Digital Foundational Learning Program in Sierra Leone - Imagine Worldwide

2023-24 Learning Gains

Research Summary, 22 November 2024

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This summary describes the learning gains achieved by schools that implemented the **Digital Foundational Learning Program** by Imagine Worldwide during school-year 2023-24 in Sierra Leone. The research results show that **learning gains met expectations** on all three sets of learning metrics examined. **These are promising results for the first full year of program implementation**. We are pleased with the initial results and will continue to monitor learning gains during the next school year and beyond, when we expect to observe compounding learning that raises the level of achievement in the participating schools over time.

Background

The Digital Foundational Learning Program **uses tablets to deliver foundational learning in literacy and numeracy** through onebillion's award-winning software, onecourse. The program is built on a strong foundation of **rigorous research evidence**: at least nine randomized controlled trials (RCTs) have been conducted on onebillion's learning software in different countries, languages, and settings. These RCTs consistently showed that onebillion's software produced positive and significant learning gains in both literacy and numeracy in the early grades (see Research Summary).

This tablet program **responds to challenges in primary education in Sub-Saharan Africa** related to literacy and numeracy achievement. In Sierra Leone, the government set out in 2018 to transform its education system by increasing access and quality across all levels of schooling. Reforms have led to significant improvements, but early-grade assessments in 2014 and 2021 showed that most students were not achieving foundational literacy and numeracy. Nearly 90% of Sierra Leone students were unable to comprehend a simple text by age 10. The education system struggles with more than 40% untrained primary school teachers and a shortage of learning materials, which contributes to these outcomes. Imagine Worldwide is **partnering with the Sierra Leone Government** on the Digital Foundational Learning Program to help meet the government's commitment to radical inclusion and to halve the country's 97% learning poverty rate by 2030.

Imagine **implemented the Digital Foundational Learning Program in Sierra Leone** in 2023-24 in collaboration with EducAid and Rising Academy Network (RAN):

▸ Twenty-seven (27) of EducAid's schools were included in the 2023-24 research: 12 of these used the tablet program for the entire 2023-24 school year beginning in September 2023 and 15 used the program for two of the three school terms, beginning in January 2024.[1] Most of these schools (23 of the 27) were government schools; four were private schools. About 10 of the government schools

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[1] The September group launched the tablet program in two different waves: six in April 2023 and six in September 2023. Because of the smaller number of EducAid schools, we did not report on the September cohort (12 schools) and January cohort (15 schools) separately.

were Islamic schools and some were run by other missions. The schools were located in eight different chiefdoms. The tablet program was offered in Grades 1-6.

▸ Sixty-five (65) of RAN's schools were included in the 2023-24 research: 25 of these schools used the tablet program for the entire 2023-24 school year (we refer to these schools as the "RAN September 2023 cohort")[2] and 40 schools used the tablet program for two of the three school terms (we refer to these schools as the "RAN January 2024 cohort"). We report separately on the two cohorts. All 65 schools were public schools located in the capital, Freetown. The 25 September schools were located in Central Freetown, while the 40 January schools were located in the East End. The tablet program was offered in Grades 1-3.

The program is delivered on tablets in English to whole classes during the school day and **supplements standard instruction** in the targeted grades. Students typically use the learning software for 20-30 minutes per day, five days per week. They alternate between literacy and numeracy instruction from one day to the next. As part of a multi-year program, children will use the tablets for 3 total years in RAN schools and 6 total years in EducAid schools.

Research Focus

Following the extensive efficacy research that was previously done on onebillion's software, **Imagine's research is now focused on ensuring that program quality and outcomes are attained** as the tablet program expands in Sierra Leone. In addition to regular program monitoring performed by the implementation team, Imagine also conducted baseline and endline assessments of foundational literacy and numeracy skills during school year 2023-24. Our primary research question during this initial implementation year was

▸ Are we obtaining the expected learning gains based on prior research and experience?

eAssessment Methodology

To measure learning gains during 2023-24 we used the **digital EGRMA**, a tablet-based version of the Early Grade Reading and Mathematics Assessment in English for Sierra Leone. The eAssessment produces valid and reliable results at about one-quarter of the cost of the traditional paper-based assessment. One enumerator supervises a group of about 6-7 children at a time, who take the offline eAssessment on Android tablets. Enumerators upload the test results on a daily basis to Imagine's Sierra Leone-EducAid repository on RTI International's secure Tangerine server. The eAssessment is publicly available and technical information, along with additional materials, can be found on the public website [here](#).

We used the eAssessment to measure **four primary learning outcomes** at both baseline and endline: average % correct scores in literacy and numeracy and the % of children attaining emergent or fluent

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[2] The 25 RAN schools launched in three waves: five pilot schools in March 2023, 10 schools in September 2023, and 10 schools in October 2023. We refer to these schools as the "September cohort," which reflects when they were all baseline assessed. The remaining 40 schools launch in January 2024.

status in literacy and numeracy. The emergent or fluent measures were based on common early grade benchmarks using EGRA and EGMA.[3]

During 2023-24, we baseline-assessed 27 EducAid schools and 25 RAN schools in September 2023; we then baseline-assessed the remaining 40 RAN schools in January 2024. The **schools launched the Digital Foundational Learning Program following their respective baseline assessment**.[4] In July 2024, we endline-assessed in all 92 schools. Enumerators were recruited by EducAid and RAN and trained by an independent researcher hired by Imagine and who has expertise in both the traditional and digital EGRMA assessments. Enumerator trainings were conducted before each baseline and endline assessment to ensure adherence to assessment guidelines.

Post-efficacy research, our assessment approach uses a **repeated cross-sectional design** to measure learning gains in tablet schools and to track progress over time. This design involves annual baseline and endline assessments at the same schools, while different (randomly selected) children are assessed in each school at each time period (i.e., repeated cross-sections). We use a **stratified cluster sampling design** to select the children for assessment. In 2023-24, EducAid and RAN "purposively" selected their schools to be part of the tablet program. Within each school (i.e., cluster), 4 boys and 4 girls were randomly selected for assessment in each targeted grade (i.e., the strata). A total of 48 learners per EducAid school (Grades 1-6) and 24 learners per RAN school (Grades 1-3) were targeted to be assessed during each assessment period.

The **final analytic samples** included children who consented to be assessed; completed both the EGRA and EGMA components of the eAssessment; and had nonmissing data on critical variables (i.e., school, grade, gender). We calculated student population weights that reflected the sampling design described above. The analyses presented below and in the attached tables reflect the **weighted results** for the final analytic samples, which are representative of the schools at baseline and endline. The design ensured **sufficient sample size** for analysis of important subgroups (i.e., by grade and gender). It should be noted that while the sampling design produces reliable population-level (EducAid, RAN September cohort, RAN January cohort) results, it does not support producing reliable school-level results due to the relatively small sample size of students assessed at each school.

Results

Setting Expectations
The primary purpose of the 2023-24 research was to **ensure that we are maintaining quality** as the program expands. Specifically, we addressed the following primary research question
▸   Are we obtaining the expected learning gains based on prior research and experience?

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[3] The benchmarks were based on the spelling subtest (for literacy) per the Technical Report for the English EGRMA and on the missing number (pattern completion) subtest (for numeracy). Additional benchmarks can be added for monitoring in future.
[4] Five of the 25 schools in the "September RAN cohort" were pilot schools that began implementing the program in March 2023. We baseline-assessed these pilot schools in September 2023 for purposes of measuring full school-year 2023-24 learning gains.

To address this question, we focused on **three sets of learning metrics** and targets

1. Statistically significant overall gains on all four outcomes measures;
2. A doubling of the % of children attaining emergent or fluent status in reading and maths;
3. Girls gaining at least as much as boys, with possible gender gaps narrowing.

Context

It is important to **consider the following contextual factors** when interpreting the results

1. Baseline assessments were conducted prior to the Digital Foundational Learning Program launching in most of the research schools.[5] Thus, the baseline results generally indicate the learners' level of achievement before they used the tablets. That is, the baseline results reflect the learning due to standard instruction that occurred in the schools up to the time of baseline assessment.
2. Endline results captured the combination of learning that occurred between baseline and endline from both standard instruction and the Digital Foundational Learning Program.

Detailed Results for 2023-24

See the attached Tables 1 and 2.

Description of the Cohort Samples

What were the characteristics of the children participating in the program?

1. Table 1 - Cohort composition at baseline
   a. Enrollments in the RAN schools were evenly distributed across Grades 1-3 (about one-third in each grade). In contrast, there was a statistically significant decline in enrollments across Grades 1-6 in the EducAid schools, with Grade 6 enrolling about half the number of learners as Grade 1 (12% vs. 24% of total learners at the EducAid schools were enrolled in Grade 6 vs. Grade 1).
   b. The assessment samples in all three cohorts of schools seen in the table were composed of approximately equal proportions of girls and boys.
2. Table 2 - Baseline achievement for the September cohorts
   a. Focusing on Grades 1-3 for both EducAid and RAN
      i. At the start of the school year, children's average baseline achievement was fairly low, with overall average % correct scores ranging from 18% to 28% in literacy and 9% to 30% in numeracy.
      ii. The % of children in these grades who were emergent or fluent at the beginning of the school year ranged from 6% to 24% in reading and 1% to 28% in maths.
      iii. Baseline achievement in the RAN schools was similar to or lower than the baseline achievement in the EducAid schools.
   b. Baseline achievement increased across the grades (1-6 for EducAid and 1-3 for RAN). These statistically significant trends suggest that children were gaining foundational skills - prior to the tablet program - as they attended school for more years. However, in the

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[5] Five RAN pilot schools and six EducAid pilot schools had launched prior to the beginning of school-year 2023-24.

EducAid schools, the increasing performance may also be affected by declining enrollments across the grades. Typically, higher-achieving students and/or those from more well-off families are more likely to persist in school.

c. Several differences between boys and girls at baseline were statistically significant:

    i. In EducAid schools, gender gaps on both literacy measures were statistically significant at baseline: average % correct scores (26% for boys vs. 23% for girls) and % attaining emergent or fluent status in reading (28% for boys and 17% for girls).

    ii. In RAN schools, the only statistically significant gender gap at baseline was in the % of the January cohort who were emergent or fluent in maths (18% for boys vs. 11% for girls).

Learning Gains

How much learning did children gain by the end of the school year?

1. Table 2 - Learning gains

    a. Learners in all three cohorts in the table exhibited **statistically significant overall gains** on all four outcome measures (in literacy and numeracy) between baseline and endline assessment.

      ▸ In mathematics, almost all subgroups (by grade and gender) also made statistically significant gains.

      ▸ Foundational literacy skills typically take longer to build than foundational maths skills. Subgroup results showed

          1. Literacy gains in the EducAid schools were driven by statistically significant gains in Grades 4 and 5. Learners in these grades may have had the baseline skills to take full advantage of the first year of the tablet program in literacy.

          2. Literacy gains in the RAN schools tended to be driven by statistically significant gains in Grades 2 and 3. Grade 1 learners often need more than one year to build early foundational skills, especially in literacy and in contexts where they have not previously participated in early childhood development or education.

    b. Learning **gains generally increased as grade level increased**.

      ▸ This reflects typical patterns of learning compounding over time. It may also be influenced by declining enrollments across the grades in the EducAid schools, where higher-achieving students may be more likely to persist.

      ▸ In the EducAid schools, while still gaining, Grade 6 learners consistently gained less than Grade 4 and 5 learners. This could signal that Grade 6 learners in these schools may be nearing foundational skill standards: at endline, 82% of 6th graders had attained emergent or fluent status in reading and 93% had attained this status in mathematics.

c. The **gain in % of children attaining emergent or fluent status in mathematics met our doubling target** (i.e., a 100% gain): the % of learners overall who attained the emergent or fluent benchmark increased by between 102% and 199% in the three cohorts.

d. The **% of learners who attained emergent or fluent status in reading** increased by 58% and 78% in the two September cohorts and by 113% in the RAN January cohort. Familiarity with English - the language of instruction used in the tablets - may affect children's literacy learning. For example, in the EducAid schools, children's home language was usually Themne or Krio and children were observed to sometimes struggle with the tablet instruction. However, teachers typically report that children's ease in using the tablets improves with time.

e. With few exceptions, both boys and girls made statistically significant gains on all four outcomes measures. Further, **gender gaps were closing**.

  ▸ In the EducAid schools, the baseline gender gaps on the two literacy outcomes were no longer statistically significant at endline.

  ▸ In the RAN January cohort, the baseline gender gap in the % of the learners who were emergent or fluent in maths was no longer statistically significant (at the 0.05 level) at endline.

Future Research

The multi-year Digital Foundational Learning Program is expected to raise the current level of achievement in the participating schools over time. Data from school-year 2024-25 will be used for the following

▸ Compare baseline results from September 2024 with the baseline results from September 2023. We expect that using the tablet program for one school year will produce higher baseline achievement for Grades 2-3 (RAN) and Grades 2-6 (EducAid) in September 2024 compared with September 2023. This analysis will be available in December 2024.

▸ Compare endline results from July 2025 with endline results from July 2024. Learning compounds over time as foundational skills are acquired. Thus, we expect endline achievement for Grades 2-3 (RAN) and Grades 2-6 (EducAid) in July 2025 to be higher than endline achievement for these same grades in July 2024, due to the children participating for 2 years in the tablet program by July 2025 compared with 1 year of tablet exposure in July 2024. This analysis will be available in September 2025.

▸ We expect to see even higher results for Grades 3 (RAN) and Grades 3-6 (EducAid) in school-year 2025-26, when these learners will be in their third year of the tablet program. This result would indicate that the program is raising the overall level of achievement in the participating schools.

▸ Further, as the onebillion software is improved annually, based on research and experience in the field, we expect the trajectory of learning using the tablet program to accelerate over time.

During school-year 2024-25, as the program expands to 130+ schools in Sierra Leone, Imagine will conduct implementation research to understand the barriers to and enablers of quality implementation at scale. We will also conduct an end-of-year survey of stakeholder perceptions of the program's impacts.

Summary

As the Digital Foundational Learning Program expands in Sierra Leone, Imagine's research is focused on ensuring that we are attaining the program quality and outcomes evidenced in prior research. During the initial implementation year in 2023-24 our primary research question was whether we obtained the expected learning gains based on this prior research and experience. The research results show that **learning gains met expectations on all three sets of learning metrics.** Table 1 summarizes these results.

Table 1. Meeting expectations for learning gains: 2023-24

Metric	EducAid	RAN Sept cohort	RAN Jan cohort
Statistically significant overall gains on all four outcomes measures	Met expectations	Met expectations	Met expectations
A doubling of the % of children attaining emergent or fluent status in reading and math	Met expectations in mathematics; Reading may be influenced by familiarity with English	Exceeded expectations in mathematics; Reading may be influenced by familiarity with English	Exceeded expectations in both mathematics and reading
Girls gaining at least as much as boys, with possible gender gaps narrowing	Met expectations for similar gains; Gender gaps closing in literacy	Met expectations for similar gains; No baseline gender gaps	Met expectations for similar gains; Gender gap closing in mathematics

While the 2023-24 results are due to the combination of standard instruction in the schools and the program, **the magnitude of the gains is generally consistent with the tablet program experience in other contexts**. Further, there is evidence of statistically significant gender gaps closing during the school year, which counters the typical trend in primary schools of gender gaps widening over time.

Research during school-year 2024-25 will provide further evidence of the specific contribution of the tablet program to learning in these schools. Imagine will continue to measure learning gains through baseline and endline assessment, focusing on measuring compounding year-over-year learning. A comparison of baseline results from September 2024 with the baseline results from September 2023 for Grades 2 to 6 specifically will indicate whether the program produced higher baseline achievement after children used the tablets for one year. This analysis will be available in December 2024. Comparing endline results from July 2025 with endline results from July 2024 will similarly indicate whether the program is changing the trajectory of learning in participating schools. Finally, Imagine will conduct **implementation research** to understand any barriers to and enablers of quality implementation as the program expands in Sierra Leone. And an **endline survey** of stakeholders (head teachers, classroom teachers, parents, and learners) will provide insights into key stakeholder perceptions of the Digital Foundational Learning Program's impacts.

Table 1. Description of the Sierra Leone assessment samples, by cohort: baseline 2023-24

| | Baseline | | | | |
| | Educaid | RAN | | Difference | |
	Sept 2023	Sept 2023	Jan 2024	between Sept cohorts	Sig.(*)
Schools					
Assessment school count	27	25	40	--	
Learners					
Final analytic sample count (n)	941	553	844	--	
Column total %	100%	100%	100%	--	
Grade					
Grade 1	24	34	33	10	
Grade 2	18	35	34	17	*
Grade 3	17	31	33	14	*
Grade 4	16	--	--	--	
Grade 5	14	--	--	--	
Grade 6	12	--	--	--	
Gender					
Male	49	47	51	-2	
Female	51	53	49	2	

Note: The table presents weighted population results based on the sampling design. Calculations are performed on unrounded numbers.

--Not applicable.

(*)Indicates significance at the $p < 0.05$ level, based on adjusted p-values using the Bonferroni correction for multiple pairwise comparisons.

Table 2. Sierra Leone learning outcomes in literacy and numeracy, by cohort: baseline, endline, and gain, 2023-24

	Educaid - Sept cohort					RAN - Sept cohort					RAN - Jan cohort				
	Baseline Sept 2023	Endline July 2023	Gain	Sig.(*)	Gain as % of baseline	Baseline Sept 2023	Endline July 2023	Gain	Sig.(*)	Gain as % of baseline	Baseline Jan 2023	Endline July 2023	Gain	Sig.(*)	Gain as % of baseline
Final analytic sample count (n)	941	1,147	--	--	--	553	522	--	--	--	844	838	--	--	--
Outcome measure															
Literacy (EGRA)															
Average correct (1)															
Overall	24.4	30.5	6.1	*	25	23.0	30.9	7.9	*	34	23.2	28.5	5.3	*	23
Grade level															
Grade 1	18.4	19.6	1.2		6	19.1	24.1	5.0		26	18.0	21.9	3.9	*	22
Grade 2	20.0	25.0	5.0		25	22.5	29.6	7.1	*	32	22.5	28.1	5.6	*	25
Grade 3	24.1	28.9	4.8		20	27.9	39.8	11.9	*	43	29.1	35.5	6.4	*	22
Grade 4	25.1	35.6	10.5	*	42	--	--	--		--	--	--	--		--
Grade 5	29.6	41.0	11.3	*	38	--	--	--		--	--	--	--		--
Grade 6	36.9	44.3	7.4		20	--	--	--		--	--	--	--		--
Gender															
Boys	25.8	30.7	4.9	*	19	22.6	30.8	8.2	*	36	23.6	28.5	4.9	*	21
Girls	23.0	30.2	7.1	*	31	23.4	31.0	7.6	*	32	22.8	28.4	5.6	*	25
Attained emergent or fluent (2)															
Overall	22.2	35.1	12.9	*	58	13.8	24.6	10.8	*	78	10.1	21.5	11.4	*	113
Grade level															
Grade 1	6.2	9.4	3.2		52	7.7	1.5	-6.2		-81	0.3	2.1	1.8		600
Grade 2	8.5	14.3	5.9		69	11.2	16.6	5.4		48	6.6	19.6	13.0	*	197
Grade 3	18.3	25.2	6.9		38	23.5	58.3	34.8	*	148	23.5	43.2	19.7	*	84
Grade 4	19.7	45.7	26.0	*	132	--	--	--		--	--	--			--
Grade 5	39.5	68.1	28.6	*	72	--	--	--		--	--	--			--
Grade 6	65.5	82.3	16.8		26	--	--	--		--	--	--			--
Gender															
Boys	27.5	38.9	11.3	*	41	16.9	28.1	11.2		66	12.1	22.9	10.8	*	89
Girls	17.1	31.3	14.2	*	83	11.1	22.2	11.1		100	8.1	20.1	12.0	*	148
Numeracy (EGMA)															
Average correct (1)															
Overall	23.4	36.5	13.2	*	56	17.5	33.3	15.8	*	90	20.3	28.8	8.5	*	42
Grade level															
Grade 1	9.2	14.3	5.1		55	6.2	13.8	7.6	*	123	7.6	12.6	5.0	*	66
Grade 2	11.1	24.3	13.2	*	120	17.3	36.0	18.7	*	108	18.1	29.9	11.8	*	65
Grade 3	23.2	37.2	14.0	*	60	30.3	51.5	21.2	*	70	35.2	43.9	8.7		25
Grade 4	30.3	47.1	16.9	*	56	--	--	--		--	--	--	--		--
Grade 5	35.4	55.6	20.1	*	57	--	--	--		--	--	--	--		--
Grade 6	48.6	63.9	15.3	*	32	--	--	--		--	--	--	--		--
Gender															
Boys	24.9	36.3	11.4	*	46	17.6	32.1	14.5	*	82	22.3	30.9	8.6	*	39
Girls	21.9	36.7	14.9	*	68	17.3	34.2	16.9	*	98	18.3	26.6	8.3	*	45
Attained emergent or fluent (3)															
Overall	21.5	43.6	22.0	*	102	12.9	38.6	25.7	*	199	14.7	33.5	18.8	*	128
Grade level															
Grade 1	7.1	11.4	4.3		60	0.8	6.2	5.4	*	675	2.0	6.7	4.7		235
Grade 2	7.6	24.8	17.2	*	227	11.3	46.2	34.9	*	309	11.6	33.3	21.7	*	187
Grade 3	19.7	37.5	17.8	*	90	28.2	65.4	37.2	*	132	30.4	60.7	30.3	*	100
Grade 4	27.8	55.9	28.1	*	101	--	--	--		--	--	--	--		--
Grade 5	34.6	76.6	42.0	*	121	--	--	--		--	--	--	--		--
Grade 6	52.1	93.0	40.9	*	78	--	--	--		--	--	--	--		--
Gender															
Boys	23.6	43.6	19.9	*	85	13.1	36.3	23.2	*	177	18.4	36.8	18.4	*	100
Girls	19.6	43.6	24.0	*	123	12.7	40.2	27.5	*	217	10.9	30.1	19.2	*	176

Note: The table presents weighted population results based on the sampling design. Calculations are performed on unrounded numbers.

--Not applicable.

(*)Indicates significance at the p<0.05 level, based on adjusted p-values using the Bonferroni correction for multiple pairwise comparisons.

(1)Average correct across available subtests for each child.

(2)Based on the spelling subtest, per the Technical Report for the English

(3)Based on the missing number (pattern completion) subtest per common practice for early grade benchmarks using EGMA.