

# Learning to read in a digital world

## Discussion

Jenny Thomson, Mirit Barzillai, Paul van den Broek & Sascha Schroeder

University of Sheffield / University of Haifa / Leiden University /  
Max Planck Institute for Human Development

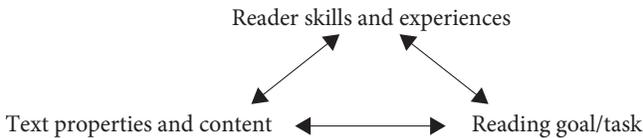
Understanding how to best support children as they learn to read in an increasingly digital world involves recognizing the many child- and text-related aspects of children's digital reading experience. In the current chapter, we consider how children's reading skills, goals, as well as the properties of digital text influence children's reading development in digital environments. We further discuss how schools, parents, media creators, and policy makers can help shape children's reading experience in digital contexts so that each child is given the tools, skills, and opportunities she needs to reach her full potential in both print and digital environments.

### 1. Introduction

The chapters in this volume reveal the multitude of issues and perspectives that must be considered as we study how children's reading develops in an increasingly digital world. Each chapter has highlighted a specific aspect of the text, the child, and the child's environment that may influence reading development in digital contexts. Accordingly, children's cognitive skills (Wylie et al., Chapter 3; Salmerón et al., Chapter 4; Ben-Yehudah et al., Chapter 5) and emotions (Kaakinen et al., Chapter 6) play an important role in reading development in digital environments, as do the properties of the text being read (Walker et al., Chapter 2), the purpose and motivation for reading (Deszcz-Tryhubczak & Huysmans, Chapter 1), and the way in which digital tools are used and taught in the classroom and for assessment (Kaakinen et al., Chapter 6; Mifsud & Petrova, Chapter 7; Baturay et al., Chapter 8;

Stöle et al., Chapter 9). It is essential, then, that all these aspects of children's digital reading experiences be considered both separately and in combination when trying to understand how to support children's reading development in digital environments.

Children's path to reading involves the ongoing acquisition of knowledge about language and the written word and the skills necessary to decode and comprehend texts (Biancarosa & Snow, 2006; Juel, 1988). To understand the influence of digital texts on this development, we must build upon models of reading that recognise the contribution of multiple child- and text-related factors in shaping reading development. Several such models exist; for example, the RAND model (RAND Reading Study Group, 2002) highlights the importance of the reader, the text, the task requirements and their interaction for meaningful reading. In addition, Jenkins model (Jenkins, 1979), as applied to reading behaviour (van den Broek, Fletcher, & Risden, 1993) posits that for an outcome of interest, such as successful reading comprehension, underlying variables (e.g. properties of the text, reader skills) and their interactions must be taken into account, particularly if disparate study findings are to be integrated. Below, we consider how characteristics of the reader, the text, the reading goal and their interplay are influenced by and in turn influence reading in a digital environment.



**Figure 1.** A triangle model of research on the development of digital reading (adapted from Jenkins, 1979; RAND, 2002)

### 1.1 Reader skills and experiences

An individual's experience reading digital text will always be influenced by the unique constellation of skills, attitudes and experiences that he/she brings to the task. For children and young people learning to read, their relative exposure to print versus digital text, before and during their school careers, may influence preferences, motivation and the relative ease with which they read in either modality, as well as perceptions of which modality represents "real" reading. In unpublished data (Thomson & Prieler, 2017), for example, 5 year old UK children demonstrated a tendency to perceive reading print books as "real" reading, with eBooks regarded more as games (see also Deszcz-Tryhubczak & Huysmans, Chapter 1).

For both print and digital reading, an individual's cognitive profile will also impact the ease and efficiency of reading – for example strong working memory, attention, executive function and language skills are a boon to reading (Wyllie et al., Chapter 3). The impact of weaknesses in such skills on digital reading, however, highlights the interplay between reader skills and text properties. For example, Ben-Yehudah et al. (Chapter 5) note that for individuals with attention deficit hyperactivity disorder (ADHD), short passages presented on screen can reduce the performance gap with age-matched peers. In contrast, comprehension of longer texts, requiring high levels of sustained attention, demonstrated a screen-inferiority effect, with better performance in the traditional print medium.

### 1.2 Text properties and content

Comprehension of digital text is intrinsically influenced by the properties and format of the text. This is not unique to digital text; research on print has demonstrated the impact of different variables on comprehension (e.g. font type and size, page size, and column structure (see Walker et al., Chapter 2). It is clear, however, that the digitisation of text potentially broadens the number of text formats individuals are exposed to. Further, it has arguably reduced the privileged position of text designers as text is now presented via a more diverse range of text window sizes (e.g. smartphones, tablets, desktop PCs), and frequently flows to fit the parameters of any given device, potentially reducing the intended couplings between e.g. text and images (e.g. Walker et al., Chapter 2).

The presence or absence of hyperlinks in digital environments is another property of digital text that influences the relative linearity of a piece of text. While some hyperlinks, such as those to word definitions or translations, are designed to facilitate meaning-making, while other types, for example advertisements, can cause distraction. The effect of these text properties, however, can only be determined through their interaction with the characteristics of different readers. Thus, each reader has distinct proclivities to follow links, in keeping with his/her specific goals, as well as differentially-developed strategies for maintaining comprehension in such a multi-layered informational context (Salmerón et al., Chapter 4). Consequently, the influence of different digital text properties can best be understood when reader characteristics, such as a reader's skills and knowledge, as well as the readers' goals, are also considered.

### 1.3 Reading goal/task

Children's goals in digital environments may be many and varied and will greatly influence their reading behaviour. Thus, for example, skimming a digital article in search of keywords elicits shallower reading behaviour and may make readers

more vulnerable to distraction than reading a gripping story posted by a friend (Fitzsimmons, 2016). In addition, how schools introduce digital texts, design assignments, and model digital reading behaviour can influence children's reading goals (Mifsud & Petrová, Chapter 7). Many schools, however, lag behind other aspects of society in terms of uptake of technology, as well as usage of the non-linear text formats that are more native to digital formats. As a result, in many countries (e.g. the UK and Poland) children are reporting more digital reading occurring outside of school and for a wider variety of goals (e.g. social communication and reading news/information related to their interests; see Deszcz-Tryhubczak & Huysmans, Chapter 1). This trend highlights the more social goal of reading that digital text is engendering, which is also marked by distinct text properties of informality and brevity.

In the face of such brevity and the abundance of hyperlinked text requiring frequent within-text decisions as to what content to read next, an open question for the field is the degree to which digital text can support 'immersive' reading experiences (Kaakinen et al., Chapter 6) that have traditionally been experienced when reading print-based literary texts. This is an area where more developmental research is sorely needed. It is also clearly a question that intersects closely with text property variables.

## 2. Summary

The transition from print to digital text precipitates shifting societal patterns of reading and shifting skillsets needed to carry out these activities. Researchers are identifying how reader and text-related factors set digital reading apart from its print predecessor and have begun to explore the complex influence of these different factors and their interaction on reading behaviour, e.g. how does flipping pages versus scrolling (text properties) affect reading assessment performance (reading task) (Sanchez & Wiley, 2009); how does a child's working memory profile (reader skills) impact navigation of hyperlinked text (text properties) (Lee & Tedder, 2003)? Continuing to pursue research that considers reader skills, goals and text properties will be essential for gaining a better understanding of the complex interplay between reader and text-factors in digital environments and for determining how to best support children's reading development.

Even as future research will prove invaluable for our understanding of reading development in digital contexts, our current knowledge suggests a range of implications for schools, parents, media creators, and policy makers to help provide opportunities for children to succeed in both digital and print worlds.

## 2.1 Implications of learning to read in a digital world: Schools

Mifsud and Petrová (Chapter 7) outline many of the curricular, classroom organisation, and teacher preparation challenges and opportunities that face schools in preparing their students to be literate individuals in a digital era. In terms of basic access to digital text, the 2015 PISA report (OECD, 2015) makes clear the manner in which schools are lagging behind in matching their students' wider technology usage: in 2012, "96% of 15-year-old students in OECD countries reported that they have a computer at home, but only 72% reported that they use a desktop, laptop or tablet computer at school, and in some countries fewer than one in two students reported doing so" (p. 3). Beyond this digital access gap, there may also be an even bigger disconnect between predominantly linear text reading at school, even on computers, and more non-linear, socially interactive, web-based reading in children's wider lives. As Salmerón and colleagues (Chapter 4) note, the latter types of activity entail an emerging set of advanced reading skills that children must master, including focused searching and navigating of hypertext and multimedia sources, integrating multiple sources of information as well as critical evaluation of the quality of claims being made (Afflerbach & Cho, 2010). These are skills that must be taught and addressed in schools.

In many cases, however, there is also the matter of how educators are trained to help their students learn from digital text and to be critical consumers of the vast amounts of information available to them via hypermedia. Although there are many examples of teachers using digital resources in innovative and creative ways, many teachers struggle to incorporate digital material into their day-to-day literacy instruction (Abrams & Merchant, 2013; Flewitt, Kucirkova, & Messer, 2014). There may be several reasons for this, including lack of confidence in using digital devices in the classroom, extra time needed to explore available digital resources, lack of guidance in how to incorporate digital reading into classroom practice and the common precedence of print reading in already-full curricula (Carrington, 2005; Turbill, 2001). Eliciting wide-scale change in teacher practice, however, is a challenge across countries. While the optimal mechanisms of teacher professional development are still being elucidated, it is clear that effective change in practice is best fostered when pedagogical instruction is accompanied by substantive opportunities to observe, practice, receive feedback and have access to a collaborative professional community of fellow-learners (Garet, Porter, Desimone, Birman, & Yoon, 2001). There is a pressing need in Europe and beyond for effective examples of this model, as applied to digital reading, to help schools keep up with their students' learning needs.

The above discussion assumes that if the issues of infrastructure and teacher preparation are addressed, then schools can be open gateways to opportunities to

engage with digital text. It is important to note, however, that prominent scholars have persuasively argued that in learning to read children may *actively* need experience with a deeper mode of processing than non-linear text typically engenders (Baron, 2015; Wolf, 2016). Kaakinen et al. (Chapter 6) note that the active decision-making needed for non-linear reading – for example, should a link be followed, which segment of text should be read next? – necessarily reduces the immersive experience of reading. This reduced immersion may impact both children and adult’s ability to engage in ‘deep reading’, i.e. the application of advanced comprehension processes (Wolf, 2016). Wolf and others are careful to note that this concern requires more concrete empirical confirmation, and indeed, there is emerging evidence that when taught strategies to manage the new and distinct demands of non-linear text, individuals can significantly deepen their comprehension of online material (e.g. Ackerman & Goldsmith, 2011). In considering, however, that online reading may require specific strategies to engender comprehension that are not fully established within teaching pedagogy, then, as Walsh (2010) notes (cited in Mifsud & Petrova, Chapter 7), it is important “to consider to what extent digital technologies can be incorporated within classroom literacy programmes without reducing the importance of the rich, imaginative and cultural knowledge that is derived from books” (Walsh, 2010, p. 211). What is the right balance of print and digital text in instruction, and how can we best determine this?

## 2.2 Implications of learning to read in a digital world: Parents

In relation to educators, parents face overlapping but distinct decisions as their children are exposed to digital reading opportunities. With digital technology typically more available for children at home than at school, whether mobile devices, tablets, or computers (OECD, 2015), the question is not one of *whether* digital devices should be accessed by children, but rather how much and in what manner. Indeed, questions surrounding when and how to introduce digital devices are becoming more and more pressing (e.g. Barzillai, Thomson, & Mangen, 2017; Kucirkova & Radesky, 2017). In their survey of UK parents of children from 0–8 years, Kucirkova and Littleton (2016) found that 31% of the parents surveyed reported feeling confused about how to use e-books with their child to best support learning. More than half of the parents reported that they would like to receive advice on how to use digital media with their children in order to support their child’s learning and to keep them entertained. The popular belief that screens can hurt children’s brains was also articulated by a proportion of respondents. These findings underscore parents’ desire and need for information about how best to manage and support their children’s use of digital devices. Yet, as this volume intimates, the information we have remains nascent.

The beliefs expressed by parents in the Kucirkova & Littleton survey (2016) also highlight the new position text finds itself in debates about how children use their time. As Deszcz-Tryhubczak & Huysmans (Chapter 1) note, when television first become widespread, there was considerable fear about the seemingly more positive activities that would be displaced by television viewing, including reading, as well as physical activity and social interaction. The evolution of reading into a screen-based activity has thus moved reading into much larger and emotive debates about ‘screen time’, which potentially adds to the confusion parents face. Progress is being made; for example, the American Academy of Pediatrics has recently amended its recommendations to parents around screen time, from the notable, but rigid ‘ $2 \times 2$ ’ rule, i.e. no screen time for children younger than 2, no more than 2 hours per day for older children, to a more nuanced acknowledgement of the multiple ways in which children use screens, including social interaction, learning, and active play (American Academy of Pediatrics Council on Communications and Media, 2016).

The updated policy statement recommends that media screen exposure is discouraged under the age of 18 months for activities other than video-chatting. For older age-groups, the guidelines still recommend placing certain limits on screen-time, especially around meal times and before going to sleep. In terms of more specific advice around media content choices, however, the recommendations are necessarily limited by the paucity of evidence available. The report advises families to “Avoid fast-paced programmes (young children do not understand them as well), apps with lots of distracting content, and any violent content” (p. 4). Advice is also given to choose “high-quality programming” (p. 3); however, this recommendation pre-supposes that clear information is available on what high quality programming is and where to find it. Both researchers and media producers are making strides in this arena; for example the resources provided by the Joan Ganz Cooney Center at Sesame Workshop (e.g. Guernsey & Levine, 2015), as well as the literacy app guide produced by Natalia Kucirkova in conjunction with the National Literacy Trust of the UK (<http://literacyapps.literacytrust.org.uk/>). Much more research is needed, however, in order to provide families with specific guidance.

### 2.3 Implications of learning to read in a digital world: Media design

The increased consumption of digital text by young readers also represents a paradigm shift for designers and media creators. The word ‘design’ within a digital reading context covers multiple domains, from text designers working at the level of font choice, letter/line spacing and placing of illustrations, to content and or instructional designers who are generating/curating text, determining the placement of hyperlinks and deciding whether information is presented via the written word, the visual image, audio or video. The digital world also brings

additional design agents – the designers of the hardware/software interfaces on which digital text is presented, as well as individual readers as designers of their own digital reading experience – with the ability to alter how both text and content are presented.

This increase in design complexity, in terms of both the number of design agents and the number of devices on which a piece of text may be presented, fundamentally changes the role of text designers, who in many ways face a loss of control in the wake of text digitisation (Walker et al., Chapter 2). The goal of a text designer is to make the text meaning as clear as possible to the reader, through the type and size of font, the column structure, relative position of illustrations etc. Within the fixed text environment that printed books typify, designer intentions can be delivered directly to the reader without modification; however, with “flowed” text, where the content is fixed but the layout varies depending on the device, the designer has far less control. Pdf format is potentially a middle ground, but this imposition of a fixed text format across a variety of digital devices can bring its own readability challenges in terms of e.g. mismatch between pdf line length and device width.

While text designers may lose control of some elements of design, digital text creation also provides a proliferation of design choices and ease of editing, offering much new opportunity too. This proliferation of choice is equally true for content and instructional designers. Rather than being constrained by the distinct learning affordances of specific media, a digital environment can offer whatever the designer wants in terms of linear versus nonlinear text, inclusion of video or audio and within the more dynamic visual forms of video/audio, these can still be paused, replayed, captioned, annotated etc. As the chapter by Baturay et al. (Chapter 8) intimates, in some respects this puts the current media affordances ahead of learning theory, in terms of knowing how best to present information for a range of individual learners and to allow optimal processing of meaning. The question of knowing how information is best consumed also implicates readers themselves as agents and ‘designers’ of their digital text experience. Studies by Ackerman and colleagues, for example (Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012; see Wylie et al., Chapter 3) report that at the undergraduate level, students are often overconfident in their perceived level of comprehension during digital reading as compared to their measured performance, an overconfidence not present in their reading of print material. Thus, research is needed on both the optimal design of digital text environments for the comprehension needs of different readers, as well as on how best to help readers understand their digital reading strengths and challenges. In addition, it is important to realise that although a clear design priority for digital text environments is meaning-making and scaffolding the experiences of young readers, there are other forces at work.

For example, market-share of platforms and compatibility of e-book reading schemes with school digital asset management systems will impact design choices. Supporting children's reading development in the face of such broader economic and societal forces brings us to the final arena for discussion: political and educational policy.

#### 2.4 Implications of learning to read in a digital world: Policy

In national and international level conversations about our 'digital youth', the most pressing agendas currently focus on internet safety, as well as the socio-emotional implications of children's lives being carried out increasingly online (Livingstone & Haddon, 2009). Although the positive contribution of digital media to children's lives are many, there are also risks. Children perceive bullying as a worrying aspect of online life, while adults have additional concerns around the risks of abuse, and potential negative emotional impacts of excessive time spent separated from the 'real', non-digital world. A Lords select committee report from the UK parliament recently stated, "we are concerned that the focus of the Government's policy is primarily danger and risk. We call on the Government to recognise that [digital] rights, literacy and education are as important in equipping children with the necessary tools to navigate the online world." (House of Lords Select Committee on Communications, 2017).

Common to both the 'risk' agenda and the need to support children in using digital text to learn is the critical reality that while children may be 'digital natives', this does not mean they know everything about how to navigate digital sources. Regarding the use of digital text for reading and learning, Salmerón et al. (Chapter 4) remind us that in navigating for information on search engines, younger children tend to rely predominantly on superficial cues to guide their selection choices, e.g. focusing on highlighted words, as opposed to the semantic information provided in the search result descriptions. Equally, learning to differentiate reliable and unreliable sources of information is a skill that students must hone throughout their school careers (Salmerón, Macedo-Rouet, & Rouet, 2016). In a recent UK report (Ofcom, 2016) around half of search engine users aged 8–11 (50%) and 12–15 (56%) reported making some type of critical judgement about search engine results, believing that some of the sites returned could be trusted and some could not, but over 25% of respondents in each age group (28% of 8–11s and 27% of 12–15s) stated that if Google lists information, the results could be trusted.

These observations highlight the pressing need for children to acquire the critical judgment skills to distinguish correct from incorrect information on the internet. This could be achieved by several routes, the most obvious being through

educational programmes that focus on digital reading skills. This brings us back to the crucial role of schools and educators in scaffolding children's digital reading experience. In the previous section on educational implications we highlighted the relative lack of digital technology access some students experience in the classroom. In these situations, the first policy move needs to be investment in ICT (information and communication technology) infrastructure. Within Europe, specific programmes have been reported in recent years that aim to increase access to technology within schools, for example the 2.0 School Program in Spain (Moreira et al., 2014), the FATIH project in Turkey (Akcaoglu, Gumus, Bellibas, & Boyer, 2014) and a Maltese initiative to provide all 7–8 year olds with tablets in school (Mifsud & Grech, 2016; see also Mifsud and Petrová, Chapter 7). Once infrastructure is in place, attention must turn to curriculum frameworks for integrating both ICT hardware, but also instructional software, into regular classroom practice. Currently the international picture with regard to ICT curricula is very varied. Some countries have nationwide curricula (e.g. Cyprus and Turkey) while in other countries (e.g., Ireland) the development of curricula is the responsibility of individual schools. Where national guidelines or curriculum do exist on the ICT competencies children should have, the level of detail specified can also vary widely. With growing evidence that foundational factors such as the presence of appropriate ICT infrastructure and ICT curriculum framework are certainly necessary (Akbulut, 2009; Gil-Flores, Rodriguez-Santero, & Torres-Gordillo, 2017), these are not sufficient, and teacher-related factors including perceived self-efficacy and ICT competence typically carry most weight in models of classroom ICT use (Akbulut et al., 2007, Lee & Lee, 2014; Tondeur et al., 2008; Valtonen et al., 2015). Thus investment in both initial teacher training as well as continuing professional development is essential. Research suggests that such training should include developing positive attitudes towards the value of ICT in teaching, as well as the building of collaborative peer-communities, both locally as well as online (Akbulut, 2009; Bas, Kubiatio, & Murat, 2016, Pelgrum & Voogt, 2009).

### 3. Conclusion

In this chapter, and throughout the edited volume, we have emphasised that learning to read in a digital world is not a single process, but rather a multidimensional problem space of learner, reading goals and digital context. This volume has showcased the recent strides made in our understanding of this problem space, while also highlighting the significant gaps in our knowledge. For example, we have yet to fully understand the complex of interplay of digital text features on the reading preferences and performance of different profiles of readers, or the

optimal approaches to pedagogy. Indeed, for researchers, the ‘digital world’ is a fast-moving target – the hardware, software and text environments that deliver digital text are evolving continually and subject to market forces far removed from the learning sciences.

This is, however, also an unparalleled opportunity for our field. Printed text has strived to provide standardised, optimal readability for the ‘average’ reader and from this paradigm, core knowledge about reading development has been generated. Yet, the increased diversity of digital reading formats, activities, and their changing nature has challenged researchers and practitioners alike to rethink and refine existing conceptualisations of reading. This in turn opens up a parallel opportunity to better understand an equally diverse population of readers; as many fields of human development research progress, e.g. genomics, biology and psychology, we are seeing that being bound to the idea of a statistical average may often obscure important individual differences in behaviour (Molenaar, 2013; Rose, Rouhani & Fischer, 2013). The digitisation of reading thus demands that we develop a far more nuanced understanding of both the reader and the reading material, incisively questioning assumptions built up from the print era. In this way, the ‘disruptive’ innovation offered by the digital world will yield rich dividends.

## References

- Abrams, S. S., & Merchant, G. (2013). The digital challenge. In K. Hall, T. Cremin, B. Comber, & L. C. Moll (Eds.), *International handbook of research on children's literacy, learning, and culture* (pp. 319–332). Oxford, UK: John Wiley & Sons. doi:10.1002/9781118323342.ch23
- Ackerman, R., & Goldsmith, M. (2011). Metacognitive regulation of text learning: On screen versus on paper. *Journal of Experimental Psychology: Applied*, 17, 18–32. doi:10.1037/a0022086
- Ackerman, R., & Lauterman, T. (2012). Taking reading comprehension exams on screen or on paper? A metacognitive analysis of learning texts under time pressure. *Computers in Human Behavior*, 28, 1816–1828. doi:10.1016/j.chb.2012.04.023
- Afflerbach, P., & Cho, B. (2009). Determining and describing reading strategies: Internet and traditional forms of reading. In H. S. Waters & W. Schneider (Eds.), *Metacognition, strategy use, and instruction* (pp. 201–225). New York, NY: Guilford.
- Akbulut, Y. (2009). Investigating underlying components of the ICT Indicators measurement scale: *The extended version*. *Journal of Educational Computing Research*, 40(4), 405–427. doi:10.2190/EC.40.4.b
- Akbulut, Y., Kesim, M., & Odabasi, H. F. (2007). Construct validation of ICT indicators measurement scale (ICTIMS). *The International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 3(3), 60–77. doi:10.4018/jicte.2007040107
- Akcaoglu, M., Gumus, S., Bellibas, M. S., & Boyer, D. M. (2014). Policy, practice, and reality: Exploring a nation-wide technology implementation in Turkish schools. *Technology, Pedagogy and Education*, 24(4), 477–491. doi:10.1080/1475939X.2014.899264

- American Academy of Pediatrics Council on Communications and Media. (2016). Media and Young Minds. *Pediatrics*, 138(5), e20162591. doi:10.1542/peds.2016-2591
- Baron, N. (2015). *Words Onscreen: The fate of reading in a digital world*. Oxford: Oxford University Press. doi:10.1163/1878-4712-11112105
- Barzillai, M., Thomson, J., & Mangen, A. (2017). *The influence of E-books on language and literacy development. I: Education and New Technologies: Perils and Promises for Learners*. London: Routledge. ISBN 9781315644851.
- Bas, G., Kubiak, M., & Murat, A. (2016). Teachers' perceptions towards ICTs in teaching-learning process: Scale validity and reliability study. *Computers in Human Behavior*, 61, 176–185. doi:10.1016/j.chb.2016.03.022
- Biancarosa, C., & Snow, C. E. (2006). *Reading next – A vision for action and research in middle and high school literacy: A report to Carnegie Corporation of New York* (2nd ed.). Washington, DC: Alliance for Excellent Education.
- Carrington, V. (2005). The uncanny, digital texts and literacy. *Language and Education*, 19(6), 467–482. doi:10.1080/09500780508668698
- Fitzsimmons, G. (2016) The influence of hyperlinks on reading on the web: An empirical approach (Doctoral thesis). University of Southampton, Southampton.
- Flewitt, R., Messer, D., & Kucirkova, N. (2014) New directions for early literacy in a digital age: The iPad. *Journal of Early Childhood Literacy*, 15(3), 289–310. doi:10.1177/1468798414533560
- Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38(4), 915–945. doi:10.3102/00028312038004915
- Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. *Computers in Human Behavior*, 68, 441–449. doi:10.1016/j.chb.2016.11.057
- Guernsey, L., & Levine, M. H. (2015). *Tap, click, read: Growing readers in a world of screens*. New Jersey: John Wiley & Sons.
- House of Lords Select Committee on Communications. (2017). *Growing up with the Internet*. 2nd Report of Session 2016–17 – published 21 March 2017 – HL Paper 130.
- Jenkins, J. J. (1979). Four points to remember: A tetrahedral model of memory experiments. In L. S. Cermak & F. I. M. Craik (Eds.), *Levels of processing in human memory* (pp. 429–446). Hillsdale, NJ: Erlbaum.
- Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology*, 80(4), 437. doi:10.1037/0022-0663.80.4.437
- Kucirkova, N., & Littleton, K. (2016) *The digital reading habits of children: A National survey of parents' perceptions of and practices in relation to children's reading for pleasure with print and digital books*. Book Trust. Retrieved from <http://www.booktrust.org.uk/news-and-blogs/news/1371>.
- Kucirkova, N., & Radesky, J. (2017) Digital media and young children's learning: How early is too early and why? Review of research on 0–2 year olds. In K. Sheehy & A. Holliman (Eds.), *Education and New Technologies: Perils And Promises For Learners*. London: Routledge.
- Lee, Y., & Lee, J. (2014). Enhancing pre-service teachers' self-efficacy beliefs for technology integration through lesson planning practice. *Computers & Education*, 73, 121–128. doi:10.1016/j.compedu.2014.01.001

- Lee, M. J., & Tedder, M. C. (2003). The effects of three different computer texts on readers' recall: Based on working memory capacity. *Computers in Human Behavior*, 19(6), 767–783. doi:10.1016/S0747-5632(03)00008-6
- Livingstone, S., & Haddon, L. (2009). *EU Kids Online: Final report*. LSE, London: EU Kids Online.
- Mifsud, C. L., & Grech, L. (2016). Literacy teaching with tablets in bilingual primary classrooms – The Malta TabLit Study. In N. Kucirkova & G. Falloon (Eds.), *Apps, technology and younger learners: International perspectives, empirical evidence, implications for practice* (pp. 89–102). London: Routledge.
- Molenaar, P. C. M. (2013). On the necessity to use person-specific data analysis approaches in psychology. *European Journal of Developmental Psychology*, 10, 29–39. doi:10.1080/17405629.2012.747435
- Moreira, M. A., Cano, C. A., Gorospe, J. M. C., Pérez, M. E. D. M., Pons, J. D. P., Labra, J. P., Chacón, J. P., Mesa, A. L. S., & Valverde-Berrocoso, J. (2014). Las políticas educativas TIC en España después del Programa Escuela 2.0: las tendencias que emergen/ICT education policies in Spain after School Program 2.0: Emerging Trends. *Revista Latinoamericana de Tecnología Educativa-RELATEC*, 13(2), 11–33.
- OECD. (2015). *Students, Computers and Learning: Making the Connection*. PISA, OECD Publishing. doi:10.1787/9789264239555-en
- Ofcom. (2016). *Children and parents: Media use and attitudes report 2016*. London, UK: Office of Communications.
- Pelgrum, W. J., & Voogt, J. (2009). School and teacher factors associated with frequency of ICT use by mathematics teachers: Country comparisons. *Education and Information Technologies*, 14(4), 293–308. doi:10.1007/s10639-009-9093-0
- RAND Reading Study Group, & Snow, C. (2002). *Reading for Understanding: Toward an R&D Program in Reading Comprehension*. Santa Monica, CA; Arlington, VA; Pittsburgh, PA: RAND Corporation.
- Rose, L. T., Rouhani, P., & Fischer, K. W. (2013). The science of the individual. *Mind, Brain, and Education*, 7, 152–158. doi:10.1111/mbe.12021
- Salmerón, L., Macedo-Rouet, M., & Rouet, J-F. (2016). Multiple viewpoints increase students' attention to source features in social question and answer forum messages. *Journal of the Association for Information Science and Technology*, 67, 2404–2419. doi:10.1002/asi.23585
- Sanchez, C. A., & Wiley, J. (2009). To scroll or not to scroll: Scrolling, working memory capacity, and comprehending complex texts. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 51(5), 730–738. doi:10.1177/0018720809352788
- Thomson, J., & Prieler, T. (2017). Evaluating the effect of exposure to digital text on early literacy development. Unpublished raw data.
- Tondeur, J., Valcke, M., & van Braak, J. (2008). A multidimensional approach to determinants of computer use in primary education: Teacher and school characteristics. *Journal of Computer Assisted Learning*, 24(6), 494–506. doi:10.1111/j.1365-2729.2008.00285.x
- Turbill, J. (2001) A researcher goes to school: Using technology in the kindergarten literacy curriculum. *Journal of Early Childhood Literacy*, 1(3), 255–279. doi:10.1177/14687984010013002
- Valtonen, T., Kukkonen, J., Kontkanen, S., Sormunen, K., Dillon, P., & Sointu, E. (2015). The impact of authentic learning experiences with ICT on pre-service teachers' intentions to use ICT for teaching and learning. *Computers & Education*, 81, 49–58. doi:10.1016/j.compedu.2014.09.008

- Van den Broek, P., Fletcher, C. R., & Ridsen, K. (1993). Investigations of inferential processes in reading: A theoretical and methodological integration. *Discourse Processes*, 16, 169–180. doi:10.1080/01638539309544835
- Walsh, M. (2010). Multimodal literacy: What does it mean for classroom practice? *Australian Journal of Language and Literacy*, 33(3), 211.
- Wolf, M. (2016). *Tales of literacy for the 21st century*. Oxford: Oxford University Press.