



NUMERACY BOOST IKEA PAKISTAN ENDLINE REPORT

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List of Acronyms and Definitions

Acronym	Definition
CLWS	Community Learning Workers
HNE	Home Numeracy Environment
NB	Numeracy Boost
SES	Socioeconomic Status
SHN	School Health and Nutrition
SIP	School Improvement Plan
SMC	School Management Committee

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Executive Summary

This report examines the results of a learner background survey and numeracy assessment conducted in Shaheed Benazir Abad and Lodhran, Pakistan, prior to beginning the Numeracy Boost (NB) intervention and again after 15 months of implementation. The baseline survey and numeracy assessment covered 540 grade 2 learners throughout 80 schools and was administered in June 2014. The January 2016 follow-up gathered data again only in Shaheed Benazir Abad from 82 of these children and 199 replacement 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.

In terms of Home Numeracy Environment, a similar percentage of children in NB and comparison schools report having math books and gains in textbooks are higher for comparison students. Playing math games with the child is uncommon and similar amongst NB and comparison schools, with children reporting on average 1.5 family members (out of 9 possible) playing a math game with them.

In terms of numeracy skills, gains were different and larger for Numeracy Boost children in only one out of 14 subtests- telling time. Some reasons why this could be the case is because the implementation was halted at various times during 2015, and the sample size of tracked students is small enough (n=82) that small differences in gains will not have been able to be captured.

By endline, students in NB schools had mastered several of the subtests including one-to-one correspondence, skip 5s, and understanding 0 beans concept. The subtests that NB students still struggle in and need additional support from the program moving forward are timed addition and subtraction. The largest gains for Numeracy Boost students were seen in the time, skip 5s, shape patterns, and word problems subtests.

Despite gains being no different between Numeracy Boost and comparison students for the majority of subtests, the results continue to highlight the importance of an appropriate Home Numeracy Environment for learners. Greater types of materials are associated with higher endline scores for the shapes, time, patterns, and measurement subtests. Numeracy Boost should continue to encourage the provision of print and play materials in the home and numeracy activities with family and community members.

Finally, the results highlight the importance of continue to support girls in Numeracy Boost programming and investigate the reasons why they might be falling behind. The results show that endline outcomes for girls are lower in 5 out of the 14 subtests at endline, their gains are smaller in two of these subtests, and struggling students are more likely to be girls.

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I. Introduction

This report examines the results of a learner background survey and numeracy assessment conducted in Shaheed Benazir Abad and Lodhran, Pakistan, prior to beginning the Numeracy Boost (NB) intervention and again after 15 months of implementation. The baseline survey and numeracy assessment covered 540 grade 2 learners throughout 80 schools and was administered in June 2014. The January 2016 follow-up gathered data again only in Shaheed Benazir Abad from 82 of these children and 199 replacement children. The program was closed in 2015 in Lodhran which prevented data to be collected again in this site. 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, socioeconomic status, home literacy and other characteristics. The results of this report will inform targeting of further interventions in the area.

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. Of the whole endline sample (including replacement students), how comparable are background characteristics among Numeracy Boost learners versus comparison learners?
4. What can the endline assessment tell us about students' math skills?
 - What does this mean for continuing Numeracy Boost programming in this area?
5. 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?
6. 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 Shaheed Benazir Abad and Lodhran districts. Next, this report gives an overview of the research methods used; including sampling, measurement, and analysis. The report then analyzes the attrition of the sample over time and how intervention and comparison groups have or have not remained statistically similar. Then, the report presents results from impact analyses investigating the

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extent to which Numeracy Boost appears to have improved learners' numeracy skills. After this, learners' endline scores for each of the numeracy skills are analysed to determine which skills learners have mastered and which require additional improvement. Finally, the report investigates any correlations between baseline to endline numeracy skill development and student background and home numeracy environment variables using multivariate regression analysis.

II. Context

Save the Children and IKEA Foundation initiated a child rights programme, "Improving the lives of children in cotton growing districts of Pakistan", in the cotton growing districts of Sindh and Punjab. The first phase of the programme extended from 2009 to 2013, focusing in one district in Punjab and one in Sindh (District Muzaffargarh and District Sanghar respectively). This is the second phase of project initiated in July 2014 in two new districts: Shaheed Benazir Abad (Sindh Province) and Lodhran (Punjab Province) that aims to reach 153,000 girls and boys in 350 communities of two cotton-growing districts of Pakistan to ensure they get to exercise their rights to survival, development, protection and participation. This is an integrated project having education, child protection and health as its three main components/themes.

For education, the objective of the project reads: "By the end of the project, 68,116 girls and boys (5-12 years) will have improved learning outcomes through education systems strengthening".

To achieve the above mentioned objective Save the Children implemented Numeracy Boost along with Literacy Boost, School Health and Nutrition (SHN), revitalization of School Management Committee (SMC), development of School Improvement Plan (SIP) and provision of school supplies in the targeted schools.

The Numeracy Boost component aims to reach 49,550 children and 113,000 parents in 350 Schools through 700 teachers and 175 Community Learning Workers (CLWS) in both Shaheed Benazir Abad and Lodhran.

The baseline study was conducted in June 2014 after which implementation activities followed. The program was put on hold in Lodhran in May 2015 and continued to take place in Shaheed Benazir Abad, although in less schools than originally planned at baseline. The endline assessment was only conducted in Shaheed Benazir Abad.

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III. Implementation History

Table 1. Implementation History

Date	Activity	Output
June 2014	Baseline assessment. Grade 2 students assessed on numeracy concepts	540 students assessed, 180 from Comparison and 360 from NB schools
Oct 2014	Conducted National Level ToT for Master Trainers	23 participants from two implementing partners' organizations (DevCon and Lodhran Pilot Project-LPP) and Government training institutes participated in the ToT.
Dec. 2014-Jan 15	Teacher Training: Basic training to math teachers on NB components (Numbers & operation, Measurement and Geometry)	300 math teachers from grade 1 and 2 of the intervention schools took the training
Dec 2014 and mid Jan 2015	School Supplies: Math supporting materials (manipulatives) and math reference books were provided	150 intervention schools got different manipulatives and math story books
Feb 2015 to Jan 2016	Supportive Supervision: School-based coaching and supportive supervision was continuously conducted by project team	150 project schools got supportive supervision and coaching
March 2015	Community Learning Workers (CLWs) training on community Action component	70 Community Learning Workers (male, female) trained on LB community action component
March 2015 to Jan 2016	Math Camp Activity: Math camps were established around the intervention schools, math camp facilitators were trained	150 math camps in 150 intervention schools were established
October 2015	Follow-up Training: Based on the reflections from supportive monitoring and coaching, a follow-up training to teachers were given	25 Master trainers from intervention schools were refreshed on key math components
January 2016	Endline Assessment: Grade 3 students tested on numeracy concepts	A total 281 students assessed from 52 schools.

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91 students assessed from 12 comparison schools and 190 from 40 NB schools.

IV. Methods

Sampling

The sample for the baseline assessment encompassed 540 grade 2 learners, divided between 54 schools set to receive the Numeracy Boost intervention (n of learners = 350) and 26 comparison schools (n of learners =190). The student sample at baseline covered the Shaheed Benazir Abad (n of learners=260) and Lodhran (n of learners=290) districts. The split at baseline of learners sampled is presented in Table 2.

Table 2. Baseline Sample

Group	Lodhran			S. Benazir Abad		
	N. of Schools	N. of Learners	Female %	N. of Schools	N. of Learners	Female %
Comparison	14	100	48.0%	12	90	41.1%
NB	24	180	48.9%	30	170	46.5%
Total	38	280	48.6%	42	260	44.6%

At each of the Numeracy Boost and comparison schools where data was collected, 20 children-10 girls and 10 boys- in grade 1 were sampled. If there was more than one section of grade 1 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 in the Shaheed Benazir Abad district excluding the children from 21 schools who did not end up having NB programming. Further, the students in Lodhran were not followed as Save the Children's operations in the district have been on hold since May 2015. Replacement students were found in Shaheed Benazir Abad to compensate for those students not assessed. The resulting sample is of 281 students, 82 of which were present at baseline. Details on the endline sample can be found on Table 3.

Table 3. Endline sample. Shaheed Benazir Abad

Group	Subsample	S. Benazir Abad	
		N. of Learners	Female %
Comparison	Present at baseline	38	36.8%
	Replacement	53	43.4%
NB	Present at baseline	44	38.6%
	Replacement	146	50.7%
Total		281	45.6%

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Measurement

For the student assessment, all learners in the sample were asked about their background characteristics (age, household possessions, household building materials, etc.). Learners were also 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 for help doing something that required math, etc). Table 4 offers examples of school survey items, background, and home literacy indicators.

Table 4. Student Background and Home Numeracy Environment Data Collected

Type of Data Collected	Examples
Student Background	
General	Sex, age, language spoken at home
School-related	Repetition history, previous ECD attendance
Socioeconomic status	Household possessions, access to public services, and livestock owned
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 one to one correspondence of items up to 22, two patterns subtests (skip counting by 5s to 50 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, number sense among ten sets of four numbers 1-100, identification of five missing numbers between 1-100, 20 timed addition problems, 20 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 three questions about

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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 Urdu. Table 4 below outlines the different components of the numeracy assessment.

Table 5. Numeracy Assessment Constructs and Measures

Construct	Measure	Scoring (# correct of ...)
Number Sense and Operations	One to one correspondence	22
	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)	6
	Number sense (10 sets of 4 numbers)	10
	Missing numbers identification (5 numbers)	5
	Timed addition (20 problems)	20
	Timed subtraction (20 problems)	20
Geometry	Shape identification (5 questions)	5
Measurement	Measuring items (3 questions)	3
Other	Time identification (3 questions)	3

Analysis

The 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. In terms of impact, this analysis must be taken with caution as the sample size of students that could be followed from baseline to endline is small, the Pakistan Reading Program which has a numeracy component was implemented in comparison schools, and there was transfer of teachers from Numeracy Boost to comparison schools during the time that the program was implemented.

Summary statistics will be used to analyze students' performance in each of the 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 at 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

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Of the 540 students surveyed at baseline, 179 out of 260 were looked for at endline in the Shaheed Benazir Abad district of which 82 were found (45.8%).¹ Student attrition was equally likely amongst students in NB and comparison schools and was not associated to particular background characteristics. Reasons for children that could not be found at endline include migration of the family and switching of schools.

Student Background Characteristics

At endline, students are 9.6 years old in average, 38% of them are female and 91% speak Sindhi at home. About 96% of them attended katchi (ECD program), and 24% repeated grade 1. In terms of socioeconomic characteristics 88% of them have access to electricity and the least owned asset in the household is a radio with 43% of children reporting they have one in their household. Appendix A1 contains further details on the characteristics of students at endline divided by comparison and intervention groups.

There are a few characteristics at baseline and endline that are different between NB and Comparison students and that need to be taken into account for impact and correlation analyses. For students present at baseline and followed through endline the main difference is that of home language.² For all students present at endline differences are: home language, chores, time spent studying, time spent working, and the presence of a radio, TV, and electricity in the home. **Controlling for the characteristics that are different will be important to understand the real extent of the program's effect in children's skills for those students tracked from baseline to endline and the differences in skills at endline for the whole sample of endline children (including replacements).**

Home Numeracy Environment

In terms of the Home Numeracy Environment (HNE), gains of students from comparison schools are larger and statistically significant only for textbooks and to a lesser extent for the number of household members that the child has seen doing math. The percentage of children with coloring books and math books is similar for NB and comparison students and lower for storybooks for comparison students although this result is not statistically significant. Further information on the students' home numeracy environment can be found in Appendix A2.

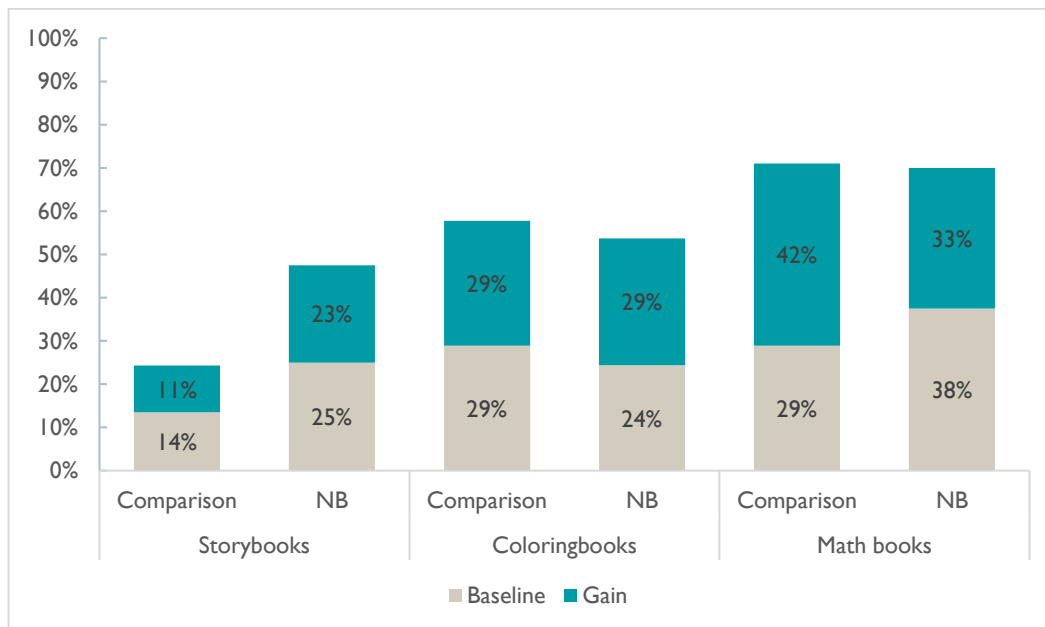
Figure 1. Reading Materials.

¹ Of the 260 students in Shaheed Benazir Abad at baseline 81 belonged to schools that did not implement Numeracy Boost programming for which they were not looked for again at endline.

² Grade repetition, doing chores, time spent working, and the presence of a TV and a bicycle in the home are also different but only significant at a 10% level

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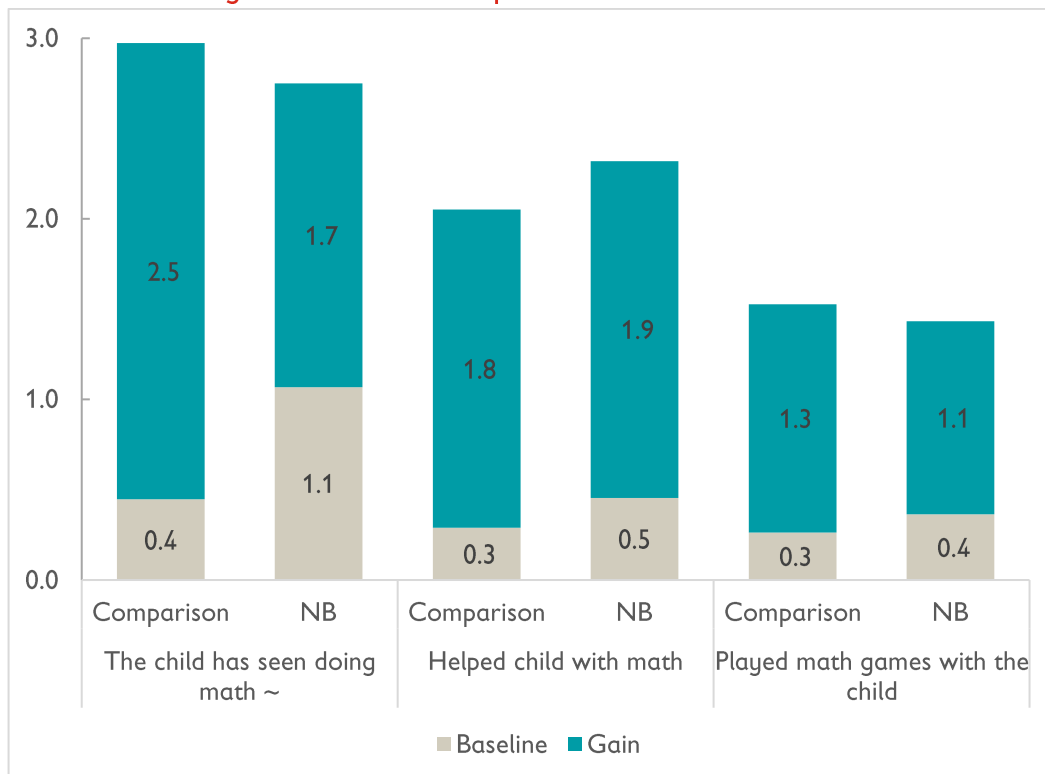
Percentage of children that report having child-friendly reading materials at home. Baseline scores and gains



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

Figure 2. Numeracy Habits

Number of family members out of 9 possible that...



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

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VI. Endline Results

Overall Impact

Over the period of 18 months children in the Numeracy Boost sample that was tracked from baseline to endline had significant higher gains as compared to students in comparison schools in 1 out of the 14 numeracy skills assessed- telling time- after controlling for background characteristics and baseline scores. The effect size of the gains difference was 0.5 (which is considered a medium effect size).³ Details on baseline scores, endline scores, and gains can be found in Table 6.

Table 6. Numeracy scores (%) at baseline/endline, significance and effect sizes

Subtest	Sample group	Baseline score	Endline score	Gain from baseline to endline	Sig diff. in gain between groups	SD Effect Size
% One to one corr. of 22	NB	97%	100%	3%		-
	Comparison	96%	100%	5%		
% Skip 5s corr. of 7	NB	43%	90%	47%		(0.02)
	Comparison	50%	94%	44%		
% Pattern corr. of 2	NB	32%	78%	47%		0.25
	Comparison	41%	62%	21%		
% Word prob. corr. of 3	NB	30%	77%	47%		0.15
	Comparison	40%	74%	33%		
Understands 0 beans concept	NB	52%	93%	41%		0.08
	Comparison	55%	90%	34%		
% Number ID corr. of 12	NB	60%	86%	26%		0.03
	Comparison	65%	89%	23%		
% Place Value corr. of 3	NB	61%	72%	11%		(0.09)
	Comparison	43%	78%	35%		
% Number sense corr. of 4	NB	53%	83%	29%		(0.10)
	Comparison	50%	87%	37%		
% Missing value corr. of 5	NB	41%	78%	37%		0.15
	Comparison	39%	74%	35%		
% Timed add. Corr. of 20	NB	6%	47%	41%		0.05

³ 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.

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	Comparison	7%	44%	37%	
% Subtraction corr. of 20	NB	3%	30%	27%	0.21
	Comparison	3%	26%	23%	
% Shapes corr. of 5	NB	45%	88%	44%	0.22
	Comparison	46%	85%	39%	
% Measurement corr. of 3	NB	36%	71%	35%	(0.03)
	Comparison	51%	70%	19%	
% Time items corr. of 3	NB	6%	56%	50%	*
	Comparison	16%	33%	18%	-

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

Individual Constructs Analysis

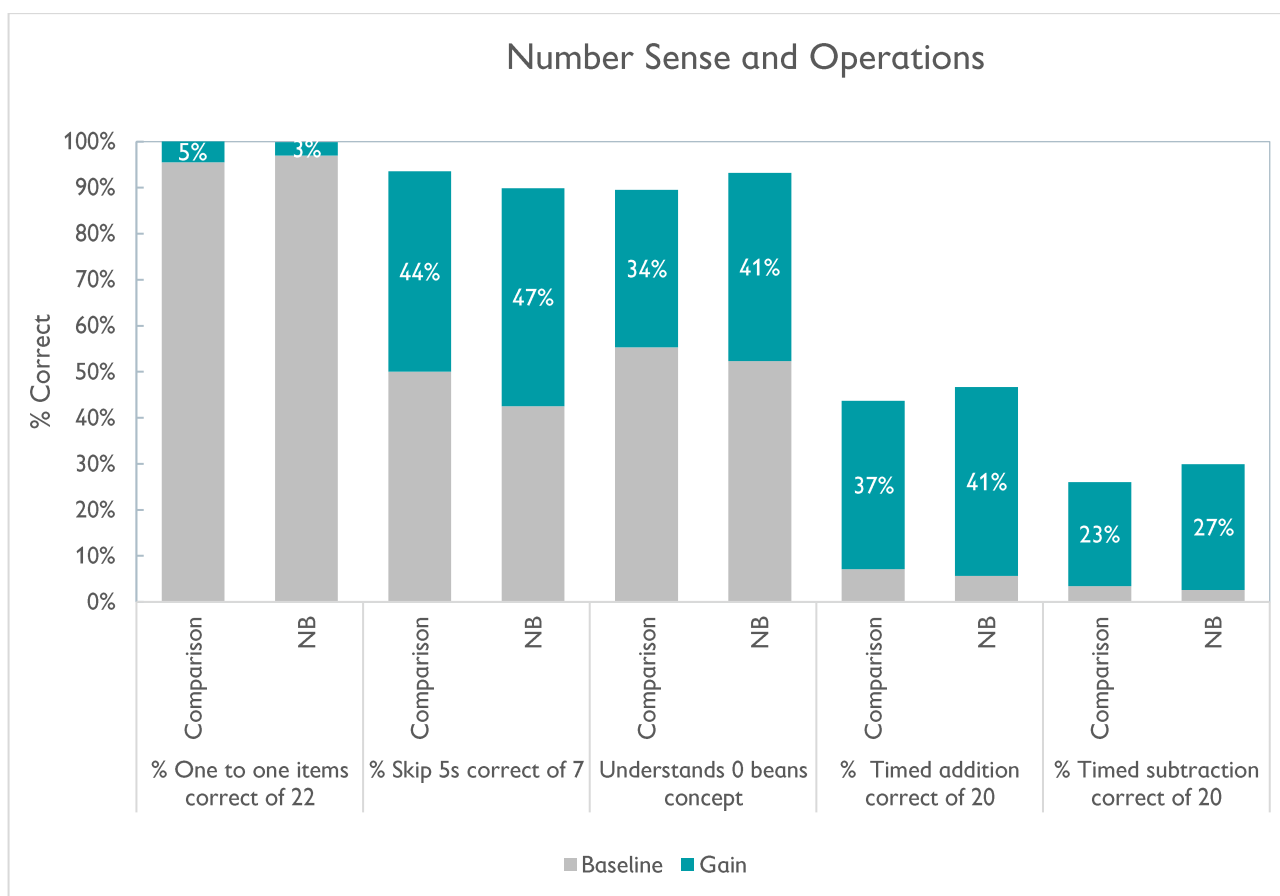
Number Sense and Operations

In Number Sense and Operations, gains of Numeracy Boost students were not statistically greater than the gains made by comparison students. In timed addition, subtraction, skipping numbers by fives and understanding the 0 beans concepts students in NB in the sample had greater gains but the difference was not statistically significant. Figure 3 shows the baseline scores and gains for all subtests under the Number Sense and Operations construct where the gains between comparison and Numeracy Boost students were total average endline score for NB students was higher than 90% or lower than 60%.

Figure 3. Number sense and operations⁴. Baseline scores and gains by subtest

⁴ For space purposes 8 subtests- patterns, word problems, number identification, place value, number sense, missing value, shapes and measurement were left out of the graph. None of these presented statistically significant difference in the gains of the students. The results presented in the graph are for those subtests where the total average endline score for NB students was higher than 90% or lower than 60%.

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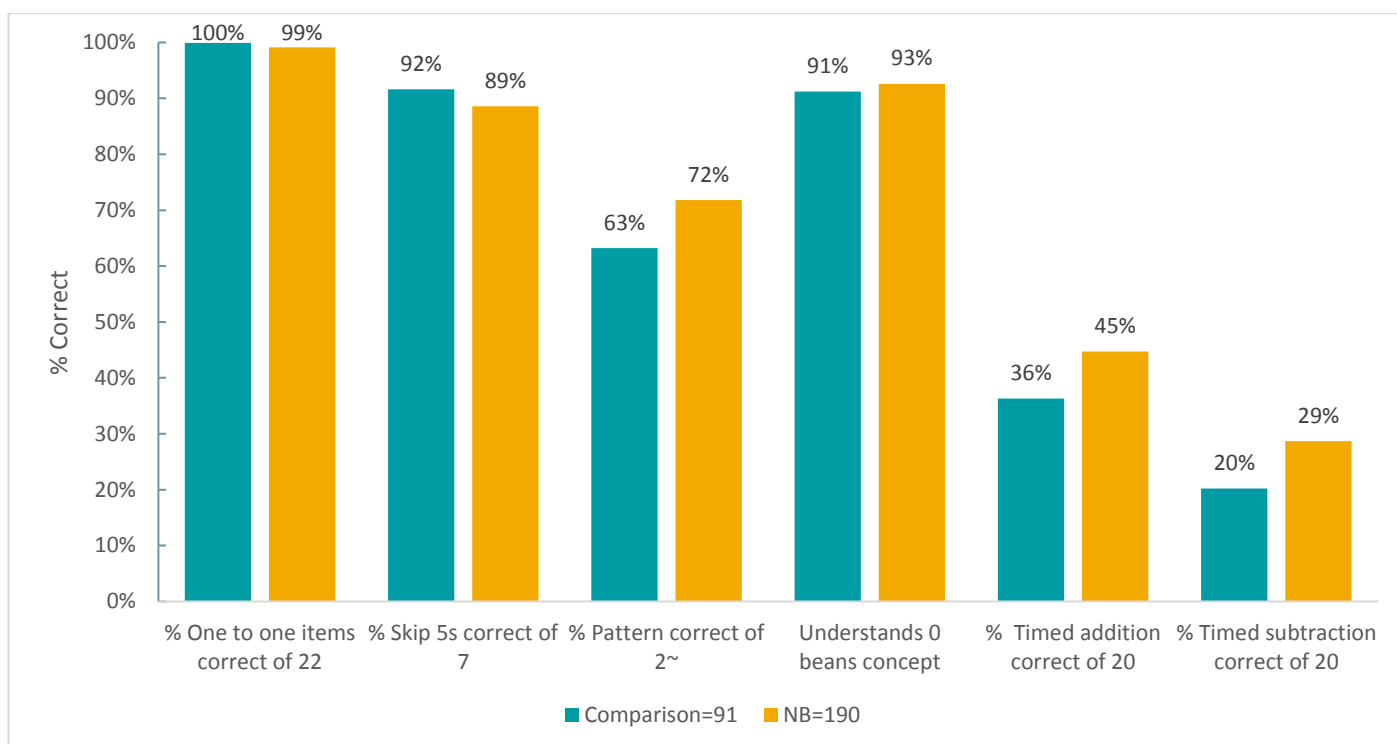


p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for background characteristics that were different amongst the groups and baseline score.

Considering all students present at endline, the patterns subtest is the only one where students in NB schools have higher gains within number sense and operations. As shown in Figure 4, by endline NB students had already mastered the one-to-one correspondence, skip fives and the zero concept subtest and **need additional support in timed addition and subtraction**. In the addition subtest students are scoring 45% on average correctly and in the subtraction subtest 29%, which roughly corresponds to the average child being able to solve 2 addition problems or 1 subtraction problem correctly every 15 seconds.

Figure 4. Number sense and operations. Endline scores for all comparison and NB students

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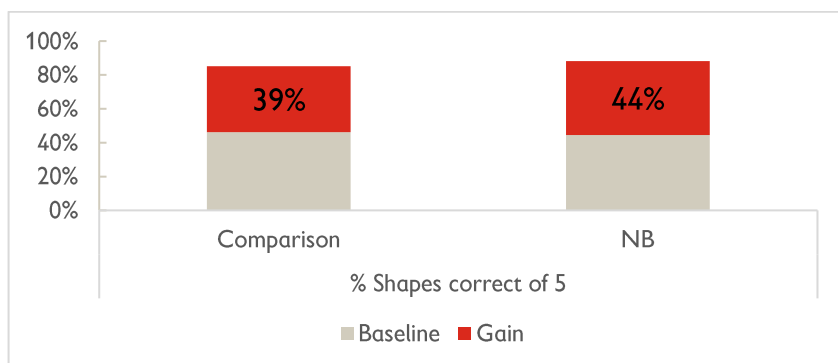


p-value for differences: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for background characteristics that were different amongst the groups.

Geometry

In the geometry subtest Numeracy Boost students did not have statistically significant higher gains than their peers. Doing a deeper dive at the questions asked, gains in the NB sampled students were larger in being able to identify a figure in the real world and larger for comparison students in being able to identify them on paper, but the differences are not statistically significant in either case. Figure 5 shows the baseline scores and gains for the geometry subtest and Figure 6 disaggregates the subtest into two out of its five questions.

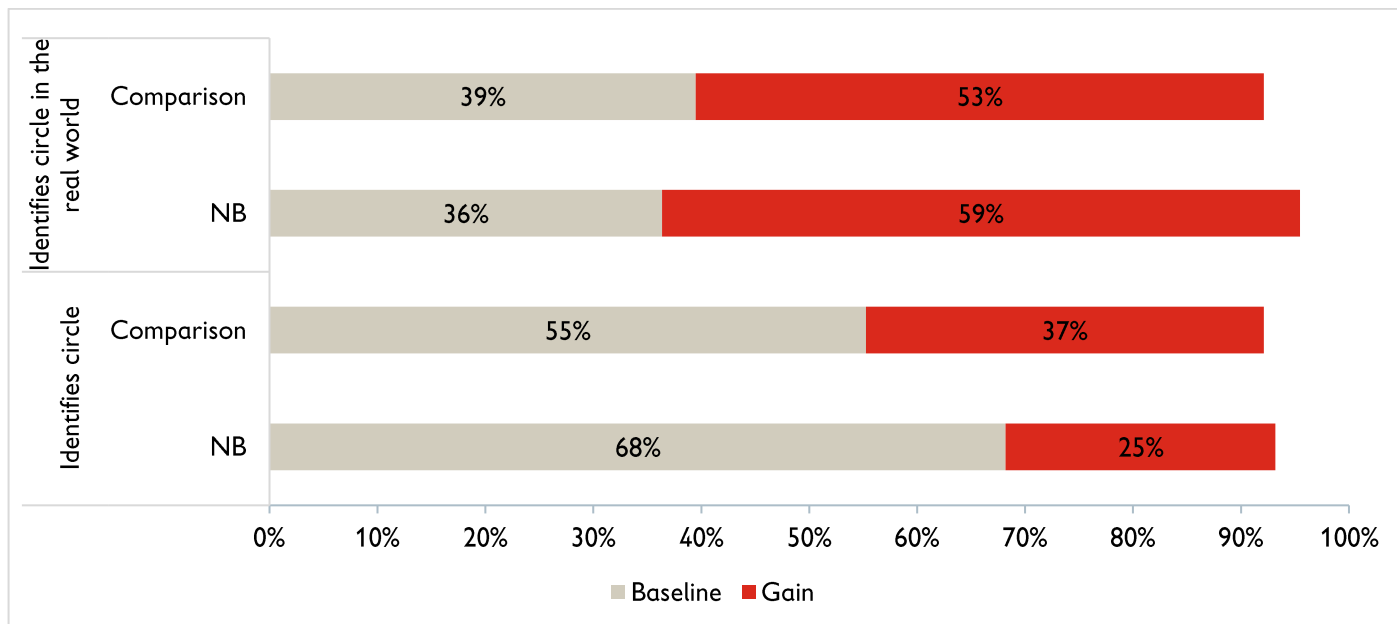
Figure 5. Geometry. Baseline scores and gains



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for background characteristics that were different amongst the groups and baseline score.

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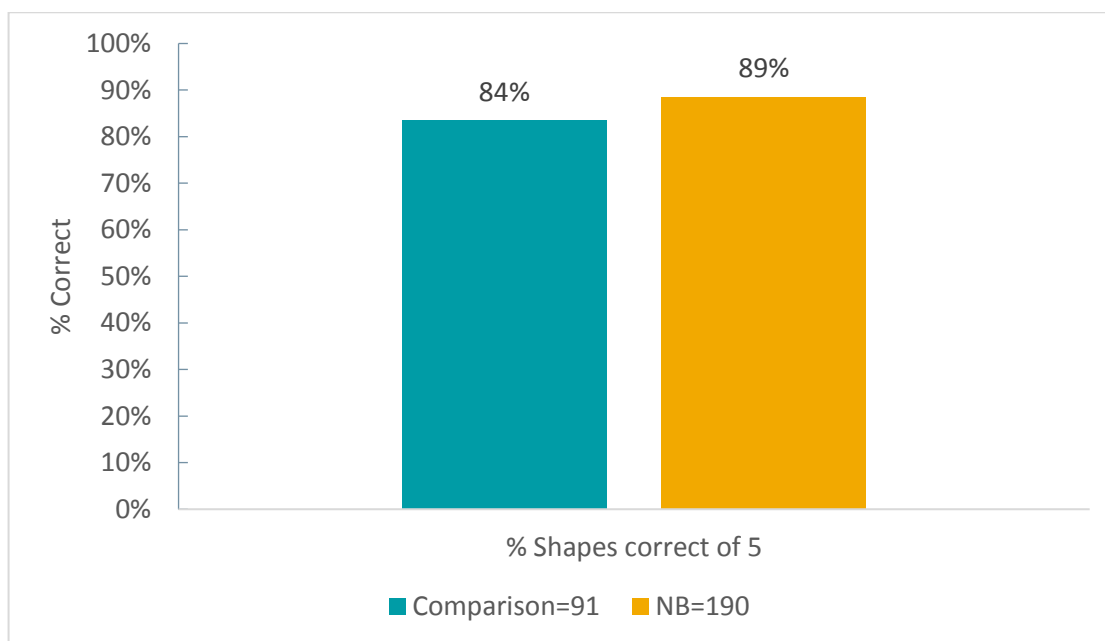
Figure 6. Geometry. Baseline scores and gains. Identifying a circle on paper and in the real world



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for background characteristics that were different amongst the groups and baseline score.

Considering all students present at endline, in the geometry subtest students in NB perform better on average, but the difference is not statistically significant.

Figure 7. Geometry. Endline scores for all comparison and NB students



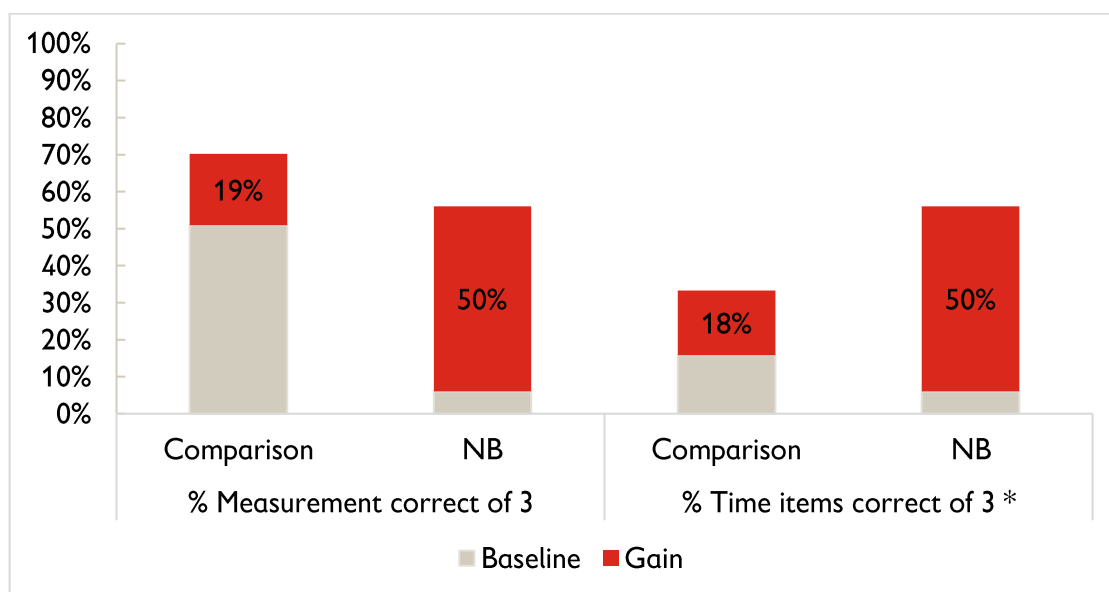
p-value for differences: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for background characteristics that were different amongst the groups.

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Measurement and Time

In the measurement construct, Numeracy Boost students in the matched sample achieved similar gain results at endline after controlling for baseline results and differences in background characteristics. In the time questions, Numeracy Boost students had significant higher gains as compared to comparison students as shown in Figure 8.

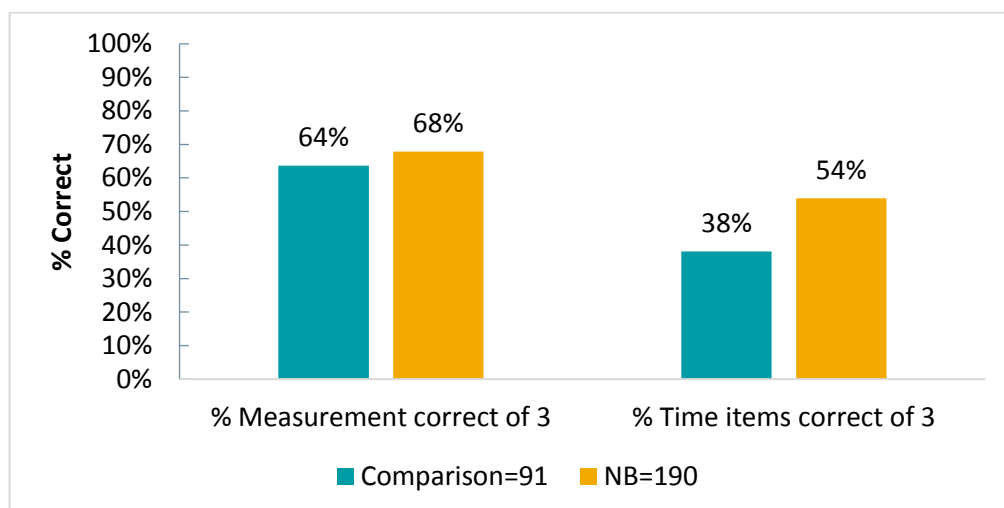
Figure 8. Measurement. Baseline Scores and Gains



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for background characteristics that were different amongst the groups and baseline score.

Considering all students present at endline, in the measurement and time subtests students in NB perform better on average, but the difference is not statistically significant.

Figure 9. Measurement. Endline scores for all comparison and NB students



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p-value for differences: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for background characteristics that were different amongst the groups.

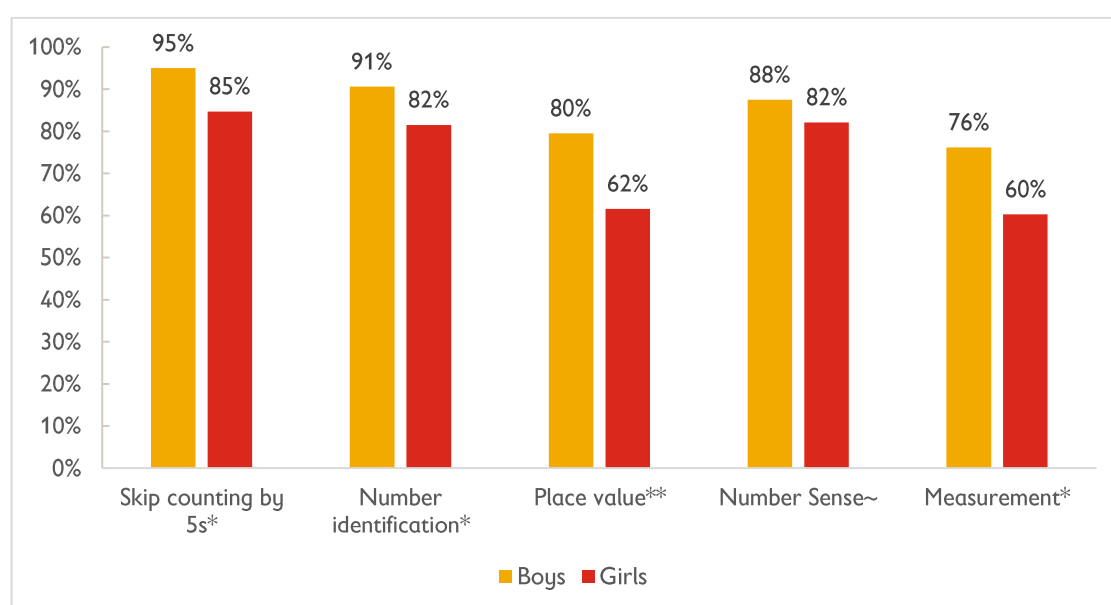
VII. Learning Equity and Struggling Students

This section analyzes the factors that relate to higher endline scores and gains in numeracy skills for Numeracy Boost students. Specifically, we investigate whether endline numeracy skills and numeracy skill gains differ for traditionally disadvantaged groups, such as girls, the poorest of the poor, the Home Numeracy Environment (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 analyses, endline data was used to construct indices of HNE and socio-economic status (SES). Multivariate regression models were used to estimate the correlation between reading skills outcomes and these measures of equity. Details on the multivariate regressions in which this section is based can be found in Appendix B.

Girls

At endline, results for girls were significantly lower in 5 out of the 14 subtests, and gains were smaller in number identification and place value- two of these subtests. The **Numeracy Boost program should be mindful of the skills in which girls might be falling behind**-four 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 10 shows the endline scores for the subtests where endline results were statistically different between girls and boys and Appendix B1 contains the corresponding regression analysis.

Figure 10. Boys and girls. Predicted endline scores with statistically significant differences



p-value for difference in gains: ~10%, * 5%, ** 1 %, ***0.1%. Statistical significance is shown after controlling for age, home language and a SES index that counts the total number of possessions in the household

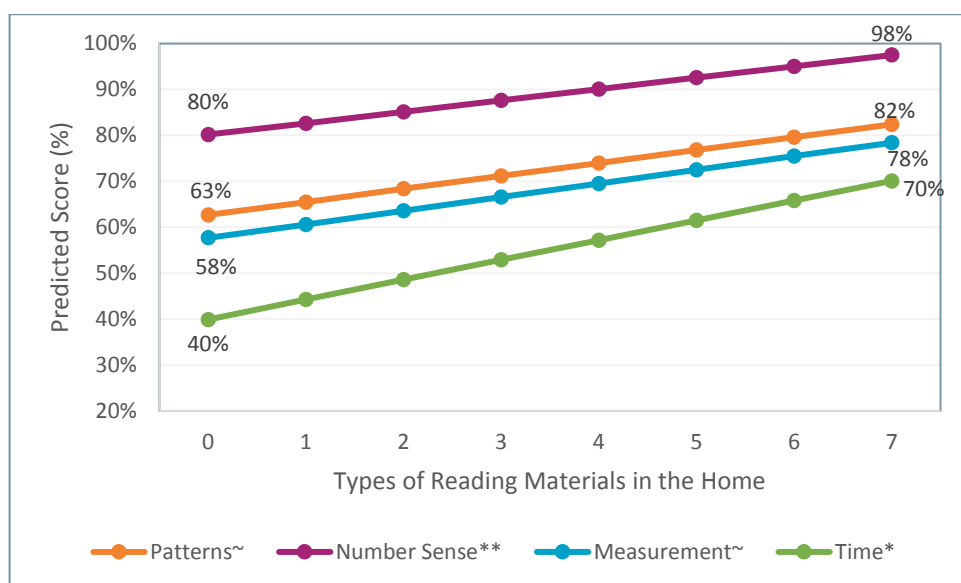
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SES and Home Numeracy Environment

After controlling for background characteristics and baseline scores, gains for Numeracy Boost students with a lower SES index are greater for three subtests- zero interpretation, place value, and number sense- and lower only for the time subtest showing that Numeracy Boost did not disproportionately benefit students depending on their socioeconomic background. The regression analysis also shows that endline scores are only higher for students with a higher SES index for the time subtest showing that the most disadvantaged students do not seem to be falling behind.

In terms of the Home Numeracy Environment, as shown in Figure 11, **greater types of math materials are associated with higher endline scores** for the shapes, time, patterns, and measurement subtests⁵. Encouraging print rich environments should continue to be a focus of the program as it enters into its third year.

Figure 11. Predicted scores by types of reading materials at home



Struggling students

For the purposes of this analysis, struggling students were defined as those students that were in the bottom quintile of the number identification subtest at endline. This subtest was chosen as it provided enough variation in students' endline scores and it had a moderately high correlation with other subtests in the different constructs as seen on Table 7.

⁵ The last two-patterns and measurement- are significant at a 10% level

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Table 7. Correlation of number identification with other subtests

Subtest	Correlation with Number ID
Number ID	1.00
One to one	0.20
Skip 5s	0.60
Patterns	0.27
Zero value	0.19
Timed addition	0.46
Timed subtraction	0.37
Place value	0.45
Number sense	0.58
Missing numbers	0.47
Problem solving	0.38
Shapes	0.27
Measurement	0.33
Time	0.14

Examining the struggling students' characteristics, they are younger on average and are more likely to be girls. **Identifying struggling students and supporting their learning can help them not to keep falling behind their more skill advantaged peers.**

VIII. Conclusion

After 15 months of Numeracy Boost programming in the Shaheed Benazir Abad district in Pakistan, Numeracy Boost learners have shown gains in Home Numeracy Environment, and all basic and advanced skills. However, these gains are no different to those of comparison schools with the exception of the time subtest. Reasons behind this include the fact that the implementation was halted at various times during 2015, the Pakistan Reading Program was implemented at comparison schools, some of the teachers from the Numeracy Boost program schools were transferred to comparison schools, and the sample size of tracked students is small enough (n=82) that small differences in gains will not have been able to be captured.

By endline, students in NB schools had mastered, and on average scored 90% or above, in several of the subtests including one-to-one correspondence, skip 5s, and understanding 0 beans concept. The subtests that NB students still struggle in, and score on average 50% or less, are timed addition and subtraction which can only be mastered by practice. Teachers should make time during class to practice this skill-by using flashcards, number games, and peer to peer support. The largest gains for Numeracy Boost students were seen in the time, skip 5s, shape patterns, and word problems subtests.

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Despite gains being no different between Literacy Boost and Comparison, the results continue to highlight the importance of an appropriate Home Environment for learners. Greater types of reading materials are associated with higher endline scores for the shapes, time, patterns, and measurement subtests. Literacy Boost should continue to encourage the provision of print materials in the home and reading activities with family and community members.

Finally, the results highlight the importance of continuing to support girls in Numeracy Boost programming and investigate the reasons why they might be falling behind. The results show that results for girls are lower in 5 out of the 14 subtests at endline, and gains are smaller in two of these subtests. Furthermore, struggling students are more likely to be girls.

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Appendix A. Descriptive Statistics

A1. Background Characteristics of Children present at Baseline and Endline

Background	Whole Sample	NB	Comparison	Statistical sig diff (NB vs. comparison)
General characteristics				
Female (%)	38%	39%	37%	
Age (yrs)	9.6	9.4	9.9	
Attended Preschool (katchi) (%)	96%	98%	95%	
Home language-Sindhi (%)	91%	83%	100%	*
Repeater- Grade 1 (%)	24%	32%	16%	~
Repeater- Grade 2 (%)	24%	30%	18%	
Does chores/works outside (%)	75%	84%	66%	~
Time spent studying (hrs)	1.4	1.4	1.3	
Time spent working (hrs)	1.4	1.0	1.8	~
SES				
Has radio (%)	43%	48%	0.4	
Has tv (%)	76%	84%	0.7	~
Has latrine (%)	88%	86%	0.9	
Has electricity (%)	88%	91%	0.8	
Has bicycle (%)	61%	51%	0.7	~
Has animals (%)	81%	86%	74%	
Observations	82	44	38	

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

A2. Background Characteristics of Children present at Endline

Background	Whole Sample	NB	Comparison	Statistical sig diff (NB vs. comparison)
General characteristics				
Female (%)	46%	48%	41%	
Age (yrs)	9.4	9.2	9.8	
Attended Preschool (katchi) (%)	98%	98%	98%	
Home language-Sindhi (%)	92%	88%	99%	**
Repeater- Grade 1 (%)	22%	23%	19%	
Repeater- Grade 2 (%)	20%	21%	18%	
Does chores/works outside (%)	74%	78%	67%	*
Time spent studying (hrs)	1.3	1.4	1.2	*
Time spent working (hrs)	1.2	1.0	1.5	***
SES				
Has radio (%)	54%	61%	40%	***
Has tv (%)	79%	85%	67%	***
Has latrine (%)	93%	94%	90%	

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Has electricity (%)	93%	95%	88%	*
Has bicycle (%)	67%	64%	73%	
Has animals (%)	87%	86%	87%	
Observations	281	190	91	

A3. Home Numeracy Environment of children. Baseline, endline, and gains

	Numeracy Boost			Comparison			Statistically significant difference in gains
Variable	NB Baseline	NB Endline	NB Gain	Comparison on Baseline	Comparison on Endline	Comparison Gain	
% of Children that have.....							
Textbooks	59%	57%	-2%	32%	87%	55%	***
Religious books	44%	58%	14%	31%	60%	29%	
Magazines	10%	40%	30%	5%	24%	19%	
Newspapers	46%	51%	5%	26%	42%	16%	
Storybooks	25%	48%	23%	14%	24%	11%	
Coloringbooks	24%	54%	29%	29%	58%	29%	
Math books	38%	70%	33%	29%	71%	42%	
N of Household members (out of 9) that the child.....							
Has seen doing math	1.1	2.8	1.7	0.4	3.0	2.5	~
Helped child with math	0.5	2.3	1.9	0.3	2.1	1.8	
Played math games with child	0.4	1.4	1.1	0.3	1.5	1.3	
Observations	44	44	44	38	38	38	
1/ values only for children with no missing data on the variable at baseline and endline							

Appendix B. Multivariate regression analyses

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

Variable	One to One % of 22	Skip Counting by 5 % of 7	Pattern % of 2	Problem Solving % of 3	Knows meaning of Zero
Female	-0.007	-0.103*	0.071	-0.026	0.004
Age	-0.003	0.025	-0.021	0.022	0.002
Home language: sindhi	-0.004	-0.083***	-0.011	0.051	-0.076*

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SES-Total number of possessions	-0.004	0.002	-0.021	0.035~	0.003
Constant	1.046***	0.780***	1.004***	0.410*	0.966***
R-squared	0.026	0.098	0.026	0.036	0.010
Observations	150	149	150	150	150

	Number ID % of 12	Place Value % of 6	Number Sense % of 10	Missing Numbers % of 5	Timed Addition % of 20
Female	-0.091*	-0.179**	-0.054~	-0.045	-0.034
Age	0.033*	0.01	0.012	0.018	0.036~
Home language: sindhi	0.004	0.102	-0.074**	0.068	0.067
SES-Total number of possessions	-0.007	-0.024	-0.009	0.017	-0.013
Constant	0.631***	0.732*	0.873***	0.518**	0.153
R-squared	0.123	0.078	0.069	0.025	0.036
Observations	148	150	150	150	148

	Timed Subtraction % of 20	Shape % of 5	Measurement % of 3	Time % of 3
Female	-0.022	-0.015	-0.158*	-0.107
Age	0.024	0.014	0.041*	0.033
Home language: sindhi	0.092	0.037	0.007	0.034
SES-Total number of possessions	-0.018	0.014	0.04	0.070**
Constant	0.087	0.670***	0.183	-0.062
R-squared	0.029	0.029	0.101	0.062
Observations	149	150	150	150

Appendix B2. Home Numeracy Environment (Reading Materials). Analysis of endline scores for NB students

	One to One % of 22	Skip Counting by 5 % of 7	Pattern % of 2	Problem Solving % of 3
Female	-0.008	-0.104*	0.073	-0.008
Age	-0.003	0.025	-0.023	0.028~
Home language: sindhi	-0.004	-0.084***	-0.011	0.052

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No. of family m.that play with the child	-0.003	-0.006	-0.030*	0.005
Types of reading materials	0	0.004	0.028~	0.022
Constant	1.036***	0.792***	0.881***	0.421*
R-squared	0.036342	0.1041239	0.0515303	0.0516305
Observations	148	147	148	148

	Knows Meaning of Zero	Number ID % of 12	Place Value % of 6	Number Sense % of 10	Missing Numbers % of 5
Female	-0.001	-0.097*	-0.163**	-0.057~	-0.037
Age	0.002	0.034*	0.016	0.012	0.021
Home language: sindhi	-0.077*	0.003	0.107	-0.075**	0.069
No. of family m.that play with the child	0.009	-0.003	-0.040*	-0.005	-0.013
Types of reading materials	-0.006	-0.012	0.037	0.003	-0.001
Constant	0.982***	0.640***	0.500~	0.826***	0.595***
R-squared	0.014908	0.1489231	0.1236872	0.0725817	0.0393511
Observations	148	146	148	148	148

	Timed Addition % of 20	Timed Subtraction % of 20	Shape % of 5	Measurement % of 3	Time % of 3
Female	-0.042	-0.025	-0.003	-0.139*	-0.072
Age	0.039*	0.027	0.017*	0.043**	0.033
Home language: sindhi	0.067	0.089	0.037	0.004	0.031
No. of family m.that play with the child	-0.027	-0.028	0.004	-0.018	0.004
Types of reading materials	-0.013	0.014	0.025**	0.030~	0.043*
Constant	0.168	(0.010)	0.604***	0.286	0.095
R-squared	0.0999015	0.062409	0.11338	0.1023435	0.0647394
Observations	146	147	148	148	148

Appendix B3. Interaction between Home Numeracy Interactions, SES and endline scores

	One to One % of 22	Skip Counting by 5 % of 7	Pattern % of 2	Problem Solving % of 3	Knows Value of Zero
SESXHLE interactions	0	0.001	-0.002	0	-0.002
SES-Total number of possessions	-0.002	0	-0.001	0.021	0.015
Total HLE interactions	-0.001	-0.012	0.008	0.006	0.008

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Female	-0.008	-0.113*	0.071	-0.014	0.007
Age	-0.003	0.022	-0.021	0.025~	0.003
Home language: sindhi	-0.004	0.080***	(0.012)	0.050	-0.077*
Constant	1.048***	0.855**	0.930**	0.389~	0.904***
R-squared	0.03	0.11	0.03	0.05	0.01
Observations	150	149	150	150	150

	Number ID % of 12	Place Value % of 6	Number Sense % of 10	Missing Numbers % of 5	Timed Addition % of 20
SESXHLE interactions	-0.006~	0.001	-0.001	0.003	-0.012*
SES-Total number of possessions	0.039	-0.029	-0.003	0.009	0.091~
Total HLE interactions	0.030~	-0.007	0.004	-0.019	0.043~
Female	-0.079*	0.184**	-0.052~	-0.061	-0.035
Age	0.037*	0.008	0.013	0.013	0.037~
Home language: sindhi	(0.002)	0.103	-0.075**	0.071	0.062
Constant	0.392	0.780*	0.840***	0.644**	-0.233
R-squared	0.15	0.08	0.07	0.04	0.12
Observations	148	150	150	150	148

	Timed Subtraction % of 20	Shape % of 5	Measurement % of 3	Time % of 3
SESXHLE interactions	-0.007	0.005	0.004	-0.004
SES-Total number of possessions	0.047	-0.033	0.019	0.082
Total HLE interactions	0.024	-0.016	-0.025	0.026
Female	-0.025	-0.011	-0.175**	-0.085
Age	0.024	0.015	0.037*	0.039
Home language: sindhi	0.090	0.039	0.011	0.029
Constant	-0.136	0.823***	0.36	-0.235
R-squared	0.07	0.11	0.11	0.07
Observations	149	150	150	150

Appendix B4. Struggling Students Characteristics

	Number identification in the lowest quantile
Age	-0.060**
Female	0.210*

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Home language: sindhi	0.011
SES-Total number of possessions	0.017
Constant	0.609*
R-squared	0.1089286
Observations	148

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