Critical Review: Electronic versus Paper Books for Phonological Awareness Development.

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Abstract

While it is well-understood that joint book reading with preschoolers leads to many positive outcomes, the digital reading movement continues to introduce new platforms that parents and educators can use to read with children. This review examined the effect of adult-mediated interactions with electronic books (e-books) compared to traditional, paper books on phonological awareness (PA) in preschoolers. The articles were evaluated according to level of evidence, validity, and importance of the information delivered in five randomized control trials (RCT's). Overall, the research is suggestive for the potential for e-books to support pre-schoolers' PA development. The effects of e-books on various populations of preschoolers, the importance of adult-mediation, the PA skills to which e-books lend themselves, and the necessary software features for supporting PA development are discussed.

Introduction

It is generally well understood that emergent literacy levels, most notably phonological awareness (PA) skills, in kindergarten and grade one is an important predictor of future reading success in school (Scarborough, 2001). PA skills encompass a child's ability to identify and manipulate sounds in a word (e.g., segmenting, blending, deletion, substitution). Rhyming is a skill that stems from a solid foundation in PA (Anthony & Francis, 2005).

With increasing and widespread inclusion of computers and other devices in education, and the current climate of online learning amid the COVID-19 pandemic, electronic books (e-books) are a type of software to which many young children are commonly exposed. These "living books" are interactive narratives that utilize multimedia features like audio read-alouds, written text, sound effects, music and animations. Educators have pointed to the potential for e-books to support children's literacy development through enhancing vocabulary, increasing motivation to read, and supporting their recognition of print (Chera & Wood, 2003). Researchers have also cautioned professionals regarding the potential limitations of e-books, arguing that aspects of multimedia and games that do not directly support story content may be distracting to children by disrupting story continuity (de Jong & Bus, 2003). Additionally, there is a growing body of evidence providing support for adult-mediated interactions with books for facilitating preschoolers' PA (Karrass & Braungart-Rieker, 2005), in comparison to independent exploration of books. The effects of these adult-mediated interactions with e-books compared to adult-mediation with paper-based books will be important for helping speech-language pathologists to make evidence-informed recommendations, to parents and educators alike, as to how to best support PA development in preschoolers.

Objectives

The primary objective of this paper was to critically review the existing literature addressing whether adult-mediated use of e-books or traditional, paper books yielded comparable outcomes on measures of PA in preschool-aged, early readers.

Methods

Search Strategy: A variety of computerized databases including PubMed, Psych Info, CINAHL, and ASHA publications were searched using the following terms: (Preschoolers) OR (toddlers) AND (e-books) OR (paper-based books) AND (phonological Awareness) OR (Early Literacy Skills) AND (adult-mediation) OR (parent-child interaction) OR (joint-reading).

Selection Criteria: Articles were included in this critical review if they followed or included the following criteria: (1) employment of a RCT design, (2) comparison of e-books against paper books, (3) direct measurement of PA as an early literacy skill, and (4) analysis regarding how adult-mediated reading of either book style affected the outcome of reading.

Data Collection: The results of the literature search yielded six RCTs that met the above-mentioned selection criteria.

Randomized Control Trials (RCTs)

Studies using a RCT design were exclusively included in this review because randomization removes many of the inherent biases that can be apparent in other research designs and provide the highest level of evidence. As the study is conducted, the only expected difference between the control and experimental

groups in a RCT is the outcome variable being studied.

Results

Korat and Shamir (2007) analyzed the emergent reading skills of 128 five- to six-year-old children from low and middle SES families using a between-subjects RCT design. Participants were randomly assigned to either a control group or one of two intervention groups (reading an e-book individually, or an adult-mediated reading using the same story in its printed book version). Pre- and post-intervention emergent literacy measures included vocabulary, word recognition and phonological awareness (sub-syllabic segmentation task with six two-syllable words found in the book and six high-frequency words). Compared with the control group, the children's vocabulary scores, and story comprehension in both intervention groups improved following reading activity. Compared to the control group, in both SES groups phonological awareness and word recognition did not improve following both reading interventions. The findings demonstrated that low SES participants showed significant improvement compared to middle SES participants.

PA measures were clearly defined in this research and tested pre- and post-intervention. Moreover, the timing of the post-treatment measurement was consistent between groups (one-four days prior to completing the three sessions). Validity was further supported by testing the differences of each early literacy skill based on the type of book interaction, as well as between low SES and middle SES participants.

Limitations of this study included that the three early literacy skills measures (PA, vocabulary, and word recognition) of each participant were only measured at one time point (after the completion of the reading sessions). The PA measure also only tested syllable segmentation, which is only one component of PA skills. The greater improvements made by the lower SES participants may be due to lower pre-test scores allowing for increased improvement in this SES group compared to the middle SES group, given that middle SES children typically have higher initial levels of PA skills than same-aged low SES peers. Additionally, the authors did not control for the interactions/learning process with e-books (i.e., previous exposure, length of time learning the controls of the e-book) prior to the test. These limitations, alongside the lack of long term follow up, contributes to the suggestive nature of these results.

Shamir and Korat (2007) used a between-subjects RCT design to determine the effects of an e-book used with adult-mediated individual learning versus paired learning with a same-age peers on emergent literacy skills. The following emergent literacy skills were assessed at the pre-intervention stage and post-intervention stage; word meaning, word recognition, emergent word writing, and PA. PA was measured using a syllable segmentation task with 12 two-syllable words placed in the "dictionary" of the e-book. A total of 72 children from low SES neighbourhoods who were at risk for learning disabilities (LD), due to a diagnosed developmental delay, participated in three 30-minute sessions with an e-book in either a paired-learning or individual learning environment. Both intervention groups were exposed to three e-book modes (one time each), "read only," "read with dictionary," and "read and play." Their results were then compared to those of a control group. Results indicated that both intervention groups (paired learning and individual learning) showed improvement on overall emergent literacy skills, with improved knowledge in three of the five literacy domains: word recognition, emergent writing, and phonological awareness.

This study's inclusion of younger, low-SES participants provides evidence for the use of e-books with a broader population. The comparison of the two intervention styles provides more specific evidence regarding the impact of the learning environment on children's interaction with e-books. This comparison has good validity as the researchers ensured that participants in both intervention groups engaged with the three variations of the same book. Although the results neither confirm nor deny the use of one learning style, the benefit of using a well-designed e-book, even in a limited number of sessions is clearly indicated. The use of a custom-made e-book allowed the authors to tailor e-book features to facilitate learning of specific early literacy skills. The authors argue that the "read and play" mode allowed children to activate PA hotspots. While this may be true for improvements in syllable segmentation of the 12 target words in the story, this assessment of PA is informal, and only addresses one PA subskill. Lastly, while Shamir and Korat outline the need for teacher instruction regarding e-book use, it remains unclear what role teachers play in facilitating e-book use to maximize children's interaction with e-books. The broader clinical implications of these results are complicated by the barriers that low SES families may face when accessing these innovative, educational e-books. Additional research focused on comparing general, widely available e-books to the educational, literacy-specific e-books is needed. These results are suggestive, and require more comprehensive

measures of PA, and more clearly defined aspects of adult-mediation to strengthen the clinical implications.

Segal-Drori, Korat, and Klein (2012) looked at the emergent reading skills of 128 Kindergarteners from low-income families using a between-subjects RCT design. Students were randomly assigned to one of four groups and participated in four 20–30-minute sessions: independent e-book reading (EB), adult-mediated e-book reading (EBM), adult-mediated printed book reading (PBM), and receiving the regular Kindergarten reading program (control group). Pre- and post-intervention emergent reading measures included recognition of letter names, phonological awareness, emergent word reading, and concept about print (CAP). The results showed that the EBM group achieved greater progress in recognition of letter names, emergent word reading, CAP, and the general emergent reading level than all other groups. For PA specifically, the EBM group was significantly higher than that of the PBM group for final sound identification, and significantly higher than the EB group and the control group for syllable substitution. Finally, the EB group performed significantly higher than the PBM group on initial sound ID tasks. The present results point to the limitations of e-books alone, stressing the importance of adult mediation to optimize the benefit from e-books. Moreover, the unique features of e-books (animations, sounds, graphics) coupled with adult-mediated interactions aimed at promoting early reading skills appears to have the greatest benefit to the development of such skills compared to joint book reading with a paper-based book.

Methodological strengths of this article include controlling for higher initial emergent reading levels (EL) among the groups using statistical analyses to determine improvements in the children's early literacy measures were a function of the intervention group. Secondly, the validity of these results is bolstered because the authors addressed the contribution of various demographic variables, proving statistically that demographic variables did not explain variance in the children's EL.

A weakness of this study was that the authors did not clearly define the nature of adult-mediated interaction. They simply stated broadly that this type of interaction consisted of facilitating book interaction through the promotion of early literacy skills, including PA (initial/final sound identification, and syllable segmentation/blending). It is mentioned that adult-mediated support occurred during and after the reading sessions, however it remains unclear as to what was required of adults to optimize book-interaction. For the above-mentioned reasons, these results are highly suggestive for the use of e-books with adult mediation to promote PA skills.

Korat, Shamir and Abriv (2011) completed a between-subjects RCT comparing the effects of reading an electronic book, with or without adult support, on kindergarten children's emergent word writing skills. Children were randomly assigned to one of three groups: independently reading e-book (EB), reading e-book with adult support (EBS), and a control group. PA was assessed comprehensively using a detailed test that looked at several PA skills (initial and closing phoneme, division into sub-syllables). Significant differences in improvement were found between the groups on three measures: opening sound identification, closing sound identification, and word writing. The EBS group was observed to perform significantly better on post-intervention measures when compared to both the EB and control groups.

A notable strength of this study was the strong internal validity supported by the researchers' use of the same book across all three intervention groups, activating different "modes" dependent on the experimental group ("Read story only" vs. "Read and Play"). An additional strength is the comprehensive and well-defined PA assessment protocol which strengthened the methodology.

A limitation of this study was that neither the children's use of the software in the EB group nor the adult-child interactions in the EBS group were documented, decreasing both the validity of the results and the replicability of the study. Moreover, the timing of adult-mediated interactions (during or after book-reading) is not carefully controlled for and may have acted as a confounding variable influencing the results. Considering both the strengths and limitations of the present study, the results were deemed suggestive in nature.

Shamir, Korat and Fellah (2012) completed a RCT comparing the effects of engaging with an educational e-book versus an adult-read printed version of the same book in preschoolers with developmental delays. One hundred and ten kindergarten children aged five to seven were randomly assigned to one of three groups: activity with the e-book, listening to the book's printed version read by an adult and a control group, with intervention groups receiving six 30-minute sessions. The e-book group experienced each mode two times (read only, read and play, and read with dictionary), while

the printed-book group were read the same story six times followed by an instructor lead discussion about the book. Word meaning and phonological awareness were assessed during the pre-intervention and post-intervention stages for all children in the study. The findings revealed that the group exposed to the e-book intervention showed greater progress in vocabulary and PA (sub-syllabic segmentation) measures compared to the other intervention group and the control group.

By using a population of preschoolers at risk for LD, these results provide support for the use of e-books for PA development beyond the typically developing population. While these authors clearly define the adult-mediation used with the printed-book group, the adult interaction with the e-book group was poorly outlined, making it difficult to draw conclusions regarding the role of adult-mediated interaction with either book form. The higher post-intervention PA scores for the e-book group compared to the control group provides additional evidence that e-book's "read and play" mode promotes PA by listening and viewing words in a multimedia format. However, the higher PA scores for the e-book group compared to the printed book group is inherently flawed as the paper-book group did not receive any direct PA intervention. A factor that limits the evidence of this study is the lack of a standardized tool to measure PA; instead, simply measuring only one component of PA – sub-syllabic segmentation. Thus, for PA development specifically, this evidence is suggestive, simply serving as a launching point for exploring the role of e-books in PA instruction more systematically.

Korat and Segal-Drori (2016) completed three RCT sub-studies within their experiment, each using a between-subjects design. The first and third study analyzed PA directly by assessing the child's segmenting skills via presentation of 12 bi-syllabic words (six high-frequency and six from the book). The first study sought to investigate the impact of age (four-to-five or five-to-six years old) and the number of book reading (three or five) on PA skill development. The results of this study demonstrated that all age groups benefited from e-book reading, and that five readings had greater benefits for this skill compared to three.

The second study examined 48 pairs of middle SES kindergarteners and their mothers to compare parental mediation in joint reading of a printed book to joint reading of two types of e-books: a considerate e-book (included multimedia aspects that are crucial to the story) and an inconsiderate e-book (includes multimedia details that are incidental to the story). The Observing Mediational Interaction Scale was used to analyze content units relating to the expansion-type talk. Results showed that the joint printed book reading yielded more expanding talk than the joint e-book reading and that reading the considerate e-book yielded higher expanding talk than reading the inconsiderate e-book.

The third study compared adult support in joint e-book reading to joint printed book reading, further comparing joint reading to children's independent reading of e-books. Participants were randomly assigned to one of three groups: independent e-book, e-book with adult support or printed book with adult support. PA was further assessed in this study by analyzing sound identification skills (i.e., asking children to identify the opening sound for 15 monosyllabic words and the closing sound of an additional 15 monosyllabic word). Results revealed that children who entered the study with low-level early literacy and received the e-book with adult support gained more in terms of their PA than those reading the printed book with adult support.

Notable strengths were found in all three studies. Comparing two types of therapy (e-book versus printed) against level of support provides more information about the efficacy of the treatment protocol. Similarly, comparing two types of e-books (considerate versus inconsiderate) holds greater clinical implications about specific e-book features needed for PA skill development. Additionally, assessing multiple components of PA (e.g., sound identification, segmenting) was a strength of the third study, allowing for a more holistic generalization to PA. Limitations to this study are found by the lack of control for behavioural factors (e.g., level of distraction, interaction with parents). While these results yield that adult-mediated interaction facilitates PA skills, the evidence remains highly suggestive due to mixed results regarding the necessity of e-books as the medium for this skill development, as well as to what extent low initial literacy levels can exaggerate the improved results.

Discussion and Clinical Implications

A critical analysis of the existing literature revealed that overall, well developed e-books have a strong potential to support preschooler's early literacy skills, including PA. While adult-mediated interactions with e-books are necessary for promoting some early literacy skills, the evidence for adult mediation to support PA skill developed remains mixed. Although several studies found positive support for children's independent exploration and adult-

mediated interaction with e-books on PA skills, these results were confounded by researchers' cursory assessment of PA skills, variation in e-book features, and poorly controlled interactional factors with adult-mediation. Taken together, the limitations of these articles reduce the strength and level of evidence, resulting in suggestive research conclusions. The evidence in this review reminds us to proceed with caution when making clinical recommendations about how to use e-books, the quality of e-book software, and the necessary interactional factors for optimizing the use of e-books.

Future Research Considerations

Additional research is needed to define the necessary features of e-book software, as well as the nature of quality of joint e-book interactions. Future studies should also aim to measure PA using a comprehensive assessment that addresses a variety of PA skills expected for preschool-age children (initial and final sound identification, syllable and sound segmentation and blending, as well as deletion tasks). Additionally, carefully defining the nature and timing of "adult-interaction" would control for teaching factors on PA skill development and bolster the clinical implications. This emphasizes the need for guiding programs for educators to use with e-book platforms to optimize adult-mediated interactions. Researchers should also compare PA development using various e-book features (considerate vs. inconsiderate e-book, audio, video animations) to concretely define what software elements are necessary or beneficial to facilitate different PA skill development.

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