

# Technology-Based Innovations to Improve Early Grade Reading Outcomes in Developing Countries

Lessons from 11 All Children Reading:  
A Grand Challenge for Development Projects



Prepared by **School-to-School International (STS)**  
For **All Children Reading: A Grand Challenge for Development (ACR GCD)**

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Photos:

This page: Sesame Workshop India

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# Introduction

All Children Reading: A Grand Challenge for Development (ACR GCD)—a partnership between the United States Agency for International Development (USAID), World Vision, and the Australian Government—is an ongoing series of competitions that leverage science and technology to source, test, and disseminate scalable solutions to improve literacy skills of early grade learners in developing countries. Round 2 of ACR GCD, which started in 2014 and continues through 2018, seeks technology-based innovations to improve early grade reading outcomes in developing countries utilizing competitions, research, and partnerships.<sup>1</sup> Through a grant competition, 14<sup>2</sup> innovators from ten countries were selected to implement technology-based projects concentrating on three focus areas:

1. **Mother tongue instruction and reading materials**
2. **Family and community engagement**
3. **Children with disabilities**

ACR GCD Round 2 projects tested a wide range of technologies and implementation approaches to address students' reading needs at and outside of school. Across projects, and regardless of focus area, grantees supported students' mother tongue language development through the promotion of classroom instruction approaches or the creation of reading materials in students' mother tongue. Grantees incorporated a wide range of technologies into their projects, including hardware such as feature phones, smartphones, computers, tablets, and radio, or various assistive devices—Digital Accessible Information SYstem (DAISY)<sup>3</sup> players, braille embossers, Jot-a-Dot portable brailers, and others—to support students who have low vision or are blind and their educators.<sup>4</sup> Grantees also provided literacy content to beneficiaries through diverse software technologies, including mobile applications, websites, and others. Grantees implemented projects in different locations—within schools, in libraries, or at children's households. See Table 1 for details on ACR GCD Round 2 grantees and projects.



ACR GCD Round 2 increased its focus on the assessment of early grade reading skills to understand the ability of technology-based innovations to improve the literacy skills of early grade learners. School-to-School International (STS) collaborated with each grantee to develop their research study design. This included advising on sampling methods; conducting Early Grade Reading Assessments (EGRA)<sup>5</sup> at baseline and endline, systematically assessing reading skills across all Round 2 grantees; and providing technical assistance on each grantee's monitoring and evaluation (M&E) and fidelity of implementation activities. During the startup of each project, STS worked collaboratively with each grantee to refine their project's causal model and theory of change, design an M&E plan, and create a research design and research questions that could adequately capture the project's impact on the literacy skills of early grade learners. In some cases, this required redesigning parts of a project's model, adding or modifying components, adjusting the implementation to accommodate multiple intervention groups, or updating the number of targeted beneficiaries.

At the end of each project, STS also conducted qualitative interviews with project managers, beneficiaries, and key stakeholders to explore lessons learned from implementation, understand the impact on beneficiaries, and assess the potential scalability.

TABLE 1

## Summary of ACR GCD Round 2 Grantees and Projects



### GraphoGame™ Teacher Training Service

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Agora Center at the University of Jyväskylä	Zambia		ciNyanja		295	\$345,650

#### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
<p>Students played GraphoGame™ in ciNyanja on smartphones at schools in rural Zambia.</p> <p>Teachers received in-person training and completed online training on techniques to teach literacy in mother tongues and support struggling readers.</p>	Smartphones	<p>GraphoGame™ digital application that helps children learn letter sounds, syllables, and words.</p> <p>Website with seven modules provided teacher training resources to support struggling readers, story reading and telling, designing literacy games and singing.</p>	School

### Bookshare India: Improving Reading Skills Among Primary Students with Low Vision or Blindness

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Beneficent Technologies, Inc.	India		Marathi		115	\$408,995

#### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
<p>Students in India who have low vision or are blind were provided accessible reading materials in their mother tongue, Marathi.</p> <p>Story uncle or auntie hosted weekly literacy sessions to support braille reading.</p> <p>Students were given independent reading time at school each day to read large-print or braille materials and listen to audio recordings of the books.</p>	DAISY players, an audio device with accessible navigation features	Fifty audio stories on DAISY players accompany braille books.	School



Mother tongue instruction and reading materials



Children with disabilities



Family and community engagement

Pre-reading



Foundational




Reading comprehension





Photo: Resources for the Blind



## Lesotho Literacy for Young Visually Impaired Persons

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Catholic Relief Services	Lesotho		Sesotho		34	\$221,530

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
Students who have low vision or are blind used Jot-a-Dot brailers in their classroom in Lesotho. Teachers received equipment to produce braille materials.	Mountbatten Pro brailer Jot-a-Dot portable brailer	Produced 400 copies of ten short stories in braille and 120 braille tactile reading materials. Drafted modules for a teacher training manual on reading strategies for students who have low-vision or are blind.	School

## Makhalidwe Athu (“Our Way of Staying”)

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Creative Associates International	Zambia		ciNyanja		1,106	\$857,889

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
Students in rural Zambia received text message stories and comprehension questions on their parents’ or caretakers’ phone in their mother tongue, ciNyanja. Parents and caretakers attended monthly meetings about the program, and many received home visits from community mobilizers. Family and community members submitted their own stories to be used in the program.	Mobile phones	Forty-one text message-based stories with comprehension questions. Hard copies of the stories were also distributed at the end of the project. Audio recording of stories.	Household



Photo: Œuvre Malienne d'Aide à l'Enfance du Sahel





Photo: Creative Associates International



Photo: Œuvre Malienne d'Aide à l'Enfance du Sahel



## Improving Deaf Children's Reading Through Technology in Morocco

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Institute for Disabilities Research and Training, Inc. École Nationale Supérieure des Mines de Rabat	Morocco		Modern Standard Arabic Moroccan Sign Language		204	\$1,563,935

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
Students who are deaf or hard of hearing and their teachers used the Moroccan Sign Language <i>Clip and Create</i> software with graphics and videos depicting signs and written words.	Computers	Software featuring more than 2,200 Moroccan Sign Language graphics and video clips to represent 5,500 Modern Standard Arabic words.	School

## E-books 4 Khmer

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Kampuchean Action for Primary Education	Cambodia		Khmer		1,541	\$299,927



### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
Students in semi-urban and rural Cambodia read leveled e-books in Khmer on the SmartBooks application and played corresponding quizzes and questions.  Teachers received training on differentiated instruction techniques and were given corresponding resources to help them implement differentiated instruction.	Tablets	Digital application containing 24 stories, with three levels of content for each story, for a total of 72 e-books.  Differentiated instruction manual for teachers including student profiles, progress tracking, and lesson planning support.	School



Photo: Little Thinking Minds

## Qysas (“Stories”): An Arabic Leveled Digital Library for Every Classroom

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Little Thinking Minds	Jordan		Arabic		703	\$486,397

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
Students in Amman, Jordan, read storybooks and leveled e-books in Arabic on tablets. Teachers hosted bi-weekly literacy clubs for students.	Tablets	Digital application containing 126 interactive e-books and 19 basic e-books, for a total of 145 e-books, with comprehension questions and assessments.	School



Mother tongue instruction and reading materials



Children with disabilities



Family and community engagement

Pre-reading





Foundational



Reading comprehension





## Your Child, Reading, and You

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Œuvre Malienne d'Aide à l'Enfance du Sahel	Mali		Bamanankan		500	\$388,416

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
<p>Students in the Segou region of Mali visited community libraries stocked with books and literacy games in Bamanankan.</p> <p>A trained volunteer librarian led reading activities including games, songs, and reading practice. They also visited homes to show parents how to engage in reading with their children.</p> <p>Half of the students had access to the Stepping Stone application containing digital audio, text, and interactive literacy activities.</p>	<p>Tablets</p> <p>Mobile phones</p>	<p>Stepping Stone digital application, a mobile delivery platform, contained stories with audio and interactive literacy games. Seventy-five Bamanankan stories were available, 50 translated from French and 25 crowd-sourced from the local community.</p>	<p>Library</p>

## Mundo de Libros (“World of Books”): Matching Children with Level-Appropriate Books and Engaging Families

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Qué Funciona para el Desarrollo, A.C.	Mexico		Spanish		856	\$317,387

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
<p>Students had access to libraries stocked with children’s books.</p> <p>A web-based platform provided individualized book recommendations to students.</p> <p>Half of the students’ parents were provided workshops and related materials to improve engagement in their child’s reading.</p>	<p>Computers</p> <p>Tablets</p>	<p>Website with student profiles and individualized book recommendations from 295 unique titles available for borrowing.</p> <p>MATCH algorithm provided personalized book recommendations based on the student’s baseline EGRA results and the books’ difficulty scores.</p>	<p>Library</p>



Mother tongue instruction and reading materials



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Foundational





Reading comprehension








## Our Children Learn to Read

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Réseau d'Acteurs Pour le Renouveau de l'Éducation	Mali		Bamanankan		1,933	\$329,265

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
<p>Students in the Sikasso region of Mali were taught in Bamanankan by teachers who received training—in person and through interactive radio instruction—to use the balanced literacy approach to teach reading.</p> <p>Half of the teachers also watched training videos modeling teaching strategies and techniques which were available on the Stepping Stone application.</p>	<p>Tablets</p> <p>Radio</p>	<p>Stepping Stone digital application, a mobile delivery platform, containing three 90-minute videos demonstrating teaching techniques.</p> <p>Interactive radio instruction providing 30-minute programs that modeled strategies to enhance student learning.</p>	School

## Reading Beyond Sight: Improving Reading Scores of Children with Visual Impairment in Early Primary Education

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Resources for the Blind	Philippines	 	Filipino English		79	\$394,784


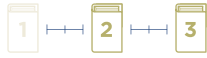
### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
<p>Students in the Philippines who have low vision or are blind used assistive technology in their classrooms.</p> <p>Teachers received equipment to support the production of large-print and braille reading materials and participated in ongoing training.</p> <p>Parents attended advocacy training to better understand their child's needs and capabilities.</p>	<p>Braille embossers</p> <p>Braille displays for computers</p> <p>Printers</p> <p>Closed Circuit Television</p> <p>DAISY players</p>	<p>Zoomtext</p> <p>Duxbury Braille Translator</p> <p>Microsoft Office</p> <p>Access to large-print and braille formatted digital books with an average of 104.1 book or reference materials in accessible formats produced on a weekly basis.</p>	School



Photo: Sesame Workshop India

## Play.Connect.Learn

Grantee	Country	Focus Area	Language	Targeted Reading Skills	Number of Children Reached	Award Amount
Sesame Workshop India Trust	India		Marathi		12,445	\$318,955

### INTERVENTION

Description	Hardware	Software & Literacy Content	Context
Students in six districts in Maharashtra, India, used the <i>Play.Connect.Learn</i> application on their parents' smartphone.  Families received monthly visits by a community facilitator.	Smartphones	Digital application contained 12 e-books, with corresponding literacy games, and 28 supplementary PDF stories.	Household



Mother tongue instruction and reading materials



Children with disabilities



Family and community engagement

Pre-reading



Foundational



Reading comprehension



This summary report examines trends across 11 ACR GCD Round 2 projects<sup>6</sup> regarding the interventions' impact on children's reading skills development and outlines lessons learned from the implementation and evaluation of these technology-based innovations. Scalability assessment and cost analysis results are also presented.

Specifically, the following key questions will be answered throughout the summary report:

1. **Were ACR GCD Round 2 projects associated with improvements in children's reading abilities?**
2. **What lessons were learned about implementing technology-based literacy projects?**
3. **What recommendations can be made for funding similar initiatives in the future?**

The ACR GCD Round 2 projects were small-scale, proof-of-concept or pilot projects implemented in a variety of contexts. They should not be compared directly due to diversity in language, location, reading intervention approach, and technology across projects. However, the trends in student reading outcomes and scalability potential across projects that are presented in this report provide tangible lessons learned and best practices for funders, implementers, and researchers when considering how to design and implement technology-based interventions.

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## How did ACR GCD Round 2 projects impact children’s reading abilities?

Given the different contexts, interventions, and beneficiary populations of each project, research designs were tailored to best measure each grantees’ project. Eight projects used an *experimental* or *quasi-experimental* study design that included at least one intervention group and one comparison group.<sup>7</sup> Six of those projects used a *difference-in-differences* approach, in which gains from baseline to endline assessments were compared between students from intervention and comparison groups.<sup>8</sup> The remaining three projects, including two that worked with students who have low vision or are blind, employed a *reflexive-comparison design* because their contexts did not allow for the inclusion of a comparison group.<sup>9</sup> The research design and results analysis for these projects focused on understanding the changes in student reading outcomes over the length of the project.<sup>10</sup> Where available, other variables—such as dosage or attendance—and contextual factors—such as socioeconomic status or parental literacy—were used to understand their relationship to participant performance.

Sample sizes and participant selection processes also varied across projects. STS and ACR GCD Round 2 grantees worked collaboratively to determine the necessary sample sizes per group, randomization and stratification processes, and data collection protocols. In most cases, STS supported grantees during this process—as well as during EGRA development workshops and tool piloting—via in-country visits. Despite having sampling and data collection protocols

in place, several projects faced a variety of challenges when collecting EGRA data, including student attrition from baseline to endline, lack of assessor accuracy testing to determine agreement in scoring, differences in subtasks across baseline and endline instruments, and teacher strikes.

Due to the variance in phonologies and orthographies of different languages, EGRA scores and fluency rates are not comparable across languages. Accordingly, this report refers to improvements in reading skills over time or to differences between groups; mean scores and fluencies are not reported.<sup>11</sup>

### Key Findings

Table 2 provides a summary of the research design and EGRA results for the 11 projects included in this summary report. Improvements in children’s reading skills were observed across all projects.



Photo: Little Thinking Minds

TABLE 2

Summary of Research Design and EGRA Results by Project

Project	GraphoGame™ Teacher Training Service	Bookshare India	Lesotho Literacy for Young Visually Impaired Persons	Makhalidwe Athu	E-books 4 Khmer		Qysas
<b>Research Design</b>	Quasi-experimental: (1) intervention and (1) comparison	Reflexive comparison: (1) intervention	Reflexive comparison: (1) intervention	Randomized controlled trial: (1) treatment and (1) control	Quasi-experimental: (2) intervention and (1) comparison		Quasi-experimental: (1) intervention and (1) comparison
<b>Sample Size<sup>12</sup></b>	451	49	21	2,054	682		536
<b>Project Subgroup</b>	N/A	N/A	N/A	N/A	Intervention A	Intervention AB	N/A
<b>PRE-READING</b>	<b>Letter Sound Identification/ Letter Name Identification</b>						
	<b>Syllable Identification</b>						
<b>FOUNDATIONAL</b>	<b>Nonword Reading</b>						
	<b>Familiar Word Reading</b>						
	<b>Oral Reading Fluency<sup>14</sup></b>						
	<b>Listening Comprehension</b>						
<b>COMPRE-HENSION</b>	<b>Reading Comprehension</b>						

Targeted EGRA Reading Skills and Results by Subtask<sup>13</sup>

Subtask not on EGRA  
 Targeted skill

Gain of intervention group was statistically significantly greater than the gains of the comparison group.



Gain of intervention group was statistically significantly greater than gains of the second intervention group and the comparison group.



Your Child, Reading, and You		Mundo de Libros	Our Children Learn to Read		Reading Beyond Sight		Play.Connect.Learn
Quasi-experimental: (2) intervention and (1) comparison		Reflexive comparison: (1) intervention	Quasi-experimental: (2) intervention and (1) comparison		Quasi-experimental: (1) intervention and (1) comparison		Quasi- experimental: (1) intervention and (1) comparison
562		457	540		143		627
Intervention A	Intervention B	N/A	Intervention A	Intervention B	English	Filipino	N/A

Endline score of intervention group was statistically significantly higher than endline score of the comparison group.



No statistical significance testing was conducted; however, the intervention group had higher score at endline than at baseline.



One intervention group had statistically significantly higher scores at endline than at baseline.



**Students who participated in ACR GCD Round 2 grantee projects improved their oral reading fluency.** Depending on the project's research design, students who participated in the interventions averaged higher fluency rates at endline than at baseline; statistically significantly higher endline fluency rates than did comparison group children; or statistically significantly greater gain scores

than did comparison group children. For projects with a comparison group, this finding indicates that the intervention supported gains in oral reading fluency beyond those gains associated with maturation over time. For the remaining projects, the results suggest that students improved their oral reading fluency as a result of the intervention and an additional year of schooling.<sup>15</sup>

### What is the oral reading fluency subtask?

The oral reading fluency subtask is a measure of overall reading competence. It is the culmination of translating letters into sounds, merging sounds to become words, linking words to become sentences, relating the text to meaning, and making inferences to fill in missing information. A student's performance on the oral reading subtask is contingent on skills assessed in previous subtasks, since students need to have some mastery of letter sounds and decoding to read fluently.

### What is the reading comprehension subtask?

Comprehension is the purpose of reading. Once students learn the sound-letter relationship, can decode, and read with automaticity, they become increasingly able to understand the meaning of a text. This subtask measures comprehension using the passage read by students on the oral reading fluency subtask.

### Students across projects improved their reading comprehension.

On projects with comparison groups for which gain scores were calculated on the reading comprehension subtask, students in the intervention group had statistically significantly greater gains on the reading comprehension subtask than did their peers in the comparison group.<sup>16</sup> For the *Your Child, Reading, and You* project and the *Our Children Learn to Read* project, both of which compared scores between intervention and comparison groups over distinct time periods, intervention group students had statistically significantly higher scores at endline than did their peers in the comparison group.<sup>17</sup> Students in the *Bookshare India*, *Lesotho Literacy for Young Visually Impaired Persons*, and *Mundo de Libros* projects averaged higher reading comprehension scores at endline than at baseline; because these projects did not have comparison groups, improvements in students' scores should be interpreted as the result of the intervention and an additional year of schooling.

### Across projects, students showed progress on most of the skills targeted through the interventions.

Each intervention implemented by an ACR GCD Round 2 grantee was designed to improve specific reading skills, although which exact set of skills differed depending on the intervention. In most instances, results indicate improvements in targeted reading skills. There were some exceptions: students in the *Bookshare India* project performed comparably on the nonword reading subtask at baseline and endline, and gains from baseline to endline on the

reading comprehension subtask were comparable across groups assessed in the *Play.Connect.Learn* project. Additionally, results from the *Makhalidwe Athu*, *Qysas*, and *Play.Connect.Learn* projects—which were among the eight projects that targeted listening comprehension—indicate that students had comparable gains from baseline to endline on the listening comprehension subtask regardless of their group assignment.

## Effect Sizes

Results in each grantees' evaluation report as well as in Table 2 convey the statistical significance of the intervention on student reading outcomes; the complement of statistical significance is an effect size. Effect sizes indicate practical significance, or the importance of the actual difference

in relative gains between groups.<sup>18</sup> The larger an effect size, the more important the difference. An effect size is measured as the difference in the number of standard deviations between an intervention group’s mean and a comparison group’s mean, and it allows for comparisons across projects with different sample sizes or scales.<sup>19</sup>

TABLE 3  
Summary of Effect Sizes by Project

Project	Project Subgroup	PRE-READING				FOUNDATIONAL							
		Letter Sound Identification/ Letter Name Identification		Syllable Identification		Nonword Reading		Familiar Word Reading		Oral Reading Fluency		Listening Comprehension	
		Effect Size	CI	Effect Size	CI	Effect Size	CI	Effect Size	CI	Effect Size	CI	Effect Size	CI
<b>GraphoGame™ Teacher Training Service</b>	N/A	0.4	± 0.2			0.3	± 0.2			0.2	± 0.2		
<b>Makhalidwe Athu<sup>20</sup></b>	N/A					0.2	N/A			0.3	N/A		
<b>E-books 4 Khmer</b>	Intervention A					0.4	± 0.2	0.5	± 0.2	0.4	± 0.2	0.3	± 0.2
	Intervention AB							0.3	± 0.2	0.3	± 0.2		
<b>Qysas</b>	N/A			0.2	± 0.2					0.2	± 0.2		
<b>Your Child, Reading, and You</b>	Intervention A	1.0	± 0.2			0.7	± 0.2						
	Intervention B	0.5	± 0.2			0.6	± 0.2						
<b>Reading Beyond Sight</b>	English	1.4	± 0.4			1.2	± 0.4			0.7	± 0.4	0.7	± 0.4
	Filipino	1.5	± 0.4			1.0	± 0.4			0.9	± 0.4	0.5	± 0.3
<b>Play.Connect.Learn</b>	N/A	0.3	± 0.2	0.2	± 0.2			0.2	± 0.2	0.2	± 0.2		

Table 3 reports treatment effect sizes as determined by Cohen’s *d* and confidence intervals of effect size for all subtasks except for reading comprehension.<sup>21,22</sup> The confidence interval is reported for each effect size to convey the level of certainty in the estimation of the effect.<sup>23</sup> Specifically, it indicates that there is a five-percent possibility that the reported effect size is due to chance. Table 3 only includes those projects with designs that included a comparison group.<sup>24,25</sup>

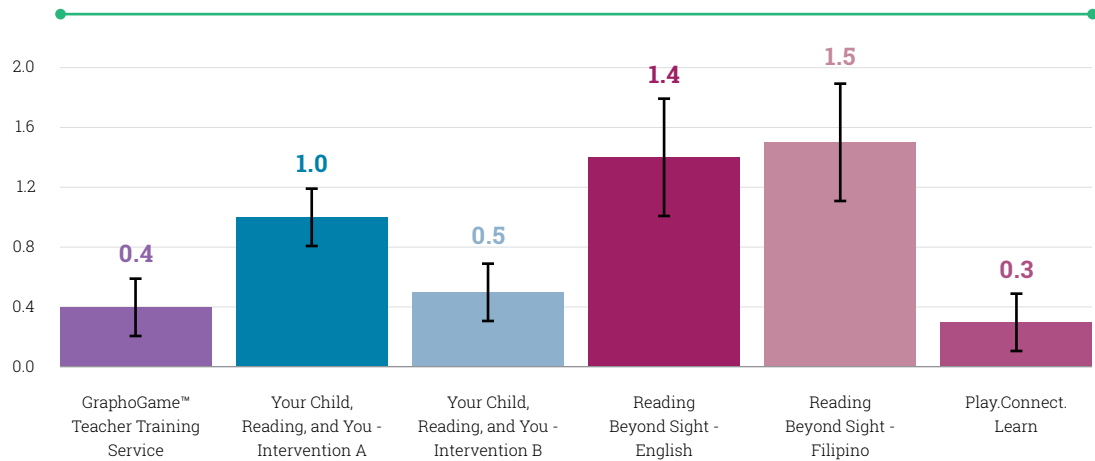
Effect size not computed due to research design or subtask not included on EGRA

One suggested interpretation of Cohen’s *d* sets thresholds of small (0.2), medium (0.5), and large (0.8),<sup>26</sup> although it should be noted that these guidelines are somewhat arbitrary and have not been universally accepted.<sup>27,28,29</sup> In interpreting effect sizes, context matters. A “small” effect may be highly meaningful for an intervention that requires few resources and imposes little on the participants; a small effect may be highly meaningful in a context with fairly intractable problems at the structural or policy levels. Generally, the importance of the effect sizes for each project and for each subtask should be interpreted considering the intervention, reading skills prioritized, target population reached through the intervention, and sample sizes. Key findings from ACR GCD Round 2 projects are detailed below.

No statistically significant different gains observed between intervention and comparison groups

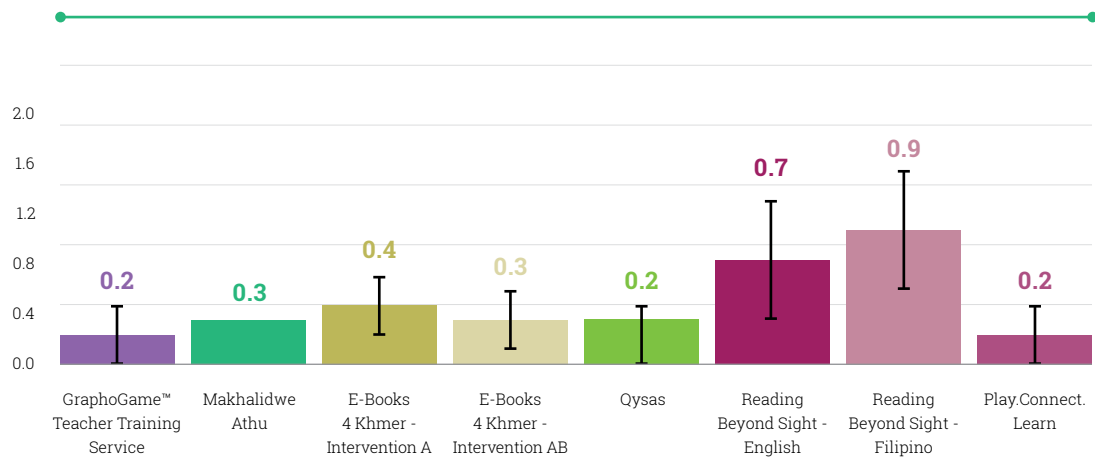
For the letter name or letter sound identification subtasks, students participating in the *Reading Beyond Sight* project and intervention group A of the *Your Child, Reading, and You* project experienced the greatest effects, followed by students participating in intervention group B of the *Your Child, Reading, and You* project, the *GraphoGame™ Teacher Training Service* project, and the *Play.Connect.Learn* project (Figure 1). No significant differences—statistically or practically—were observed for students participating in the *E-books 4 Khmer*, *Makhalidwe Athu*, or *Qysas* projects.

FIGURE 1  
Letter Name Identification or Letter Sound Identification Effect Sizes



On the oral reading fluency subtask, all projects with a comparison group had a statistically significant difference between the intervention and comparison group gains. Their effect sizes are presented in Figure 2. **Intervention group students participating in the *Reading Beyond Sight* project had the largest treatment effect on the oral reading fluency subtask**, followed by students participating in the intervention group of the *E-books 4 Khmer*, *GraphoGame™ Teacher Training Service*, *Makhalidwe Athu*, *Qysas*, and *Play.Connect.Learn* projects.

FIGURE 2  
Oral Reading Fluency Effect Sizes<sup>30</sup>





## Additional Findings

While research on ACR GCD Round 2 projects indicates improvements in students' reading skills from baseline to endline, **it is unclear if the observed magnitudes of changes in students' reading skills were meaningful in practical terms—in other words, it is unclear if the improvements were great enough to contribute to students' ability to become readers.** Further exploration into reading benchmarks in each language would contribute to a better understanding of what thresholds should be met to practically improve reading skills.

**Analyses showed that no single contextual factor was associated with improved learning outcomes across projects, although small sample sizes may have reduced the ability to detect these correlations.**

All projects collected data on different contextual factors that may have impacted student reading gains apart from the intervention. These included language use at home and at school, socioeconomic status, parental literacy, family and teacher reading support, and students' disposition to reading. On the *Our Children Learn to Read* project, positive correlations were observed between students' disposition to reading and their pre-reading skills. On the *Play.Connect.Learn* project, weak but statistically significant correlations indicate that both students whose parents had greater rates of literacy and students who had a greater disposition to reading had greater gains on all subtasks. Furthermore, results from the *E-books 4 Khmer* project showed that students with either more family support for reading or a greater disposition to reading tended to have greater gains on all subtasks except the listening comprehension subtask.<sup>31</sup> Additionally, students in that same project with lower socioeconomic status tended to have smaller gains on the nonword reading, oral reading fluency, and reading comprehension subtasks.

EGRA results were also disaggregated and analyzed by students' gender. Across projects, girls and boys started the interventions with different literacy levels, which were captured in their average performance on subtasks at baseline. Therefore, to track their relative performance, each genders' average progression over the period of projects was analyzed in one of three ways:

- *In projects without a comparison group, the gains of girls were evaluated against those of boys.*
- *In projects with one intervention and one comparison group, the progression of girls in the intervention group was assessed against that of girls in the comparison group; the progression of boys was similarly assessed.*
- *In the projects with two intervention groups and one comparison group, analysis focused both on differences in progression of girls and boys across all three groups and overall differences in gains between genders regardless of their group assignment.*

**A review of the findings across projects indicates no clear trend in differences between boys' and girls' literacy gains over time. Results by gender varied widely across projects, and findings were interpreted within each project's specific context.**<sup>32</sup>



Photo: Réseau d'Acteurs Pour le Renouveau de l'Éducation

## Lessons learned about implementing technology-based literacy projects

The ACR GCD Round 2 grantees used radio, feature phones, smartphones, tablets, assistive devices, and desktop computers to deliver literacy content such as interactive books and games to students and instructional support content to teachers. Each project provided unique literacy content to students who often lack sufficient reading materials in their mother tongue. Furthermore, most of the projects provided individualized learning experiences for students. By utilizing technology, the grantees gave students access to appropriate, leveled reading materials and the ability to self-pace their learning, the latter of which is particularly useful in contexts where teachers struggle to differentiate instruction based on a student's needs. The grantees provided these technology-based literacy experiences within both in- and out-of-school contexts.

As each ACR GCD Round 2 grantee piloted a new and innovative intervention, many of the lessons from implementation and observed impacts on student reading outcomes are unique to specific projects. Nevertheless, there are five notable overarching themes.

**Technology-based literacy projects have the potential to effectively disseminate new or existing learning materials to underserved populations in their mother tongue.**

In each ACR GCD Round 2 project, materials were provided to students who did not have sufficient access to materials in their mother tongue. These projects used technology to provide literacy content where traditional access to materials through publishers may not be possible. Access to this literacy content represented an increase—sometimes dramatic—over the existing literacy resources available to these students.

For example, through the *Qysas* project, students in Jordan had access to 126 interactive e-books and 19 basic e-books in Modern Standard Arabic that spanned nine levels of difficulty. Those students read an average of 105 e-books during the academic year in which the program was implemented. In end-of-project interviews, most students reported having little access to engaging reading materials before the project. Similarly, students in the *E-books 4 Khmer* project had the opportunity to read 24 e-books, at three difficulty levels, that were developed from stories in the standard textbooks approved by Cambodia's Ministry of Education, Youth, and Sport. Students who struggled to read the print story from the textbook could practice on an e-book written at an easier level; with it, students could gain an understanding of key vocabulary and grammar before graduating to the "standard" classroom version. Students who were already sufficient readers could read the story at a more complex level, continuing to challenge their growth.

In the *GraphoGame™ Teacher Training Service* project, students played GraphoGame™, a mobile phone-based game that provides practice in letter sounds, syllables, and words in ciNyanja, a mother tongue language in the Eastern Province of Zambia. In a context with limited local-language materials apart from curriculum textbooks, the project provided students with the opportunity to build their fundamental literacy skills. The *Makhalidwe Athu* project, also implemented in the Eastern Province of Zambia, sent 41 stories in ciNyanja via text message to



Technology provides literacy content where traditional access to print materials may not be possible.

be read at home by children with their parents or caretakers. Prior to the project, few parents or caretakers read with their children at home; the delivery of stories to their mobile phones allowed them to better engage in their children’s literacy skills development.

Students in Mali have little access to reading materials in their mother language of Bamanankan. The *Your Child, Reading, and You* project gave students access to 75 Bamanankan stories—50 of which were translated from French and 25 were locally sourced—through community libraries established by the project. Half of the students could also read digital versions of these stories on tablets through the Stepping Stone application. The increased access to reading materials was viewed favorably by participants and the wider community. So many children and community members beyond the project’s participants attended the *Your Child, Reading, and You* libraries that there was oversubscription. As such, librarians had to limit the greater community’s access.

Students in Maharashtra, India, were given access to literacy content in Marathi through the *Bookshare India* and *Play.Connect.Learn* projects. Through the *Bookshare India* project, students who have low vision or are blind received 50 stories accessible in braille and audio on a DAISY player. During end-of-project interviews, teachers and headmasters expressed that students showed increased motivation to read as a result of having increased access to stories. The *Play.Connect.Learn* project provided 12 interactive audio storybooks and 28 supplemental storybooks to children through a smartphone application. Parents noted in interviews that the content provided a way to engage in reading experiences with their children.

In the Philippines, where the *Reading Beyond Sight* project was implemented, teachers traditionally had to create materials for students who were blind or had low vision with a slate and stylus, a process that was often slow and error-prone. Through the project, embossers were provided to the 15 participating schools, and teachers printed an average of 104 new Filipino or English reading or learning materials in braille or large print each week for their students. Increased access to reading materials, in tandem with other components of the project, led to significant reading gains for participating students.



The *Your Child, Reading, and You* project gave students access to 75 Bamanankan stories through community libraries established by the project.

### **Technology-based literacy projects can offer beneficial individualized learning experiences to students.**

Several ACR GCD Round 2 grantees used technology to provide different levels of reading content to students, and the technologies facilitated individual student advancement. Feedback from teachers and students across these projects indicate that these technologies, which allowed students to advance through reading content at their own pace, supported teachers and engaged students, who were excited about advancing through the reading levels.

In the *GraphoGame™ Teacher Training Service* project, *GraphoGame™* allowed struggling readers to advance through different modules—letter sounds, syllables, and words—at their own pace. In the *Qysas* application used in Jordan, students could advance through nine levels of e-books as their reading skills improved. Their achievement was measured through reading comprehension questions answered at the end of each e-book. Qué Funciona para el Desarrollo, A.C. developed a MATCH algorithm for the *Mundo de Libros* project in Mexico that considered both a student’s reading level and a book’s difficulty levels to make customized reading recommendations. Via a computer program, students had a unique user log-in that allowed them to access their individual recommendations and rate the books they had read. The *E-books 4 Khmer* project in Cambodia provided students with a differentiated learning experience through the *SmartBooks* application,

in which students advanced through three levels of difficulty of the same e-story. When students responded correctly to digitized games and quizzes at each e-story level, they received stars. After receiving enough stars, students could advance to more difficult e-stories levels.

### Technology-based projects can facilitate the digital tracking of students' literacy experiences, although the implementation was a challenge for grantees.

Technology has the capacity to capture individual user experiences, such as the content accessed, exposure amount, quiz and question responses, and progression through difficulty levels. These data can help projects provide individualized experiences for students. They can also generate critical information that allows implementers to strengthen project design and better understand how user experiences correlate to reading outcomes. However, tracking students' experiences was a challenge for most of the ACR GCD Round 2 projects. Although most projects intended to track users' experience with the technology and literacy content, only the *GraphoGame™ Teacher Training Service* and *Mundo de Libros* projects could do so accurately.<sup>33</sup>

Several grantees expected that data from their software would be synced to a server in real time; however, challenges made this nearly impossible. For several projects—including *Qysas*, *E-books 4 Khmer*, and *Play.Connect.Learn*—software updates or deletions resulted in lost user data. In some instances, the software itself had limitations in its ability to synchronize with a server—an issue that would require more time and investment to reconcile. For the *Your Child, Reading, and You* and the *Our Children Learn to Read* projects, the technology used did not allow for unique logins, meaning that there was no way to verify who had used the application during a recorded session. In all these instances, opportunities to utilize experience data to better understand reading outcomes were hindered.

Despite these limitations with technology, several projects—including *Bookshare India*; *Qysas*; *Your Child, Reading, and You*; and *E-books 4 Khmer*—managed to capture exposure data by manually tracking student attendance or advancement through content. Analyses of these projects, as well as those that digitally captured exposure, provided valuable findings about the relationship between the amount of exposure students had to the project and their reading gains.<sup>34</sup>

### The quality of the hardware and software used to deliver the literacy content often impacted implementation.

Some grantees chose to deliver literacy content through hardware already owned by beneficiaries, while others also provided the hardware to beneficiaries. Both options had successes and challenges, highlighting the importance of thoughtful hardware selection for technology projects. The *Makhalidwe Athu* project sent levelled stories through text messages directly to families' mobile phones; this lessened the project's burden of caring for and maintaining the hardware. The *Qysas* project initially planned to use desktop computers already in schools to deliver literacy content. When the team subsequently discovered that some computers were more than 15 years old and did not meet the minimum requirements necessary to run the application, they instead procured tablets. However, some tablets cracked during implementation, which required the project to replace screens. Similarly, the *Play.Connect.Learn* project initially chose to deliver its content through smartphones already owned by families. However, early in the implementation, the team discovered that most the target population did not own smartphones. As a result, the project purchased smartphones for 90 percent of the intervention families.



Although some adults struggled, across projects, children did not report having significant problems using the technologies.



Photo: Agora Center at the University of Jyväskylä



Photo: Little Thinking Minds

In addition to hardware challenges, feedback from the ACR GCD Round 2 grantees highlighted the fact that sufficient time is required to develop quality software. Several grantees—*Qysas*, *E-books 4 Khmer*, *Play.Connect.Learn*, and *Mundo de Libros*—developed software specifically for the project; others used existing software. Among the projects that developed new software, all expressed challenges and delays related to that development. In many cases, the end users of these technologies also reported challenges, noting that the applications froze, did not allow children to advance, or required too much memory to run effectively. Two projects—*Qysas* and *E-books 4 Khmer*—received extensions to their original grant to refine and update their software, which allowed for an improved user experience. Similarly, staff and software developers for other projects suggested longer timelines would have been beneficial when creating new software. One stakeholder suggested one year is needed for any software development and, ideally, an additional six months for pilot testing and corresponding revisions.

### **Users' comfort with information and communications technologies (ICT) should be considered when developing technology-based, literacy projects.**

A key challenge with ACR GCD Round 2 projects was low digital literacy among users—particularly adults. Feedback from librarians on the *Your Child, Reading, and You* project indicated that they struggled to use the tablets and the Stepping Stone application; most teachers on the *Lesotho Literacy for Young Visually Impaired Persons* project were not able to effectively use the project's technologies, despite receiving training. On the *Mundo de Libros* project, both children and adults had trouble utilizing the web-based platform to access children's individualized book recommendations because of technical issues with the platform or lack of comfort with technology. Instead, children preferred to go directly to the library to choose their books based on the illustrations or topic. Teachers in the *Qysas* project expressed challenges using the tablets, particularly when trying to troubleshoot software and hardware errors; instead, they often relied on interns and project staff who had more intensive training to help operate the tablets and software. Most librarians and teachers on the *E-books 4 Khmer* project noted that they had not used technology for learning in the past. Teachers from the *GraphoGame™ Teacher Training Service* project also had trouble accessing the teacher training website on the smartphones provided by the project due to low ICT literacy. Only a few projects collected baseline and endline data on adult beneficiaries' experience with technology and digital literacy, but given the feedback in end-of-project interviews, it appears that these shortfalls may have affected projects' ability to be implemented as intended and with fidelity. **Notably, across projects, children did not report having significant problems using the technologies.**

## Lessons learned about scalability of technology-based literacy projects

To scale up means to expand, replicate, adapt, and sustain a successful intervention in a new geographic area or to reach more beneficiaries over time.<sup>35</sup> ACR GCD Round 2 grantees implemented small-scale, literacy-focused, proof-of-concept or pilot projects. An important consideration after each project is the feasibility of replicating or expanding the technology-based innovation and project models to a different or larger population or area. To inform this decision, STS conducted a scalability assessment for each project based on seven parameters. The seven parameters

were adapted from the USAID-funded Scalability Assessment Tool developed by Management Systems International.<sup>36</sup> STS collected and analyzed data from end-of-project interviews, EGRA results, literature reviews, and project M&E to assess scalability parameters.

The results of the scalability assessments are meant to inform program staff, stakeholders, and donors about key parameters to consider before scaling ACR GCD Round 2 grantees' project models and technologies. These are not prescriptive results. The data available for each project differed, and STS was not able to conduct comprehensive analyses of the existing literacy and technology landscape in each country; therefore, findings should be interpreted as indicative, not conclusive.

Table 4 presents a summary of STS's assessment regarding each project's ease of scale on six parameters of scalability. The seventh parameter, cost, is detailed in Table 5.<sup>37,38</sup>



Photo: Little Thinking Minds

TABLE 4

## Summary of Scalability Assessment Results by Project

Project	Credibility	Observability	Relevance	Relative Advantage	Ease of Transfer and Adoption	Testability
GraphoGame™ Teacher Training Service						
Bookshare India						
Lesotho Literacy for Young Visually Impaired Persons						
E-books 4 Khmer						
Qysas						
Your Child, Reading, and You						
Mundo de Libros		N/A		N/A	N/A	N/A
Our Children Learn to Read						
Reading Beyond Sight						
Play.Connect.Learn						



Scaling is easier

Scaling is somewhat easy /  
more information is needed

Scaling is harder

The credibility parameter considers if various stakeholders—including potential adopters, funders, implementers, and beneficiaries—believe that the model has a strong evidence base. This may include existing empirical research or anecdotal information. **Projects were deemed to be easier to scale under the credibility parameter if they utilized existing evidence or theoretical knowledge about the efficacy of a specific component, literacy approach, or technology in designing their model.** Projects were rated as somewhat easier to scale or difficult to scale if they did not provide complete evidence on how their project approach was conceptualized. This does not indicate that the model is not credible; instead, it indicates limited research could be identified to support the project.

The observability parameter assesses if the project, in its current form, has visual and observable results that are related to the intervention. This parameter was assessed considering EGRA results and feedback from teachers, parents, and caretakers on observable changes in children's abilities. **As improvements in children's reading skills were observed—both through EGRA results and from the perspective of participants—across all ACR GCD Round 2 projects, they appear to be easy or somewhat easy to scale according to the observability parameter.** For most projects, although available data on observability indicated that they would be somewhat easy to scale, STS advises that additional research would further strengthen this evidence.

The relevance parameter assesses if a project effectively addresses a problem that is recognizable and considered important by stakeholders. **In nearly all projects, there was strong evidence to support scaling under the relevance parameter.** For projects that did not receive an easier-to-scale rating, it was generally due to a lack of stakeholder engagement in the project or because the projects did not target the full range of literacy skills deemed important by stakeholders.

The relative advantage parameter relates to whether the intervention offers improvement over current or alternative solutions to the literacy problem addressed by the projects. On this parameter, STS only considered the evidence available through end-of-project interviewees and did not conduct a comprehensive landscape analysis of existing solutions—or the evidence of their efficacy. Due to this limitation, **ACR GCD Round 2 projects had mixed scalability results under this parameter. More in-depth research should be conducted to fully understand whether ACR GCD Round 2 projects have a relative advantage over current and alternative solutions to the literacy problems they seek to solve.**

The ease of transfer and adoption parameter assesses whether the characteristics and components of the intervention lend themselves to being adopted by organizations other than the original implementer. This parameter considers the interventions' level of technical sophistication and complexity, as well as the level of supervision and monitoring needed to implement it. **ACR GCD Round 2 projects appear to be more difficult to scale under the ease of transfer and adoption parameter. The difficulty is due to the expertise required to develop the ICT components, the extent of literacy and context-specific knowledge required to execute, and the high levels of supervision and monitoring required to implement the projects well.** As these were pilot projects, it is likely that stabilization of technologies and project models through further refinement will make transfer and adoption easier.

The testability parameter assesses whether potential adopters would need to commit significant resources or time to test the model if they chose to pilot it in a new context. Almost all projects rated as somewhat easy or difficult to scale under the testability parameter. **ACR GCD Round 2 grantee projects could be tested in new contexts, where adopters would need to invest in updating project models to reflect language and literacy needs, technology availability, internet connectivity, and costs.**



The final parameter of the scalability assessment was a cost analysis using the ingredients method, in which the costs of each project were categorized as management, development, or implementation.<sup>39</sup> The purpose of the cost analysis was to better understand expenditures during the pilot phase of each project and recognize the types of costs required to implement technology-based literacy projects. The management category includes costs that are not directly related to implementation and are likely to vary widely based on who is overseeing the implementation of the intervention. The development category includes the costs related to the development of materials, survey instruments, programs, and other content that would not need to be redeveloped in the scale-up of a project. The implementation category is arguably the most relevant for stakeholders who are considering scaling a project or intervention. This category includes all the recurrent activities and costs that would need to be expensed should the project be replicated, including materials printing and distribution, training, M&E, events and presentations, workshops, and human resources activities.

Project staff completed a costing template with guidance from World Vision and STS. Costs were outlined based on the activities from the project work plan, and each expenditure was classified based on the three categories. A summary of each cost analysis result is presented in Table 5. As each ACR GCD Round 2 project promoted different literacy approaches and utilized technologies in different stages of development, the proportions of costs are not necessarily comparable across projects; indeed, project spending by category varied widely between grantees. Further, many of these projects implemented new approaches and invested heavily in development costs to establish their technology innovations. These initial development costs would not necessarily be incurred again if the technology were to be replicated or scaled. As a result, the findings below should not be generalized beyond the proof-of-concept or pilot phase of the project. Once the intervention and its innovations are stable, a comprehensive cost-effectiveness analysis should be conducted.

TABLE 5  
**Summary of Cost Analysis (Percentage of Total Budget Spent by Cost Category)**<sup>40, 41</sup>

Project	Management (%)	Development (%)	Implementation (%)
GraphoGame™ Teacher Training Service	27.0	2.1	70.9
Bookshare India	34.4	34.2	31.4
Lesotho Literacy for Young Visually Impaired Persons	21.7	16.0	62.3
E-books 4 Khmer	38.3	25.5	36.1
Qysas	34.3	25.9	39.8
Your Child, Reading, and You	53.9	23.4	22.7
Mundo de Libros	23.5	26.1	50.4
Our Children Learn to Read	53.2	7.2	39.6
Reading Beyond Sight	17.5	15.2	67.2
Play.Connect.Learn	26.1	37.5	36.5

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# Lessons Learned for Future Funding

Through the extensive qualitative and quantitative research conducted on ACR GCD Round 2 projects, several recommendations emerged that can be used to guide funding decisions, project design, and research priorities for similar initiatives in the future.



**Funders should consider supporting technology-based projects that provide access to reading content in languages in which there is a shortage of print content.**

Many of the ACR GCD Round 2 projects utilized technology to deliver reading materials to students in electronic format where children, schools, or families had little or no access to print materials. Further, for children who have low vision or are blind, using technology to produce reading materials at the school level has the potential to greatly impact reading gains, as many education systems do not have the capacity to produce sufficient learning materials for these students. Overall, leveraging technology to deliver reading materials appears to have been anecdotally and empirically beneficial to children.



**Further research could strengthen knowledge on how much literacy content should be offered through projects to significantly and practically impact student reading outcomes.**

ACR GCD Round 2 projects offered different amounts of reading material to children across projects; even within projects, children accessed different quantities of content. With an individualized log in, technology offers the potential to track each child's experience with electronic content, providing critical details on how much each child reads, how fast they read it, and which content was most popular. These data provide critical information that can be used to strengthen project design and better correlate both the quantity of content and user experience with content to reading outcomes.

**Implementers can mitigate barriers that impede reading skills development by leveraging technology's ability to deliver an individualized learning experience.**



In many places where ACR GCD Round 2 projects were implemented, technology provides the opportunity for an individualized learning experience and the ability to track students' progress. Given the challenges to helping students learn to read, funders should continue to research ways individualized learning can impact student learning as well as experiment with better ways to track student usage of technology.

**Funders, implementers, and researchers should invest time into better understanding reading benchmarks to contextualize observed reading gains.**



Across all ACR GCD Round 2 projects, improvements in children's reading skills were observed, most notably on the oral reading fluency and reading comprehension subtasks. However, it was not always clear if the improvements were enough to meaningfully contribute to students' ability to become readers. Future funding for understanding reading skills benchmarks would help funders and implementers know if projects are providing the amount of support needed to meaningfully impact children's skills.

**In contexts in which technologies are not widespread, projects should consider incorporating ICT training, particularly for participating adults.**



Across projects, adults expressed challenges using or troubleshooting technologies, which sometimes limited their ability to provide a quality learning experience for themselves or students. Funders should look for projects that provide sufficient attention to reading development capacity building and training for adult participants.

**Sufficient time to develop, pilot, and refine technologies before implementation would be beneficial for projects that propose new and untested technological innovations.**



Several projects required extensions to stabilize new technologies before their roll-out. Nearly all grantees who developed original technologies expressed that there could be improvements to their innovations had there been more time for development and piloting before implementation. In the future, funders should consider extending timelines for projects that promote original technologies to ensure that innovations are developed and rolled-out in a manner that provides impact and a quality user experience.



**Before creating new technologies, projects should assess whether existing technologies—particularly assistive technologies that support children who have low vision or are blind—could adequately address the literacy challenges in a specific context.**

A select number of ACR GCD Round 2 grantees chose to incorporate off-the-shelf technologies into their intervention model. In each case, these technologies were already developed and tested but had not been used in the intervention context prior to ACR GCD Round 2. In most cases, this helped grantees avoid challenges experienced by projects that chose to develop new technologies as part of their intervention. All the projects that supported students who have low vision or are blind used previously developed, tested, and widely available assistive technologies, which allowed the projects to focus on distribution of the technologies and training on their use. Funders should encourage technology-focused projects to critically evaluate existing technology options and how they address literacy needs prior to encouraging the development of original technologies.



**Implementers should take into consideration the limitations of existing ICT infrastructure in target areas and the options for distributing content to users when selecting their technologies.**

Many ACR GCD Round 2 projects faced challenges related to intermittent or nonexistent internet connectivity, large software applications that exceeded the hardware and software capacity, and limited ability for users to receive new or updated literacy content in low-bandwidth contexts. Although the grantees adapted to these challenges, in some cases creating offline options for applications or designing a content distribution plan, these modifications required time and financial resources from the project. Innovators that seek to use technology to deliver literacy content to students should adequately assess the ICT infrastructure in the targeted implementation areas, specifically internet connectivity, when designing their projects.



**Funders should consider providing ample time and budget to allow innovators and researchers to explore what works and what does not during pilot projects.**

ACR GCD Round 2 grantees collected significant amounts of data through M&E tools and EGRAs, although better measurement of fidelity of implementation would have been beneficial to fully understand where projects were succeeding or experiencing major challenges in implementing as intended. Funders may want to consider a graduated approach when funding pilot projects. This would allow research during the initial phase of the projects to focus on measuring implementation and technology use, and student learning outcomes to be measured after the approach has been stabilized. Further, funders should allot sufficient time and financial resources for M&E and research for each project, especially before project start-up.

ACR GCD Round 2 grantees implemented a diverse range of technology-based literacy interventions in ten countries. These projects had measurable, positive impacts on the reading skills of early grade learners, although the magnitude of these impacts varied. The research conducted on each project has served to strengthen the evidence base on what technologies and implementation approaches have the potential to improve children's early grade reading skills. The lessons learned from the projects' development and implementation as well as the scalability analysis for each project can help support innovators and funders seeking to leverage technology to improve early grade literacy worldwide.



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## FOOTNOTES

- 1 All Children Reading: A Grand Challenge for Development. (2017, June). *About us*. Retrieved from <http://allchildrenreading.org/about-us/>
- 2 Only 11 of these projects will be covered in this report. The Institute for Disabilities Research and Training project in Morocco is still being implemented and final results will be available in December 2018. The ChildFund International project in Afghanistan closed due to contextual challenges outside of their control. The Studio ADC project in Georgia was terminated early.
- 3 DAISY is a technical standard for digital talking books for people who have low vision or are blind or who have a print disability (e.g., dyslexia). DAISY is an audio substitute for print material that allows users to search, navigate, place bookmarks, and regulate the speaking speed of books found in the digital repository.
- 4 For more details on the hardware used by ACR GCD Round 2 grantees that worked with students who have low vision or are blind, please see *ACR GCD Report: Supporting Technology-Based Innovations to Improve Early Grade Reading Outcomes for Students Who Have Low Vision or are Blind* at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 5 The EGRA is an oral assessment that measures students' most basic foundational literacy skills in the early grades—specifically, recognizing letters of the alphabet, reading simple words, understanding sentences and paragraphs, and listening with comprehension. The EGRA methodology was developed under EdData II and has been applied in more than 30 countries and 60 languages. For three ACR GCD projects, EGRA instruments were adapted for students who have low vision or are blind; for one project, the EGRA instrument was adapted for students who are deaf or hard of hearing.
- 6 The *Improving Deaf Children's Reading Through Technology in Morocco* project received an extension through 2018. Results for that project are not included in this report.
- 7 Quasi-experimental designs are similar to experimental designs with randomized controlled trials; they both include a group receiving an intervention (i.e., an intervention group) and a group who does not receive any components of the intervention (i.e., a comparison group). Although several of the projects that ACR GCD Round 2 funded used quasi-experimental designs, randomly assigning students into groups, the sample frame construction (i.e., purposive selection of intervention sites) and randomization (i.e., self-selection into intervention and selection by administrators, teachers, or governments, etc.) processes lacked the rigor required of a true experimental design.
- 8 Longitudinal tracking of students was not possible for the *Our Children Learn to Read* project because of the high replacement rate of assessed students at endline EGRA data collection. For the *Your Child, Reading, and You* project, a difference-in-difference approach was used for analyzing all subtasks—except the oral reading fluency, reading comprehension, and listening comprehension subtasks—due to differences in passages utilized on the baseline and endline instruments.
- 9 Reflexive comparison designs compare results of the same group before and after an intervention. In this design, the assessment of the program participants before the intervention serves as a proxy for a comparison group.
- 10 For more detailed results and lessons learned on projects that worked with students who have low vision or are blind, see *ACR GCD Report: Supporting Technology-Based Innovations to Improve Early Grade Reading Outcomes for Students Who Have Low Vision or are Blind* at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 11 For project-level mean scores and fluency results, see individual evaluation reports for each grantee, available at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 12 *N* represent sample size used for the final analysis; this number does not include students who were assessed at baseline but not at endline.
- 13 Orientation to print and initial sound identification subtasks are not included in this table because they are not standard EGRA subtasks and were not assessed across projects. For results on these subtasks, see individual evaluation reports for each grantee, available at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 14 The *E-books 4 Khmer* project assessed oral reading fluency through an oral reading fluency-sentences and an oral reading fluency-story subtask. On both oral reading fluency subtasks, both intervention groups had statistically greater gains than the comparison group.
- 15 Additional research may allow for a better understanding of how performance on the oral reading fluencies subtask is associated with the intervention and with maturation.
- 16 On the *E-Books 4 Khmer* project, students from one of the two intervention groups had statistically significantly greater gains than did students in the comparison group, while students in the second intervention group had comparable gains to their peers in the comparison group. All students who were assessed as part of the *Play.Connect.Learn* project had comparable reading comprehension gains.
- 17 Due to research limitations, it was not possible to compare students' reading comprehension scores at baseline to scores at endline for these projects.
- 18 Effect sizes mathematically normalize the average raw gain in a population by the variability, or pooled standard deviation, in individuals' scores; it yields a measure of how substantially the scores differ. Effect size has no upper boundary, though effect sizes are generally less than 2.0.
- 19 Two of the most commonly used measures of effect size are Cohen's *d* and Hedges' *g*. Both are scale free, meaning that they do not adopt the underlying scale of the original raw score on which it is calculated.

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## FOOTNOTES

- 20 STS did not evaluate the *Makhalidwe Athu* project. An impact evaluation was conducted by NORC at the University of Chicago. Results, including the effect size calculations provided in Table 3, will be posted at [www.allchildrenreading.org](http://www.allchildrenreading.org) when available. Confidence intervals were not presented in NORC's report.
- 21 Cohen's *d* is reported because the difference between Cohen's *d* and Hedges' *g* calculations were minimal.
- 22 The reading comprehension subtask consists of a limited number of items and, as a result, has low reliability. Because of this limitation, effect sizes are not reported.
- 23 The confidence interval for an effect size provides information of lower and upper bounds similar to a confidence interval for a mean score. For results of means and confidence intervals for each subtasks, subgroup, and intervention condition, see individual evaluation reports for each grantee, available at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 24 For projects with research designs that did not include a comparison group, data was not available to calculate a Cohen's *d* treatment effect. For the *Our Children Learn to Read* project, gain score and effect sizes were not computed because of the difference in the research sample population at baseline and endline.
- 25 Treatment effect sizes were computed only for subtasks in which there was a statistically significant difference between the gains of the intervention and comparison group.
- 26 Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- 27 R. V. Lenth, R. V. (2001), "Some practical guidelines for effective sample size determination," *The American Statistician*, 55, 187-193.
- 28 Hill, C. J., Bloom, H. S., Black, A. R., and Lipsey, M. W., (2008). *Empirical benchmarks for interpreting effect sizes in research, child development perspectives*, 2 (3), 172-177.
- 29 Researchers have attempted to capture the ranges of effect sizes typical to a specific discipline and topic of study. For example, education researchers have suggested the following interpretation of effect sizes: greater than 0.25 as large, 0.15 as medium, and 0.05 to 0.10 as small. They also note that these interpretations—as with Cohen's—cannot serve as universal guidelines.
- 30 Confidence interval for the *Makhalidwe Athu* project not reported in the source report. Results of the impact evaluation conducted by NORC will be posted at [www.allchildrenreading.org](http://www.allchildrenreading.org) when available.
- 31 On the *E-books 4 Khmer* project, there was no statistically significant correlation between gains on the listening comprehension subtask and students' family support for reading or disposition to reading.
- 32 For project-level results by gender, see individual evaluation reports for each grantee, available at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 33 The *GraphoGame™ Teacher Training Service* project tracked student experiences directly through GraphoGame™, which captured student exposure in minutes and student advancement through modules. The *Mundo de Libros* project collected data on student log-ins to the website, book checkouts, and parent workshop attendance through an online integrated library system.
- 34 For specific findings on exposure, see individual evaluation reports for each grantee, available at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 35 Cooley, L., & Linn, J. F. (2014). *Taking Innovations to scale: Methods, applications and lessons*. Results for Development Institute. Washington, D.C. Retrieved from: [https://www.usaid.gov/sites/default/files/documents/1865/v5web\\_R4D\\_MSI-BrookingsSynthPaper0914-3.pdf](https://www.usaid.gov/sites/default/files/documents/1865/v5web_R4D_MSI-BrookingsSynthPaper0914-3.pdf)
- 36 Cooley, L., & Linn, J. F. (2014). *Taking Innovations to scale: Methods, applications and lessons*. Results for Development Institute. Washington, D.C. Retrieved from: [https://www.usaid.gov/sites/default/files/documents/1865/v5web\\_R4D\\_MSI-BrookingsSynthPaper0914-3.pdf](https://www.usaid.gov/sites/default/files/documents/1865/v5web_R4D_MSI-BrookingsSynthPaper0914-3.pdf)
- 37 STS did not conduct a scalability assessment on the *Makhalidwe Athu* project. An impact evaluation was conducted by NORC at the University of Chicago, and results will be posted at [www.allchildrenreading.org](http://www.allchildrenreading.org) when available. The *Mundo de Libros* project was only assessed on two of seven parameters of scalability due to implementation challenges.
- 38 For detailed scalability assessment results, see individual evaluation reports for each grantee, available at [www.allchildrenreading.org](http://www.allchildrenreading.org).
- 39 RTI International. (2015). Measurement and research support to education strategy goal 1: Early grade reading costing template and guidance. Washington, D.C.: USAID. Retrieved from [http://pdf.usaid.gov/pdf\\_docs/PBAAF458.pdf](http://pdf.usaid.gov/pdf_docs/PBAAF458.pdf)
- 40 Due to rounding, cost percentages for each project may not always add up to 100.
- 41 No cost analysis was conducted on the *Makhalidwe Athu* project.

[www.AllChildrenReading.org](http://www.AllChildrenReading.org)

