NB	72	96	24	*	0.14
	Comparison	80	95	15		
Ordering numbers	NB	47	92	45	***	0.33
	Comparison	55	80	26		
Magnitude dis.	NB	54	89	35	***	0.34
	Comparison	59	83	24		
Missing value	NB	35	85	49	***	0.61
	Comparison	40	68	27		
Place Value	NB	40	89	49	***	0.62
	Comparison	49	60	11		
Skip 2s	NB	55	92	37	*	0.22
	Comparison	67	84	17		
Skip 5s	NB	35	95	60	***	0.36
	Comparison	45	85	40		
Shape Patterns	NB	21	72	51	***	0.46
	Comparison	23	54	31		
Addition	NB	13	45	32	***	0.79
	Comparison	15	34	19		
Subtraction	NB	8	37	29	***	0.72
	Comparison	11	25	14		

[2] Calculated through multivariate regression analysis accounting for clustering of students in schools and controlling for a variety of factors including baseline score, sex, age, years in school, number of household members, whether the child attended ECD, a SES index and a HNE index.

Word problems	NB	31	80	49	**	0.31
	Comparison	36	72	36		
Shapes	NB	53	96	43	***	0.67
	Comparison	56	78	22		
Measurement	NB	53	94	42		0.05
	Comparison	65	93	28		
Time	NB	3	70	66	***	0.98
	Comparison	4	30	26		

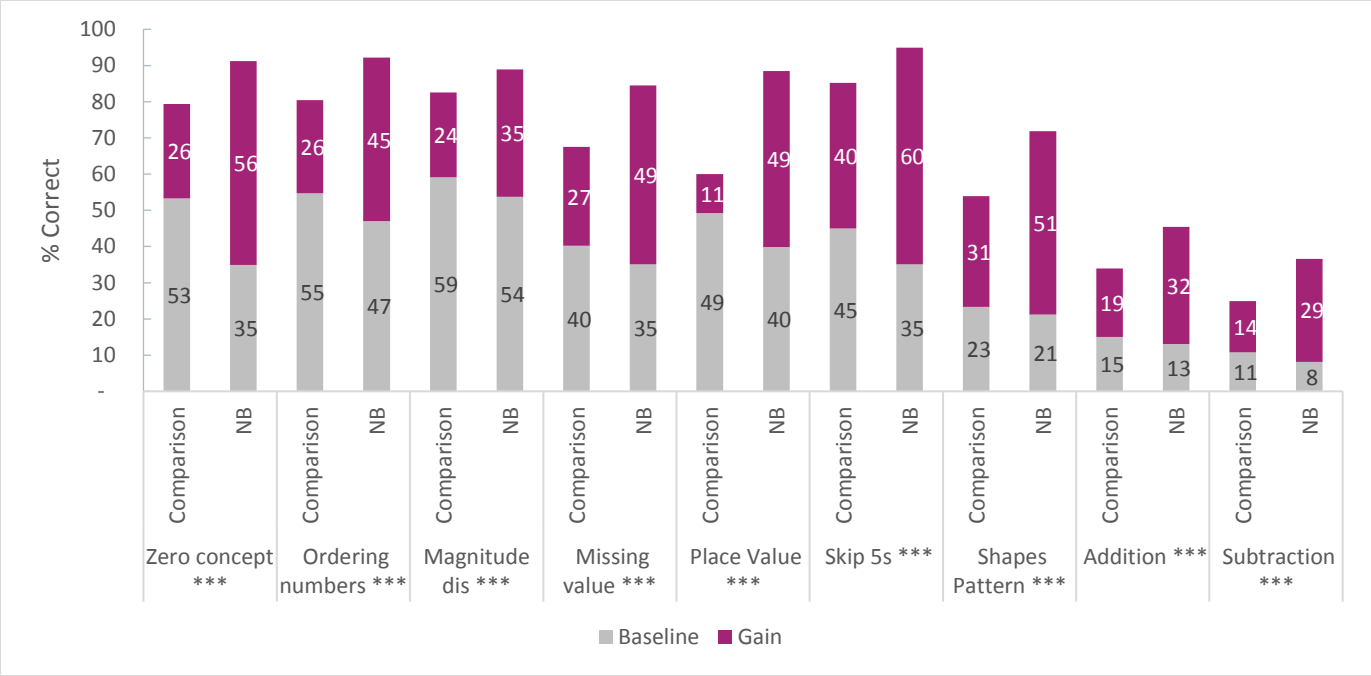
Individual Constructs Analysis

Numbers and Operations

In Numbers and Operations, gains of Numeracy Boost students were statistically greater that the gains made by comparison students in 12 out of 14 subtests. The two subtests where the gains were not significantly greater were counting and one to one correspondence. However, students already mastered these skills at endline so the no difference in gains is not practically significant. **Addition and subtraction are two skills that although significant gains were made in require further attention.** In the addition subtest students are scoring 45% on average correctly and in the subtraction subtest 37% correct, which roughly corresponds to 1 problem correct every 15 seconds. Figure 3 shows the baseline scores and gains for all subtests under the numbers and operations construct where the gains between comparison and Numeracy Boost students were significantly different at a 1% level.

Figure 3. Number sense and operations[3]. Baseline scores and gains by subtest

[3] For space purposes 5 subtests were left out of the graph: One to one correspondence and counting had no significant differences in gains while number identification, skip2s, and word problems gains were statistically different at a 5% level

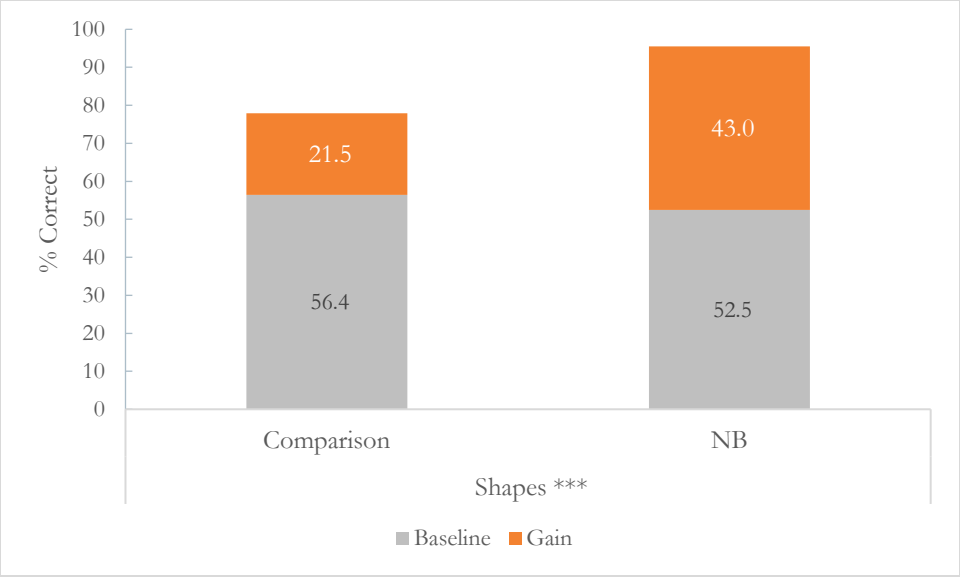


p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Significance was calculated through multivariate regression analysis accounting for clustering of students in schools and controlling for a variety of factors including baseline score, sex, age, years in school, number of household members, whether the child attended ECD, a SES index and a HNE index.

Geometry

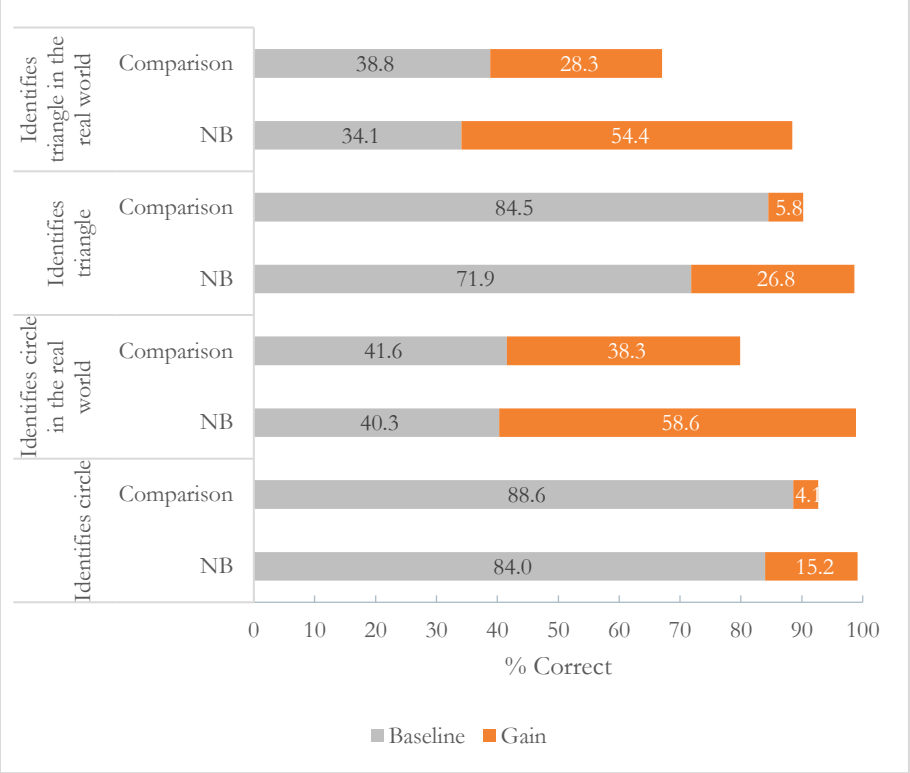
In the geometry subtest Numeracy Boost students had significantly higher gains than their peers. Doing a deeper glance at the questions asked, gains were not only large in identifying figures on paper, but also in being able to identify them in the real world. Figure 4 show the baseline scores and gains for the geometry subtest and Figure 5 disaggregates the subtest into four out of its five questions.

Figure 4. Geometry. Baseline scores and gains



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Significance was calculated through multivariate regression analysis accounting for clustering of students in schools and controlling for a variety of factors including baseline score, sex, age, years in school, number of household members, whether the child attended ECD, a SES index and a HNE index.

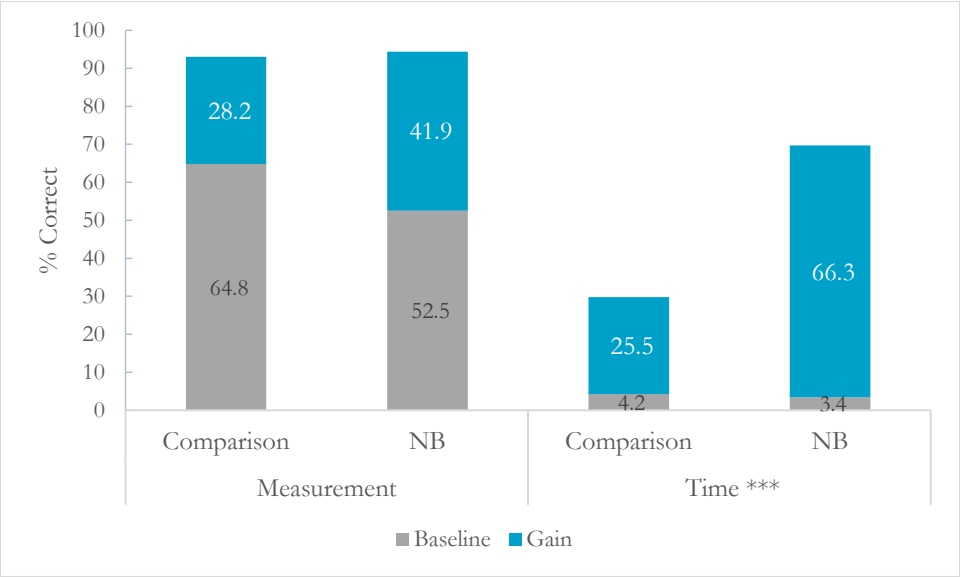
Figure 5. Geometry. Baseline scores and gains. Identifying figures on paper and in the real world



Measurement

In the measurement construct, Numeracy Boost students achieved the similar results at endline in the measurement items, in which they had started at a lower level than comparison students. In the time questions, Numeracy Boost students did significant gains as compared to comparison students as shown in Figure 6.

Figure 6. Measurement. Baseline Scores and Gains



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Significance was calculated through multivariate regression analysis accounting for clustering of students in schools and controlling for a variety of factors including baseline score, sex, age, years in school, number of household members, whether the child attended ECD, a SES index and a HNE index.

Impact by Subgroups (ELM and LB)

It is worth noting that the impact by subgroups is limited by the fact that even though students were purposely sampled in districts with ELM and LB programs, the questions in the student assessment do not allow us to confirm whether the students had actually been exposed to LB or ELM.

In the case of LB, there were no questions in the assessment related to whether the student had been exposed to LB so we cannot be certain of their exposure. In the case of the ELM subgroup, there are reasons to believe that some of the students that were sampled had not been exposed to these programs before: 50.6% of students in the sample from the ELM districts responded that they had not attended any sort of preschool learning program before enrolling into school.

ELM

The differences in gains between those students in ELM and NB exposure and those that had just NB exposure are inconclusive. Students in areas with ELM programs had greater gains in the "zero" subtest (0.1 effect size), lower gains in number identification (-0.01 effect size) and for all other skills the differences were not statistically significant. Further, even for these two skills were there was a statistical difference, the difference was significant at a 10% level and the effect sizes are small.

LB

Students in LB had higher numeracy gains than students not exposed to LB in 2 out of 17 skills assessed: counting and skip2s. The effect size was 0.06 for counting (and the difference significant at a 10% level) and 0.1 for skip2s (and significant at a 5% level). Given the data limitations, this suggest that students exposed to LB might have greater gains in other skills, but we are not able to capture them with the current data.

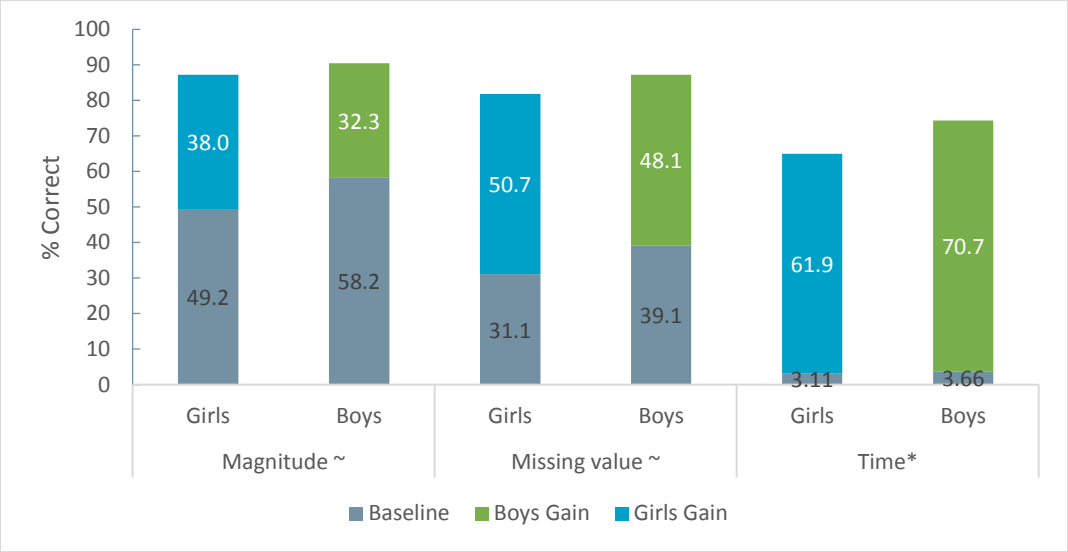
VII. Learning Equity and Struggling Students

This section analyzes the factors that relate to higher endline numeracy skills and higher gains in numeracy skiils for the group of Numeracy Boost students. Specifically, we investigate whether baseline numeracy skills and numeracy skill gains differ for traditionally disadvantaged groups, such as girls, the poorest of the poor, the HNE-deprived, and children without previous ECD experience. We also investigate whether students who struggled at baseline improved their test scores differently than other students, and whether struggling students share certain demographic characteristics. To conduct this analysis, baseline and endline data were used to construct indices of HNE and SES socio-economic status (SES) and HNE. Multivariate regression models were used to estimate the correlation between reading skills outcomes and these measures of equity. Details on the multivariate regressions that this section refers to can be found in Appendix B.

Girls

Results for boys and girls that were present at baseline and endline were different for three out of the 17 subtests at endline, and gains were different only for one of these subtests. The **Numeracy Boost program should be mindful of the skills in which girls might be falling behind**-two of which are related to number sense and operations and one which is related to measurement- **and help them catch up with their male peers**. Figure 7 shows the baseline scores and gains for the skills where endline results were statistically different between girls and boys and Appendix B1 contains the corresponding regression analysis. In the case of the time questions, not only where endline scores but also gains statistically different for boys and girls after controlling for baseline scores and background characteristics.

Figure 7. Boys and girls. Baseline scores and gains for skills with statistically significant differences in endline scores



p-value for difference in endline scores: ~10%, * 5%, ** 1 %, ***0.1%. Significance was calculated through multivariate regression analysis accounting for clustering of students in schools and controlling for a variety of factors including baseline score, sex, age, years in school, number of household members, whether the child attended ECD, a SES index and a HNE index.

ECD attendance

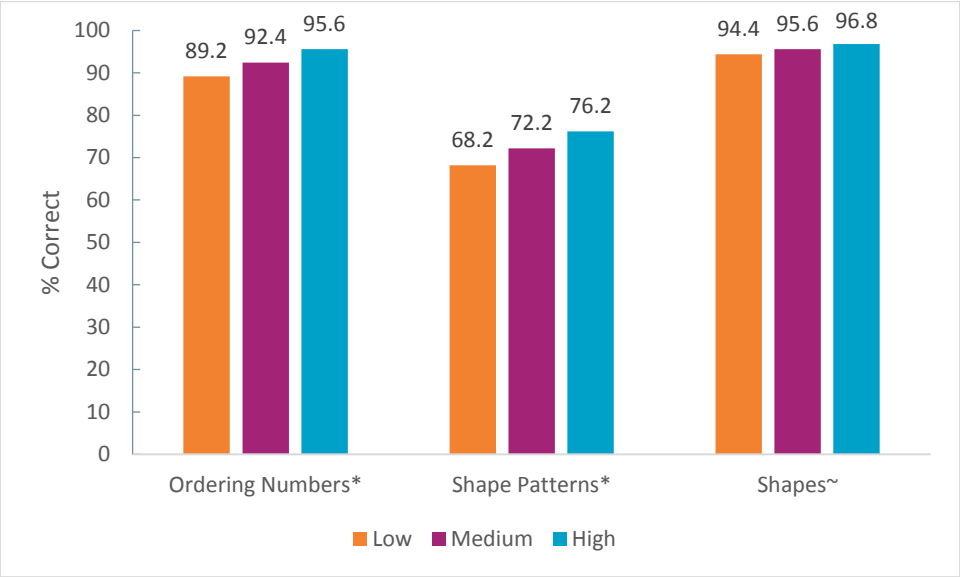
In three out of 17 skills, students reporting having attended an ECD program had lower gains. For two of these skills, zero and place value, the results are marginally significant and with low effect sizes (-0.096 and -0.09 respectively). For the time subtest the effect size was -0.2 and the difference in gains was significant at a 5% level.

SES and Home Numeracy Environment

Gains for Numeracy Boost students were no different depending on their socioeconomic status after controlling for other background characteristics and baseline scores showing that Numeracy Boost did not disproportionately benefit students depending on their socioeconomic background. The regression analysis also shows that endline scores are not different depending on SES (except for skip 5s where it is marginally significant) showing that the most disadvantaged students do not seem to be falling behind.

Gains and endline scores, however, were different depending on the Home Numeracy environment of the child. A higher baseline Home Numeracy Environment index was related to higher gains (in three of the numeracy skills assessed) and a higher Home Numeracy Environment index at endline was related with higher endline scores (in two of the numeracy skills assessed). **This demonstrates the importance of continuing to influence the Home Numeracy Environment of children through the program's activities**. Figure 8 shows the predicted endline scores for children for ordering numbers, patterns, and shapes taking into account their Home Numeracy Environment.

Figure 8. Predicted endline score by Home Numeracy environment tercile (low, medium, high)



p-value for difference in endline scores: ~10%, * 5%, ** 1 %, ***0.1%.

Struggling students

For the purposes of this analysis, struggling students were defined as those students that where in the bottom two quintiles of the number identification subtest at baseline. This subtest was chosen as it provided enough variation in students' baseline scores and the average in baseline scores in this subtest was fairly high (72%).

Examining the struggling students' characteristics, they are younger on average and pertain to a lower Home Numeracy Environment household. In terms of their gains, they are likely to have lower gains in 13 out of the 17 subtests assessed. **Identifying struggling students and supporting their learning can help them not to keep falling behind their more skill advantaged peers.**

VIII. Conclusion

The results show that the overall impact of the Numeracy Boost program in the region has been high. **Over the period of eight months children in Numeracy Boost schools had significant higher gains as compared to students in comparison schools in 14 out of the 17 numeracy skills assessed after controlling for background characteristics and baseline scores.** The three skills were statistically equal gains between intervention and comparison groups were found were counting, one-to-one correspondence and measurement, with the first two being skills that students had already mastered so the no difference in gains is not practically significant.

In terms of the difference in achievement amongst subgroups (those children that had been exposed to ELM programming and LB programming before) the results are limited in this front as we did not have a reliable source of information to determine whether the students in the sample were exposed to these programs. The results show however modest higher gains for children in LB programming schools in three out of 17 skills and modest higher gains for the "zero subtest" and a lower one for number identification for students in districts with ELM programming. **One avenue**

for future research is to purposely identify students that have had confirmed participation in ELM and/or Literacy Boost, and create the evaluation sample based on these students.

Finally, in terms of learning equity there are a few skills were boys scores outperform girls at endline (magnitude, missing value, time) and were high numeracy environments at endline are predictive of higher endline scores (ordering numbers, shape patterns, shapes).

Appendix A. Descriptive Statistics

A1. Background Characteristics of Children at Endline

	Whole Sample	NB	Comparison	Statistical sig diff (NB vs. comparison)
General characteristics				
Female (%)	48.2	50.0	44.2	
Age (yrs)	10.1	9.9	10.4	**
Attended ECD/Preeschool (%)	33.8	45.1	9.1	***
Time in school (yrs)	2.6	2.8	2.3	***
Household members (n)	5.8	5.7	6.1	**
Repeater- Grade 1 (%)	21.4	24.2	15.2	*
Repeater- Grade 2 (%)	11.2	10.7	12.1	
Does chores (%)	99.8	99.7	100.0	
Home language-Afaan Oroomo (%)	99.2	98.9	100.0	
SES				
House- iron sheets roof (%)	84.3	81.3	90.9	**
House- poles walls (%)	100.0	100.0	100.0	
House- dirt floor (%)	100.0	100.0	100.0	
Has radio (%)	60.3	61.3	58.2	
Has tv (%)	6.8	6.9	6.7	
Has latrine (%)	88.3	87.6	89.7	
Has electricity (%)	20.4	18.4	24.8	~
Has bicycle (%)	1.1	1.7	0.0	~
Livestock (n)	4.6	4.5	4.6	
Observations	529	364	165	

p-value: ~10%, ** 5%, *** 1 %

A2. Home Numeracy Environment of children. Baseline, endline, and gains.

	Numeracy Boost			Comparison			
	Baseline	Endline	Gain	Baseline	Endline	Gain	Statistically significant difference in gains
% of Children that have……							
Textbooks	58.2	55.8	(2.5)	79.4	58.2	(21.2)	
Religious books	8.5	22.8	14.3	9.1	30.3	21.2	
Magazines					21.2		

	0.3	12.6	12.4	6.1		15.2	
Newspapers	1.4	11.0	9.6	1.8	6.67	4.9	
Storybooks	0.8	5.5	4.7	2.4	10.3	7.9	
Coloringbooks	2.5	6.6	4.1	0.6	6.06	5.5	
Comics	0.3	2.8	2.5	0.6	1.21	0.6	
Booklets	-	0.8	0.8	-	0	-	
% of Household members that the child……							
Has seen doing math	39.6	64.8	25.2	34.3	65.2	30.9	~
Told child to study	51.8	68.4	16.6	47.5	68.1	20.6	
Told child to do math	34.3	64.4	30.1	28.0	60.8	32.8	
Played math games with child	37.2	62.8	25.6	30.2	58	27.8	
Observations	364	364	364	165	364	165	

Appendix B. Multivariate regression analyses

Appendix B1. Girls and Boys. Analysis of endline scores for NB students

Variable	% Counting items correct	% One to one items correct	Zero concept	% Number ID correct	% Ordering numbers correct	% Magnitude correct
Student sex	**0.006**	**0.003**	**0.006**	**-0.019**	**-0.036**	**-0.036~**
Student age	0.003	0.001	0.003	0.009~	0.019*	0.005
Repeater- Grade 2	-0.026	0.003	0.014	-0.013	-0.023	-0.007
Attended ECD/Preeschool	0.010	-0.003	-0.052~	0.014	0.021	-0.028
SES quintiles at endline	0.001	0.002	0.017	0.003	0.011	0.004
Constant	0.949***	0.987***	0.854***	0.866***	0.719***	0.860***
R-squared	0.016	0.016	0.014	0.023	0.026	0.017
Observations	364	364	364	364	364	364

Variable	% Missing value correct	% Place Value Correct	% Skip 2s correct	% Skip 5s correct	% Pattern correct
Student sex	**-0.059~**	**0.026**	**-0.024**	**-0.014**	**0.029**

Student age	0.007	0.009	0.012	0.004	0.010
Repeater- Grade 2	-0.053	0.039	0.033~	0.006	-0.042
Attended ECD/Preeschool	-0.043*	-0.063*	0.012	0.002	-0.101**
SES quintiles at endline	0.014	-0.002	0.011	0.012~	0.006
Constant	0.795***	0.816***	0.780***	0.880***	0.636***
R-squared	0.031	0.022	0.017	0.009	0.023
Observations	364	364	364	364	364

Variable	% Addition correct	% Subtraction correct	% Word problems correct	% Shapes correct	% Measurement correct	% Time items correct
Student sex	**-0.001**	**-0.031**	**-0.022**	**-0.016**	**-0.028**	**-0.100***
Student age	0.015	0.008	0.011	-0.002	-0.001	0.001
Repeater- Grade 2	0.041	-0.017	0.016	-0.022	-0.003	-0.065
Attended ECD/Preeschool	-0.079**	-0.037	-0.018	-0.025	0.005	-0.118*
SES quintiles at endline	0.017	0.016	0.004	-0.001	-0.003	0.014
Constant	0.294*	0.275*	0.704***	0.999***	0.972***	0.752***
R-squared	0.048	0.022	0.005	0.016	0.005	0.037
Observations	364	364	364	364	364	364

Appendix B2. Home Numeracy Environment and Endline Scores

Variable	% Counting items correct	% One to one items correct	Zero concept	% Number ID correct	% Ordering numbers correct
Student sex	**0.005**	**0.003**	**0.001**	**-0.019**	**-0.038**
Student age	0.002	0.000	0.001	0.009~	0.018~
Repeater- Grade 2	-0.026	0.002	0.007	-0.012	-0.018
Attended ECD/Preeschool	0.010	-0.003	-0.050~	0.014	0.021
HLE quintiles endline	0.001	0.001	0.003	0.006	0.019*
Constant	0.952***	0.992***	0.916***	0.865***	0.715***
R-squared	0.015	0.012	0.008	0.028	0.040
Observations	364	364	364	364	364

Variable	% Magnitude correct	% Missing value correct	% Place Value Correct	% Skip 2s correct	% Skip 5s correct	% Pattern correct
Student sex	**-0.037***	**-0.062***	**0.026**	**-0.027**	**-0.017**	**0.028**
Student age	0.004	0.005	0.009	0.010	0.002	0.009
Repeater- Grade 2	-0.003	-0.055	0.040	0.027	0.005	-0.033
Attended ECD/Preeschool	-0.028	-0.042~	-0.063*	0.014	0.003	-0.101**
HLE quintiles endline	0.011	0.011	0.001	0.001	0.010	0.022*
Constant	0.847***	0.827***	0.807***	0.827***	0.905***	0.604***
R-squared	0.024	0.030	0.021	0.012	0.009	0.031
Observations	364	364	364	364	364	364

Variable	% Addition correct	% Subtraction correct	% Word problems correct	% Shapes correct	% Measurement correct	% Time items correct
Student sex	**-0.006**	**-0.036**	**-0.023**	**-0.016**	**-0.026**	**-0.104***
Student age	0.013	0.006	0.010	-0.002	-0.001	-0.000
Repeater- Grade 2	0.036	-0.023	0.017	-0.018	0.004	-0.073
Attended ECD/Preeschool	-0.078*	-0.035	-0.017	-0.025	0.004	-0.116*
HLE quintiles endline	0.007	0.006	0.007	0.007~	0.012	-0.001
Constant	0.345**	0.327*	0.705***	0.978***	0.931***	0.816***
R-squared	0.042	0.016	0.006	0.024	0.014	0.035
Observations	364	364	364	364	364	364

Appendix B3. Struggling Students Characteristics

Variable	Student struggled at baseline (number ID)
Student sex	0.093
Student age	-0.063**
Attended ECD/Preeschool	-0.076
Number of household members	-0.009

Repeater-Grade 1	-0.007
Repeater- Grade 2	-0.046
SES quintiles	-0.025
HLE quintiles	-0.034*
Chores	0.244
Constant	0.971***
R-squared	0.075
Observations	364

Appendix B3. Predicted gains for struggling students

Variable	Counting Gain (%)	One-To-One Gain (%)	% Zero Gain (%)	Numberid Gain (%)	Order Gain (%)
Student struggled at baseline	**0.009**	**-0.005**	**-0.055~**	**0.107****	**-0.082****
Student sex	0.015~	0.003	0.016	-0.012	-0.015
Student age	-0.000	0.000	0.001	0.002	0.011
ECD/Preeschool attendance	0.014~	-0.004	0.008	0.007	0.025~
Number of household members	-0.000	-0.000	-0.008	-0.001	0.000
Repeater-grade 1	-0.013	0.002	0.025	0.002	0.024
Repeater-grade 2	-0.011	0.001	0.014	0.002	0.009
SES quintiles	-0.001	0.001	0.010	0.001	0.014*
HLE quintiles	0.002	-0.001	0.001	0.004	0.012~
Do you do chores?	-0.003	-0.002	0.062	-0.022	0.040
% Counting items correct	-0.808***				
% One to one items correct		-1.007***			
Zero			-0.953***		
% Number ID correct				-0.654***	
% Ordering numbers correct					-0.891***
% Magnitude correct					
% Missing value correct					
% Place Value Correct					
% Skip 2s correct					
% Skip 5s correct					
% Pattern					
% Addition					
% Subtraction					
% Wordproblems					
% Shapes					
% Measurement					
% Time					
Constant	0.806***	1.009***	0.844***	0.669***	0.679***
R-squared	0.863	0.850	0.721	0.871	0.741

Observations	364	364	364	364	364

Variable	Magnitude Gain (%)	Missing Gain (%)	Value Gain (%)	Skip2S Gain (%)	Skip5S Gain (%)
Student struggled at baseline	**-0.098****	**-0.176*****	**-0.128****	**-0.052~**	**-0.064*****
Student sex	-0.008	-0.036	0.027	-0.004	0.002
Student age	-0.005	-0.008	0.002	0.007	0.002
ECD/Preeschool attendance	-0.025	-0.017	-0.094**	0.030*	0.026
Number of household members	-0.003	0.009	0.019~	0.004	-0.001
Repeater-grade 1	0.011	0.031	-0.003	0.018	0.008
Repeater-grade 2	0.013	0.006	0.002	-0.004	-0.030
SES quintiles	0.001	0.005	-0.003	0.009	0.005
HLE quintiles	0.002	0.020*	0.007	0.003	0.003
Do you do chores?	-0.039*	0.034	0.055	-0.056*	-0.041*
% Counting items correct					
% One to one items correct					
Zero					
% Number ID correct					
% Ordering numbers correct					
% Magnitude correct	-0.801***				
% Missing value correct		-0.854***			
% Place Value Correct			-0.966***		
% Skip 2s correct				-0.909***	
% Skip 5s correct					-0.880***
% Pattern					
% Addition					
% Subtraction					
% Wordproblems					
% Shapes					
% Measurement					
% Time					
Constant	0.923***	0.809***	0.767***	0.813***	0.934***
R-squared	0.604	0.506	0.676	0.792	0.685
Observations	364	364	364	364	364

Variable	Pattern Gain (%)	Addition Gain (%)	Subtraction Gain (%)	Wordproblems Gain (%)	Shapes Gain (%)
Student struggled at baseline	**-0.150****	**-0.114*****	**-0.150*****	**-0.145*****	**-0.038****
Student sex	0.039	0.027	0.003	-0.005	-0.009
Student age	0.003	0.001	-0.004	-0.007	-0.005
ECD/Preeschool attendance	-0.032	-0.078**	-0.032	-0.027	-0.013

Number of household members	0.003	0.001	0.007	0.011	0.006
Repeater-grade 1	0.044	0.015	0.002	0.050	-0.011
Repeater-grade 2	0.037	0.004	-0.028	0.006	-0.004
SES quintiles	0.005	0.004	0.005	-0.010	-0.000
HLE quintiles	0.024~	0.005	0.005	0.010	0.004
Do you do chores?	0.198	-0.080	0.016	-0.034	0.016
% Counting items correct					
% One to one items correct					
Zero					
% Number ID correct					
% Ordering numbers correct					
% Magnitude correct					
% Missing value correct					
% Place Value Correct					
% Skip 2s correct					
% Skip 5s correct					
% Pattern	-0.980***				
% Addition		-0.304**			
% Subtraction			-0.345**		
% Wordproblems				-0.825***	
% Shapes					-0.921***
% Measurement					
% Time					
Constant	0.429*	0.460***	0.346**	0.844***	0.936***
R-squared	0.471	0.097	0.125	0.475	0.840
Observations	364	364	364	364	364

Variable	Measurement Gain (%)	Time Gain (%)
Student struggled at baseline	**-0.013**	**-0.237*** **
Student sex	-0.023	-0.084*
Student age	-0.005	-0.008
ECD/Preeschool attendance	-0.008	-0.149*
Number of household members	0.004	-0.014
Repeater-grade 1	-0.023	0.010
Repeater-grade 2	0.011	-0.072
SES quintiles	-0.007	0.003
HLE quintiles	0.001	0.026~
Do you do chores?	0.020	0.032
% Counting items correct		
% One to one items correct		

Zero		
% Number ID correct		
% Ordering numbers correct		
% Magnitude correct		
% Missing value correct		
% Place Value Correct		
% Skip 2s correct		
% Skip 5s correct		
% Pattern		
% Addition		
% Subtraction		
% Wordproblems		
% Shapes		
% Measurement	-0.933***	
% Time		-0.780***
Constant	0.953***	0.932***
R-squared	0.816	0.164
Observations	364	364