

Children's reading in the digital age: a research summary on children's digital books

## Abstract

In alignment with contemporary theoretical models of reading on screen, this review suggests avenues for future multi-method research by drawing on psychological as well as socio-cultural aspects of reading. Experimental and meta-analytical studies can help develop a more refined understanding of the added value of specific new features in digital books. The key contribution of qualitative studies is the theoretical extension they provide to cognitive models of reading, including the focus on socio-emotional outcomes and corporal responses to texts. Interdisciplinary approaches can provide complementary perspectives and convergent recommendations issued to children's publishing industry and adults mediating their use.

## **Children's reading on screens: how do children make meaning from digital books and what is the role of adults in this process?**

The aim of this chapter is to discuss the current state of knowledge concerning children's digital books and to suggest a research agenda designed to enhance the field of children's independent and shared e-reading practices. The chapter summarises extant research on parent-child reading of digital books at home as part of daily routine as well as at research sites as part of laboratory studies, including both qualitative and quantitative research approaches. Methodological, theoretical and practical suggestions are made to inspire future interdisciplinary and methodologically diverse research of children's reading on screen, with the aim of inspiring innovative design and effective use in practice.

### **Delineation of terms: digital books**

Digital books carry many names, including e-books, ibooks, apps, storybook apps, iPad books or digital stories. In some literature, the label "apps" is used for interactive digital books and "e-books" for digital books with no hyperlinks or hotspots. To avoid generic terms, some researchers describe a particular resource using several terms, e.g., 'book-like e-book apps that include multimedia, but little digital interactivity' (Zipke, 2016, p.5). While the term "iPad books" is relevant for digital books developed only for iPad platforms, the terms e-books and digital books better reflect the fact that most of today's software is platform-agnostic. For inclusiveness, this review therefore uses the umbrella term "digital books" but emphasises the particular dimensions of individual digital books. The review builds on the author's review of digital *interactive* books, that was specifically focused on the interactivity feature (Kucirkova, 2017b). Not all digital books are interactive, so the present review is broader in scope.

## **The scope of the review**

This review provides an overview of research studies published between 2011-2017, identified through searching two main databases (Psychinfo and ERIC), through the author's familiarity with the research field and by asking lead researchers in the field for recommendation. The review is narrative in nature, aimed to map the field, outline and integrate key studies concerned with children's digital books. Although focused on the last six years and the era of touchscreen devices, the review should not be read as touchscreen-specific because it includes some results of meta-analyses, which, in their calculations, included studies examining digital books available for classic desktop computers. The review is concerned with studies related to children's independent and shared adult-child book reading sessions, which occurred in formal and informal learning contexts. The reviewed studies are divided into two broad conceptual groups, according to the focus of the individual researchers. Drawing on the reference triangle, also known as a joint attention triangle, between an adult, object and a child, the review considers the reading impact on the child, on the book's features, or on the relationship between the child and the adult. The research reported in this chapter is arbitrarily divided according to these three axes to facilitate interpretative synthesis.

### **Studies focused on the features of digital books**

Authors in the first group of studies ask detailed questions about the features of digital books that have an effect on the child. For example, Takacs, Swart, and Bus (2014) conducted a meta-analysis focused on the benefits of multimedia features (animated illustrations, background music and sound effects) as opposed to interactive features, which the authors defined as scaffolding supports provided in a print-based story or a print-like story presented on a screen. The print-based or print-like stories included only text and static

pictures and were presented to the child with and without adult's support. Although some of the studies included in the meta-analysis focused on the parent-child relationship, the focus of the meta-analysis was on the book features and the role of interactivity and multimedia in children's learning. Overall, the meta-analysis included 29 studies with 1272 children and found that for children's story comprehension and vocabulary, the multimedia features in digital books were more effective than print books when read without adult support (effect sizes:  $g+ = 0.40$ ,  $k = 18$ ) and ( $g+ = 0.30$ ,  $k = 11$ ). There was no difference between multimedia story and paper book when read with adult's support.

In a follow-up meta-analysis, Takacs, Swart & Bus (2015) examined the benefits of multimedia features in comparison to interactive features. Multimedia features were those that were aligned with the storyline, while interactive features were additional activities embedded in the digital books, such as puzzles, memory tasks, amusing visual or sound effects that were available through the user's activation and hyperlinks. Forty-three studies including 2,147 children, were included in the meta-analysis, with a comparison between digital and print-based books. The meta-analysis found that the interactive features did not support children's story comprehension and vocabulary learning (regardless of whether they were congruent or not with the story). On the other hand, digital books, which complemented the story with multimedia features (i.e. through pictures, sounds and voiceovers), supported children's story comprehension and expressive vocabulary, when the children either had the story read to them by an adult or by an audio-recording (Takacs, Swart & Bus, 2015, effect sizes  $g+ = 0.17$  for story comprehension and  $g+ = 0.20$  for expressive vocabulary).

These findings are in accordance with studies that examined learning from videos (see e.g., Nussenbaum & Amso, 2015) or desktop computer e-books (e.g., Korat, Shamir, and Segal-Drori, 2013) and found positive learning effects of multimedia, as would be predicted by the dual-coding theories (see Bus, Takacs & Kegel, 2015). As I wrote before (Kucirkova,

2014c), these results also align with studies showing that alphabet flap books (i.e. print books with manipulable flaps) are less conducive to children's word learning, when compared to simple print books (Tare, Chiong, Ganea, & DeLoache, 2010).

However, the meta-analytic results have not been corroborated with recent empirical research that examined interactive features in children's digital books. For example, Zipke (2016) examined the effects of interactivity in two digital books on children's word recognition and story comprehension. Twenty-five US 4-5-year olds participated in two experiments. All children were pre-readers and had not read any digital books before. Children's word recognition and story comprehension scores were highest in the interactive digital book condition, read by the children on their own. The interactive features used in Zipke's study consisted of elements that offered an additional experience to a print book, such as for example: spoken narration, text highlighting, sound effects, music and moving characters. Within one of the tested digital books, there were also small games, which were related to the story characters. Qualitative observations explained that children's independent manipulation of hotspots enhanced their story comprehension through interest-driven, self-motivated exploration.

Kelley and Kinney (2016) conducted two experiments with thirty pre-schoolers, focused on the comparison between "interactive" and "non-interactive" books for children's word learning and story comprehension. The researchers found no difference between the interactive and non-interactive books for children's learning on either of the measures, even after three reading sessions.

The main reason for the different results relates to the definition of interactivity in the meta-analytic and experimental investigations. Interactivity was touted to be 'the most grossly misunderstood and callously misused term associated with computers' (Crawford, 2005, p. 25) and in the field of digital reading, there is also a range of uses and meanings

associated with the term. Zipke (2016) suggests that the definition of interactivity in Takacs et al. (2015) was too broad; the more constrained definition employed by Zipke might explain why her studies found beneficial effects of interactivity for children's learning in contrast to Takacs et al. Since many interactive features are subsumed by multimedia, or they work because of multimedia (e.g., tapping a hotspot on the screen activates a sound recording), it is difficult to draw a clear line between what counts as an interactive and what as a multimedia feature. In Kucirkova (2017), I argue that focus on interactivity as a unified variable might be misleading and outline five key ingredients of interactivity: Synaesthesia, Scaffolding, Datafication, User Control and Computer Vision Techniques. A focus on specific types of interactivity might help overcome methodological discrepancies and inconsistent findings in the literature.

A precise definition of individual features is crucial in studies focused on interactivity but also other types of digital books. The next section illustrates this point by drawing on the author's empirical data concerned with personalized digital books. This section is intended to provide a concrete example of how the study of narrowly defined features of digital books might provide distinct insights into parent-child and child-text engagement patterns.

### **Personalization as an example of detailed feature analysis**

In 2014, I put forward the thesis that unlike customization that is available for PC-based or simple e-reader books, personalization becomes significantly foregrounded in children's iPad books (Kucirkova, 2014a). This is because digital books available on touchscreen devices offer the child seamless and multimedia options for individualizing the reading content and context. Namely, children can create their own audio recordings, texts, pictures, drawings or short videos and with a single tap, include these in the story they read. There are open-ended applications that allow children to create personal digital books based entirely on the child's

own content (e.g., Our Story) and there are apps that provide children with template that they can personalize with specific multimedia elements (e.g., Mr Glue Stories). Personalization is thus a feature that further specifies interactive and multimedia features and in terms of children's learning, its impact relates to five possible variables (the so-called 5As framework): authenticity, attachment, authorship, autonomy and aesthetics (Kucirkova, 2017a). These effects can be either positive or negative, depending on the context and content of reading, but also on the child's agency in influencing the personalization process (Author, in press).

Together with my colleagues, I have studied children's reading on screen through the lens of personalization in the past five years. A key early finding was that personalization can positively affect parent-child joint reading of digital books at home (Kucirkova, Messer, Sheehy & Flewitt, 2013). This finding was an important addition to the literature concerned with children's reading on screen and some early studies comparing print versus digital medium (e.g., Parish-Morris et al., 2013; Krcmar & Cingel, 2014). Rather than focusing on digital books as an unvarying, homogenous format, our observation study revealed positive engagement patterns in relation to a personalizable digital book, which enriched rather than diminished the parent-child conversation. Later on, we hypothesized these effects to be a result of the parent's and child's increased motivation in a reading activity that is about them rather than a fictional character and that provides various opportunities for the child's autonomy, authorship and an authentic, aesthetically pleasing, content. In the next section, I provide a vignette to illustrate the significant relationship between the personalization features and the child's and parent's engagement in the reading process.

### **Vignette**

This vignette draws on data collected as part of a research study conducted together with Dr Sakr (Middlesex University) in 2016/2017. The participants were a five-year old girl and her father, who were observed using the app called 'Mr Glue Stories'. The pair used the app on a weekday evening in the home of the child's grandparents. Mr Glue Stories allows users to change the name of the main story character to a name of their choice. The user's name then automatically replaces all instances of the main story character's name, giving the impression that the story is about the user rather than a fictional character. Users can also personalise the illustrations by adding their own drawings and they can add their own audio-recordings or voice-overs to selected pages of the book.

The vignette is taken from the first father-child observed interaction that lasted for 23 minutes and 55 seconds. The interaction was video-recorded and later transcribed and analysed with multimodal analysis method. For the purpose of the present discussion, I selected three short excerpts that illustrate the points advanced in relation to personalization and parent-child reading dynamics.

### *Vignette*

Time stamp: 0.21-0.49

(D= child's father; C= child)

D is reading out the story blurb from the screen

D: What am I looking at M? Is it a game? Is it a story?

C: It's a game and a story.

D: I see something flashing up there that says 'recording studio'

Time stamp: 0.55-1.06

C: No you don't need to press it... so you can say anything

D: Ok

C: No you can make up, and when I press this, you've got to say something

D: So shall we read these and then we'll say something?

C: Ok, read that

D reads out loud

Time stamp: 4.00-5.00

C: But who is that?

D: Create a book that says, no that one says go back, that one says create a book

Who's doing it me or you?

C: We're both

D: Are you showing me something that you made last week or are we doing a new one

C: We're doing a new one

D :So what can we say

C: It's a girl and a boy so

D: It's a girl

Or a goy

Girl or boy?

C: Erm, I say dirl

D: A dirl? A daddy and a girl... a daddy and a daughter

C: Look look I'll do this

D: That's going to confuse it, but ok

It's accepted something

Time stamp: 5:00-5:45

D: Go on then let's do it

C: Daddy! Cos you're new to it, you're new, let's do you

D: Dalika

C: No, just daddy, just daddy

D: Good job good job

Excellent spelling

Then click ok

Music starts

D: Err...ready? D starts reading out, with the name change 'Daddy' recurring

Continues reading

Time stamp: 15:33-16:21

D begins reading out loud

C laughs

C: He keeps on saying daddy because he typed in daddy, because it's daddy and me doing it,  
but we just typed in daddy

And then it keeps on saying daddy daddy... daddy shouted out for Jenny... daddy did this  
daddy did that...

He's not even a kid!

D continues reading out loud

C interrupts – and Jenny isn't even his friend; Jenny isn't his friend

C laughs

She's my friend

C continues laughing while D reads out loud

I put in Jenny and Jenny isn't even daddy's friend

D: I'm now on an adventure with your friend from school and I'm getting rescued by a five year old

C laughs

C: It's meant to be you rescuing her

D: We should've put in [child's name] or Dalika or Malikada

C: No we should've put in Jenny and Daddy saved Jenny

D: Yeah that would've been much better

C: But now Jenny saved you

C laughs again

D continues to read out loud

### **Commentary on the vignette**

The beginning of this extract shows typical patterns that occur during parent-child shared use of digital books. The participants negotiate who holds the device, who taps which button and how the story progresses. The interaction dynamic and the child's level of participation change dramatically at minute 15:33, when the father starts reading the personalized portion of the story. The child bursts into laughter and can't resist shouting and sharing her enthusiasm with the researcher, who has been quietly observing the interaction from the back of the room. The child is clearly amused that the main character turned to be her dad and that her best friend Jenny features in the story. The focus of the parent-child conversation moves from the device manipulation to a more personal territory, with the parent and child

discussing friendships and possible story plots. This shift in discourse and overall atmosphere of the interaction are directly traceable to the personalization affordances of the Mr Glue Stories app. Namely, the possibility to change the name of the story character and to see the new name being seamlessly replaced in the story text is a unique feature of the app. With a non-personalisable digital book the parent could pretend to be the story character and perhaps pretend that his name is part of the text, he could have acted out the story and dramatize it outside the text. Here, however, the personalising process becomes ‘cemented’ in the story, through a quick and seamless process. This contributes to the positive atmosphere of story-sharing and adds an element of surprise for both reading partners. An analytic focus on the personalization features thus allows for a more fine-grained perspective on the interaction at stake here.

### **Studies focused on the parent-child relationship**

In the second group of studies reviewed in this chapter, the investigation emphasis is laid on the interactivity that happens *around* the book. Scholars following this research tradition ask detailed questions about the context of the reading interaction and study closely the parent-child dynamics. Early comparative research found that pre-recorded messages and interactive hotspots in digital books disrupt the parent-child dialogue during book reading and subsequently, negatively affect children’s story comprehension (Parish-Morris et al., 2013; Krcmar & Cingel, 2014). However, some reading styles adopted by the parents can overcome this limitation: Hassinger-Das et al. (2016) carried out an experiment with 86 parent-child dyads of three to five-years olds and compared child’s story comprehension in relation to a traditional paper book, an e-book with many additional activities, a simple e-book with no hotspots and an audio book with pre-recorded narration of the text. The study did not examine other possible influencing factors and interactions (e.g., child’s language and the parent-child dynamics), but found that even with highly interactive digital books, children

whose parents used distancing talk - that is talk that linked the story plot to the child's own life experiences - scored highest on the story comprehension test, regardless of the reading condition.

Thus far, most children's e-reading research has focused on fiction, with the exception of Strouse & Ganea (2016), who compared children's learning of biological concepts after the reading of non-fiction books by adults as opposed to non-fiction books read independently by the child. The results of an experiment with ninety-one 4-year olds were that for children's learning of biological concepts, parents' prompting was as effective as the prompting provided by the digital book.

If we were to analyse the parent-child relationship in the aforementioned vignette, we could focus on the parent's use of language, his choice of vocabulary, intonation and dramatization of the story. We could examine the affective relationship between the parent and child as they read the personalized book together and analyse their verbal as well as physical engagement with the digital book. Such a focus would place the emphasis on the parent's and child's response to the book's features. Unlike in a study focused on the book's features, this lens of analysis would assign the agency and volition to the interaction partners who are actively shaping the interaction, rather than being subjects or recipients of the book's influence. In a detailed observation of two parent-child dyads reading a personalisable digital book together, Kucirkova, Sheehy & Messer (2015) noted that the 'triological perspective of learning appears to be a suitable framework for future studies seeking to analyse both *the process and product* of knowledge representation during parent-child iPad story sharing' (p.11, italics added). The open-ended character of the digital books in our study invited the parent's and child's direct contribution to the story content, with their own audio-recordings, digital photos and text added to the story. The session involved the sequence of collaborative projects of planning, composing, reviewing and correcting (Fernández Cárdenas, 2004) and

contributed to a range of literacy and digital literacy skills practiced by the child. The teacher-apprentice notion reminiscent of Vygotsky's 'more knowledgeable other', who scaffolds the child's learning in the zone of proximal development, needed to be extended to an 'intermental development zone' (Mercer & Littleton, 2007), where both the adult and child learn from each other and construct new knowledge.

The analytical focus can be also directed to the child's individual response, reviewed next.

### **Studies focused on the child's response to digital books**

Research shows that open-ended digital storybooks which encourage the child to become the hero of the story and which reposition both the child and parent as active agents in the story-sharing, can encourage the child to produce unique and empowering responses to the text (Aliagas & Margallo, 2016).

If, in the presented vignette, the research focus was on the child, then factors such as the child's increased language would be considered relevant for the analysis. We could have analysed the girls' attempt at involving other adults in the room in the conversation and her enthusiastic and sophisticated response to the app's personalisation features. The analytical focus would be shifted to the child's verbal and physical engagement with the app and those around her and would foreground the child's abilities, skills and engagement patterns rather than her interaction with the father or the influence of the app's features.

Children's individual characteristics are, potentially, important sources of variability in the impact of digital books on their learning. Recent research by Strouse and Ganea (2017) shows that for younger children (toddlers between 17 to 26 months) parent-child reading of digital books is more beneficial than reading print books because the toddlers pay more attention and are more participative in the reading interaction with digital books. This is different from pre-schoolers where interactivity was found to be impeding parent-child

conversation. So, the first marker of individual differences that researchers need to better understand is children's age, followed by possible gender differences and other key markers of self.

Research that is focused on the child highlights children's unique needs, preferences and talents, which can be effectively supported with the customisation and personalisation possibilities available within digital books. In Kucirkova, Messer, Critten & Harwood (2014), we saw how the use of the story-making application Our Story supported children's unique story-telling profiles in two different schools catering for children with complex educational needs. The teachers noted children's enthusiasm to share their ideas expressed in the format of a multimedia story and commented on the benefits of easy and seamless personalization options of the story-making app. This was echoed by practitioners in a study with two African adolescents with severe speech and communication difficulties, who used the Our Story app to support the two boys' multimedia story-making (Critten & Kucirkova, 2015).

Digital books can be used to support personalized and therefore highly authentic content, as well as customized content relevant for groups of children/individuals. For example, Walker, Adams, Restrepo, Fialko & Glenberg (2017) showed how the possibility of Spanish text within an English-language digital book supported story comprehension of children whose first language was not English. These children benefitted from the presence of interactive additions in the book, even though they were not story-related. The interactive features provided explanation in the children's native (Spanish) language, which facilitated the children's text comprehension in English.

### **Future research**

The three review axes concerning the features of digital books, parent-child interaction patterns or children's individual characteristics, are a crude illustration of possible research foci in the field. Researchers' theoretical frameworks and epistemologies will guide

their decisions. It is likely that those who follow a socio-cultural orientation (e.g., Vygotsky, 1978) would favour a focus on parent-child interaction while researchers who follow a constructivist tradition (e.g., Papert & Harel, 1991) might favour a focus on the individual books' features. Regardless of the theoretical or epistemological orientation adopted by the researchers, there are three key areas that are needed to be refined and examined in future research on children's digital books. These three areas relate to the nomenclature and methodological and theoretical extensions.

### **Nomenclature**

For research to provide productive guidance for future design of children's digital books, there is a need for a more precise and detailed definition of the key features studied by researchers, notably in relation to interactive and multimedia digital books. Whether researchers conceptualise interactivity as a variable influencing child's response directly or via parent's mediation, it is important to clearly name and delineate individual features that comprise it. Isolating individual features elucidates the mechanisms of learning (see Takacs & Bus, 2016) and some exciting lab-based studies are progressing the research in this area. In parallel, it is important to recognise that individual features always work in conjunction with different story contents and story genres and these interactions need to be addressed by both qualitative and quantitative research.

The issues related to defining interactivity in children's digital books highlights the need for a careful assessment of continuities and discontinuities between old and new reading formats. Some recently developed digital books have the option of personalising the story characters (e.g., My Story™) and customising the story plot by choosing the story ending (e.g., the Little Red Riding Hood app by Nosy Crow™). Such possibilities imply the need for studying the active, autonomous and agentic role children can take on when they interact with customisable digital books (*interactive* versus *interpassive*).

## **Methodological extensions**

Thus far, research emphasis has been on children's cognitive and mental responses to digital books. However, reading involves a range of physical, emotional and social responses and it evokes corporal and physical responses too. As Mangen (2016) writes: 'kinesthetic aspects of reading merit more scholarly attention in a time when reading texts on the substrate of paper (print) gives way to reading on an increasing diversity of screens' (p.458). We noted the embodied nature of children's engagement with touchscreens and the children's profound affective response to the digital books was noted in a qualitative study in a special needs school (Kucirkova, Messer, Critten & Harwood, 2014). The use of touchscreens implies that children employ a wider range of touch movements than they do when manipulating paper-based resources. These include tapping, pressing, scratching and, when adding their own drawings and early marks, also using straight and circular strokes (Price, Jewitt, and Crescenzi, 2015). Notably in relation to newer digital books formats, which include augmented reality features, research needs to concentrate on the importance of touch and body for children's cognitive as well as affective response. Importantly, the touch-sensitivity of touchscreens can influence children's subsequent fine-motor development, which is as an important developmental milestone (Bedford et al., 2016).

Children's embodied responses can be studied in the moment of interaction, but also in relation to their accumulation over time (see Mackey, 2016). While print-based books preserve traces of frequent use and touch on their pages, digital books can change in content as updated versions of the same book become available or as parents and children modify the book's content in the process of book sharing. The flexibility of the digital format is likely to affect parent- child interaction in a different way than sharing a static printed book. In particular, repeated readings of digital books include new contents, which is not the case with

print books. Longitudinal studies are therefore required to elucidate how digital books affect children's preferences for specific books and their lifelong love of reading.

In addition to readily apparent responses, future research in this area might extrapolate from adult studies the focus on readers' mental stimulation, which occurs as a result of 'tactile perception' (Brunyé et al., 2012). In this vein, neuro-imaging studies that examine how changes to content (e.g., fiction versus non-fiction) and to first-, second- and third-person narration influence text processing (see e.g., Tettamanti et al., 2005; Brunyé et al., 2009) would be invaluable.

### **Theoretical extensions**

Children's reading in the digital age is 'much more eclectic, fast-moving and multi-layered' (Sefton-Green, Marsh, Erstad and Flewitt, 2016, p.19) than reading on paper. This implies refined models of children's reading in the digital age, which would include alternative outcome measures as well as wider range of comparison conditions.

Moreover, the criteria for categorising children's responses need to be expanded in light of new theoretical insights. For example, systematic observations of children's play with a range of apps, including literacy apps, led Marsh, Plowman, Yamada-Rice and Bishop (2016) conclude that there is an additional category to consider when studying children's engagement with touchscreens: transgressive play, which relates to children 'transgressing' the original design of the apps, by extending it to a new kind of play. They also suggest that 'it is not so much *the types* of play that have changed as a result of new digital contexts as the *nature* of play' (Marsh et al., 2016, p.243, italics added). Similar reasoning may well apply in measuring children's responses to the digital books and identifying possible learning mechanisms. For instance, children's reading is often categorised as to involve two main types: reading for pleasure and reading for learning. With digital books, the nature of reading

changes, with many digital books designed to support children's learning of words through hotspots and hyperlinks, all embedded in an immersing narrative. Digital books understood as a new genre that can hybridise several polarities in children's reading research and practice is one of their greatest potentials (Kucirkova, 2014b).

In addition, digital books could expand the model of parent-child book reading to peer-to-peer interaction. While traditional research of parent-child reading focuses on adult-child interaction, digital books could inspire more child-to-child reading interactions. In a study we conducted with Spanish pre-schoolers and a range of apps, we found that the feedback from peers was instructive in supporting effective peer talk among the participating children (Kucirkova, Messer, Sheehy & Panadero, 2014). In another study, peer feedback led to collaboration among US and Turkish kindergartners when observed during "buddy reading" at school (Christ, Wang & Erdemir, 2016). Interestingly, Troseth, Russo & Strouse, (2016) suggest expanding the analytical lens from co-reading and co-viewing to co-playing. Such an analytical lens would move from the traditionally dialogic and dyad-based research to more community-oriented studies.

Clearly, the applicability of these methodological and theoretical extensions to the book context will need to be studied in relation to diverse and varied populations of parents/caregivers and their children. Current research on book reading, and educational research more broadly, are often approached from a biased Anglo-centric Western viewpoint, which can dominate the study design and conclusions drawn from research.

### **Practical considerations**

The model of "many-to-many" has taken a step towards participatory approach to the production and distribution of digital games, with user-generated content shared widely on

social media and community-driven digital spaces. This could be expanded to digital books' production, with teachers and parents developing their own story contents in local languages, reflecting a diverse range of contents. Indeed, in many studies that I conducted with the Our Story story-making app, parents, children and teachers co-created their own multimedia content. These self-made digital books were directly relevant to the 5As of personalization, and children's agency in shaping the content they consume on screen is an important consideration for future work. While participatory approaches (such as design-based research, action research and formative experiments, see Reinking & Watkins, 2000) are well-known in human-computer interaction studies and classroom research, they are less-known in the book reading area and ought to be explored.

In addition to participatory approaches, children's designers and researchers could work together in partnerships. For example, Rees, Rvachew and Nadig (2016) worked with the company Triba Nova and co-developed a suite of iRead apps. Academia-industry collaboration could significantly contribute to the improvement of low quality of digital books currently on the market. Vaala, Ly & Levine (2015) analysed the content of best-selling apps on the US App market and found that the majority targeted only rote academic skills, missing the creative potential offered by digital books. Similarly, an analysis of Greek digital books available on the Android app store concluded that they 'in no way justify their title as educational, as they do not meet the developmental needs of the target age group.' (Papadakis, Kalogiannakis, & Zaranis, 2018, p.150). It is important to be aware of these content-related concerns. As discussed in chapter x in this book, the quality of many European digital books is extremely low and many often don't even offer stories in local languages. The content and format are intimately interlinked in children's books and this applies to digital books with even more urgency. The Working Group<sup>3</sup> of the DigiLitEY

COST project is dedicated to addressing this issue through their work with local governments, literacy charities and publishers.

In conclusion, digital books are an intrinsic part of children's contemporary reading experiences. The integration of multiple forms of engagement (music, audio, text and illustrations) in digital books has intensified the discussions about differences in reading on screen and reading on paper. Moreover, the advent of touchscreen devices and the possibility to interact with digital books through direct manipulation has brought to fore issues around children's own involvement in the reading experience and innovative personalization design. Current research provides some answers to how digital books might affect parent-child interaction and how children's own characteristics and the books' features might influence children's learning from the books. However, there are far many more questions than answers and it is essential that interdisciplinary and multimethod approaches inform the theoretical discussions preceding the formulation of research questions. There is no doubt that researchers need to collaborate more actively with the industry to improve the current low content quality offered to our young/emerging readers, and examine in more detail the individual facets that add value to children's reading on screen. As advocated in the DigiLitEY Action, it is only through multiple-stakeholder engagement that researchers can successfully sculpt the landscape of children's digital literacies.

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