Systematic review of young children's writing on screen: what do we know and what do we need to know

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Abstract

Writing is part and parcel of children's active meaning-making on and with screens, but it has been relatively neglected in the literature focused on children's digital literacies. This study synthesises existing empirical evidence focused on young children's (aged between 2 and 8 years) writing on screen and identifies the relationships between dominant themes in published literature and contemporary theories of children's technology use. A systematic literature review that included studies from diverse disciplines yielded 21 papers. Constant comparative analysis generated five themes that indicate four key directions for future research. We call attention to researchers' *theoretical framing* to supplement mono-disciplinary approaches and single levels of analysis. We suggest that future research should provide greater *specification of the purpose* of children's writing on screen and the different *types of tools and applications* supporting the activity. We also highlight the need for interdisciplinary approaches that would capture the composing stages involved in the writing process with and *around* screens. Finally, we point out possible *age-related differences* in documenting and reporting the composing process in classrooms. Overall, limitations in the current evidence base highlight the need for research conducted from a critical perspective and focused more directly on multimodality.

Key words: writing, mark-making, composing, digital writing, screens, early writing

Introduction

National surveys conducted since the 2010s provide insights into the sharp increase of access and use of digital technologies, such as smartphones and tablets, by young children growing up in Western countries (e.g. Common Sense Media, 2013 in the USA; UK Ofcom, 2014 in the UK and Australian Bureau of Statistics, 2016 in Australia). With these technologies, children can access multimedia texts and games with a selection of visual, textual and audio representations of meaning (Sefton-Green et al., 2016). While a significant amount of literature and public attention is concerned with the relationship between technologies and children's reading on screen, there is less attention to children's writing on screen.

Studies have shown that the use of portable touchscreens contributes to children's motivation to take part in educational activities (e.g. Flewitt et al., 2015) and that this is best supported with open-ended software programs that encourage exploration and children's own production of content (Kucirkova et al., 2014). What is less known is how to harness this motivation for actual text-composition and writing on screen. In a recent study, Dunn and Sweeney (2018) used iPads to support various stages of the writing process with specific apps to generate character planning, sound recordings and visuals (photos, pictures and stickers) to spark creativity. In our previous research, we established that the study of children's writing is shaped by macro influences, such as researchers' epistemologies and their study methods; meso influences, such as human and object mediation; and the micro influences of children's own dispositions and characteristics (Kucirkova et al., 2017).

While writing on non-digital surfaces such as paper or sand affects the surface itself, screens open up potentially limitless possibilities for editing and storing content. Not all content produced by children carries a linguistic message and there has been substantial debate in the literature about the blurring that occurs when children have access to readily available composing resources, such as digital cameras, typewriters, drawing tools and voice-recorders, all embedded in one portable device. Children's writing on screen often combines linguistic and iconic representations of meaning (Merchant, 2007) and is mediated by access to technologies and adults' assumptions about their use (Peterson and McClay, 2012). New means of text-making and text-sharing have been meta-analysed in relation to their effects on children's comprehension of linear narratives (e.g. Takacs et al., 2014), celebrated for

their potential to contribute to children's creative experiences of texts (e.g. Pahl and Rowsell, 2012; Wohlwend and Rowsell, 2016) or the product-oriented culture of 'mass writing' in the 21st century (Brandt, 2015), compared to writing by hand in pen and pencil (Mangen, 2018) and richly theorised by Street (1984), Gee (2003) and other New Literacy Scholars in relation to adolescent and adult readers. We were interested in establishing the current empirical evidence concerning writing on screen by young children aged between 2 and 8 years through a systematic review of qualitative and quantitative studies published in the last 7 years.

A systematic review of current evidence is necessary to advance the field and to meaningfully advise practitioners and researchers interested in the potential of digital technologies for children's literacy. Our critical synthesis of existing evidence focused on research in which children were *actively* making meaning by composing with digital technologies. This focus was guided by our theoretical framework.

Theoretical framework

Our guiding theoretical premise was that children's writing has a lasting impact on their writer identity when it is agentic and engaging, rather than imposed on them and formulaic. We were inspired by the robust literature on engaged reading and research that studies agency in reading for pleasure (e.g. Wigfield and Guthrie, 2000; Cremin et al., 2014). In this research, adults mediate and support children's autonomy in fostering long-term and intrinsic motivation to read, with confidence (e.g. Ross, 2000), affect (e.g. Nell, 1988) and personal resonance (e.g. Seilman and Larsen, 1989) and place it high on the agenda to foster readers' competences and dispositions. Our understanding of volitional writing or writing for pleasure was derived from this literature and strongly influenced our definition of the key term 'writing'.

Definition of children's writing

For young children, digital composing of this kind has been described by a range of terms, including *composing*, *creating*, *drawing*, *mark-making* and *writing*. Writing on screen also refers to "*alphabetic meaning-making practices that are digitally mediated, whether those practices involve the use of laptop or desktop computers, online or offline practices, word processing or messaging software*" (Merchant, 2008, p. 197, emphasis by authors). Our definition of writing in this review was deliberately broad. We concur with earlier work on children's writing that acknowledges that reading and writing are both composing acts (Graves and Hansen, 1983) and we conceptualise writing as an active practice of producing signs and symbols on paper or any other solid medium (Rowe and Miller, 2016). We were interested in children's multiple modalities of expression, which in addition to alphabetic composition (Selfe, 2009) include

gestures, eye gaze, body positioning, sounds (recorded and music), photography, exploratory play and drama. This focus echoes contemporary understanding of children's writing on screen, which, as part of digital literacy, can involve "accessing, using and analysing texts in addition to their production and dissemination" (Sefton-Green et al., 2016, p. 15). A broad definition of writing is also part of our effort to address the theoretical tension between writing and drawing, where the 'traditional view' (Vygotsky, 1976) is that writing evolves from drawing, while a more recent view (Levin and Bus, 2003, p. 892) is that "drawing and writing are systems that originate independently and that develop separately, neither one preceding the other".

Aims

Our first aim was to aggregate and synthesise existing empirical evidence concerning young children's writing on screen. Our first research question was: What are the key empirical themes in studies concerned with young children's writing on screen published between 2010 and 2017?

Our second aim was to identify the relationships between the dominant themes in the reviewed studies and contemporary theories of children's engagement with technologies. Summarising decades of research and latest developments in the area, Mangen and van der Weel (2016) propose an integrative, transdisciplinary model of children's *reading* on screen. Regarding children's writing on screen, the literature is far less developed. We aimed to achieve an interpretive synthesis by analysing the key concepts discussed in the reviewed studies, with a view of forming some theory-informed recommendations for future research in this area. Our second research question therefore was: To what extent does the current empirical evidence map onto contemporary theories of children's engagement with technologies?

Methods

The systematic review followed standard procedure for systematic reviews (see Oliver et al., 2012) and involved five key steps: (1) defining the focus of the review and basic criteria for inclusion or exclusion of studies; (2) identifying keywords describing research activity in the area; (3) using electronic and hand-searching procedures to identify potentially relevant publications; (4) developing, operationalising and using a set of codes to systematically analyse study features; and (5) synthesising the results of analysis of relevant studies. We included peer reviewed empirical research studies that were clearly written and methodologically sound, conducted in any context but published in English. Our criteria for methodologically sound studies in this area were initially formulated in Kucirkova et al. (2017) and included (1) the study needs to make an original and significant empirical contribution to knowledge and follow a

robust methodological and theoretical framework; (2) the study must be published given that unpublished studies do not have the sequential advantage of published work; (3) the study needs to focus on children's active meaning-making and linguistic message-making on screen; (4) the study examines writing in formal or informal learning environments and can cover collaborative or independent writing with peers and family; (5) the study participants need to be aged between 2 and 8 years, in alignment with the project funder's requirements. Journal articles, proceedings, papers and book chapters (if peer-reviewed) were included in the review. We bounded the time span of publication to articles published between 2010 and 2017 (inclusive and as per the date of publication by the journal) because we wanted to capture the latest evidence that may be most pertinent to children's writing on screen. We chose 2010 as the start date for the review because, in that year, iPads and Android tablets began to be used widely among all sections of population, as documented by numerous national surveys (e.g. Ofcom in the UK or Common Sense Media in the USA).

The literature search process included keyword search of databases, snowball approach of following up reference lists and manual searching of key journals and sources (e.g. ERIC, PsychINFO, BEI, AEI, BPLC, COPAC, Dissertations, ECO, Education Abs and Papers First). When identifying keywords, the following search terms were included in the initial search: *emergent writing, writing; joint writing; drawing; conventional writing; name writing; letter writing; spelling; alphabet knowledge; emergent writing skills; print motivation; multisensory learning; letter-name recognition; young children; graphicacy; designing; meaning making; graphic signs; finger painting; pre-school; iPads; touchscreens, screens; Touch screen tablets; Apps; Emergent literacy; Home literacy.* After conversations among the authors and the subject librarians, these keywords were later condensed into the search phrase "digital AND writing AND (children OR child)". Five key databases were searched with this search phrase: ERIC, Web of Science, PsychInfo, EBSCO and SCOPUS. Studies found through this search were manually checked to accord with our inclusion criteria. A number of quality assurance procedures were implemented throughout the review, including the use of a protocol that made the review procedure transparent through explicit criteria for inclusion/exclusion of studies (available from the authors upon request). The definition of the individual categories was kept in a code book, along with illustrative examples of included and excluded cases. A coding file in SPSS version 24 was used as a tool for data extraction. The final database was subjected to multiple analyses, guided by our two key research questions.

The initial search resulted in a database of 77 potentially relevant studies. These sources were retrieved, read in full by at least two reviewers and subjected to further screening using our agreed inclusion/exclusion criteria. Fifty-six studies did not meet all criteria for relevance and quality. Of these, 24 were not empirical studies but descriptions of practice, theoretical papers or literature reviews. Participants in three studies were of unspecified age or were of mixed ages with little or no separate data provided on the age group in question. Nine studies focused on aspects of writing other than linguistic meaning-making or did not include a digital component. Two studies were not available in English. Eighteen studies provided only brief or descriptive accounts of analysis methods and were therefore excluded from the review, although given the shortage of pertinent studies in the field, a relatively inclusive approach was adopted regarding methodological detail. Overall, 21 papers were judged to satisfy all criteria and were selected for in-depth analysis and synthesis.

The first part of the analysis sought to identify the main concerns, frames of analysis and foci of past research. The second part of analysis aimed to establish the alignment between the reviewed studies and current theoretical perspectives on children's engagement with technologies. We treated the studies as data that can be subjected to a thematic analysis and conducted a constant comparative analysis (Fram, 2013). We first identified patterns by reading through all identified empirical studies of digital composing, comparing notes, and then inductively developed a set of categories describing the themes emerging across the studies. In accordance with standard thematic analysis procedure for synthesising evidence (see Pope et al., 2007), the themes were developed, discussed and refined within the research team through extensive conversations, with a focus on the representativeness and validity of the individual themes.

Findings

Table 1 maps the field and delineates the details of published studies, including authors, journals of publication, target age group and countries of research.

Theme 1: Mono-disciplinary approaches and single-level analysis predominate in current research

Out of the 21 studies we analysed, 15 followed a broadly defined socio-cultural and multimodality/multiliteracies/New Literacies theoretical framework. Three studies identified with specific theoretical approaches: social semiotics, critical literacy, Translanguaging/Funds of Knowledge and three studies followed a Cognitive/component skills framework, with a psychology tradition of effects investigation (see Table 1 for details on the theoretical framing in all 21 studies). It was interesting to note that studies in the former group adopted a strongly qualitative orientation, with inductive methods guided by larger theoretical constructs. These studies tended to focus on a broad range of skills and the interrelationships and interactions that comprise children's experience of writing on screen. Studies framed in a cognitive

Table 1: Overview of the 21 studies that were analysed thematically and comparatively

Author/s	Year	Journal/Book	Title of the article	Theoretical underpinning	Age of child participants
Skantz Åberg, Lantz-Andersson & Pramling	2014	Early Child Development and Care	Once upon a time there was a mouse: children's technology-mediated storytelling in preschool class	Socio-cultural and technology-mediated learning	6–7
Åberg, Lantz-Andersson & Pramling	2015	Understanding Digital Technologies and Young Children	I think it should be a little kind of exciting	Socio-cultural perspective on learning	6–7
Andersson & Sofkova-Hashemi	2016	Nordic Journal of Digital Literacy	Screen-based literacy practices in Swedish primary schools	Digital literacies, new literacies and multiliteracies	7–8
Baker	2017	Reading Research Quarterly	Apps, iPads, and literacy: examining the feasibility of speech recognition in a first-grade classroom	Socio-cultural perspective and systems theory perspective	6–7
Beam & Williams	2015	Computers in the Schools	Technology-mediated writing instruction in the early literacy program: perils, procedures, and possibilities	Activity theory	5–6
Beschorner & Hutchison	2013	International Journal of Education in Mathematics, Science and Technology	iPads as a literacy teaching tool in early childhood	Roots of literacy proposed by Goodman (1986)	4–5
Bigelow	2013	PhD Dissertation	iWrite: digital message making practices of young children	Children as meaning-makers; socio-cultural and multimodality as rooted in social semiotics	3–4
Björkvall & Engblom	2010	Journal of Early Childhood Literacy	Young children's exploration of semiotic resources during unofficial computer activities in the classroom	Social semiotic ethnography	7–8
Bratitsis, Kotopoulos & Mandila	2012	International Journal of Knowledge and Learning	Kindergarten children's motivation and collaboration being triggered via computers while creating digital stories: a case study	Narrative theories	4–5
Genlott & Grönlund	2013	Computers and Education	Improving literacy skills through learning reading by	Socio-cultural perspective	6–7

(*Continues*)

Table 1: (Continued)

Authors/s	Year	Journal/Book	Title of the article	Theoretical underpinning	Age of child participants
			writing: the iWTR method presented and tested		
Kist, Carvalho & Bittencourt	2013	Revista Electrónica de Investigación Educativa	Una computadora por niño y las implicaciones en el proceso de aprendizaje de la lengua escrita: estudio de caso en Brazil	Papert's learning by doing, literacy, written language fluency, technological fluency, written language conceptualisation	6–7
Lisy	2015	PhD Dissertation	Examining the impact of technology on primary students' revision of written work	Socio-cultural	7–8
Marsh	2016	Media Education	The digital literacy skills and competences of children of pre-school age	Digital literacy, ludic literacies	2–3
Martinez-Alvarez, Ghiso & Martinez	2012	Learning Landscapes	Creative literacies and learning with Latino emergent bilinguals	Cultural historical activity theory (expansive learning)	6–7
MCkee & Heydon	2015	Journal of Early Childhood Literacy	Orchestrating literacies: print literacy learning opportunities within multimodal intergenerational ensembles	Multimodality and the multimodal ensemble	4–5
Neumann	2014	Australian Journal of Education	An examination of touch screen tablets and emergent literacy in Australian pre-school children	Socio-cultural	3–4
Neumann	2016	Computers and Education	Young children's use of touch screen tablets for writing and reading at home: relationships with emergent literacy	Not stated	2–3
Rowe, Miller & Pacheco	2014	Handbook of Research on Digital Tools for Writing Instruction in K-12 Settings	Preschoolers as digital designers: composing dual language eBooks	New literacies	3–4
Rowe & Miller	2016	Journal of Early Childhood Literacy	Designing for diverse classrooms: using iPads and digital cameras to compose eBooks with emergent	Emergent literacy perspectives, trans-languaging theories, sociocultural theories	3–4

(Continues)

Table 1: (Continued)

Author/s	Year	Journal/Book	Title of the article	Theoretical underpinning	Age of child participants
			bilingual/biliterate four-year-olds		
Stover	2012	PhD Dissertation	Digital collaborative literacy, critical literacy, and writing for social justice: a case study of meaningful learning in a first grade classroom	Critical pedagogy and social constructivist theory	6–7
Yuan	2015	PhD Dissertation	Children as multimodal composers: a case study of early elementary students' digital literacy practices	New Literacies Multimodality	7–8

theoretical approach used an experimental or correlational design to deductively identify key variables of interest and analyse a priori categories. The overall trend seemed to be towards mono-disciplinary approaches with a single level of analysis. In relation to the approaches towards print and digital literacies, Sefton-Green et al. (2016) write that a mono-level approach "is somewhat of a paradox in an era reliant on digital devices both in the home and in the knowledge society, where means and forms of communication have diversified" (p. 12). Mangen and van der Weel (2016) call for more interdisciplinary approaches to children's reading on screen and based on our findings, we extend this call to children's writing on screen. Also, participatory literacies could usefully inform future studies of children's writing on screen. For example, Rowsell and Wohlwend (2016; Wohlwend, 2017) have outlined a more complex understanding of children's participation in the globalised world that is afforded by Web 2.0 technologies. They conceptualise new, 21st century literacies as building on the concept of participatory culture, first coined by Jenkins (2006) and including multiplayer, productive, multimodal, multilinear, pleasurable and connected literacies.

Theme 2: Social control and purpose of children's writing on screen needs an intentional analysis

The second theme noted in the corpus of reviewed studies relates to researchers' conceptualisation of the purpose of children's writing. To a large extent, the purpose of children's writing is determined by adults, who 'gate-keep' children's activities with resources at home and in classrooms. Teachers and parents make decisions about how and why writing occurs and, in some cases, these decisions limit the purpose of writing to, for example, only happy stories (e.g. Skantz Åberg, Lantz-Andersson & Pramling, 2014). In addition, and this is particularly the case with writing online, adults monitor the appropriateness of the material children access (e.g. Baker, 2017) and in some cases, limit children's access to websites and social media networks (e.g. in Marsh, 2016, the child was loading creations to Facebook until her parents logged her out). Adults also monitor the words children write or even say when using speech recognition software to support their writing (e.g. Baker, 2017). In contrast to these restrictions, adults can also enrich and extend the content of children's writing on screen, particularly if they scaffold and model the process for children who struggle on their own (e.g. Bigelow, 2013; Pelletier et al., 2006; Rowe and Miller, 2016; Rowe et al., 2014). Adults can also provide practical support, including troubleshooting technical problems when these occur during the activity (e.g. Åberg, Lantz-Andersson, & Pramling, 2015; Baker, 2017).

Adults' mediation of writing on screen closely relates to children's agency using technologies at home and in school. Based on workshops and focus group interviews with teenagers, Leaton Gray and Phippen (2017)

concluded that there is often unnecessary intrusion of adults into children's digital lives, with too much regulation and intervention in young people's online activities. From a historical perspective, there have always been moral panics about the probability and severity of accidents children might encounter and Leaton Gray and Phippen (2017) remind us to reflect on the real risk associated with children using screens to compose their own texts. With the lack of research on this topic, the issue continues to be hotly debated in both parent and educational professional circles. Although writing on screen could significantly influence the flow between children's school and home lives and could be shared with wider and even global audiences, this potential becomes significantly lower if all content children produce is subject to adults' approval of safety and appropriateness. Contrary to popular belief, children's agency in using technologies is sometimes greater at school than at home, because parents' monitoring, supervision and discipline practices reduce children's choices and volition in using the technologies available to them (Kucirkova, 2018). If the purpose of children's writing is to communicate their inner feelings, understandings and meanings, then there is a strong need to widen the scope of design and analysis in future research. Future studies that wish to address questions around children's agency, adults' regulation and its relationship with the overall purpose of children's writing on screen, might find some postmodern ideas of interaction useful in navigating these complex questions. Deleuze and Guattari's (1987) concept of rhizome is a fitting way of capturing the many interconnected "lines of flight" and "lines of becoming" in any human being and their interactions with others. Rhizomatic studies involve very small sample sizes and need to be interpreted with caution but conceptualising the purpose of children's writing on screen as 'rhizomatic' acknowledges the abundant, developing and growing extensions of children's experiences with technologies and opens a more ambitious range of research questions. We recommend this approach because it accommodates the complex confluences of dynamics involved in multimedia composing that need to be acknowledged and teased apart by researchers in relation to the different purposes of writing.

Theme 3: Research does not fully specify and describe the types of tools and applications supporting children's writing on screen

The third theme relates to the level of detail necessary for describing and discussing the tools that children used in the process of their writing on screen. For replicability purposes, researchers need to know which device (e.g. iPad, tablet and computer), which application (e.g. Angry Birds and Find the Monster) was used as part of the writing process. Some research (e.g. Neumann, 2014; Marsh, 2016; Neumann, 2016) described the apps used in the home context in detail. In the school context, some research (e.g. Lisy, 2015) reported the use of only

one application (e.g. word processing), while other research (e.g. Björkvall and Engblom, 2010) reported the use of multiple applications (e.g. garageband, built-in camera, email, pedagogical websites, photobooth and word processing). If researchers expect practitioners to implement any of the research designs in their settings, they need to provide detailed sample and process description as in traditional research with children's writing, as well as an exact description of the hardware and software deployed in the on-screen activities. Aside from this methodological point, there is a tension between the reviewed studies and current literature in relation to the multifunctionality of writing on screen.

Eisen and Lillard (2017) found striking differences between adults' and children's perceptions of the functions served by different devices (e.g. computers are used for work while touchscreens for entertainment). Multifunctionality of new technologies implies that they can be used for writing a story but also for adding photographs, digital drawings, hyperlinks and audio recordings to the written text. It is this multimedia quality of digital texts that might add value to children's writing experiences. Current research taps into this potential by focusing on multimedia story-making apps but future research needs to take this focus a step further by specifying *the individual stages* children move through as they compose on *and* off-screen.

The concept of multimodality might be pertinent for future studies interested in this area. Rooted in social semiotics, multimodality is a theoretical concept that highlights the importance of multiple modes involved in children's meaning-making. The multimodality perspective encourages a more fine-grained analysis of children's writing on screen, including an examination of the multimedia affordances that digital technologies offer for sign- and meaning-making (Jewitt and Kress, 2003). Jewitt (2005) outlined that different modes fit different purposes and children selectively use different modes to express their thoughts. Kress and Van Leeuwen (2001) raised the point that culture and particular characteristics of media *afford* different possibilities. The combined use of children's touchscreens for multimodal meaning-making *and* traditional writing activities remains a future fertile field for both research and practice.

Theme 4: Few studies describe and analyse children's on-screen writing processes and social interactions

In addition to a more detailed description of the tools used for children's writing, it is important to establish details of the interaction around these tools. Borrowing the concept of a reference triangle in applied linguistics (see Gunderson, 1975), we explain this point by specifying the concurrent influence of child's attention and parent–child mediation of this attention to the object they are interacting with. Lack of descriptive detail contained in some of the studies that we reviewed meant

that we were unable to evaluate whether children's writing was positioned as a collaborative (adult–child or child-to-child) or as an individual activity. During each writing activity, children's attention needs to be directed to the object of interaction (the writing device) as well as to the adults' mediation of the activity. With some digital devices, there is an additional 'third interactant', the digital tool that might give children instructions, suggestions or even correct their writing.

To inspire future, more rigorous, research, we include some examples that captured social interactions around writing on screen with older participants. Magnifico et al. (2015) analysed the peer feedback offered on popular authoring websites FanFiction.net and Figment.com and concluded that it contained little support for improving students' craft of writing, reinforcing the need for teachers' expert guidance. Extant research with older children also suggests that children's use of technologies is characterised by collaborative and abundant writing. For example, Nagle and Stooke (2016) documented how 13- to 14-year-olds' composition of multimodal identity texts could bridge the students' in-school and out-of-school writing practices. Future research could benefit by exploring the relationship between children's writing on screen and community literacy practices related to children's sign-making (Lancaster, 2013) to specify the social function of children's writing on screen.

Theme 5: Research conducted with older and younger age groups varies in focus

Given the small cohort of studies and the differences of methods and contexts within them, comparisons between age groups must remain tentative. However, for the sample of studies included in our review, two trends are notable when we compare the studies focused on children aged 2–5 years versus studies with 6- to 8-year-olds. In terms of the composing process, studies concerned with 2- to 5-year-olds seemed to emphasise the creative potential of the tool and its associated apps/programs. For example, Beschorner and Hutchison (2013) highlighted how the drawing apps enabled children's positioning as writers and Bigelow (2013) underlined the possibilities for visual story embellishments with colours and stamps. For older children, emphasis seemed to be more on peer collaboration during composing, as illustrated in studies by Skantz Åberg et al. (2014) or Andersson and Sofkova-Hashemi (2016) where students typed their stories in pairs. The role of adults in enabling and restricting children's writing was clear for both age groups, but while for older children (e.g. Björkvall and Engblom, 2010), the emphasis was on the teacher–child unit, for younger children (e.g. Rowe and Miller, 2016), there was more acknowledgment of the many adults involved in influencing children's writing, including parents and communities. This pattern is intriguing considering the socio-cultural changes associated with children's transition to formal schooling. It is crucial that future research considers whether the age-related differences reflect differences in the life-worlds of children of different ages or are a reflection of researchers' ideologies about what is most important for different age groups. It may be important to empirically explore both continuities and disjunctions in the experiences of very young children and those who are entering formal schooling. Related research shows that while for young children, writing on screen is typically focused on stories and personal narratives, older children and students might write on screen as part of English instruction and compose, for example, multimodal arguments, as studied by Howell et al. (2017).

Discussion: Study limitations and future avenues

Our review was grounded in the values and principles of a theoretical framework that emphasises children's active, volitional and engaged involvement in literacy. Agentic and intrinsically motivated writing for pleasure can occur in any form or format and we focused on children's writing with touchscreens because it constitutes a popular contemporary writing context. We purposefully did not conduct a comparative systematic review that would evaluate the difference between children's writing on and off screen, because we were interested in the features of children's writing, such as agency and active engagement, that run across different modes of presentation. Such a theoretical framework revealed varied and encompassing themes that specify the strengths and shortcomings within literature focused on children's writing with touchscreens. We highlight the need for multiple level analyses and cross-disciplinary work that would include and specify the purpose of children's writing on screen, the specific applications and programs used to support the activity, with focus on the process of writing and its variations according to children's age. Our findings deepen current understanding of the field and constitute the first published guidance for research on children's writing on screen based on a systematic literature review. We encourage both researchers and practitioners to consider multimodality, social control and purpose of children's writing and the specific types of tools and applications supporting children's writing on screen.

One possible limitation of this review is the choice of the final keywords used for mining the literature. We chose the keyword 'writing' for our search because this is the term used by educational professionals and literacy scholars and has a historical place within education. The findings indicate that when it comes to the use of touchscreens, researchers might be using other verbs to describe children's text-composing. Our focus on writing rather than, for example, multimedia composition excluded work that is located in the children's art literature. For future reviews, the keywords 'composing' and

'multimodality' might capture studies that document children's multimodal expression with digital devices. It would be interesting to see how researchers would interpret children's 'writing' on screen, as opposed to story telling, audio-visual composing or artistic explorations (see Miller, 2013). Future literature reviews could also expand the timespan to 2000–2017 to capture the evolution of literature on children's multimodal engagement. For example, it would be interesting to conduct a systematic search of studies that compare the state of knowledge before and after the emergence of touchscreens.

In conclusion, we show that the current empirical base on children's writing on screen is slim and the studies that have been conducted focus on a wide range of diverse aspects of writing. Based on our findings, it is difficult to generate a unified empirically based understanding about children's writing on screen. Instead, we point out the most significant issues and suggest a worthy agenda for future research. Our five themes consist of conceptually distinct areas that need to be addressed in a joint and coordinated future research effort. For example, the lack of multidisciplinary multi-level studies needs to be addressed together with a more focused analysis of the purpose of children's writing, the types of tools and applications supporting the activity and the characteristics of the adults and children involved in the writing process. Perhaps unsurprisingly for a nascent field, there are several research gaps that need to be addressed. Based on this review, we recommend that researchers avoid reductionist ways of accounting for the diversity of children's writing on screen and continue exploring its multifaceted nature, as part of the long and intense continuum between children's writing on and off screen, and intense continuum between children's writing on and off-screen.

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