



Digital4Literacy:

Leveraging Interactive Literacy for Low-Income Families
through Access to Ebooks

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Xavier is cuddled up on the couch with his much-loved stuffed rabbit, waiting impatiently for his mother, Carmen, to finish singing his baby sister to sleep. When Carmen settles in beside him, Xavier eagerly pushes a well-creased copy of *Adivina cuanto te quiero* (Guess How Much I Love You) into her hands. Carmen smiles and begins to read, even as her tired eyes reveal her long day of working two jobs. She knows that reading at bedtime offers a rare moment of one-on-one time with her 4-year-old son. Besides, he seems to love it – the more they read together, the more he asks for it. They have fallen into a nightly routine: Carmen holds the book and Xavier turns the pages. She reads; he points. They have read this particular book several times a week for the past few months, taking turns to hold their arms wide: “Te quiero esto mucho” (“I love you this much”). As the baby rabbit in the book falls asleep, Xavier’s eyes drift closed and a moment later, so do Carmen’s.

The scene looks more like a cozy bedtime ritual than a deliberate act of academic preparation. However, the past three decades of research on literacy development have shown that the five to ten minutes of nightly reading that Carmen does with her preschool son is one of the most important ways she can support his literacy development and even his chances for school success. When it comes to literacy, learning to “decode” letters and words is only a small part of what young children need to master. They must also learn to sustain their attention, acquire new words, grasp the meaning of words and sentences, and follow the plot (Snow, 1991). Children who engage in routine interactive reading at home with a parent or caregiver are more successful at literacy acquisition (Bennett, Weigel, & Martin, 2002; Sénéchal & LeFevre, 2002; Sénéchal & Young, 2008; Snow, Barnes, Chandler, Goodman, & Hemphill, 1991; Sonnenschein & Munsterman, 2002). While scientists are only beginning to understand the changes that occur in the brain during the emergence of reading skill (Schlaggar & McCandliss, 2007), regardless of household income or parent education, children who engage in routine interactive book reading at home with a parent or caregiver are more successful at the complex task of literacy acquisition (Bus, Van Ijzendoorn, & Pellegrini, 1995).

Joint book reading is "the single most important activity for developing the knowledge required for eventual success in reading"

-Commission on Reading, National Academy of Education, 1985

However, children from low-income homes are dramatically less likely to be reading at grade level by third grade and are at greater risk for dropping out of high school compared to children from middle and upper-income homes (Reardon, 2011; The Annie E. Casey Foundation, 2010). Low-income families live in neighborhoods that can be described as book deserts (Herman, 2014), with limited access to good-quality books that parents can read to their children in their native language. There is also evidence that less-educated parents do not fully realize the role that parents play in their child’s cognitive development (Rowe, 2008). As a consequence of these structural barriers, low-income parents spend less time talking directly and reading to their young children in ways that support cognitive development (Weisleder & Fernald, 2013). Despite research evidence and the efforts of programs aimed at promoting interactive book reading at home, the percentage of less-educated families who read to young children at home has been declining since 2005, as shown in Figure 1. By age 3, children in families on welfare have heard an average of 30 million fewer words addressed to them than children growing up in professional families (Hart & Risley, 2003).

A striking marker of this gap is the difference in preschool vocabulary: the average 3-year-old child from a low-income family has acquired 500 words, compared to over 1,000 at the same age for a child from a higher-income family (Hart & Risley, 2003). Preschoolers who experience more child-directed speech (speech by an adult directed toward a child, as opposed to other adults) are more proficient in processing familiar words in real time and have larger expressive vocabularies (Rowe, 2008). During parent-child book-sharing, stopping to elaborate on a story element and providing explanations has a positive effect on vocabulary knowledge among children in low-income families (DeTemple & Snow,

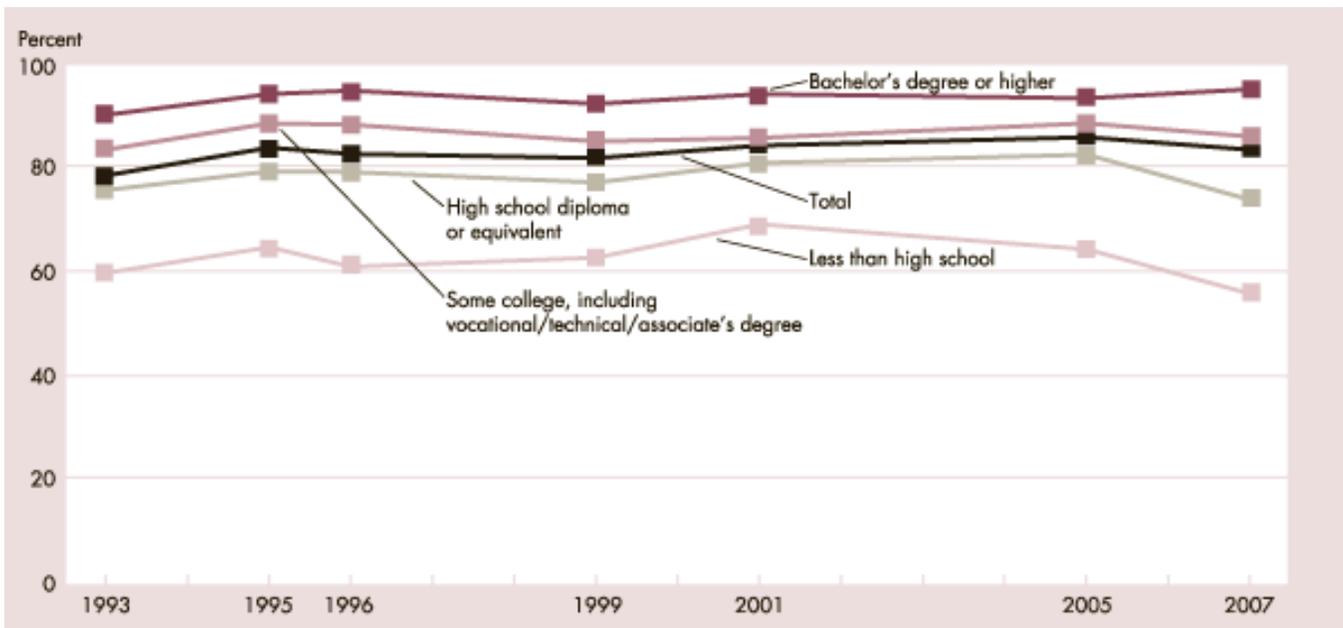


Figure 1: Percentage of U.S. children ages 3–5 who were read to three or more times in the last week by a family member, by mother's education

SOURCE: U.S. Department of Education, National Center for Education Statistics, <http://www.childstats.gov/americaschil->

2003; Dickinson & Tabors, 2001; Snow, 1991; Tabors, Beals, & Weizman, 2001; Tabors & Snow, 2001; Whitehurst et al., 1994). Programs aimed at helping low-income parents understand the essential role they play in literacy development have been shown to help close this gap (Jordan, Snow, & Porche, 2000; Kim & Quinn, 2013; O'Brien et al., 2014).

New technologies and educational media have fostered both hopes and concerns for early childhood literacy acquisition. Among U.S. families with children age 8 and under, there was a fivefold increase from 2011-2013 in ownership of tablet devices such as iPads (from 8% to 40%). Although 20% of lower-income children now have a tablet device at home, 63% of higher-income children do; and while 35% of lower-income parents have downloaded educational apps for their child, 75% of higher-income parents have done so (Common Sense Media, 2013). Surveys of educators and parents suggest that tablets and other devices could benefit literacy through greatly expanded access to reading material, convenience, and motivation (Blackwell, Lauricella & Wartella, 2014; Fuller, Lizárraga & Gray; 2015; Lee & Barron, 2015; Trautweiler, 2013; Wartella et al., 2013; Wartella et al., 2014), as well as literacy development (Chera & Wood, 2003; Korat, 2010; Shamir & Korat, 2009). However, some researchers have found that, compared to print books, ebooks are less supportive of story-focused conversation and story comprehension (De Jong & Bus, 2002; Miller & Warschauer, 2014; Parish-Morris et al., 2013). In one study comparing parent-child interactions while reading print books and ebooks, researchers found that print books were more advantageous for literacy building, whereas ebooks, particularly interactive ebooks, were more advantageous for engaging children and prompting physical interaction (Chiong, Ree, & Takeuchi, 2014). However, when parents are provided guidance in interactive reading strategies, tablet-based ebook readers can facilitate parent-child interactions that promote reading comprehension (Tseng, Liu, C. & Liu, B., 2012).

Three facts stand out from the emerging research on the role of electronic books in literacy development:

1. Digital technology is here to stay. Children live in a world of interactive media. A critical issue is how parents and caregivers of young children can be supported to learn about appropriate

and healthy use of digital resources for interactive literacy (Campbell & Koester, 2014; Hoog, 2014).

2. Digital devices offer the potential to dramatically increase the number of books available to low-income families at a scale needed to reverse the steady drop in home book reading over the past 10 years. Rates of at-home book reading in lower-income and less-educated households in the United States have been declining since 2005. In 2007, only 71% of children from lower income families were read to three or more times per week by a family member, compared to almost 90% of children in families from middle to upper income homes (ChildStats Forum on Family and Child Statistics, 2013). Getting enough high-quality age- and culturally-appropriate books into low-income homes is a critical factor in moving the needle on rates of home book-reading.
3. Finally, increased access to books (whether digital or print) must be combined with effective support to help parents and caregivers gain skills for reading interactively with their young children. Currently, few programs address how ebooks can be used to promote both access and skill-building.

There has never been a more important time to apply principles of development and learning when considering the use of cutting-edge technologies and new media.

-National Association for the Education of Young Children & Fred Rogers
Center for Early Learning and Children's Media (2012)

This research brief tells the story of Literacy Lab, a nonprofit organization based in Oakland, California, focused on building a strong foundation for literacy in low-income families and exploring the role of digital technology in bridging the gap in early literacy and school readiness for low-income children. Given the clear need to increase access to books in low-income families, Literacy Lab has focused on understanding the range of available technology options and supporting parents in navigating the digital world once their preschool-age children begin to explore technology, including how best to engage their children in interactive parent-child book-reading. Literacy Lab conducted a pilot study of its new program Digital4Literacy, which provided low-income families with digital access to books and trained them how to interactively engage in shared ebook reading with their preschool children. A central goal of the pilot study was to assess the gains in children's literacy development that took place during the program.

This research brief summarizes the results of the Digital4Literacy pilot study. The study found greater improvements on four measures of early literacy and numeracy for children whose caregivers were given access to ebooks compared to children whose caregivers were provided with print books, even though caregivers in both groups received comparable skill-development workshops in interactive book reading. The study found the highest gains for children whose caregivers had access to interactive ebooks (compared to ebooks without interactive features) in all four outcome areas. The results provide convincing evidence that, in conjunction with parent training, digital access to books at home can support low-income caregivers in developing interactive literacy experiences with their children that quickly translate into gains in kindergarten readiness.

The Digital4Literacy Program

Literacy Lab grew out of Bring Me A Book (BMAB), a nonprofit organization founded in 1997 to increase access to books and parent-preschooler home reading in low-income and English Language Learner families. To date, BMAB has provided libraries and read-aloud training to more than 450,000 children, parents, and teachers in nine states and eight countries. In 2012, the leadership of BMAB began exploring

the idea of developing a technology-based solution to increase book access and interactive reading opportunities for the children and families already served by the organization. In June 2013, BMAB was identified as one of 12 organizations across the country to receive a Morgan Stanley Challenge grant, receiving over 800 hours of pro bono consulting to develop the Digital4Literacy pilot. The team went on to win the highly competitive Morgan Stanley Challenge in New York City, coming in first place out of the finalist organizations presenting strategic initiatives.

The Digital4Literacy pilot program incorporated three critical components early learners need when building a strong learning foundation: access to high quality interactive literacy resources; attention to relationships between children, family and educators; and use of technologies that personalize learning and propel a child into reading success and a lifelong love of learning. The Bookcase Library placed bookcases filled with approximately 30 age-appropriate books in transitional and pre-kindergarten classrooms. All of the books were new children's books selected to be developmentally appropriate, culturally relevant, in the languages appropriate to the community, and supportive of critical thinking, vocabulary, and background knowledge development. The First Teacher workshops trained and supported parents, caregivers, and teachers on the critical importance of being involved in a child's early learning and how to implement strategies that foster a child's literacy, language, and overall development. Both the Bookcase Library and First Teacher workshops were core components of the original BMAB program model, updated over time to incorporate feedback and evaluation from parents, teachers, and other stakeholders.

Finally, the Digital4Literacy pilot program provided families with tablet devices loaded with either interactive or non-interactive ebooks for children and their caregivers to read at home. Tablets loaded with interactive ebooks contained 22 animated books that could be read or listened to in either Spanish or English and included games that reinforced vocabulary, comprehension, and critical thinking skills. The tablets with non-interactive ebooks contained a library of 18 Spanish and English titles and did not have an audio capability or interactive features.

The Digital4Literacy Pilot Study

Six classrooms were selected for the pilot study. All six classrooms were already participating in the Bookcase Library program, which provided children and teachers access to high-quality, language appropriate print books. Families of the children in each of the four classrooms selected for the Digital4Literacy pilot program were randomly assigned to receive a tablet loaded with either interactive or non-interactive ebooks. The families in the two control classrooms received a weekly book set in a canvas book bag that included a high-quality print book, a drawing-writing journal folio, a booklet of prompts and activities that served as reading comprehension extenders, and ready-to-use supports for parents and caregivers in reading aloud as well as connecting the text to the child's world to make the reading experience more meaningful. A total of 134 families participated in the pilot study.

Literacy Lab distributed the tablets at First Teacher workshops at the beginning of the school year and taught parents and caregivers how to use the devices and access the ebooks. At each of two subsequent workshops, parents and caregivers engaged in exercises and discussions to learn the value of interactive book reading, create home routines for parent-child reading, and use prompts to support different kinds of literacy skills, such as vocabulary, letter naming, rhyming, number naming, counting, and listening comprehension. First Teacher workshops were also conducted with parents of children in the control group classrooms. Participation in the workshops was over 90% for all classrooms. Parents attending the workshops were asked to complete a survey with questions about current frequency of home reading, length of time spent reading, number of children's books in the home, access to internet and wifi, comfort using technology, devices available at home, and home language. Parents also completed a survey at the end of the school year, which included questions about changes in frequency of home reading, use of the skill prompts, and feedback on the program.

Trained staff carried out assessments of emerging literacy and numeracy skills for each child at the start of the program and again seven months later using standardized pre-K assessment software. Table 1 provides an overview of the pilot study design.

Table 1: Overview of the Digital4Literacy Pilot Study

Goal	Inform a technology-based solution to increase book access and interactive reading opportunities for preschool children from low-income families.
Participants	134 children from six pre-K classrooms supporting low-income and English Language Learners (ELL).
Research questions	Does access to books through tablet devices increase the number of books read by parents and children? What impact does access digital access to books have on early literacy skills? Is there a greater impact from access to interactive ebooks compared to regular (non-interactive) ebooks?
Intervention groups	(a) Interactive ebooks accessed through tablet, (b) non-interactive ebooks accessed through tablet, (c) weekly take-home print books.
Other program activities	Caregivers from all three intervention groups were invited to participate in First Teacher workshops. Participating classrooms were provided with the Bookcase Library.
Key outcome measures	Beginning of year and follow-up assessment of Letter Recognition, Phonological Awareness, Vocabulary, Math Skills.

Descriptive statistics for the three intervention groups are shown in Table 2. The average age of the children in each group was about 5 years old (60 months), though the control group had a somewhat wider age range (3.3 to 6.5 years compared to 4.0 to 5.5 years for the digital groups). The groups all had a strong majority of Hispanic children, most of whom spoke Spanish at home. Each group contained approximately equal numbers of boys and girls.

Table 2: Characteristics of Pilot Study Intervention Groups

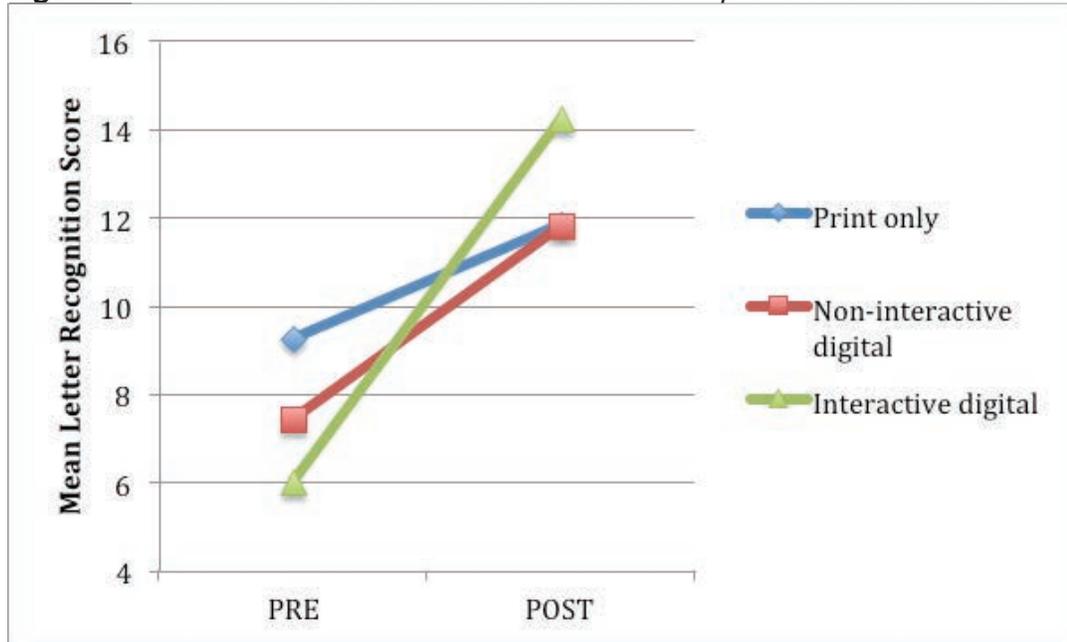
	Print (control group)	Non-interactive digital	Interactive digital
Number of participants	50	41	43
Mean age in months (range)	61.9 (40-78)	60.3 (47-67)	60.1 (49-68)
% Hispanic	74%	78%	87%
% Male	50%	56%	48%

Children who received access to interactive ebooks showed the greatest gains in emerging literacy and numeracy skills

The letter recognition assessment evaluated the number of uppercase and lowercase letters that a child could name in 60 seconds. Figure 2 shows that on average, children whose families had access to interactive ebooks had more growth in their ability to recognize letters than children in either of the other two groups. Both groups with digital access had statistically significant greater gains compared to the control group. In addition, the interactive ebook group had statistically significant greater gains compared to the non-interactive ebook group. Despite starting with lower scores at the beginning of the

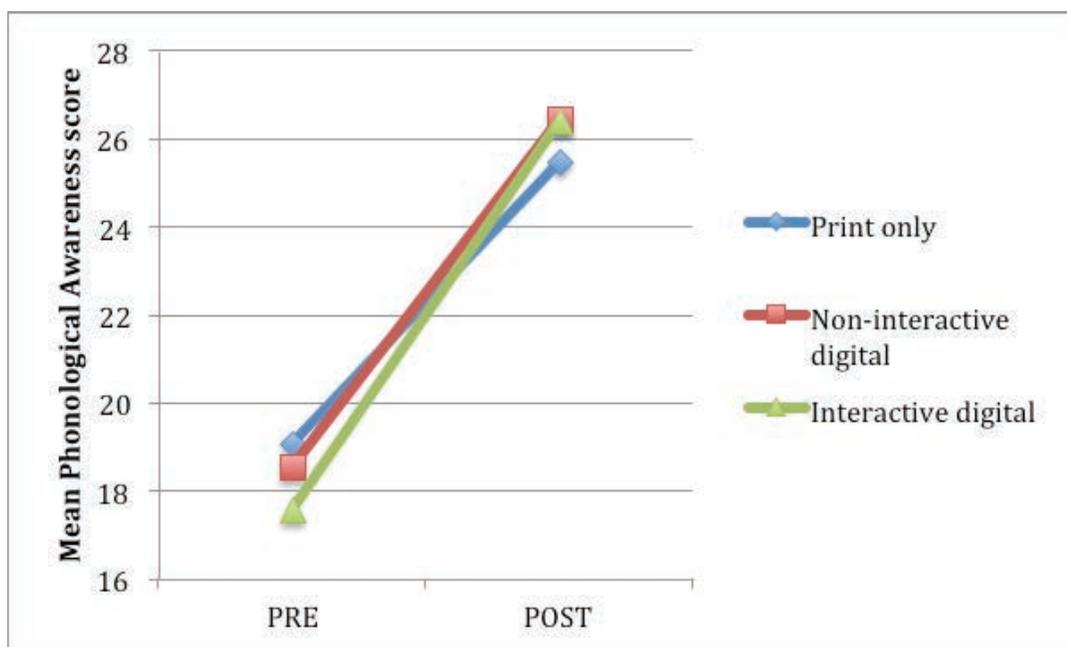
school year, children in the group receiving access to interactive ebooks had not only the greatest gains on average, but also the highest scores at the time of the seven-month follow-up assessment.

Figure 2: Children with access to interactive ebooks improved the most in letter recognition skills



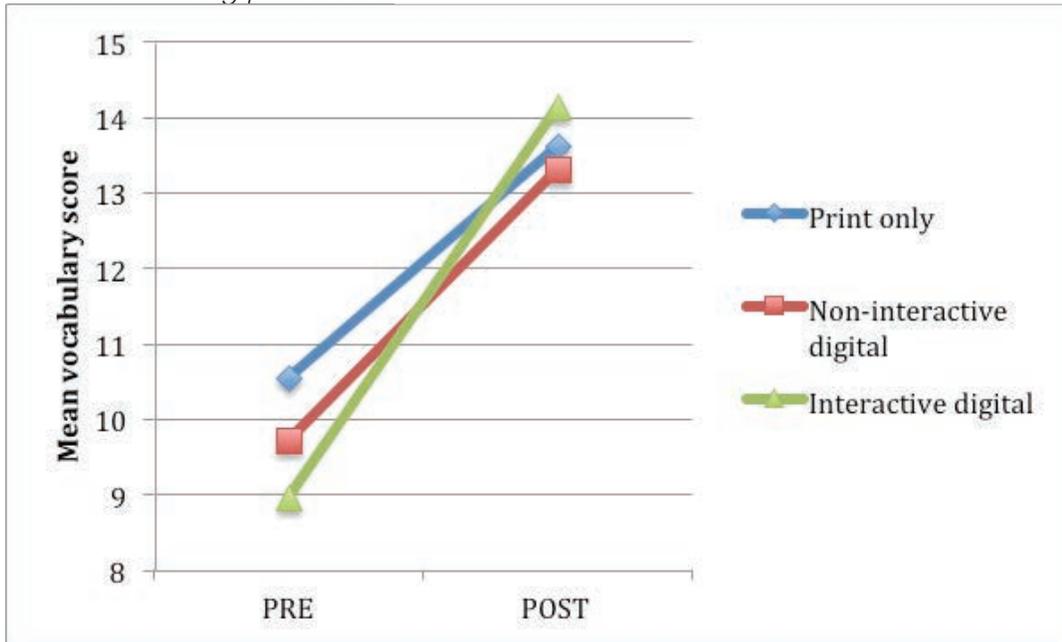
Phonological awareness skills include a child's ability to detect and manipulate sounds within spoken language (e.g., identification of words that rhyme, blending, and elision). Children learn to manipulate and understand large and concrete units of sound (e.g., compound words) prior to understanding how to manipulate smaller sounds (phonemes). Figure 3 shows that, on average, children who received access to interactive ebooks had somewhat greater gains in phonological awareness compared to children who received print books. Differences in growth in phonological awareness between children with access to non-interactive ebooks and those who received print books was not statistically significant, nor was the difference between the interactive ebook group and the non-interactive ebook group.

Figure 3: Children with access to interactive ebooks had slightly greater growth in phonological awareness compared to children who received print books



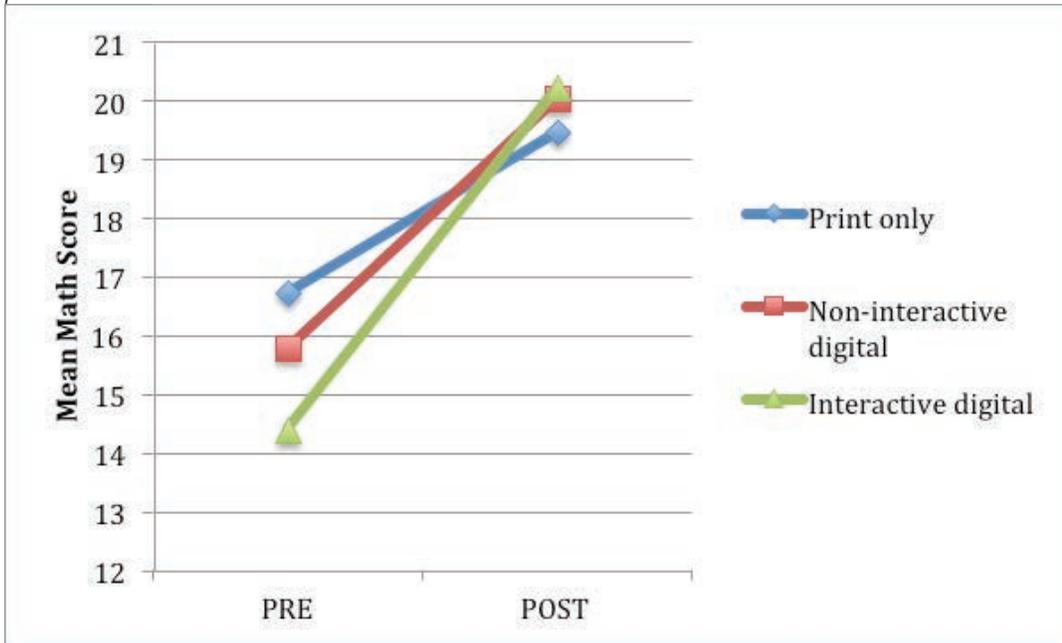
The same pattern was also true for vocabulary, as shown in Figure 4. Children were given a set of pictures to identify. On average, children who received access to interactive ebooks had more growth in their vocabulary compared to children in the control (print book) group. Although there appeared to be a greater gain for children who received access to interactive ebooks compared to those who received non-interactive ebooks, this difference was not statistically significant. Similarly, the difference in growth between the non-interactive ebook group and the control group was not statistically significant.

Figure 4: Children with access to interactive ebooks had greater gains in vocabulary compared to children receiving print books



Finally, the math assessment evaluated children's skills across multiple math content domains including counting, shape naming, operations, number identification, and shape discrimination. On average, children with access to interactive ebooks also showed the greatest gains in math skills, as shown in Figure 5. Both groups with digital access had statistically significant greater gains compared to the control group. However, the interactive ebook group did not have greater gains compared to the non-interactive ebook group.

Figure 5: Children with access to ebooks had greater gains in math compared to children who received print books

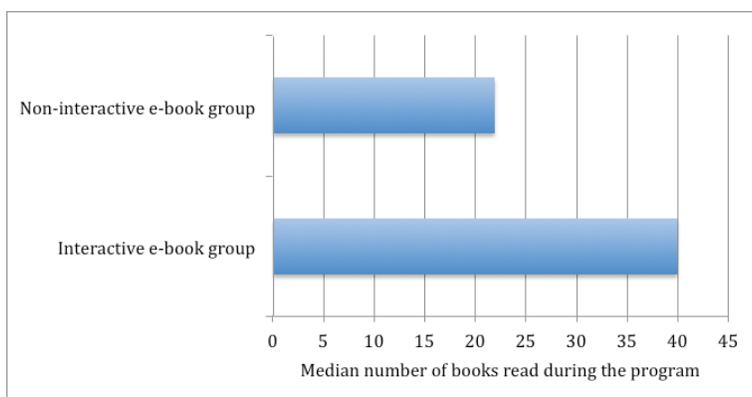


Potential benefits of access to ebooks

Given that gaining access to ebooks, particularly interactive ebooks, was related to greater gains in early literacy and numeracy outcomes, the question is what about ebook access might translate into benefits? The pilot study analysis examined whether families who received tablet devices read more books, read more frequently, or were more likely to use targeted skill prompts for encouraging particular kinds of interactions when reading books.

Families with access to interactive ebooks appeared to read more books. The tablet devices tracked the number of books opened by both ebook groups. Families provided with access to interactive ebooks accessed more books on average than those with access to non-interactive ebooks (Figure 6), though there was a great deal of variation across families. Although there is no way of knowing how many of these books were read together by the adult and child, interactive ebooks may be more intrinsically interesting to adults and children alike. However, literacy development was generally not related to the number of ebooks accessed. Only the letter recognition outcome was associated with number of books accessed – children who looked at more ebooks had higher letter recognition scores.

Figure 6: Median number of books read was higher for the interactive ebook group



Self-reported book-reading frequency was not related to gains in literacy or numeracy. With greater access to books as well as skills and knowledge gained in First Teacher workshops, parents and caregivers might begin to read more frequently with their children. If so, more frequent reading could lead to greater gains in early literacy and math outcomes. Although the majority of parents in each group reported reading more often with their children than before the program, this did not map to the pattern of outcomes described above. Table 3 shows that 92% of parents of children in the print book group reported they were reading more often, but children in this group had the lowest gain in each outcome area, on average. The percent of parents reporting that they read with their child daily also was not related to better outcomes on average. A greater percentage of families in the non-interactive ebook group (61%) reported reading daily at the end of the school year compared to the print book group (45%), but daily reading was less common in the interactive ebook group, which showed the greatest gains in all of the outcome areas on average.

Table 3: Parents report reading more often with child as a result of the program

	Print books	Non-interactive ebooks	Interactive ebooks
Read more often with my child than before this program	92%	86%	79%
Read daily (end of school year)	45%	61%	42%
Used skill prompts	85%	64%	96%

Use of skill prompts was not related to greater gains. Reading frequency may be one significant benefit of the parent workshops, but it is distinct from the issue of how parents interact with children during book reading. Parents were provided skill-prompt cards at the workshops, which were intended to support them in using specific techniques to help children learn new words, pay attention to rhymes, count, and other targeted interactions. Children whose parents used the skill prompts at home might be expected to show greater gains compared to those who did not use them. However, Table 3 shows that 85% of parents in the print book group reported using the skill prompts, while only 64% of the parents in the non-interactive ebook group did. This does not line up with the pattern of results in any outcome area; children in the non-interactive ebook group tended to have greater gains compared to the print book group. Specific data on which skill prompts were used by each family might shed light on the role of skill prompts in promoting interactions that benefit particular outcome areas.

Conclusions

The results of the Digital4Literacy pilot study provide evidence that, in conjunction with parent training, access to digital books at home can support low-income caregivers in developing interactive literacy experiences that translate into gains in kindergarten readiness. The pilot study found higher gains for children whose caregivers had access to interactive ebooks compared to those with access only to print books in all four outcome areas. In two outcome areas, letter recognition and math, both digital access groups showed greater growth than the group that received access to only print books. It is important to acknowledge the gains in math, which are evidence that interactive book reading supports numeracy as well as literacy development. However, except for letter recognition, children with access to interactive ebooks did not achieve statistically significant greater gains compared to children who received non-interactive ebooks. Although the descriptive data suggest that interactive ebooks might support parents in reading interactively with their children, the reasons for this are not yet clear.

Except for letter recognition, the study did not find greater gains for children whose tablet devices showed they looked at more books. Frequency of reading and use of skill prompts to support interactions during book reading were also not associated with greater development in the outcome areas. How, then, does gaining access to ebooks, particularly interactive ebooks, support children's literacy development? Digital books might increase motivation for parent-child book reading, or time spent reading could

increase through re-reading a smaller number of books. Although these hypotheses were not possible to address in the pilot study, they raise important questions for using technology to support interactive adult-child reading in low-income families.

Literacy Lab will continue to explore the relationships among technology, interactive literacy, parent support, and early learning outcomes. In June 2014, the Digital4Literacy program won another highly competitive grant challenge, the Google Bay Area Impact Challenge, and was awarded \$500,000 anchor funding and project incubation support from the Google team to scale up the Digital4Literacy in the Bay Area. As they do so, a major point of exploration will be expanding access beyond books and use of digital platforms to support ongoing parent engagement (e.g., through information sharing and text prompts), as well as extending the Bookcase Library to focus on vocabulary and creating workshops targeting vocabulary development.

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