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Theorising Materiality in Children's Digital Books

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Participatory literacies are new ways of experiencing narratives and of "interpreting, making, sharing and belonging in increasingly globally and digitally mediated cultures" (Wohlwend 2017a: 62). This paper discusses the material features of children's digital books and the extent to which they support participatory literacies. The material features of digital books are conceptualised in terms of their external and internal properties. Based on a theoretical discussion and empirical observations it is argued that specific internal material properties of children's digital books, namely their interactivity and multimedia, are uniquely positioned to support participatory literacies and are therefore a site of novelty in children's experiences of narratives.

Keywords: interactivity, multimedia, personalised engagement, participatory literacies, materiality, e-books, digital books, apps, early literacy

Today's children encounter stories and make meaning of texts in an unprecedented and diverse range of physical, virtual, and hybrid media. Digital books are part of this media landscape, gradually making their way into the hands of increasingly young children worldwide (Cesário, Freitas, Pimentel and Nisi 2016). Digital interactive books, also known as apps, story apps, picturebook apps, enhanced e-books, or simply ***digital books***, are available to download for touchscreens, such as smartphones and tablets. Unlike printed story books, digital books carry a story in additional modes of expression and allow readers to interact with story characters by moving them around on the digital page. The page thus becomes an interactive stage where the reader's touch and gestures bring to life what would otherwise be fixed meanings and static pictures. With these new features, digital books have reinvigorated researchers' interest in the 'materiality' of children's reading.

While many psychology studies are aimed at extending the empirical basis of books' material properties, such as comparing the effects of children's digital and print books on parent-child dialogue (Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff and Collins 2013) or children's attention and engagement during book reading (Richter and Courage 2017), there is a dualistic tension between digital and non-digital reading formats. This theoretical paper aims to bridge this tension with a focus on materiality to more fully understand the added value that children's digital books give to children's reading experiences. I consider the following research question: to what extent are the material features of digital books a source of ***novel*** story experiences for young children?

The extent to which new media genuinely offer new experiences has been the subject of many theoretical discussions, fittingly captured in the term 'remediation', highlighting the inevitable influence of old media on new media (Bolter and Grusin 2000). I argue that a focus on materiality can provide insights into features that cut across different formats and types of books. I reflect on the novel aspect of materiality in light of the participatory literacies theory and the observational data of a parent-child shared reading session with a digital book at home.

The paper is laid out as follows: I begin with a brief exposé of socio-cultural theory and the participatory literacies framework, followed by a theoretical analysis of the material features of digital books. An empirical example that illustrates how the internal material properties of digital books map on children's participatory literacies allows me to consider the novel aspects of materiality. The discussion is framed in the context of reading for pleasure (or reading for enjoyment) and children of pre- and lower primary school age, also referred to as early readers and typically aged 4–8 years.

Theoretical framework

Originated by Vygotsky (1978) and later developed as neo-Vygotskian theory (Mercer 1994), the central tenets of socio-cultural theory are that learning is socially co-constructed, through dialogue between people, with or through cultural tools. The theory provides an account of interaction that is inter-relational and influenced by the particular properties of objects and the overall context of the objects' use. An individual's contribution cannot be divorced from social (or collective) interaction, as fittingly demonstrated by Wegerif, Mercer and Dawes (1999) in their study of the teaching rules of exploratory talk in small groups. I borrow two key concepts from socio-cultural theory for my discussion of materiality in digital books: first, socio-cultural theory guides my theoretical interpretation of novelty in digital books. The question of novelty admits many different answers but, from a socio-cultural perspective, innovative experiences happen at the intersection of participatory and personalised engagement (Kucirkova and Littleton 2017). In this paper, I study the extent to which children's experiences with digital books are new in relation to participatory literacies. Second, I use the notion of the mediated action of socio-cultural theory according to which tools (and their material features) "are directed at the objects of nature", while "psychological

tools mediate humans' own psychological processes" (Kozulin and Presseisen 2010: 68). This allows me to consider parent-child actions with digital books in relation to the material properties of these books in conjunction with the parent's and child's own unique responses.

Materiality in digital books

The material properties of digital books are, as I postulate them, external and internal. The external material properties are peripheral, easily noticeable and common to all digital books. The internal material properties are embedded and often different in different book titles. The external properties are implicated in children's haptic and embodied engagement while the internal properties influence children's interactive and multimedia engagement. In some digital books, the internal and external properties jointly influence a child's reading experience. For example, in the *Cinderella* app by Nosy Crow, children are encouraged to help the main character, Cinderella, clean the kitchen by dragging various objects on the screen with their finger. For this experience to occur, children need to tilt the iPad screen using both hands, drag various objects on the screen with their finger, and repeatedly tap the main character to activate the voiceover.

The external material properties of digital books

Traditional children's picturebooks are made of non-toxic materials and their shape and weight vary from book to book. The pages are three-dimensional and they "have a width, a height, and a depth that is given by the thickness of the sheets of paper" (Trogu 2015: 29). The books' external material properties are tailored for young children's behaviour, which often includes chewing and banging with their fists. In contrast, digital books can only be accessed through digital readers (e.g. Kindle, tablet, iPad) that are standardised in shape, weight, size and material. Printed books have different surfaces to touch; some, for instance *The Little Fur Family* by Margaret Wise Brown (1946), even come in imitation fur. Digital books, on the other hand, have the same scratch-resistant durable glass surface for all titles. Consequently, several researchers have been keen to understand how the external properties of digital books influence children's physical (haptic and embodied) engagement in reading.

Physical responses to the external material properties of digital books

Embodied engagement can relate to manual, verbal or entire body movements. Mackey (2016: 170) writes about the "literacy material connections" and the importance of hand-manipulation when it comes to print and digital books. She points out that a lot of literacy research mistakenly assumes that reading is a visual and cerebral activity and that more attention should be paid to corporeal responses to digital texts. In a similar vein, Mangen (2016: 465) describes how digital and print texts differ in kinaesthetic affordances: "When reading on paper, we can discern visually, as well

as sense kinaesthetically, our page-by-page progress through the text", but this is not possible with digital books. Hermansson (2017) argues that specific properties of the devices – such as audio features in touchscreens – engender new modes of physical engagement with digital books.

As for haptic engagement and children's sensory experiences with digital books, Wohlwend (2017b) identified a set of specific multimodal actions and corresponding onscreen reading practices: tapping, swiping, pinching, stretching, dragging, which relate to turning a page, resizing an image, repositioning or deleting an image. The action of speaking is supported with pressing buttons, such as pressing the power on/off button, and voice reading and recognition (Wohlwend 2017b). Based on a comparison of pre-schoolers' interaction with iPads and paper-based resources, Crescenzi, Jewitt and Price (2014) argued that children's "touch repertoire" with iPads was different in terms of children's tapping, pressing, and straight or circular strokes.

Given that the texture is the same for all digital books, children need to distinguish between some complex combinations of touch-manipulable possibilities present in different titles. In particular, the multidirectional nature of digital reading (Simpson, Walsh and Rowsell 2013) affects children's awareness of the many consequences their touch might have on the screen. As Baykal, Veryeri Alaca, Yantaç and Göksun (2018) point out, there is no suitable design model for interactive and tangible interfaces for young children, but the potential for supporting children's early literacy as well as spatial experiences with these technologies is substantial.

The impact of external features on children's learning

So far, research concerning the external features of digital books has been descriptive and scarce. However, for printed books, a considerable body of research points to the importance of the external material properties of children's books. Developmental psychologists at the University of Virginia, Tare, Chiong, Ganea and DeLoache (2010) compared children's acquisition of labels and facts from picturebooks with simple and manipulative features (so-called "pop-ups") with 20-month-old children. They found that children generalised novel labels less well when taught from a book with manipulative features than from the same book without manipulative elements. Similarly, in a study with 30- to 36-month-old children, Chiong and DeLoache (2013) compared children's learning of the alphabet with a standard type of children's book and one with manipulative features, including flaps, levers and different textures. The study showed that children learned more letters with the plain books, even if the manipulative features specifically drew children's attention to the letters in the book. These findings are consistent with the theoretical model of dual representation (DeLoache 2000) and the developmental perspective on symbolic development (Piaget 1995[1962]; Bruner, Olver and Greenfield 1966). According to this research, non-manipulative plain books are more effective for supporting children's early language learning. Similar findings are emerging from Bus's (2017) recent study that investigated the effects of distraction-free, animated versions of books (so-called "living books") on children's attention

and literacy learning. It is worth noting that from a human-computer interaction perspective, digital manipulatives, such as digital interactive books, are used for a variety of sensory (auditory, visual or haptic) experiences (Ishii 2007). While hotspots and other interactive features might distract children's attention from the narrative (and their subsequent story comprehension), visual and haptic stimulation can also provide opportunities for creative explorations and artistic development. For example, Harwood, Bajovic, Woloshyn, Di Cesare, Lane and Scott (2015) describe how the use of story-related apps in an early-years classroom motivated children's curiosity and learning through the exploration of new ideas and concepts. Thus, the same material properties can have a beneficial or limiting effect on children's learning, depending on the learning goal and purpose.

The internal material properties of digital books

As with any educational software, the internal material properties of digital books can be defined in terms of interactivity, multimedia and graphic design (Barretto, Piazzalunga, Ribeiro, Dalla and Leon Filho 2003). Multimedia means a combination of media and, in the case of touchscreens, refers to the combination of an embedded camera, microphone, keyboard and loudspeaker. Multimedia in digital books implies that they can deliver content in multiple modes of representation: the visual, textual and audio mode. Graphic design deals with both communicative and visual signs, that is, "signs, symbols, words and pictures" that are "collected and assembled into a total message" (Meggs 1992: viii). Graphic design and user interactivity are interlinked. For example, with digital books designed for touchscreens, graphic design becomes interactive through hotspots, hyperlinks and other forms of data processing. Interactivity or interactive features are, according to Fleischmann (2013), the distinguishing and most advanced features of digital media. In the case of digital books, interactivity refers to the features and elements on the screen that can be activated by touch: for example, tapping a character makes it move or directs the user to a new page.

Table 1 summarises the key internal and external properties of four book formats available to young children today: simple e-books, enhanced digital books, audio books and print books. These four formats of children's books convey a narrative through different means and, as can be seen in the fourth row, digital interactive books, unlike print or simple e-books, present the content in three modes of representation (audio, image and text), enhanced with interactive features.

For most commercial producers of children's digital books, interactivity and multimedia are key means through which they draw the child's attention to the book's content. With the same touchscreen, children could be reading a digital book or they could be playing digital games such as *Mario Kart* or watching animated films and educational programmes, such as the *CBeebies*. Focusing a child's attention on text rather than other attractive activities available from within the tablet thus becomes

Table 1. Summary of four main book formats and their internal and external material properties

Book format	Graphic design and multimedia features			Inter-active features	Page turning	Ergonomic properties
	Audio	Image	Text			
Print books in physical (analogue) books	X	X	X	√	Turning pages by hand and finger manipulation	Book as an object
Audio books	√	X	X	X	No page turning	No physical experience
Simple e-books available on PCs	X	X	√	X	Turning pages by mouse-clicks	Stationary reading device
Enhanced digital storybooks available on tablets and smartphones	√	√	√	√	Turning pages by tapping, pressing, pinching, stretching, dragging, pressing buttons on screen	Light-weight and portable reading device

a considerable challenge for app designers and educators. The uneasy alliance of traditional book features and games in children's interactive books has been recognised by scholars, with some celebrating the new medium as a new hybrid artefact (e.g. Frederico 2014) and some cautioning against its adoption for literacy instruction without reservation. The latter stance is based on a body of experimental research that has investigated the effects of interactive and multimedia properties of children's digital books on children's language and literacy skills (Korat 2010; Shamir and Baruch 2012; Takacs, Swart and Bus 2015). A qualitative synthesis of this experimental research showed that with high-quality digital books, children's language skills can be enhanced, while with digital books that contain many multimedia features that are not congruent with the storyline, children's learning is reduced (Reich, Yau and Warschauer 2016).

I have argued before that the added value that digital books give to children's contemporary reading experiences can be established only if we move beyond print-digital and books-games comparisons to more detailed considerations of features that cut across children's learning experiences (Kucirkova 2019). Such a focus requires an effort to move towards a new theoretical proposition. In what follows, I contemplate the novelty of the material properties of digital books with empirical data from a new theoretical stance: the perspective of participatory literacies.

Participatory literacies

Participatory literacies are new, 21st century literacies afforded by Web 2.0 technologies (Wohlwend 2017a). Wohlwend and Rowsell (2016) analysed a selection of children's literacy apps in relation to their novel interaction opportunities and developed a set of practical criteria for gauging the extent to which children's digital books support participatory literacies. Their evaluation criteria included five categories (Wohlwend and Rowsell 2016: 73):

> Multiplayer or design teams rather than individual. Productive, enabling children to produce their own multimedia rather than simply reading or playing a game someone else has made. Multimodal rather than print-centric, using multiple modes (sound, touch, image, music) to manage images, video, or animation. Multilinear, using hypertext that allows multiple and dynamic storylines. Connected, shared on digital networks.

I use these criteria to establish the *novel* aspects of materiality in children's interactions with digital books by drawing on a case study that I conducted together with Mona Sakr in 2016.

Parent-child novel story encounters

The data consisted of video observations of a five-year-old child and her father using the app *Mr Glue Stories*. The app supports multimedia personalisation: users can personalise the names of the main story characters, they can add their own audio recordings to the story templates, and they can also add their own drawings (finger drawings enabled by the digital paintbrush) to selected story illustrations. The stories can be customised by selecting specific story props and they can be adjusted to three options of difficulty. The interaction was video-recorded by Mona and was later transcribed verbatim. For the purpose of the argument advanced in this paper, I conducted a deductive (theory-driven) thematic analysis (Braun and Clarke 2006) of the videoed interaction (total length 23 minutes and 55 seconds) and organised relevant excerpts according to the participatory literacies categories.

Multimodal literacies

The *Mr Glue Stories* app supports children's authorship, thanks to the multimedia features (internal properties) of digital books that allow children to compose their own stories in audio, text and pictures. As this short extract illustrates, the *Mr Glue Stories* app supports textual as well as audio authorship:

> 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]

Unlike traditional paper-based books, the multimedia assemblage inside the *Mr Glue Stories* app provided a unique reading experience for the child who had the opportunity to add her own audio recordings and drawings. Wohlwend and Rowsell (2016) conceptualised multimodal literacies on the scale of low (those that offer print word only) to high (those that afford four modes of music, image, sound effects and animation), and the *Mr Glue Stories* app fits the medium category. Story-authorship is a significant advantage of children's digital books that often contain story-making engines, either at the end or at the beginning of the story. Based on the story templates, children can re-create their own versions of the narrative, which instils in them feelings of agency and empowerment (Kucirkova 2017).

Multiplayer literacies

Multiplayer literacies influence children's creative and social contributions to the reading experience. Blom and Monk (2003) theorised the aesthetic dimensions of personalisation as an interpersonal identity dimension. The authors' research with adult users showed that they wanted to make their mobile phones more aligned with their own as well as others' aesthetic preferences. The app's design does not explicitly invite a shared or collective contribution, but, in this episode, the father and the child collaborated on the story production. The screen-based input from the father and child directly resulted in changes to the story content. This was possible thanks to the embedded interactive and multimedia features in the app. In addition, the father's and child's haptic engagement with the screen supported a conversation around each partner's contribution to the fictional story, as captured in this short dialogue extract:

> 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?

The possibility to directly touch story characters and move them around the screen might be another key factor in children's experience of multiplayer literacies. Zhao and Unsworth (2016) analysed the design of a story app called *The Heart and the Bottle* (Jeffers 2012) from a social semiotic perspective and showed that it positioned readers as characters or as those who can act on characters. Multiplayer literacies can also become programmatic and personalised when children's interaction with the screen is monitored through algorithms that record the child's performance and make recommendations for further content. For example, in the Kuato Studios *Dino Tales* app (2018), children's interaction with a fictional character (dinosaur) is recorded by the app and generates a customised story at the end of the interaction based on the child's performance.

Multilinear literacies and authenticity

Multilinear literacies refer to the possibilities of digital books to explore various multi-directional "reading paths" (Simpson, Walsh and Rowsell 2013). Wohlwend and Rowsell (2016) explain that multilinear literacies range from a single storyline that cannot be changed to open-ended storytelling. With the *Mr Glue Stories*, children can change the narrative by adding their own audio-recordings and drawings at selected points in the book. This can, at times, create the impression of genre hybridity, as noticed by the father and child when using the *Mr Glue* app:

> 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'

In terms of multiliteracy, the app lies somewhere between a fully open-ended and closed story. What is remarkable from the novelty point of view is that the modified version of the story can be ordered as a paperback. The child's drawings are included in the printed version which can be purchased and delivered to any UK address within a week. The paperback can also have the child's name on the cover. This means that children's digital drawings and story extensions become embedded into a professionally designed paperback, giving the child a sense of ownership. Such experiences would not be possible with non-digital versions of personalised books where drawings become difficult to edit and alter over time, or to incorporate them into future books available for purchase.

Connected literacies

At the beginning of each story, users of the *Mr Glue Stories* can choose the name of the key story characters. In this video episode, the child chose the name 'daddy' as the main story hero, and the app automatically inserted daddy into the text, for all instances where the key story character appears. The use of two distinct material inputs (textual input of daddy, supported with a sound recording) could be seen in this instance as name-based autobiographical intertextuality, introducing a new element to the reading experience.

> 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]

Name-based personalisation is a popular marketing strategy and many commercially produced personalised books use it as a hook for the child's, and parent's, attention (see, for example, *I See Me Books* at ISeeMeLLC (2018)). With the *Mr Glue Stories*, children and parents can use any name for several story characters and it is interesting to note that the child opted for her father to be the main story hero. It

was also interesting to note the amount of laughter this choice produced: there were many smiles when "daddy" did things which the child did not expect but the story text revealed. Another point worth noting in this extract is the combination of several literacies and the space the app afforded for their interplay. With each page, the text automatically presented the personalised version of the story, with some music and the child's drawings occasionally enriching the illustrations. Although users cannot choose the type of music recording, they can customise its length and volume, thus connecting and interlinking various types of literacies.

Productive literacies

When children produce their own content, they become the content owners and assume control of their own products. In this extract, the child decided to draw a "scary" dinosaur into the story. The chance to add the child's own artwork to the book pages meant that she could express her own take on the story and own it.

D: This is supposed to scare me, remember?
C: Yep, I'm trying to scare you… if it doesn't, I'm just trying my best
D [gasps]
D [gasps again and laughs]
D: No, don't draw anymore. I can't take it
C [laughs]

While the child's intention might have been to simply elicit her father's attention as they read the book together, her drawing has also become part of the digital story which could be later revisited, revised or saved and purchased as part of a personalised paperback. The child took great delight in adding her own colours and marks to the story illustrations. The internal properties of the digital medium here – the possibility to add colours and lines by simply touching the screen – contributed to a new production and the child's experience as a producer.

Conclusion

Key insights into the value of materiality for children's reading for pleasure become apparent when we reflect on the specific internal and external properties of digital books. From a socio-cultural perspective, children's experiences with tools such as digital books provide a context in which children can experience cultural structures and play out their social identities. Such experiences can become a site of innovation when they afford participatory literacies. In this paper, I have illustrated and argued theoretically that the material properties of digital books are external and internal. External material properties lend themselves to several digital and print comparisons. While a printed book can be used for play and creative activities (e.g. stacking books on top of each other can prompt a spine poetry activity), a digital book is embedded in a device that is used for many other edutainment purposes. Tapping, pressing buttons and dragging story characters in a digital book are kinaesthetically different experiences

from stroking and turning pages in a printed book. Similarly, meaning making with story characters that move, speak and play music is different from static images in a printed book. A nuanced discussion of the internal material properties and the multiplayer, productive, multimodal, connected and multilinear literacies they afford is necessary to move beyond the digital/print dichotomy and recognise the novelty in children's contemporary reading experiences.

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Teoretiziranje o materijalnosti u digitalnim dječjim knjigama

Sudjelujuće pismenosti su novi načini upoznavanja pripovijedi kao i „tumačenja, stvaranja, dijeljenja i pripadanja u sve izrazitije globalnim i digitalno posredovanim kulturama" (Wohlwend 2017a: 62). Ovaj je rad usmjeren na materijalna obilježja digitalnih dječjih knjiga te razmatra do koje mjere one podupiru razvoj sudjelujućih pismenosti. Materijalna svojstva digitalnih knjiga promatraju se s obzirom na njihove vanjske i unutrašnje karakteristike. Na temelju teorijske rasprave i empirijskih zapažanja utvrđuje se da su određene unutrašnje materijalne karakteristike digitalnih dječjih knjiga, odnosno njihova interaktivnost i multimedijalnost, postavljene na jedinstven način tako da podržavaju sudjelujuće pismenosti i da stoga predstavljaju novost u dječjem iskustvu upoznavanja pripovijedi.

Ključne riječi: interaktivnost, multimedija, osobni angažman, sudjelujuće pismenosti, materijalnost, e-knjige, digitalne knjige, aplikacije, rana pismenost