CHILDREN’S READING WITH DIGITAL BOOKS

Children’s reading with digital books: past moving quickly to the future

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Abstract

Digital books, such as e-books, story apps, picture book apps and interactive stories, are narratives presented on touchscreens with multimedia and interactive features. Accumulating evidence suggests that early reading of print versus digital books is associated with different parent-child engagement patterns and children’s outcomes. Parents’ verbal scaffolding, children’s age and congruence between the narrative and the book’s interactive/multimedia features, are three so far documented process variables that explain the difference between reading print and digital books. To maximize the added value of digital books for children, the interaction among parent, child and book characteristics need to be studied in future research and be targeted through interventions and design-research collaborations.
Children’s increased use of digital media from a very young age and the undisputable benefits of children’s reading of print books make it imperative to identify the benefits and limitations of children’s digital books. Thus far, the findings have been mixed, with researchers following different theoretical and methodological approaches and reaching different conclusions, as highlighted in two recent literature reviews (Reich, Yau & Warschauer, 2016; Kucirkova, 2019). From a medium-focused perspective, which assumes that digital books unidirectionally alter the nature of parent-child interaction, parent-child reading of digital books is inferior to shared reading of print books, while from a socio-material perspective, different digital books are suitable for different children and parents.

The children’s digital books research field has grown over the past two decades into a multi-disciplinary and methodologically diverse area, with qualitative and/or quantitative research techniques and books that were produced commercially or by the researchers. This commentary focuses on children’s digital books in relation to the interaction among parents’ reading strategies, child’s characteristics and book features, and explains the mixed pattern of findings in the print-versus-digital books comparison literature. It is argued that comparisons of children’s outcomes in relation to digital versus print books isolate elements of context and design. Such an approach neglects several important process variables, such as parents’ and children’s behaviors with different book features, which jointly impact children’s learning. The field needs more practice-focused scholarship that considers nuanced socio-cultural influences, which dovetail with the design features of individual e-book titles.

The focus is on children aged up to five years (inclusive), which reflects the non-reader age and the popular “under 5” category targeted by commercial e-book producers (Apple). The umbrella term “digital books” is used to refer to e-books, story apps, picture book apps and iBooks, which offer fictional narratives in texts and illustrations, sounds and
interactive features and are available via touchscreen technologies. The review includes studies of children reading digital books with adults, with other children as well as reading on their own.

First, the key findings from studies that compared digital and print books in relation to children’s early literacy outcomes are considered, followed by research concerned with three components that mediate these outcomes: the relationship between digital books and parent-child variables. The interaction among these variables, together with inconclusive evidence based on small negative correlations between digital books and children’s outcomes, problematize the conclusion reached by some pediatricians that the promise of digital books improving children’s learning has not been fulfilled and their use should be discouraged in favor of print books (Tomopoulos, Klass & Mendelsohn, 2019). Recommendations for a joint future research and design agenda are provided.

**Children’s learning outcomes with digital versus paper books**

A substantial body of research focuses on comparing digital books with print books, with evidence of both positive and negative effects for children’s emergent literacy skills. For example, an experiment with 102 toddlers aged 17–26 months that compared electronic books and two print format books found that children learned more new words and displayed more engaged and socially desirable behavior when reading the digital books (Strouse & Ganea, 2017a). Another experiment, in which researchers compared the readings of 20 children aged 3–4 with digital and print books found that children’s receptive vocabulary scores were higher with the digital book (Gremmen, Molenaar & Teepe, 2016). Yet, a study with thirty-nine four-year-old US children reading digital and paper books found that children’s story comprehension scores were almost equal for both book formats (Lauricella, Barr & Calvert, 2014). Similarly, when digital and print books were compared in relation to
three-to-five-year olds’ story recall scores, there was no difference between the two reading formats (Richter & Courage, 2017).

Mixed findings are also present in research reviews evaluating the benefits of digital books for children’s early literacy. One review focused on the utility of digital books for supplementing literacy teaching and outlined the positive benefits of digital books for children’s emergent literacy skills (Biancarosa & Griffiths, 2012), while another review concluded that print books lead to higher learning benefits than digital books (Miller & Warschauer, 2014). Although the reviews did not follow systematic review procedures used in biomedical reviews and did not evaluate methodology quality of the research studies, their contrasting conclusions highlight the substantial conceptual differences in the field.

Format comparison studies operate from the premise that the “medium is the message” (McLuhan, 1951), which can, in and of itself, explain variation in distal variables, such as children’s literacy outcomes. Such an approach does not accord with the socio-material research tradition (Barad, 2003), which maintains that there is a continuing to-and-fro between social actors (e.g., parents and children) and material, non-living objects (e.g., digital books) in complex networks of multiple subjectivities. Moreover, in line with typical reading practice with print books, most digital versus print book-comparison studies investigate children’s outcomes with books read by an adult. It follows that children’s engagement and outcomes need to be studied in relation to parents’/caregivers’ interaction techniques (reading strategies).

**Parents’ reading strategies**

Studies that included children aged two up to five years have repeatedly found that when compared with print books, parents’ reading strategies with digital books are more focused on behavioral and technical aspects than on the story content (Krcmar & Cingel, 2014).
Comments on how to hold the iPad, how the pages are swiped etc. dominate parents’ talk during shared reading of digital books, with less language-stimulating dialogic reading strategies than with print books (Munzer, Miller, Weeks, Kaciroti & Radesky, 2019). Similar patterns are found in studies that compare different types of digital books, with more interactive features correlating with less language-stimulating talk by the parent. For example, an experiment with 165 US parent–child dyads found that parents’ use of dialogic reading techniques (such as prompts, questions, pointing) and children’s story comprehension skills were lower with digital books when compared to electronic console books and CD-rom books with fewer ‘bells and whistles’ (Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff & Collins, 2013).

Parents’ different reading strategies with print and digital books may be related to their strong preference for children’s print books. Interviews with twelve Australian mothers of two-year-olds showed that they strongly preferred using printed storybooks, particularly during bedtime (Nicholas & Paatsch, 2018) and a national survey of 1511 British parents revealed that parents of 0-2-year-olds had major concerns and minimized children’s exposure to digital books (Kucirkova & Littleton, 2016). Parents’ attitudes towards digital books might influence their perceptions of children’s engagement and enjoyment of the reading sessions. For example, when asked about their children’s engagement with digital and print books, parents of 1-4-year-old children reported that their children engage and enjoy print books more than digital books (Strouse & Ganea, 2017b). Parents’ perceptions do not accord with researchers’ observations that show that children prefer digital books (ibid) or enjoy print and digital books equally (Grimshaw, Dungworth, McKnight & Morris, 2007). Parents’ negative and incorrect beliefs about children’s preference for digital books are likely to contribute to their lower-quality reading strategies, which, in turn, influence children’s lower-quality
learning with digital books (Strouse & Ganea, 2016). It is therefore vital that future research identifies factors that shape parents’ negative attitudes toward children’s digital books.

Parents’ attitudes and strategies might explain the superiority of digital books for children’s learning from reading digital books on their own. A meta-analysis of 29 studies and 1272 preschool, kindergarten, and elementary school children, compared children's comprehension and word learning from digital and print books read with and without the support of an adult (Takacs, Swart & Bus, 2014). Digital books, which included synchronization of illustration with narrative, were more beneficial than print books without the help of an adult. When the adult was present, there was no difference in children’s story comprehension with a digital or print book (ibid). There were only differences between paper and digital books (in favor of digital books) when no adult was involved which led to the conclusion that what adults do during paper book reading has the same impact as the multimedia additions in the digital books. In addition, several children’s characteristics, including the child’s age, language and temperament vitally influence parents’ perceptions and reading strategies.

**Children’s characteristics**

Cumulative evidence shows that children’s engagement, as measured by visual attention or observer ratings, is greater with digital than with print books (Richter & Courage, 2017; Strouse & Ganea, 2017b). Whether this engagement is greater because of children’s restricted access to digital books or because of their parents’ mediating strategies and/or the books’ interactive and multimedia features, is not known. Research focusing on children’s characteristics is beginning to explore children’s age and executive functioning in children’s learning with digital books. In a study with 20 three-year-olds, 38 four-year-olds and 21 five-year-olds reading digital and print books, children’s greater engagement with digital books
was only significant for the three-year-old children (Richter & Courage, 2017). In another study with children aged 2-3, the children verbalized and collaborated more during the reading of print as opposed to digital books (Munzer, Miller, Weeks, Kaciroti & Radesky, 2019). These findings suggest that children aged 2-3 are more engaged with digital books than older toddlers. However, when researchers compared the outcomes with digital versus print books, it was the children’s executive functioning, not their age, that explained variation in children’s attention and story recall (Lauricella, Barr & Calvert, 2014). It is difficult to draw strong conclusions about developmental trends as there are no longitudinal or cross-sectional studies involving infants (children under the age of two) and digital books. Richter and Courage (2017) make the sensible recommendation to use maturity of children’s executive functioning for gauging the suitability of digital books for young children’s use.

For minority language children or children from households with little history of reading, the distributed authorship and free-to-the-reader pricing of digital libraries (e.g. International Children’s Digital Library; Storyweaver) indicate a significant potential of digital books to increase reading choice and volume through access to low-cost and diverse reading materials. Systems of scalable reading apps designed to teach children to read (e.g., Curious Learning; BookNook) and to promote parent-child story-sharing (e.g. the Worldreader Kidss App) provide a means for individualizing reading instruction for children from low-income countries. It will be important for future research to identify which groups of children and in which circumstances benefit from such digital books most.

**Book characteristics**

Adults’ negative perceptions of children’s digital books are typically countered by highlighting the added value of digital books for bilingual education, for motivating reluctant readers, for supplementing the learning for children with special educational needs and for
reaching low-literate families who own few print materials but have smartphones or tablets. Most evidence for these benefits comes from individual case studies, which use digital books (co)designed by researchers with scaffolding features that are specially constructed to foster emergent literacy skills. Such books were found helpful, among others, for children at risk for learning disability (Shamir, Korat & Fellah, 2012), children from low socio-economic backgrounds (Korat & Shneor, 2019), and children with Special Language Impairment (Korat, Graister & Altman, 2019) or poor letter knowledge (Rvachew, Rees, Carolan & Nadig, 2017). Moreover, digital books specifically designed to encourage parent-child conversation increased parent–child conversational turns between caregivers and 2-5-year-olds from low-income backgrounds (Troseth, Strouse, Flores, Stuckelman & Johnson, 2019).

These results must be interpreted with the big caveat that unlike researcher-designed books, commercially produced digital books are of very low quality. A descriptive analysis of English and Hebrew digital books indicated that they have distracting multimedia features and very few features supporting story comprehension or language learning (Korat & Falk, 2017). Similarly, the most popular (best-selling) digital books in Hungary, Turkey, Greece and the Netherlands are of low educational value (Sari, Takacs & Bus, 2017). Despite well-formulated research suggestions for design improvement (Hirsh-Pasek et al., 2015; Richards & Calvert, 2017), there has been little progress in the quality of digital books over the past ten years of their commercial development (Korat & Falk, 2017).

Poor quality relates to the books’ content as well as format features such as weight, brightness and quality of images/illustrations, sensory affordances, and presence or absence of Augmented Reality. Extant research has been mostly preoccupied with two features: interactivity (touch-activated movements of story characters, changes to story plot or play of games embedded in the story) and multimedia (combination of media such as
sounds/music/voice-overs, illustrations/photos/drawings, text and videos). Unlike external properties of digital books, such as the devices they are accessed on, multimedia and interactivity are embedded inside digital books and they are realized in an interaction between the reader and the book.

Experiments that compared children’s learning from interactive versus non-interactive digital books for children’s learning found a positive effect of interactivity (Zipke, 2017; Kelley & Kinney, 2017). In these studies, interactivity consisted of features that constitute reading experiences beyond what a print book can offer, such as, for example, spoken narration, text highlighting, sound effects, music, and moving characters. However, two major research summaries, a meta-analysis (Takacs, Swart & Bus, 2015) and a systematic literature search that included studies with two to twelve-year-olds with comparison of outcomes with effect sizes (Zucker, Moody & McKenna, 2009), concluded that interactive features (broadly defined) have a negative impact on children’s learning when they are incongruent with the story plot/main narrative. Incongruent interactivity includes features that are not aligned with the main storyline and draw the child’s attention away from the story to games or other activities embedded in the digital books. Incongruent interactivity was found to be negatively related to vocabulary scores, retelling and inference also in a detailed analysis of children aged five and six reading digital books over one school year (Christ, Wang, Chiu & Cho, 2019).

The importance of congruence also applies to multimedia features which, if not congruent with the story, impede children’s story comprehension and word learning (Bus, Takacs & Kegel, 2015). These findings can be explained with the capacity theory of attention (Kahneman, 1973), according to which performance on a task is limited by the cognitive resources available to an individual (incongruent interactivity consumes the cognitive
resources that would be otherwise available for children’s inferencing or story comprehension). Thus, it is not interactivity or multimedia per se but their incongruent versions that are not helpful for children’s early literacy outcomes.

There is no conventional design for children’s digital books, which limits their usability as well as consistency of analytical focus across research studies. The development of typologies and characterization of the various types and kinds of features available with digital books has been the focus of several qualitative studies (e.g., Turrión, 2014). Detailed observations of children’s engagement with digital books at home show that interactive and multimedia features that actively involve the child in the story, increase the child's autonomy, enjoyment and agency (Aliagas & Margallo, 2017). Such personalized reading experiences with digital books are created through embedded algorithms (automatic personalization) or a reader’s active contribution of content (agentic personalization). Personalized interactivity and multimedia features position the child as collaborator, storyteller or author of the story and they support positive reading atmosphere at home (Kucirkova, Messer, Sheehy & Flewitt, 2013) and children’s sense of volition (Kucirkova, 2018). In sum, when it comes to book characteristics, high-quality content and features of digital books are proffered for their significant potential to add value for children at risk of academic success.

**Research and practice issues**

The inter-relationships among parent, child and book characteristics behoove researchers to draw on a dynamic model of book reading, in which design and research work together to strengthen the research base and enhance children’s contemporary reading experiences. This dynamic model hypothesizes an interplay between parent, child and book characteristics in a complex model of interactions (see Figure1).
Three different avenues are suggested for research-design collaborations to progress the field.

1. **User-led participatory approaches**

   To break the negative cycle of low-quality content and low-quality mediation of parent-child shared reading of digital books (Strouse & Ganea, 2017a), researchers need to address the mediators of parents’ negative attitudes towards digital books. These include the aforementioned poor quality of commercially-offered children’s digital books but also the development of guidelines and best-practice examples for parents. Such a research-practice approach can be referred to as user-led participatory design or human-centered design, which dominate best-practice models in children’s technology field (Druin, 1999) and could add valuable tools to the field of children’s digital books.

2. **Qualitative markers of digital book features**

   Understanding the properties of specific book features would refine the explanatory factors for current findings. For example, incongruent interactive features (e.g. illustration that distracts from the text) can be detrimental to children’s learning but personalized incongruent interactive features (e.g. a child’s own illustration that distracts from the text) might reinforce or mitigate against these effects. Building on the large body of evidence concerning interactive and multimedia features of children’s digital books, it is time to move towards features specific to reading digitally. In particular, more researchers should capitalize on the possibility of using digital books to simultaneously provide a reading experience for the child and provide data about this experience. Personal data can be used for prompting parents to personalize the reading experience for their child and data on children’s reading progress can
be used for identifying individual children’s reading strategies and adopting the content
(Huang & Liang, 2015). A fine-grained focus on qualitative markers of digital book features
expands the current research/design focus on verbal interaction to embodied reading, where
all modes of communication are given equal value. Embodied reading, i.e. reading
understood as a sensual and intimate experience, constitutes a vibrant research field in adults’
reading research (e.g., Mangen, 2008) but is underrepresented in children’s reading research.
Adults’ and children’s literature studies have been unhelpfully segregated for several decades
and the study of digital books could pioneer research that integrates adult and child data with
a shared analytical focus.

3. Combination of different types of content with different types of formats

With a few exceptions of studies that looked at parent-child reading of non-fictional
digital books (Strouse & Ganea, 2016), most of the research knowledge about digital books
comes from studies focused on fictional, narrative content. The interaction between diverse
types of content with diverse types of books’ features is little understood and needs to be
urgently addressed given the increased policy interest of some countries (e.g., China) to
replace all print-based textbooks with digital textbooks in elementary schools. The potential
of digital books to bridge home-school reading (Roskos, Brueck & Lenhart, 2017) and
provide multimedia, multi-lingual education (Wang, Christ & Mifsud, 2019) will be more
realistic if researchers prioritize the study of diverse contents that cover reading for pleasure
as well as reading for information. In addition, the development of high-quality content and
formats of children’s digital books necessitates strategic government investment on national
and international levels, and removing unfair advantage for the distribution of print books
such as the VAT on digital publications (“Reading tax” in the UK).
In conclusion, given the evidence that high-quality digital books can add learning value to children’s reading experiences, future research-practice efforts need to optimize the design and use of children’s digital books for keeping the status of reading as the most important activity for children’s learning.
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