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## 2

# Summary of research on children's digital books

This chapter aims to provide a concise summary of the existing empirical evidence concerning children's digital books. In selecting the studies for this review, I was guided by two principal aims: to include interdisciplinary evidence that uses mixed methods in examining the relationship between digital books and children's learning, and to give equal weight to both positive and negative impacts of children's digital books. Although I tried to include studies that were conducted in various countries, I could not escape the fact that the current evidence base is dominated by Anglo-American research with a quantitative orientation.

## Introduction to the research on children's digital books

The novelty of screens and the vast amount of mediocre and inappropriate content that can be accessed through them have, understandably, led to some concerns about the negative effect of screens on the coveted activity of reading. I understand and share some of the concerns. It is important that we all engage in a considered reflection on both the benefits and limitations of reading on screen.

You may want to begin the reflection with the question of novelty and the challenge of new developments that are often perceived as a threat rather than an opportunity. Although decades of research demonstrate the beneficial effects of children's reading print/paper books, research on children's use of screens still needs to develop. A major challenge faced by research on emerging technologies is that its findings are typically based on single rather than repeated studies and on short-term and small-scale rather than longitudinal and large-scale investigations. One of the key questions that researchers therefore need to ask is what

are the most relevant *features* and *effects* that they should examine in a given research context. You can think of ‘features’ in terms of the characteristics of digital books that influence children’s learning. For example, multimedia features of digital books are one variable that psychology research teams study and often break down into specific media such as, for instance, the presence of music or video images. The ‘effects’ are the outcomes of children’s reading of digital books, that is, the learning gains or losses for a specific child or group of children.

When it comes to children’s reading digital books and online texts, researchers need to answer questions around the process of reading as well as the screen on which the reading occurs. Given this book’s focus on reading for pleasure, I have focused on research that investigates the relationships between digital books and children’s literacy-related skills. There are, however, many other things that researchers study and that you might be interested in exploring further. For instance, digital books could be used to foster children’s creativity or they could be used to support children’s acquisition of factual knowledge, coding and computational thinking, fine motor skills or spatial recognition. As with any multifunctional tool, there is significant potential to support various skills (and for researchers to study the effectiveness of that support).

My focus on digital books as a specific type of children’s engagement with screens is narrow but also specific to ensure a more thorough discussion of the key issues. After a résumé of research on digital books, I zoom in on personalised books and the influence of personalisation on children’s learning with books. I break down the research findings in relation to their relevance for specific features of digital books and then the effects of these features.

## The influence of the features of children’s books on children’s learning

Early experimental research on children’s digital books began as comparative research in which researchers compared the effects of children’s digital books against the effects of print books. For example, Segal-Drori, Korat, Shamir and Klein (2010) compared children’s learning of reading-related skills with e-books and print books with and without adults’ support. They found that reading the e-book with adult instruction was the most beneficial option and led to higher levels of children’s learning than reading the print book alone or the print book with adult

instruction. Researchers have also compared different kinds of e-books. For example, Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff and Collins (2013) compared the level of dialogue between parents and children and the children's story comprehension after they read one of three types of books: electronic console book, CD-ROM book and interactive multimedia digital book. They found that the more electronic features there were in the book, the lower the children's understanding of the story and the parent-child dialogue. The e-book/print book comparative studies indicated that so long as electronic books provide space for parents to have a conversation with their child about the story content, they may be a viable alternative to print books. However, the challenge of comparative studies is to ensure that researchers compare like with like, which is not always possible with e-books. You saw in Chapter 1 the many different types and kinds of e-books out there. A more nuanced approach is therefore to compare different *characteristics* of digital books and print books or to study digital books in their own right. In the latter case, researchers have examined the effects of multimedia and interactive features on children's learning.

## Considering the influence of multimedia features in children's digital books

Multimedia features in digital books have been mostly studied in relation to the presence of audio features, that is, sounds, music and spoken narrative. These are key distinguishing characteristics of digital books: digital books are different from print books because they have words that can be highlighted when spoken aloud by the recorded voice. Some digital books display the text passage and highlight in colour the individual words that are read aloud, and some digital books display the individual words one by one as they are being spoken aloud. This feature is an important teaching technique for children's word recognition and letter knowledge, especially for children who struggle with recognising letters on the page. So much so that an early study by the Dutch researchers de Jong and Bus (2002) examining this feature in simple e-books found that digitally spoken text accompanied with corresponding written text that was highlighted as it was being spoken was for some children a more effective teaching tool than an adult reading from a print book with the child. The authors suggested that this might be because the digital format is more attractive to children in that the spoken words get

highlighted in colour as soon as children tap the icon whereas words in print books are static and lack any special visual effects. De Jong and Bus concluded that 'Exploration of electronic books is not a replacement for regular book-reading sessions but a valuable supplement' (p. 154).

A key aspect of investigation by researchers has been whether the audio features of digital books are related to the storyline or not and how this alignment may influence children's understanding of the story. This focus of research is important because there is a great variety in the current design of children's popular digital books: some digital books contain music that interferes with the voiceover or distracts the child from the text, and some digital books have music to enhance the story plot. For example, in the *Little Red Riding Hood* digital book by Nosy Crow, there are pages that play calm background music (for example when Little Red Riding Hood is using a jar to get water from a pond) as well as simple sounds (for example when Little Red Riding Hood knocks on the door of Grandma's house). Most researchers agree that audio features aligned with the storyline support children's learning. For instance, researchers at the Bar-Ilan University found out that calming music played in the background of a digital book enhances children's story comprehension (Shabat & Korat 2017).

## Considering the influence of interactive features in children's digital books

Studies that examine interactive features have focused on two main mechanisms that support children's learning from digital books: hotspots that activate words when children touch them and hotspots that animate/move the book's illustrations. Verhallen and Bus (2010) studied the latter with 92 immigrant, low-income five-year-olds living in the Netherlands, who read digital books with images that either moved or did not move. The researchers found that the children who read digital books with moving images learnt the words in the book better than children who read the same book but with static images. The researchers hypothesise that this may be because the movement helped children make an association between word and illustration. Children who are beginning to read get most of their story understanding from the illustrations, so enhancing the illustrations may facilitate the learning process. It is important to note that the illustrations in the study matched the story text and as such acted as a scaffold for the child to understand the

words. This is different from digital books that include shiny illustrations and ‘bells and whistles’ that engage the child but do little to teach them new words. There is an appealing possibility of teaching children new words through interactive features and animated words, that is, words that get highlighted and explain the meaning when touched by the child (Smeets & Bus 2012).

The benefits of interactive features for children’s language outcomes hold not only for children’s first language but also if they are learning a second language. Walker, Adams, Restrepo, Fialko and Glenberg (2017) examined how children who were not native English speakers performed on different tasks of reading comprehension when the digital books they read contained additional support in Spanish. They found that adding some interactive support in children’s native language improved these children’s performance, since it supported their understanding of the story meaning. The added interactivity supported children’s understanding of stories not only in Spanish but also in English. It thus seems to be the case that if interactivity is well applied to specifically target language cues, it can support children’s understanding of a story, even if this story appears in a language they are not proficient in.

## Considering the outcomes and effects of children’s reading on screen

The studies I have described so far were conducted in university laboratories and used digital books designed or co-designed by the researchers for the purpose of studying specific features of the books. The content and features of the books were therefore controlled and carefully crafted. Yet, the quality of the digital books that children actually interact with – and that their parents can buy from the App Stores – is far from the quality of researcher-developed digital books. The reasons for this are multiple (e.g. it takes time to translate research findings into products and not all findings make it to designers anyway) but suffice it to say that this is an issue that researchers and designers need to be actively working on.

Rather than testing specific features of digital books and what might work in a structured environment, researchers with an ethnographic, post-humanist or qualitative orientation apply other methods and ask other questions. Experimental studies compare and contrast one book feature against another one, while keeping all other variables under control. Such a methodology allows experimental researchers to

answer precise questions and attribute specific effects to specific features. Qualitative researchers do not restrict or control the ‘external variables’ that influence a child’s experience, but rather acknowledge the combined influence of multiple factors on children’s learning. These researchers study how children interact with existing apps or digital books in their homes and classrooms, in order to document children’s experiences with them in their full complexity. The different methodological approaches mean that qualitative and experimental researchers can provide different insights into the overall value of a digital book for children’s learning. Whereas experimental researchers study whether digital books impact on children’s learning of words or story comprehension, for example, qualitative researchers study children’s general engagement with digital books. For qualitative researchers, digital books are a unique context in which to document how children practise their digital literacies.

## Digital literacies

‘Digital literacy’ is defined by Sefton-Green, Marsh, Erstad and Flewitt (2016) as ‘a social practice that involves reading, writing and multimodal meaning-making through the use of a range of digital technologies. It describes literacy events and practices that involve digital technologies, but which may also involve non-digital practices. Digital literacy can cross online/offline and material/immaterial boundaries and, as a consequence, create complex communication trajectories across time and space (Leander and Sheehy 2004; Burnett 2014). Using “reading” and “writing” in their broadest terms, digital literacy can involve accessing, using and analysing texts in addition to their production and dissemination’ (p. 15).

One of the researchers interested in children’s digital literacy and multimedia books, Karen Wohlwend from Indiana University, has been studying children’s interactions with iPads in relation to collaborative composing. Wohlwend has richly documented the many ways in which children can compose their own story worlds with story-related apps. She has explored children’s collaborative composing using iPads and noted the generative opportunities the medium provides for children to author their own texts, as well as the range of different touch moves children need to perform to understand digital narratives (Wohlwend 2015). She describes how children browse, click, tap, drag, navigate and otherwise interact with a digital story, providing insights into children’s active role when interacting with hotspots in a digital book. In her study

of children's use of touchscreens, Wohlwend (2015) was particularly interested in the complex layering of meaning that occurs when children use digital puppetry. To make their digital puppets move, children need to decide on the story characters, the backdrop for the scene, sound effects and voiceover/narration for the individual puppets. They need to combine these distinct elements into a coherent narrative, acting as narrators, designers, composers and scene directors. When sharing their video-recorded narratives with their peers, children learn what makes a narrative appealing to their friends and other audiences and they can take this understanding to a revised version of their story. The multimedia features in story-making thus offer a particularly fertile ground for children to experiment with, learn and practise a range of composing and critical literacy skills. Together with other researchers in the field of digital literacies (for example Cathy Burnett and Guy Merchant at Sheffield Hallam University), Wohlwend argues that digital books and apps offer important opportunities for children to practise a range of new digital literacies.

## **The influence of the content of children's books on children's learning**

So far, I have outlined research studies that examine specific features of digital books. These features draw connecting lines between the format of the digital book and its content. The content of a digital book therefore influences child's learning and experience too.

Content quality in the case of a digital story relates to the quality of its text and illustrations. High-quality books (print or digital) typically contain strong grammatical structures and introduce children to vocabulary they may not know. Award-winning children's books feature text that is simple to read but also carries a complex story, often with several layers of meaning, so that it can be reread several times and its meaning cemented in a child's memory. High-quality books have illustrations that use zoom-in and zoom-out effects to convey emotions or characteristics of the story characters. Award-winning books also feature illustrations that complement the text with extra detail and explanation. Quality of content can also be interpreted in terms of its accessibility for children from diverse backgrounds and of the values transmitted through the narrative. All-time classics often have stories with a strong moral message, empathy and humour. These markers of quality in children's books are applicable to both print and digital books. However, whereas the content



of print children's books has enjoyed a long tradition of being produced, consumed and evaluated, content development in digital books is very much in its infancy. Publishers of children's digital books face the commercial pressures of content producers in other media such as filmmakers and professional photographers. The App Stores have been described as the 'biggest shops with the smallest shopping window', which reflects the large number of products they sell and the narrow selection of products visible to the consumer. To feature in the small shop window, producers need to compete with major and well-known publishers and authors who are supported by large marketing budgets. For small publishers or indie writers, the return on investment is minimal unless they produce a best-seller and sell millions of copies. Given these wider trends, it is perhaps not surprising that when researchers have systematically investigated the quality of content in the currently most popular children's digital books the results have been disappointing. A group of European researchers (Sari et al. 2017) found that the most popular digital books in Hungary, Turkey, Greece and the Netherlands have extremely low levels of quality and often don't even offer stories in the local language. A group of US researchers (Vaala et al. 2015) found that the bestselling digital books focus on promoting basic reading-acquisition skills but do not expand children's reading creatively or imaginatively.

This concern is relevant to the education of all children, but particularly children from disadvantaged backgrounds. Unlike that of print books, technology ownership is high among all sections of the population and research shows that children from lower socio-economic backgrounds engage with mobile phone applications on a frequent basis (Kabali et al. 2015). If the quality of apps' educational content is low and if many of the children who engage with this content are ones in need of more educational stimulation, then apps are exacerbating existing inequalities in society. This is the so-called 'second app gap', pertaining to the ways in which technologies are used in rich and poor families (e.g. Vaala et al. 2015), beyond the 'first app gap' of access and availability.

To address the lack of digital books in local languages and the quality of digital content more broadly, a pan-European group funded by the COST (European Cooperation in Science and Technology) Action called DigiLitEY (Digital Literacy and Multimodal Practices in the Early Years) has issued a set of guidelines to encourage better quality in children's digital books. Given the potential of multimedia and interactive features in digital books to foster children's literacy skills, it seems

important that publishers think more seriously about digital books and invest in higher-quality content. The group also suggests that developers allow content to be optimised for speakers of other languages and that in some countries direct government support may be necessary to cover translation costs. The cost shouldn't need to be high; once an app has been set up to be localised into other languages, the cost of adding another language is essentially only the cost of getting the text translated. If this cost was subsidised for smaller languages, more developers might be motivated to offer content in multiple languages.

An alternative suggestion is that the translation of content be crowdsourced and/or supplied by users, who could create their own digital books. This is the approach promoted in this textbook; Chapters 6, 7 and 8 are dedicated to strategies involving teachers, parents and children in personalising digital books and producing their own content. The next section reviews research on personalised books produced by children, parents, teachers and researchers.

## Personalised books

### Personalised print books

Personalised books can be both printed and digital. Research has examined the effects of both formats on children's language and reading skills as well as socio-emotional skills. In some of my early work with colleagues at the Open University, we examined how children's learning of new words changed in relation to books that were either personalised to them or non-personalised. The personalised books contained children's names, photos and favourite things they liked to do and both the personalised and non-personalised books contained some new words the children didn't know before the beginning of the study. The books were produced by us, researchers, using information and photographs provided by the children's parents. In Kucirkova, Messer and Sheehy (2014a) we found that children learnt more new words if these appeared in the personalised book. In Kucirkova, Messer and Sheehy (2014b) we found that children spoke more when reading the personalised books, that is, they spontaneously described the illustrations and told the adult reading with them about their personal experiences. This spontaneous speech during reading personalised books may have been one mechanism through which children learnt the unknown words. In another study

examining printed personalised books, DeMoulin (2001) found that using rhymes together with personalisation can boost children's reading skills. In DeMoulin's and my studies, personalised books were created for the children with the help of their parents. When children could create their own personalised books, it contributed to home-school and community dialogue (Bernhard et al. 2008) and parent-child shared book reading at home (Janes & Kermani 2001), which are the two key aspects that I focus on in this book.

A limitation of personalised books is that they draw children's attention to themselves, which can result in self-centred speech around the book. In a comparison study with personalised and non-personalised books (Kucirkova 2014c), we found that children referred to themselves much more when reading personalised books, by using personal pronouns and adjectives such as 'me' and 'my'. Given that most personalised books are about a child's experience, questions may be raised about the extent to which these books can teach children about other people's emotions or experiences. A healthy balance between personalised and non-personalised books is necessary for books to both motivate children to read and show them alternative worlds and viewpoints. Even more importantly, research on personalised books powerfully drives home the message that adults' role in mediating children's reading of books is accentuated with books that deepen – and at times temper – the connections between children's personal and fictional lives.

## Personalised digital books and multimedia features

Digital books contain multimedia features. Multimedia features that can be personalised in children's digital books include the use of children's own photographs (visual personalisation), children's own voiceovers (audio personalisation), children's own texts (textual personalisation) and children's own illustrations and drawings (artistic personalisation). Not all digital books allow users' own input, so personalised multimedia features are not a standard feature studied by researchers. So far, most research has focused on digital books that are personalised because they were created by the child with a story-making application.

For example, in a study with seven-year-old multilingual children in the US, Rowe (2018) showed how the opportunity to audio-record their own sounds in digital books meant that multilingual children could translate the digital books for each other, creating bilingual digital books. The study found that children enjoyed creating their own multimedia

bilingual books and skilfully integrated drawings, photos and audio-recordings into their books, enriching the classroom's provision of literacy resources.

In homes and communities, digital books can be enhanced with a voiceover that is audio-recorded by a parent or carer of the child. In one of my early studies, a mother created a digital book for her daughter based on their recent holiday to Greece. The mother used the girl's Barbie as the main story character and audio-recorded an engaging voice-over pretending to be various story characters in the book. Her daughter loved the book and repeatedly requested it to be read. The observation of the session showed a lot of positive affect and bonding between the parent and child reading the personalised digital book together (Kucirkova et al. 2013).

### Personalised digital books and interactive features

In children's actual use of digital books, there isn't a staunch distinction between interactivity and personalisation and there is also an overlap between interactivity and multimedia. This is why many qualitative researchers study all four aspects together. For example, Aliagas and Margallo (2017) studied children's experiences with digital books at home and focused on interactivity, which was often interwoven with multimedia effects. The researchers studied four Spanish families using digital books for two years and analysed children's experiences of interactivity with qualitative approaches such as video observations and interviews with the parents. Their study showed that interactivity is more than just children tapping on hotspots that trigger a certain sound effect. There was interactivity between the digital book and the child's response and, according to Aliagas and Margallo, it contributed to the child's sense of being part of the story. The four children studied by the researchers were particularly immersed in the story narratives when they could touch the story characters and become the story's co-authors or even one of its characters. The study provides an example of interactivity that carries the potential to transform children's experiences with stories.

In studying interactivity, it is important to first understand the various types of interactivity that digital books contain. Kiousis (2002, p. 357) noted in relation to the study of interactivity in digital games, 'A major limitation with some experimental inquiries is that a condition is often called "interactive" without considering multiple levels of the variable.' What Kiousis means by 'multiple levels' are the different kinds of interactive engagement

a child can have with the screen, from miniature games that are unrelated to the story to immersive involvement when the reader takes on the persona of a story character. I had the opportunity to look at the various kinds of interactivity in a systematic manner during my advisory role with the National Literacy Trust, a UK literacy charity to develop the curated database of Literacy Apps (<http://literacyapps.literacytrust.org.uk/>). When developing this database, I reviewed the 100 most popular literacy-oriented apps available from the App Store and Google Play in English. According to this review, there are five different categories of interactivity in children's digital books. First, interactivity involves the use of senses, which with some innovative digital books means not only touch and sight but also taste and odour that are added to the reading experience. Second, as mentioned earlier, hotspots can be linked to words and matching illustrations to prompt explanations. Third, hotspots can be used to grab attention, such as with problem-solving features and questions or commands to the user. Fourth, the story can be enhanced by computer vision techniques such as virtual reality and augmented reality. Fifth, there are personalised interactive features that are based on datafication. Taking this broader perspective on interactivity, it is important to recognise that designers use interactivity for various purposes. In some digital books interactivity is used to highlight text and teach children new words, but it is also, or mainly, used to engage them in the story, as shown by Aliagas and Margallo (2017).

While some researchers draw strict boundaries between digital games and digital books, other researchers study their points of convergence. If we were to adopt the latter stance, we could usefully include here research that examines children's word learning from interactive digital games. Aghlara and Tamjid (2011) compared Iranian children's learning of vocabulary with a digital game and from traditional face-to-face teaching. They found that the opportunity for children to actively interact with new words as they played the game led to higher vocabulary scores than in the children in the control group. Dictionaries can potentially disrupt the story narrative but in doing so they can teach children new words, as shown in this study. The research findings lead us to the conclusion that conceptualising digital interactive books as a binary choice between a game and a printed book may preclude several generative possibilities and their additional features. The context of reading and the individual child who is reading are crucial factors in the learning outcomes.

## Chapter summary

In this chapter you learnt that:

- questions around benefits and limitations of digital books can be answered through paying attention to their multimedia and interactive features;
- multimedia features of children's digital books which are aligned with the storyline can increase children's story comprehension and vocabulary learning;
- some interactive features, such as highlighting text or adding narration in the child's native language, can enhance children's story comprehension;
- personalised multimedia and interactive books provide a strong context for immersion and story enjoyment;
- digital books can foster children's digital literacy, particularly in relation to knowing how to navigate digital content;
- Research evidence needs to be interpreted with attention paid to the diverse research methods and research traditions applied to the study of children's digital books.

### Further reading

Reading on screen:

Guernsey, L. & Levine, M. H. (2015) *Tap, Click, Read: Growing Readers in a World of Screens*. New York: John Wiley.

Research methods with children:

Prior, J. & Van Herwegen, J. (eds) (2016) *Practical Research with Children*. London: Routledge.

Supporting literacy more widely:

Goodwin, P. (ed.) (2017) *The Literate Classroom*. London: Routledge.

Free online articles about children's digital books:

Kucirkova, N. (2017) 'Children's reading on screen: in the beginning was the word, not a hotspot', *The Guardian*,  
<https://www.theguardian.com/education/head-quarters/2017/dec/04/childrens-reading-on-screen-in-the-beginning-was-the-word-not-a-hotspot>

Kucirkova, N. (2014) 'Shiny appy children', *The Guardian*,  
<https://www.theguardian.com/science/head-quarters/2014/dec/15/shiny-appy-children>

Kucirkova, N. (2015) 'Confused by the mysterious world of children's digital books?', *Huffington Post*,  
[https://www.huffingtonpost.co.uk/dr-natalia-kucirkova/childrens-digital-books\\_b\\_7825836.html](https://www.huffingtonpost.co.uk/dr-natalia-kucirkova/childrens-digital-books_b_7825836.html)

Kucirkova, N. (2015) 'Personalised books: exciting but also risky times for children's stories', *Huffington Post*,  
[https://www.huffingtonpost.co.uk/dr-natalia-kucirkova/personalised-books\\_b\\_8167436.html](https://www.huffingtonpost.co.uk/dr-natalia-kucirkova/personalised-books_b_8167436.html)

## Further resources

There are some fantastic online courses that provide guidance and insight concerning technology use in classrooms and the use of digital media more broadly.

### **Childhood in the Digital Age**

This free massive open online course from the Open University and Future-Learn provides an overview of the benefits and limitations of technology use in classrooms and children's lives.

<https://www.futurelearn.com/courses/childhood-in-the-digital-age>

### **Raspberry Pi Foundation**

The Raspberry Pi Foundation runs several online courses for teachers, including some face-to-face professional development training courses. The focus of the courses is mostly on coding and the benefits of open-ended hardware for computational thinking, with many ideas to inspire use of technologies in the classroom.

<https://www.raspberrypi.org/training/online/>

### **Google for Education**

Google runs its own online Training Centre for educators interested in exploring technologies and their use in the classroom. This is essentially a free self-paced online course with some valuable resources (all linked to Google technologies).

<https://edutrainningcenter.withgoogle.com/training>