Digital Literacy in the Early Years: Practices in Formal Settings, Teacher Education, and the Role of Informal Learning Spaces

A Review of the Literature

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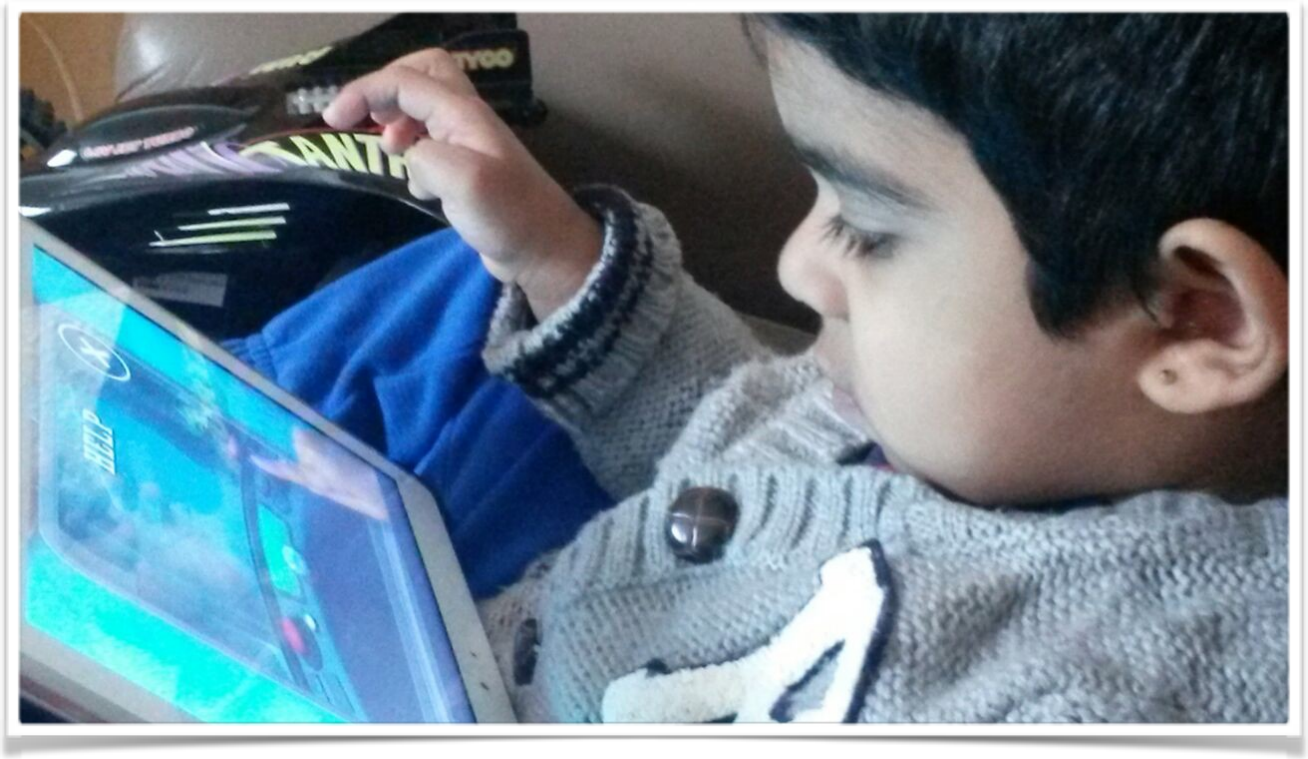
Introduction

Exploration of the digital literacy practices of young children involves at least two challenges: first, the difficulty of defining and delineating literacy in the digital age, and second, the consideration of younger learners in related research. While there have been calls to develop definitions that are broad enough to consider not only particular skills and competences but also the situatedness of literacy in both local and broader sociocultural and political contexts, the scarcity of research both within such a theoretical frame and on young learners has persisted over time (e.g. Burnett, 2010; Lankshear & Knobel, 2003; Sefton-Green, Marsh, Erstad, & Flewitt, 2016).

Addressing these two challenges, this paper presents a review of research on young children and changing views of literacy in digital times. The review stems from COST Action IS 1410 "Digital literacy and multimodal practices of young children" (DigiLitEY), and is undertaken as part of the actions of working group (WG) 2, which focuses on young children's practices in early years settings, schools and informal learning spaces. The particular research questions that concern WG2 and to which the authors of this review aspire to contribute foreground the need to (a) identify practices with regard to the teaching and learning of digital literacy in early-years settings and primary schools, and (b) discuss the role of informal learning spaces in shaping young children's digital literacy practices (see Sefton-Green et al., 2016 for a comprehensive overview of the COST Action Agenda). These research questions and the objectives of WG2 constitute the parameters for this review, which aims to identify the state

of knowledge with regard to the digital literacies of young children in early-years settings and primary schools, including the preparation and training of teachers and teachers' relevant beliefs, as well as in informal learning spaces. Identified research studies are organised into three broad thematic areas, as those pertain to the aforementioned focal points. These are brought together in the conclusion, where connections across the three areas are discussed vis-à-vis the conceptualisation of digital literacy as involving multiple processes and contexts.



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Methodology

This paper foregrounds research that has focused on early-years educational settings, which —according to Burnett's (2010) definition—refer to social and institutional spaces where children aged 0–8 engage in planned activities. As a result, the studies considered for this review took place in care centres, preschools, kindergartens and early primary classrooms (Grades 1–2 or 1–3, depending on particular contexts). Due also to the scope of the WG2 objectives, research on teachers and teacher education, as well as in informal learning spaces (including libraries, museums, galleries, learning and community centres), was key to the identification of existing knowledge on young children's digital literacy practices.

Further criteria for the identification of studies were set at a meeting of WG2 participants in October 2015 and derived from a discussion of the needs and gaps identified in the area of digital literacy and/or new technologies in the early years. Those criteria included: (a) consideration of publications in peer-reviewed journals, excluding books and contributions to edited volumes, but allowing for consideration of other published reviews of research (with the exception of a small number of resources relating to defining key terms in the third thematic area); (b) identification of published work strictly associated with the emphases and objectives of WG2, which meant: consideration of studies of/with children aged 0–8 (excluding empirical research, reviews of research or theoretical papers that related to older ages and or focused on broader terms such as multimodality, e.g. Eshet-Alkalai, 2004; Jewitt, 2008; Jones & Flannigan, 2006; Mills, 2010; Siegel, 2006 – or, on digital competence

as a technical skill rather than a practice, e.g. Gallardo-Echenique, de Oliveira, Marqu, & Esteve-Mon, 2015), which took place in formal and informal educational spaces (excluding work on children's digital and multimodal practices at home and/or with caretakers, e.g. Davidson, 2009; Kucirkova & Sakr, 2015; Marsh, 2004; Plowman, 2015); (c) consideration of work published in English, to address an international audience; and (d) identification of 2000–2015 as the timespan to cover, given the assumed expansion of work in the area during the first 15 years of the 21st century. From the outset of this review, it was acknowledged that the identified timespan might overlap with that of existing reviews on digital literacy practices in educational settings. However, this overlap was considered unavoidable due to the extended scope of the present review concerning issues relating to teachers and teacher education, and to the shaping of young children's digital literacy practices in informal learning spaces.

A search for research that met these criteria was carried out between October 2015 and January 2017, and it was framed by the utilisation of particular keywords in a few rounds of searching. In initial searches, digital literacy was used as a stable term and in combination with the keywords: Preschool, Kindergarten, Early primary years (6–8), Informal settings, Multiliteracies, Multimodality, Early childhood, Teacher Education and Curriculum. Further searches included: (1) focused searches in areas where only a small number of studies were initially generated (especially on digital literacies in informal settings, resulting in the use of additional keywords such as informal learning, informal learning spaces, informal learning settings, informal learning environments, out-of-school literacy practices, learning theory, literacy theory, young children, libraries, museums, community centres and learning centres); (2) focused searches in peer-reviewed journals; (3) focused searches of articles and reviews

cited in pieces of work identified through initial searches; (4) focused searches of databases and collections of articles generated by professional groups and networks relating to this work (e.g. DigiLitEY WG5 database; EECERA Digital Childhoods SIG website).

To combine keywords, Boolean operators and truncation were used. The databases of Scopus (EBSCO), ProQuest (Education and Social Sciences) and various library and information science databases were used for an initial search for articles, which generated a list of approximately 350 unique entries (after the exclusion of duplicate articles). To filter the articles, titles and abstracts were further read by the researchers in order to select target papers, as per the parameters and selection criteria discussed above. Finally, 126 articles were identified as suitable for this review and organized into three broad categories that adhered to WG2 foci and objectives: curriculum and pedagogical practices (including multimodal practices and multiliteracies), teachers and teacher education, and informal learning spaces.

The studies reviewed in this paper are primarily of a qualitative nature, with research methodologies ranging from case-study research to action research and ethnographic studies. Fewer studies utilised methods such as surveys and questionnaires, randomised controlled experiments, quasi-experimental, representative, mixed-methods and comparative designs. Perhaps due to the limitation that only research published in English was to be included, the identified studies were primarily located in the USA, Australia and the United Kingdom. Also represented are studies from Norway, the Netherlands, Finland, Germany, Spain, Greece, Canada, New Zealand, Israel, Turkey and Jordan, with only a few of them being reports of cross-national projects.

In what follows, each of the thematic areas mentioned above is separately discussed through the identification of sub-categories and a section summary. In the last section of this review, concluding remarks are made with regard to how research across the three thematic areas relates to the conceptualisation of digital literacy set forth in the COST Action White Paper on ‘Establishing a Research Agenda for the Digital Literacy Practices of Young Children’ (c.f. Sefton-Green et al., 2016).

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Early Literacy Practices in the Digital Era

3.1 Overview

In this section, research is discussed that focuses specifically on digital literacy practices in early-years educational settings. While these might include children's centres, schools and other early-years settings, this section focuses primarily on research in preschools, kindergartens and early primary grades. This reflect a tendency across the studies identified for the purposes of this review and thus signifies a gap in research on younger children.

To begin with, it is important to summarise key realisations from two earlier reviews of research. Seven years apart, Lankshear and Knobel (2003) and Burnett (2010) affirmed that in research on literacy and new or digital technologies, early learners were radically underrepresented compared to other age groups. In addition, each of them, through different theoretical constructs, concluded that the majority of studies reviewed promoted a tokenistic, instrumentalist view of digital literacy, where much was assumed about the potential of particular technologies to advance literacy and literacy learning. As Lankshear and Knobel (2003) put it:

> Needless to say, the corpus of studies [was] swamped by an emphasis on developing a generic capacity to encode and decode alphabetic print rather than to promote competence as 'insiders' of practices and discourse communities that extend beyond conventional classroom reading and writing. (p. 77).

In line with this, Burnett (2010) pointed out that most of the studies included in her review centred on computer-based stand-alone technologies and the ways in which those facilitated the development of particular aspects of literacy. Hence the calls for an expansion of the meaning of literacy in the digital era: Lankshear and Knobel (2003) assert that research should move towards the examination of situations where networked machines, including the use of non-interactive and/or interactive software, may be used to enhance "discursive prowess" (p. 75) in communities of sociocultural practice. And Burnett (2010) employed Latour's actor network theory to highlight the importance of examining "taken-for-granted assumptions and relationships that may become embedded in new technologies and activated in use" (p. 262). Burnett (2010) further suggests that meaning-making with digital texts and tools should take on a meaning that is broader than immediate social/ classroom interaction and be considered within broader sociocultural and political contexts and in relation to discursive audiences and producers of texts.

With the conclusions and recommendations from these two reviews as the background, the relationship of early-years schooling to the new digital landscape is further examined in the sub-sections below, which include research published up to 2015. These sections are organized based on four focal points: (a) ideas or guidelines for the integration of ICTs and digital media into early childhood education (ECE); (b) discussion of the potential of particular

pedagogical frameworks to support children's development of digital skills; (c) discussion of the pedagogical potential of particular digital tools and applications; and (d) exploration of children's meaning-making with digital technologies.

3.2 Ideas or Guidelines for the Integration of ICTs and Digital Media into Early Childhood Education

A number of identified studies utilised findings from research enquiries primarily to discuss the integration of ICTs and or digital media into early childhood education and thus argue for the expansion of early literacy curricula. A key point raised by researchers like Bearne (2009) and Bazalgette and Buckingham (2013) was the need to expand definitions of multimodality, which has increasingly become commonsensical in the description of early childhood literacies (see, e.g., Siegel, 2006). While Bearne (2009) points to different instantiations of multimodality across digital and or print-based texts, Bazalgette and Buckingham (2013) provide classroom examples that highlight the specificities of children's multimodal engagement with moving image media; and both, among others, conclude that notions of multimodality should destabilise rather than reinforce the binary between print and non-print literacies.

This destabilisation related to the acknowledgement that young children's repertoires as meaning-makers had expanded, largely because of their immersion in "digitally mediated environments," which shape the construction of a particular "habitus" (Zevenberger, 2007, p. 27). This meant that young children were portrayed as entering educational settings with specific dispositions as literate beings that might differ from those traditionally identified in

literacy curricula. Accordingly, notions of emergent literacy skills as well as of reading and writing in the early years were found to be in need of expansion so that children's exposure to and creative use of digital media, new technologies and changing texts were considered, often in relation to or in the context of sociocultural forms of literacy (Hassett, 2006; Hisrich & Blanchard, 2009; Walsh, 2006). Expanding early-years curricula through the integration of digital technologies thus appeared to be an imperative connected to issues of access and equality (e.g. Forzani & Leu, 2012; Zevenberger, 2007), with particular implications for the conceptualization of children and of key practices in early-years settings. As Dietze and Kashin (2013) suggest, children should be seen as capable of learning with technology, while play and collaboration should be understood as taking innovative forms when integrating digital tools and technologies to foster children's curiosity, problem-solving and thinking skills (Bølgan, 2012; Szmodis & Columba, 2013).

3.3 Pedagogical Frameworks for Children's Development of Digital Skills

Starting from this idea of expanded early years' curricula, other researchers, whose work is reviewed in this second sub-section, set out to consider the potential of particular pedagogical frameworks for children's development of digital literacies, including the assessment thereof. Such research has suggested the need for child-centred, enquiry-based pedagogies that allow for children's engagement with powerful environments for purposes directly linked to their everyday lives (e.g. Alper, 2013; Hesterman, 2011a, 2013). According to Bruce and Casey (2012), the practice of enquiry, which supports children to ask, investigate, create, discuss and reflect, is a better fit than traditional pedagogical practices for teaching and learning in a technologically mediated world, and thus should frame children's experiences in primary education.

Connected to this was Mills' (2010) analysis of children's cross-disciplinary repertoires of knowledge that was facilitated through the production of networked digital media. Utilising Kalantzis and Cope's framework of "Learning by Design", Mills (2010) argues that, through the production of digital media, children in early primary classrooms experiment, conceptualize, analyse and apply new combinations of technological, textual and content knowledge, thus expanding their funds of knowledge and increasing their possibilities for success in a new era. Focusing particularly on young children's digital activity in early childhood settings, Edwards and Bird (2015) argue for the utilisation of learner-centred pedagogical frameworks, such as play, which support exploration, problem-solving and skill acquisition on behalf of children. Thus they introduced the Digital Play Framework, a tool to understand children's use of technologies as two forms of play: as play-oriented toward

figuring out the potential of technologies, and as lucid play that allows and foregrounds children's use of technologies in symbolic or generative ways (see also: Edwards, 2013; Kangas, 2010).

The notion of generativity, in the sense of expanding children's repertoires of and potential for meaning-making, was implied in a group of identified studies that focused on multimodal literacies and multiliteracies in early-years educational settings (e.g. Binder, 2014; Britsch, 2005; Granly & Maagerø, 2012; Mellgren, E. & Gustafsson, 2011). Across studies, researchers have examined the ways in which digital technologies have reframed literacy learning, often drawing directly on the New London Group's (1996) notion of multiliteracies (e.g. Lotherington & Jenson, 2011; Walsh, 2008) or combining theoretical frameworks to address issues of multisemiosis and criticality (e.g. Crafton, Brennan & Silvers, 2007).

Locating her studies in Australia, Walsh (2008, 2010) explored different forms that literacy learning took on when print-based and digital technologies were combined, suggesting that the merging and interdependence of modes produced new meanings of literacy that expanded children's potential for meaning-making. Edwards-Groves (2011) reached a similar conclusion in an action-research project conducted in the UK, where she studied process-writing that involved the utilisation of technology alongside print-based and more conventional means of writing. As she suggests, such convergence opens up new pedagogical spaces, where communication across students and between students-teachers and online spaces is enabled, the recursiveness rather than the linearity of text production is acknowledged, and pedagogical practices are generative and draw upon children's out-of-school experiences with technology. In addition, Eiserman and Blatter (2014) argue that a

multimodal approach helps children to better understand story elements, such as story plot, characters and episodes. They note that “through multimodal collaborative contexts, children learn to find meaning by exploring a concept through different kinds of texts; understand that learning is a process in which one inquiry leads to another; collaborate in ways which allow each to contribute to a shared inquiry that makes knowledge richer and more meaningful; reach a sense of belonging and achievement” (p. 181).

Such pedagogical spaces have been found to be beneficial in studies involving children of diverse and or multiple linguistic backgrounds: located mostly in the USA and Canada and conducted in classroom settings ranging from kindergarten to Grade 3 (8-year-olds), researchers have argued that digital technologies (including personal computers, iPods and iPads) provide learners of languages other than the school norm with opportunities to engage in school literacy in differential ways and thus destabilise their positioning as deficient learners (e.g. Lotherington & Jenson, 2011; Siegel, Kontovourki, Schmier, & Enriquez, 2008).

Often, this also involved their engagement in critical enquiries relating to issues of personal and social import (e.g. Crafton, Brennan, & Silvers, 2007; Ntelioglou, Fannin, Montanera, & Cummins, 2014; Silvers, Shorey, & Crafton, 2010). Locating their work in a Grade 2/3 classroom in a Canadian inner-city school with a high percentage of multilingual-multiethnic children, Ntelioglou and colleagues (2014) point out that pedagogies that provide children with opportunities for meaning-making across languages, media and modes can foster learner autonomy, identity investment and literacy engagement (p. 8), thus challenging societal power structures that marginalise children's cultural and linguistic capital.

3.4 Pedagogical Potential of Particular Digital Tools and Applications

In the research studies reviewed in this sub-section, the need to expand the meanings of literacy and pedagogical spaces is discussed in connection to the potentials of particular digital tools and technologies. Foregrounding such potentials, several studies have shown that technology can help young children to create and write stories and various texts. Åberg, Lantz-Andersson and Pramling (2015) describe how young children created digital narratives with images from *Storybirds*, while Brown (2013) shows how second-graders understood story details and created digital versions of graphic stories by exploring *Babymouse Queen of the World* (Holm & Holm, 2005 as cited in Brown 2013) and spending time with characters including Baby mouse, Felicia Furry paws and Wilson the Weasel.

Observing how 41 Spanish 4- and 5-year olds utilized a story-making application, called *Our Story*, along with colouring and drawing applications, Kucirkova, Messer, Sheehy, Fernandez

and Panadero (2014) concluded that children are best supported by engaging them in exploratory talk, joint problem-solving and collaborative learning. A similar conclusion was reached McKenney and Voogt (2009), who present *PictoPal*: a technology-supported intervention developed in the Netherlands that integrates a number of authoring and drawing applications whose use can be flexibly combined with non-computer activities. As the authors suggest, the intervention supports children's development of emerging literacy skills, while concurrently scaffolding them to develop as independent learners. Adding to that, McDonald and Howell (2012) note how the collaborative building of a robot in a creative digital environment in an early-years setting in Australia enhanced children's knowledge of literacy and numeracy but also fostered the development of interpersonal and social skills, including their ability to negotiate complex social interactions with peers.

Such learning is also evident in studies of children's writing and production with word-processor (van Leeuwen & Gabriel, 2007, in 1st Grade in Canada), photo-story (Beam & Williams, 2015, in kindergarten in the USA) and video-editing (Marsh, 2006, with 3-to 4-years-old in a nursery school in the UK) software. While researchers like Beam and Williams (2015) have traced the challenges practitioners encountered in their attempts to incorporate such tools into literacy learning, there is much agreement across studies that these support the development of particular skills and knowledge on the part of children. As Marsh (2006) posits, those may include technical and visual skills, as well as understandings of genres, text types and multimodality, and the ability to engage critically with texts and ideas. Taking a similar stance, Luke, Tracy and Bricker (2015) show how, by using digital tools such as digital cameras, children are motivated to create their own photographs and write captions representing their thoughts, observations and understandings. While most of this research

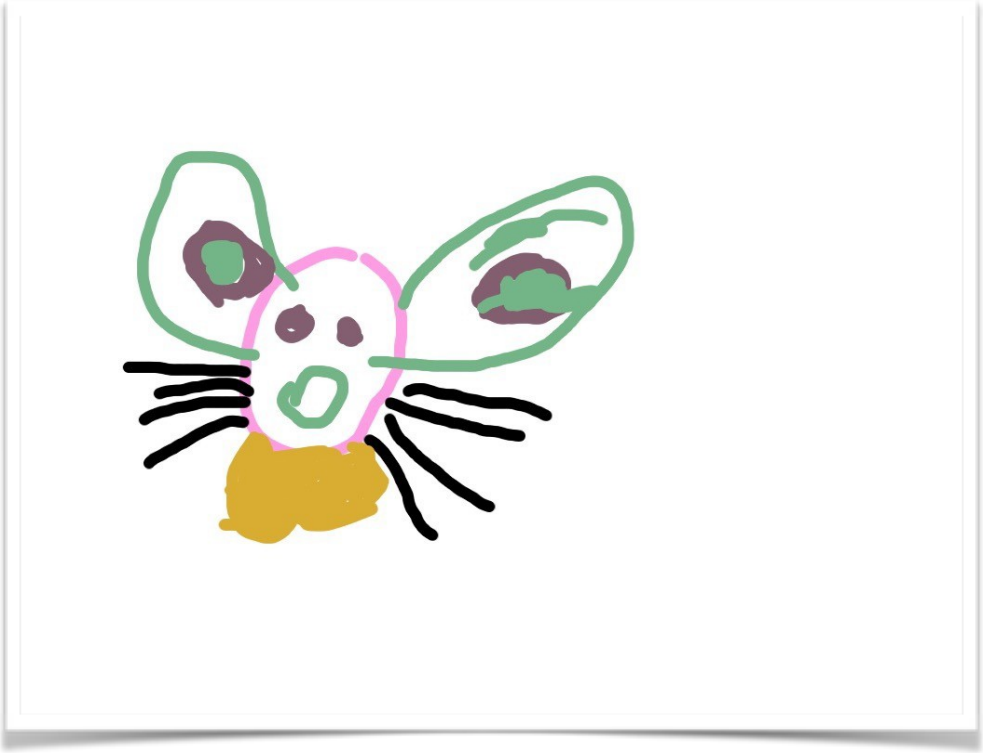
has focused on text production, similar conclusions have been reached in studies on the utilisation of digital storybooks and e-books for reading (Brueck & Lenhart, 2015; Homer et al., 2014; Morgan, 2013; Shuker & Terreni, 2013). Across these studies, emphasis has been placed on the facilitation by digital tools and technologies of children's motivation, engagement and development of diverse skills and expanded understandings of literacy.

Nevertheless, researchers have cautioned that children's engagement with digital technologies needs to be adequately supported, either through teachers' own development of skills and understandings of literacy in the digital age and/or through particular tools such as the interactive whiteboard (e.g. Beam & Williams, 2015). While there is more discussion of teachers in a later section, worth mentioning here is Vangsnes, Økland and Krumsvik's (2012) study on the use of educational computer games in Norwegian kindergartens. As the researchers suggest, educational computer games can be beneficial for children's exploration and learning but, nevertheless, this necessitates pre-school teachers reconsidering their pedagogical role and didactic understanding. On the other hand, tools like interactive whiteboards are considered useful for enhancing teaching and young children's learning. Berson, Cross, Ward and Berson (2014) explored ways to use whiteboards in a preschool classroom and found that by using those to facilitate access to Internet resources, children were supported to learn about a topic of interest (panda bears) that was beyond their physical reach. They thus argue that whiteboards support pedagogical practices that help young children in active learning processes. Reporting on teachers' use of interactive whiteboards for science teaching with children aged five to six years in

Australia, Teck (2013) also discussed the possibilities thereof by pointing to multiple ways in which those could be used: introducing and presenting content, facilitating children-teacher interaction and/or promoting group or individual evaluation.

Research has further shown that children have different opportunities to use and learn about the Internet and this affects their understanding of this tool as a place of information and a social space (Dodge, Husain, & Duke, 2011). As Fantozzi (2012) argues, by using various websites such as VoiceThread, children are offered "multiple pathways […] to communicate and collaborate with others" (p. 42). Such tools allow young children to connect with places they could not access before, such as other classes in their school or beyond. They are also able to speak, type or dictate their comments and thus develop a repertoire of communication methods that support their social communicative behaviours and emergent literacy skills. The issue that technologies have positive effects on children's performance across developmental domains has been also shown by Hsin, Li and Tsai (2014), who argue that in most of the 87 studies they reviewed, the results suggest that technologies enhance children's collaboration and interaction with others and their development of multiculturalism.

Among the studies reviewed, especially those published in recent years, many foreground the benefits from the integration of tablets into curricula for the development of not only the literacy (Haggerty, & Mitchell 2010; Simpson, Walsh, & Rowsell, 2013) but also mathematical competencies (Carlsen, 2013) of young children. Focusing particularly on the use of iPads, researchers have suggested that this particular device may be a platform for pre-school and kindergarten children's learning of literacy concepts, development of emergent literacies,



contextual meaning-making including the presentation of their ideas, and social interaction facilitated by children's observations of one another's screens and the manipulation of one device (Beschoner & Hutchinson, 2013; Couse & Chen, 2010; Sandvik, Smørdal, & Østerud, 2012). Further, iPads are found to foster the achievement of given curriculum guidelines, including traditional print-based literacy skills, but also extending toward self-contained gamified literacy. This is possible for children of diverse ability levels, including those with moderate to complex cognitive and physical impairments (Flewitt, Kucirkova, & Messer, 2014; Flewitt, Messer, & Kucirkova, 2014; Lynch & Redpath, 2014). Many of these are facilitated through device-specific specifications, such as touch-screen sensitivity, that allow the development of motor skills and the coordination of movement and gesture, but also through the tool's capacity for networked learning that fosters children's increased familiarity with locating, launching and operating particular applications. While this, as in other cases, presents teachers with particular challenges to design and scaffold learning, it is nevertheless

asserted that tablets can foster children's communication, independent and pleasurable learning, as well as collaborative interaction.

3.5 Children's Meaning-Making with Digital Technologies

A final group of studies identified in this review focuses specifically on children's engagement with digital technologies and other literacy tools and their complex subjectification as meaning-makers through such transactions, thus indirectly responding to Lankshear and Knobel's (2003) and Burnett's (2010) calls for expanding the ways in which children's engagement with digital technologies are understood. Despite acknowledging the merits of tablet technology, Rowsell and Harwood (2015) invited scholars to also consider the complexities of understanding young children as users of iPads. Analysing data from a US-based study of iPad use across five early-years classrooms, the authors suggest that children's meaning-making with digital tools should be understood as indicative of their positioning as consumers of artefacts and popular culture media and images, active producers of multimedia/ multimodal texts and inventors of new meanings. In her studies of pre-school and kindergarten children in the USA, Wohlwend (2008, 2009, 2010, 2015) discusses how young children negotiate such positions and identities in their interactions with one another through play in either physical or virtual space. As she argues, in those situations, text is under constant negotiation and construction (2010) and children's play is rich in the creation of imagined technologies and user identities (2009), while responsibility is shared and involves not only human but also non-human agents such as artefacts and objects (2008, 2015).

In addition, studies like those of Leinonen and Sintonen (2014), Mills (2011) and Pahl (2009) highlight how children's creativity is facilitated through participatory action, meaning transformation, improvisation and adaptations of the affordances of different tools and media. Such realisations are linked to theorisations of children's engagement in literacy, especially in the digital era, as a matter of human and non-human interaction, material-immaterial transaction, affective and indeterminate learning, which open up the space of the classroom and allow the bending of boundaries, not only between spaces (virtual, physical, classroom, school-based, out-of-school) but also between modes and processes of meaning-making (e.g. Burnett, 2014; Burnett, Merchant, Pahl, & Rowsell, 2014; Lafton, 2015).

3.6 Summary

A first conclusion to be drawn in terms of the relationship between early-years schooling and the new digital era is relevant to the number of studies categorised under each of the identified themes/ sub-sections. The fact that most of them appear under the pedagogical potential of particular digital tools and applications might be explained through the increasing numbers of digital tools and applications, as well as their availability and ease of use (see, e.g., Flewitt, Messer, & Kucirkova, 2014). It can thus be further assumed that this is a sign of the changing digital landscape and, consequently, of the very notion of digital literacy. This is particularly important if one takes into account that most of these studies were published after 2009. The review of these studies partially confirms earlier realisations about the comparatively larger number of studies in which digital technologies were portrayed as

facilitators of literacy learning or aspects thereof (Burnett, 2010; Lankshear & Knobel, 2003). Even so, there is considerable discussion on the ways in which the notion of literacy can be reframed.

This expansion of the discussion on literacy in the digital era is also connected to the ways in which young children's early experiences of literacy may be reshaped. Studies have shown that expanded definitions of multimodality destabilise the binary between print and non-print literacy, as well as how notions of emergent literacy (including reading and writing in the early years) foreground engagement with digital technologies as part of children's semiotic repertoire or habitus prior to or beyond their experience in school. Collectively, researchers have also considered children's engagement with new technologies in terms of particular skills, but also in terms of access and equality.

This attention to skills, but also to access and equality, is evident not only in studies focusing more on guidelines but also in studies of particular pedagogical choices/ frameworks and the pedagogical potentials of digital tools and applications. Across all sub-sections, potential benefits for early learners connect to, for instance, problem-solving, exploration, skills acquisition, collaborative learning, social interaction and meaning generativity, as well as multisemiosis and criticality. In many studies these benefits are discussed and seen as being of particular value for children whom Lankshear and Knobel (2003) refer to as "disadvantaged": namely, of diverse or multiple linguistic, socio-economic, race-ethnic backgrounds and diverse ability levels. In addition, the studies included in the last sub-section foreground the multiplicity, complexity and fluidity of children's meaning-making with digital technologies by connecting those with issues of children's positionality and subjectivity

vis-à-vis notions of agency and the disruption of boundaries. Despite the differential emphases on those aspects across studies, the research reviewed in this last thematic area collectively suggests that the very meaning of literacy in the digital age might be expanded to reflect operational, cultural and critical dimensions (c.f. Sefton-Green et al., 2016). The implications of this discussion on the potential benefits for young literacy learners are further discussed in the final section of this review in terms of the contexts of young children's digital literacy practices on the micro-, meso- and macro-levels.

4

Teachers' Views and Teacher Education

4.1 Attitudes and Practice

The quest to identify pedagogical practices relating to the teaching and learning of digital literacy in early-years settings and primary schools, which was the locus of attention in the previous section, is extended in this review through consideration of teachers and relevant teacher education. Assuming that teachers' role, preparation and in-service training are key to the integration of digital technologies in official school spaces, research is reviewed that centres on particular factors and conditions that might influence teachers' decisions towards that end.

To explore this issue, and based on the findings of Merchant (2011, in Gruszczynska, Merchant & Pountney, 2013) on digital literacy and sociocultural models of digital practice, Gruszczynska, Merchant and Pountney (2013) distinguish two different but related perspectives on factors influencing digital technology integration into early years and primary classrooms:

- The frame for access, skills and practices, which includes functional access to networks, devices and so on;
- The contexts for these practices/skills, including the workplace, learning environments, the personal/social context and community.

Taking these into consideration, it was concluded that there is a need for a close combination of theory and practice, as well as to address practical issues of access and availability.

On the other hand, Friedrich-Liesenkötter (2015) used Pierre Bourdieu's concept of habitus in order to systematise the factors influencing the successful implementation of digital literacy in one's professional repertoire, finding that teachers' beliefs and attitudes are a strong factor of their pedagogical practice. A similar conclusion was reached by Blackwell, Lauricella and Wartella (2014), who examined the influence and relationship of extrinsic and intrinsic factors in the use of technology. These authors found, in a study of more than 1,200 early childhood teachers, that attitude is the most significant factor, given that teachers' belief in the value of technology as an integral part of children's learning is strongly related to their decisions to incorporate this in their teaching. Teachers' attitudes are followed by their confidence in their own abilities and providing them with technological support (see Figure 1).

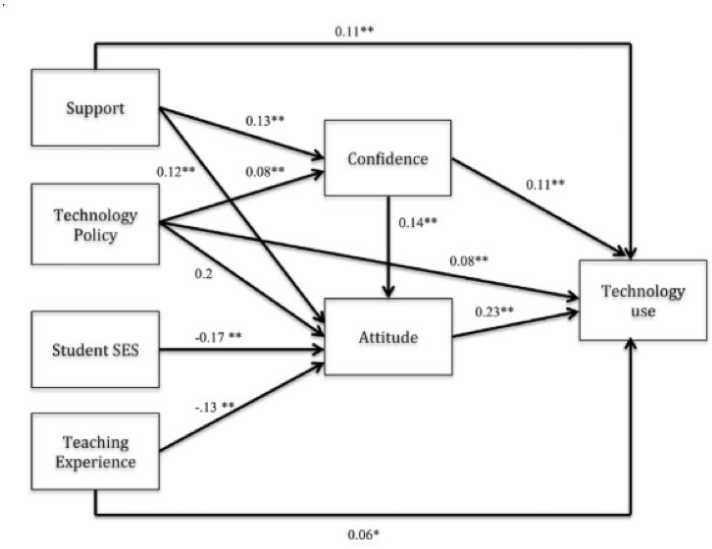


Figure 1: Results of path analysis. p* < .05, **p < .01.
(Blackwell, Lauricella & Wartella 2014, p. 86).

Attitudes, skills and practice appear to be interrelated variables (Chen & Chang, 2006), given that self-efficacy (Bandura, 1977 in Chen & Chang, 2006) and confidence underpin the implementation of digital literacy practices. As shown by Inan (2015), through the example of digital storytelling as a way of helping children to understand mathematical problems, pre-service teachers and preschool students are rather cautious in their initial reactions to technology integration. However, after weeks of training, most study participants stated that they would prefer to continue to instruct mathematics classes using the digital storytelling technique. In particular, working within heterogeneous groups helped to integrate this new technique.

Rosean and Terpstra (2012) describe a similar experience. Their article discusses two teacher educators' engagement in a collaborative self-study as they implemented a new literacies project to help pre-service teachers expand their conceptions of literacy and their knowledge of how to incorporate new literacies pedagogies into K-6 teaching and learning. Their positive learning experiences were powerful enough to strengthen teachers' self-efficacy. The teacher candidates seemed to gain knowledge, skill and understanding of digital technologies by designing a product for a real audience (their peers) and blogging about their learning processes. Teacher candidates who completed the project opened up their thinking about new literacies. Many of them expanded their conceptions of literacy to incorporate digital literacy, and most were able to talk broadly about the implications for classroom teaching and learning. But still: teacher candidates differed in the extent to which they were able to apply insights about their own learning to the K-6 classroom, as many of them were not able to fully integrate technology and new literacies into lesson planning.

In a survey study, McDougall (2009) examined the impact of changing views of literacies on primary teachers' identities and beliefs about their pedagogical role. She found that when boundaries between the conventional and the new were drawn in the discourse on literacies, a crisis in the way teachers perceive their identity might occur. When teachers adopt a future-oriented perspective they are more able to integrate digital literacy into their teaching repertoires, whereas a rather traditionalistic perception of literacy connects to teachers' seeing teaching media as an unnecessary burden. Nevertheless, actual experience with new media was found to improve teachers' motivation as well as the learning processes of reading and writing. The study thus signalled that new perceptions of primary teachers' identities are emerging, given that those teachers eventually believed that old and new media and media skills had the potential to complement each other rather than compete for space in the curriculum.

Ihmeideh (2009) also focused on the professional identity of primary teachers and the important aspect of teachers' views and attitudes. In his literature review on barriers to using technology in preschool education, he profiled different types of learners, which is relevant not only to the context of Jordan, where the study took place: those teachers-learners who justified their traditionalist proprieties on ideological grounds, and others who admitted a lack of confidence in embracing new forms of literacy. Some teachers could recognise that media studies represent an important aspect of learning for today's students, but they also felt that they were not confident in their own capacity to teach it. Some teachers defended their more traditionalist approaches because they felt that their key responsibility was to teach basic numeracy and literacy, and that any new curriculum initiatives were simply a diversion from their core business. Of course, not all teachers view the incorporation of new media as a

dilemma. Some teachers were enthusiastic supporters of the benefits of teaching media. Even teachers who did not include media activities in their own planning commented on the motivational benefits of new media activities when observing the work of their colleagues. According to their self-reports, the most important reason for not employing technology in the classroom was the lack of time to prepare it and become accustomed to it. That was also the argument of teachers in the study of Inan (2015), in Turkey. Other duties and responsibilities and the heavy workload teachers had in kindergartens seemed to make it impossible for them to engage with the adequate use of ICT in preschool education.

Across different studies, further conditions were identified that facilitated or hindered the advancement of digital literacy in early years' education. For instance, in her investigation of teachers' perceptions of students' knowledge of digital literacy practices in low- and middle-SES schools, the differences between them as well as the question of how teachers relate these to academic literacies, Honan (2009) points out that teaching routines – not mere knowledge of ICT itself – have to be adapted so that new digital as well as traditional print texts can be incorporated into literacy teaching. Laffey's (2004) findings from a three-year study had earlier suggested that the pathway to the appropriation of technology is multi-dimensional and driven by experiencing the engagement of children working within multimodal settings. On the one hand, teachers are willing to engage in digital literacy, but on the other they are wary of losing their emotional contact with children, given that they perceive technology to interfere with that relationship.

Adding to teachers' perceptions and attitudes, Chen and Chang (2006) found that teachers' technological competence varies as a function of the number of years teaching and their individual roles as lead or assistant teachers, as well as their home computer access and the length of their in-service training. Implied is an assertion that familiarity with technology plays a significant role in teachers' sense of competence, a point that resonates with the conclusion that such familiarity positively affects student teachers' perceptions of the Internet as a pedagogical and self-development tool (e.g. Gialamas, Nikolopoulou, & Koutromanos, 2013; Gialamas & Nikolopoulou, 2010; Kerckaert, Vanderlinde, & van Braak, 2015). Rosen and Jaruczewicz (2009) add to these findings, as they discuss the implications for teachers' personal and professional development. To do so, they discuss a longitudinal research project, whereby pre-service teachers were presented with children in two contrasting classroom scenarios and asked to illustrate developmentally appropriate technology use. Teacher educators – according to Rosen and Jaruczewicz – had to demonstrate and model

an interest in, disposition towards and expertise with technology if their pre-service students were to do likewise with young children in their classrooms. The authors also stress the centrality of users' developmental and cultural characteristics, as well as teachers' sense of an overall responsibility in relation to decision-making and scaffolding strategies. Finally, technological capacities for documentation and assessment were found to be important for teachers wishing to devise new strategies.

Although the importance of strong knowledge of available technology is stressed across identified studies, it appears that one need not be an early adopter of all state-of-the-art-technology in order to design digitally-enhanced learning in early childhood settings. Rather, pedagogical and content knowledge emerge as most important types of knowledge that are influential for designing effective digitally-rich learning environments. Along the same line of thinking, Thorpe, Hansen, Danby, Zaki, Grant, Houen, Davidson and Given (2015), from Australia, confirm the observation that teachers' pedagogical beliefs are highly relevant for successful web-searching in class. Focusing more on content knowledge, Steckel, Shinas and Van Vaerenewyck (2015) concluded that, especially, the use of artistic technology necessitates a language-rich discourse, both digital and verbal, which can support the development of emerging language and literacy skills, problem-solving and communication.

In terms of pedagogical practices that facilitate pre-service teachers' and students' learning in teacher education programmes, digital learning settings are found to be quite attractive. As suggested in an Australian action-research study by Ryan, Scott and Walsh (2010), self-regulated learning processes were greatly enhanced by the use of digital tools and applications. Attempting to identify the types of knowledge that teachers need to teach in

contemporary multimodal, digital contexts, Ryan and colleagues assert that it is pre-service teachers' expertise as analysts and critics of texts that first guides their planning and teaching in this new digital environment. On the other hand, they found that the inherent characteristics of multimodal/ digital learning environments obviously provide motivation to pre-service teachers, who quickly develop into self-directed independent learners. As reported by Ryan and colleagues, students made gains in autonomy, retrained cooperative skills and team-building. Based on four identified knowledge processes – experiencing, conceptualising, analysing and applying – the version of multi-literacy learning model adopted in the study suggests a balanced provision of resources and the facilitation of experiences for situated practice based on a systematic review of theoretical understandings and a critical framing of learning in context, which were relevant to the learners involved. Thus, transformed practice would mean that newly designed and experienced settings could transfer to and expand regular classroom implementation.

According to Landerholm, Gehrie and Hao (2004), this would require continuous work on a developing curriculum where teachers' (and students') reflective skills would constantly adjust to current discourses on education, such as multicultural/ international or special needs. Relevant to this is the notion of design, which was central to the study of Rosean and Terpstra (2012). Therein, many participating teacher candidates were not able to fully integrate technology and new literacies into their literacy curricula designs, but they were at least able to select a starting point for planning by either focusing their lessons on building knowledge and skills associated with new technology or working towards developing one of the other new literacies. As Rosean and Terpstra (2012) concluded, a central feature of pre-service teachers' success is what they call design, i.e. the process of designing a product for a real audience and blogging about their learning experience, while concurrently learning about new literacies, making strategic decisions about the representation of ideas and attempting to take advantage of the affordances of different technologies as media for communication.

Extending pedagogical considerations further, Husbye, Buchholz, Coggin, Wessel-Powell and Wohlwend (2012) stress the role of a play-based curriculum for teachers as well as children as a means for establishing collaborative spaces to facilitate literacy-learning with digital technologies. Inan (2015), too, stresses the importance of collaboration, concluding that it seems to be necessary to form homogeneous study groups in order to get the best possible results. Toren, Maiselman and Inbar (2008), in Israel, demonstrated how an integrative curriculum worked effectively within their kindergarten teacher training programme, when that combined the use of technology with artistic expressions of children's literature.

Keengwe and Onchwari (2009) as well as McVee, Bailey and Shanahan (2008) examined how practising teachers and teachers' educators learn from new literacies and new technologies. McVee and colleagues (2008) concluded that their results showed a shift in teachers' attitudes towards digital media, from fear and loathing towards shared problem-solving and distributed learning. Teachers were also found to be able to change their views from learning designs that emphasised print-based texts to designs and multimodal redesigns of texts. In this sense, they were able to take a transactional stance on literacy and technology integration rather than a dichotomous perspective. According to the authors, teachers' own experiences with technology are necessary for them to develop a different view on literacy that integrates multimodality. This is particularly important given that digital multiliteracies are often portrayed as offering high accessibility for students and thus constructed as more attractive than traditional literacies. Still, in spite of the positive learning experiences and the progress made by teachers, the authors felt that their study raised some issues as self-efficiency does not immediately lead to a complete change in attitudes and working habits. Robertson, Hughes and Smith (2012), in Canada, confirmed those findings with their own qualitative research based on written reflections from pre-service teachers, as did Kildan and Incikabi (2015). Keeping a more optimistic stance, Kildan and Incikabi (2015) emphasise that even though teachers need to be encouraged and well supported to try new ways of designing learning activities with technology, after successfully creating their own digital stories, they become more critical in their reflections on former teaching practices, explaining how their design for a digital story created a space for their expression and growth that they had not anticipated.

In general, according to Graham (2008), teachers move into digital worlds via three different approaches: self-taught, school-taught or in a playful manner of experiencing. These reflect some aspects of the research presented above, spanning teachers' use or familiarity with digital technologies for non-professional reasons, their participation in teacher education programmes, and the experiential learning processes therein. A final point to be added connects to how technology may address teachers' differential learning styles, given that, for some, digital communication seems to reduce the fear of participation in learning experiences that take place in physical settings. For instance, Hungerford-Kresser, Wiggins and Amaro-Jimenez (2014) point out that, in their research on pre-service teachers' blogging in the USA, those who did not participate in face-to-face discussions were able to express themselves online. Mills and Chandra (2011) from Australia reached a similar conclusion, having described the potential of micro-blogging to develop participatory culture and encourage the use of multiliteracies.

4.2 Summary

The research reviewed in this section has dealt with aspects that are relevant for the implementation of digital literacy in early childhood teachers' education, as well as the conditions that may apply if digital technologies are to become part of teachers' repertoires for early literacy teaching. One can thus distinguish different kinds of influencing factors – external and internal ones. External factors may include the existence of technical infrastructure, the length of teachers' experience with new or digital technologies, and the continuous support and reassurance of teacher-learners. Internal factors may distinguish between attitude and confidence, with self-efficacy being the condition that mostly influences

what is put into practice. The development of positive attitudes toward digital literacies and technologies is also considered necessary for the integration of digital literacy into current models of pedagogical practice. This does not lead to the replacement of traditional literacies, but rather to the broadening of both learning tools and media, as well as teaching methods. Implied in the studies presented above is also a need for teachers to develop a flexible attitude towards further changes in technology and school curricula. That necessary flexibility seems to be a continuous challenge for experienced in-service teachers, given that, compared to pre-service teachers, they have more difficulties in keeping up to date with changes to the technological and communication landscape, as well as the potential of new and multi-literacies.

The research reviewed in this section also leads to recommendations regarding teachers' learning (see also Marsh, Kontovourki, Tafa and Salomaa, 2017). Accordingly, an experiential and participatory learning culture in teacher education and training programmes has the potential to change and enrich teachers' awareness of digital possibilities, whether related to practical work with digital storytelling in literature or mathematics, or creative art with audio, video or written text. Digital participation might partially compensate for face-to-face communication, and thus it appears to offer varied opportunities for developing inclusive learning settings for teachers' education and training. In teacher learning, continuous critical and metacognitive reflection might help teachers to establish their own learning profiles and adjust to children's actual needs in their own pedagogical competences as professionals. Openness to change might be key to keeping up with changing technologies and the demands of current and future digital culture in pedagogical contexts, including children in class as well as pre-service teachers in universities (Parette, Quesenberry & Blum 2009).

After all, there does not seem to be just one “silver bullet” to integrate technology into early childhood education (Hesterman, 2011b). Finally, quality support and reliable resources are needed to perceive information and communication technologies as a potential means of connecting to the varied interests of students in ways that encompass multiple tools and modes.

5

Digital Literacy of Young Children in Informal Learning Spaces

5.1 Informal Learning

In this section, the review of research expands on the digital literacy practices of young children (0–8 years) in out-of-school settings or informal learning spaces, given the centrality of those to their overall experience with and of digital literacy. The aim in this section is to identify the literature and topics that arise from research in non-school-based or informal spaces and thus address the second of the two research questions this review set out to explore: What is the role of informal learning spaces in shaping children's digital literacy practices?

Addressing this question is grounded on the premise that learning occurs every day, in many ways and in a range of settings. Scholars in the emerging field of learning sciences stress that learning develops across multiple timeframes and settings, and they emphasise the importance of "supporting deep links between formal schooling and the many other learning institutions available to students – libraries, science centres and history museums, after-school clubs, online activities that can be accessed from home, and even collaborations between students and working professionals" (Sawyer 2005, in Institute of Museum and Library Services, 2009, p.11). Children do not just learn about their world through formal

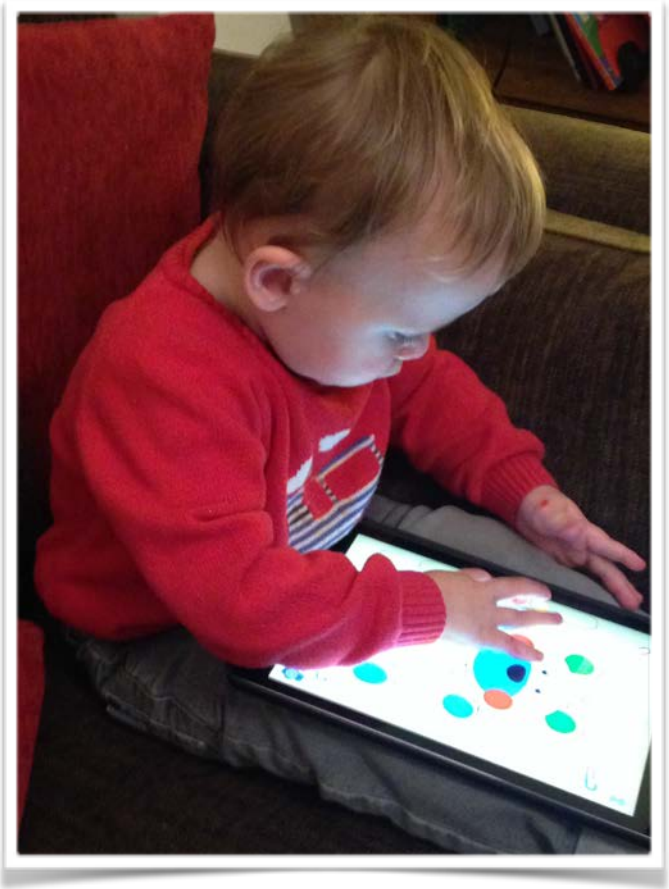
education, as they also experience wider influences at home, including parents and siblings, and the community and society in which they live. A range of non-formal learning spaces, such as libraries, museums and galleries, shape young children's engagement with digital literacy, both online and offline.

Furthermore, and in addition to museums, nature centres or other designed settings, informal learning can occur [and include] everyday activities like gardening, as well as recreational activities such as hiking and fishing, and participation in clubs (Rodari 2009, p. 14). The term "learning environment" thus suggests place and space, e.g. a school, classroom or library. Learning in the 21st century mainly takes place in such physical locations, but in today's interconnected and technology-driven world, a learning environment is often virtual, online, remote, formal or informal.

A better way of thinking about informal learning systems is as support systems that organise the conditions in which humans learn best – systems that accommodate the unique learning needs of every learner and support the positive human relationships that are needed for effective learning (Brown, 2006). In informal learning spaces or settings, children engage in a range of digital meaning-making practices (Sefton-Green et al 2016). School-aged children spend the overwhelming majority of their waking hours in non-school settings and increasingly spend their time in organised out-of-school settings such as afterschool, museum and library programmes. In these settings, they develop important skills, "such as problem solving, collaboration, global awareness, and self-direction not only for lifelong learning and everyday activities" (Institute of Museum and Library Services, 2009, p.4).

Everyday cultural resources that originate outside school offer possibilities for multimodal creativity and identity play, as children consume, transform and produce multimodal texts (Collier, 2015). These practices are an under-researched area in relation to children aged from birth to eight (Sefton-Green et al., 2016). However, an understanding of the connections between digital literacy in formal and informal learning environments is essential to furthering children' digital literacy skills. This offers a broad framework for conceptualising the operational, cultural and critical dimensions of diverse schooled and informal literacy practices, providing a theorised and growing research-evidence base for thinking beyond the focus on 'basic skills' that currently prevails in many EU literacy curricula and policy discourses (Sefton-Green et al., 2016).

This section of the review attempts to bridge the gap that exists between children's uses of digital technology at home and in other informal settings. It contributes to and highlights the need for studying learning more holistically.



5.2 Definitions

The literature distinguishes three main forms of learning – formal, non-formal and informal. Key literature reviews and theoretical frameworks from multiple fields provide a variety of definitions of informal learning. Each field provides different ways of defining informal learning and a unique perspective on learning. For example, the informal learning and adult and lifelong learning literature typically examines informal learning from the individual learner's perspective, whereas the workplace learning literature often takes an organisational standpoint. Livingstone (2001) defines informal learning as "any activity involving the pursuit of understanding, knowledge or skill which occurs without the presence of externally imposed curricular criteria" (cited in Van Noy et al., 2016). Meanwhile Scheerens (2009) posits that informal learning is a "truly lifelong process whereby every individual acquires attitudes, values, skills and knowledge from daily experience […] from family, neighbours, from work and play, from the market place and from the library and the mass media" (p. 2).

However:

> ...formal learning is institutionalised (e.g. schools or universities) and follows a mandatory curriculum that defines the learning goals as well as means. Non-formal learning takes place outside the formal education system and is based on voluntary participation in an educational institution (e.g. cooking classes, driving lessons and language courses). Hence, the learner implicitly controls the learning goals, but the means through which these goals are achieved are controlled by the offering institution, e.g. through a predefined learning agenda or milestones. Informal learning comprises the forms of learning outside both formal and non-formal settings. (Bilandzic, 2013, p. 160)

Bilandzic (2013) notes that, in practice, the lines between these categories are often blurred. Thus, learning occurs every day in a multitude of ways and in a range of settings. This learning which is often referred to as 'informal learning' has an impact on individuals, organisations and the economy in many ways (Van Noy et al., 2016, p.1). More than 70 per cent (Grebow, 2002; Tough, 1979 [both cited in Bilandzic, 2013, p.158]) of the knowledge and skills that people acquire and adopt throughout their lifetime is based on free-choice learning activities, as opposed to the formal education system and educational programmes with a dedicated curriculum.

For the purposes of this section, Van Noy and colleagues' (2016) classification of informal learning is used. They categorise informal learning into several broad categories and state that organised informal learning may occur in a range of settings, including schools, work, the community and home. Everyday informal learning also takes place at school, at work, in the community and at home, but it does not include an instructor or an organised curriculum, and learners have a range of intentions in which learning can be self-directed, incidental and/or embedded in the process of socialisation. In addition, technology plays an important role in how learning occurs across all types of learning. What are termed 'informal learning spaces' are referred to more frequently in the literature as 'out-of-school contexts'. The main informal settings, informal spaces or out-of-school contexts explored are libraries, learning centres, museums, galleries, clubs and community centres.

5.3 Young Children's Digital Literacy Practices in Out-of-school Settings

There are increasing numbers of settings where children can learn informally. Multiliteracy studies have explored the relationship between classroom-based and everyday literacy practices, and they include, amongst others, Maybin's (2007) analysis of young girls' formal and informal literacies and Dyson's (2008) study of the hybridisation of in- and out-of-school writing practices. Studies of the 'digital turn' have investigated literacy practices in digital environments across social and cultural contexts (e.g. Lankshear and Knobel, 2008; Mills, 2010; both cited in Sefton-Green et al., 2016, p.15).

Research on the digital literacy practices of young children (0-8 years) in out-of-school settings or in informal learning spaces can be divided into the following topics:

- Informal learning in Libraries and Museums;
- Informal Learning in Learning Centres and Community Centres;
- Informal Learning via Social Media;
- Informal Learning via Games;
- Mixed-Setting Studies

5.3.1 5.3.1 Informal Learning in Libraries and Museums

As far as libraries are concerned, "informal learning spaces are defined as non-discipline specific spaces used frequently by both staff and students for self-directed learning activities and can be within and outside library spaces" (Harrop & Turpin, 2013, p. 59). Libraries and

museums act in highly collaborative partnerships as they offer environments and services and create experiences which build the 21st century skills of young learners. Although the majority of the literature focuses on informal learning in libraries, in many cases libraries and museums are treated as one unifying force. They "reach millions of children each year" (Howard, 2013, p.2) and they "have long held a trusted place in society and a responsibility for preservation, research, education, and access to their diverse holdings" (Mack, 2013, p. 21). More specifically:

> ...the collections in libraries and museums — books, artwork, scientific specimens, and other cultural artifacts — connect people to the full spectrum of human experience: culture, science, history, and art. By preserving and conserving material and digital artifacts, libraries and museums link us with humankind's history. These institutions operate as places of social inclusion that promote curiosity, learning by doing, and discovery. In them, we learn about ourselves and others, and enhance the skills that contribute to empathy, tolerance, and understanding. (Institute of Museum and Library Services 2009, p.8)

Furthermore, they form an extensive and pluralistic informal learning setting "that is equipped to deliver critical early learning resources to young children and families, especially those most in need" (Howard 2013, p.5).

Especially, public libraries are an example of learning spaces that are deliberately curated to support free-choice learning (Bilandzic, 2013, p.158). MacLean (2008) notes that "public libraries have traditionally offered early literacy programming to preschool children in the form

of storytime. Through the use of a wide range of high-quality picture books, songs, poetry, finger plays, puppets and crafts, public libraries have been making literacy fun. They have created inviting spaces for children to enjoy literacy-rich, hands-on experiences in an interactive and caring environment. Many public libraries have also provided tips for parents and caregivers on how to select and use age appropriate materials for their children" (p. 2).

The following constitute distinct cases and examples that illustrate the aforementioned points:

- The International Federation of Library Associations issued Guidelines for Library Services to Babies and Toddlers and mentioned best-practice examples from the EU and all over the world which were undertaken those past years. Some of these projects are complete but are worth mentioning and some still continue, such as Born to Read (Nascuts per llegir) in Catalonia, Spain; Boekenpret in the Netherlands; Bookstart in the UK (International Federation of Library Associations and Institutions, 2007).
- Another new effort in Greece is Read to Grow, which was founded in 2013 by a group of professionals, among them librarians, with the aspiration to secure access to reading materials and provide a favourable environment for the promotion of reading to all children starting in infancy, thereby helping them to become active skilled readers (Read to Grow, 2014).
- Also, Calderón (2009) presents an intervention action research that took place in two settings outside school: a computer club and a series of technology-enhanced workshops in a museum in London (UK). Examples of museums are The New York Hall of Science with the programme "Little Makers" for children aged 3 to 6 and the

> Yew Dell Botanical Gardens in Crestwood, Kentucky, which offers nature and garden backpacks as well as “Books and Blankets” baskets that include children’s books and blankets for families to read with children in the gardens, as well as scavenger hunts to develop vocabulary and problem-solving skills (Howard, 2013, p.18).

Libraries and museums support a growing number of school-based efforts to build a coordinated set of learning experiences and effective transition practices, e.g. the Dayton Metro Library system is a partner in the city’s “Passport to Kindergarten” programme, designed to help preschoolers prepare for kindergarten through a focus on building oral language skills and vocabulary. Also the Normal Park Museum Magnet School has, since 2001, increased student proficiency in reading and language arts. Key to its success has been the school’s partnership with seven local museums (Howard, 2013, pp. 15–19).

Mills et al. (2015) designed and implemented a research study in which they used iPads to create digital storytimes for preschoolers. They carefully chose apps and designed hybrid experiences that included both traditional and digital pieces. They then asked participants to complete a survey describing their reactions to storytime and were surprised and pleased to discover that both parents and children preferred digital storytimes.

The aforementioned cases offer a snapshot of how informal learning environments are support systems which are “valuable not as ends, but as means to a greater goal – to helping children grow emotionally, socially, physically, and academically” (Brown, 2006, p. 4). Maclean (2008) notes that “by capturing a child’s interest and imagination early, librarians intuitively believe that they help children discover that libraries and literacy can be an

enjoyable and valued part of their lives. Librarians believe that young children who become regular library users will benefit from the meaningful early literacy experiences available through storytime. They also believe that this will allow children to develop the early literacy, communication and social skills needed to be ready to learn by the time they enter school" (p. 2).

A review of the literature shows that there is evidence to support that meaningful literacy activities, such as reading, singing and playing with children, can impact on a child's brain development and subsequently help provide them with the pre-reading skills they need to start school (Maclean, 2008, p.3). "Libraries and museums are trusted, welcoming places where children make discoveries, deepen common interests, expand words and knowledge, and connect their natural curiosity to the wider world. Neuroscientists tell us that the type of learning that occurs in these institutions — self-directed, experiential, content rich — promotes executive function skills that can shape a child's success in school and life. The experiences, resources, and interactions provided by libraries and museums build brains and fuel a love of learning" (Howard 2013, p. 4). These literacy activities are found in public library storytimes and provide evidence to support the intuitive beliefs held by librarians that preschool storytimes can and do make a difference. Public libraries have a very important role to play in helping children develop the pre-reading literacy skills they need to be ready for school (Maclean, 2008, p.3).

5.3.2 Informal Learning in Learning Centres and Community Centres

Informal learning occurs also in community centres, learning centres and public libraries; in some communities, these centres serve the local community under the same umbrella. For example, Calderón (2009) presents an intervention action research that took place in two settings outside school: a computer club and a series of technology-enhanced workshops in a museum in London (UK). It is also important to mention that even though libraries are in the forefront of offering informal learning, communities, via a variety of centres or clubs, are active informal learning mediators offering a variety of learning sessions and playing a role in helping the public to learn.

5.3.3 Informal Learning via Social Media

Russo et al. (2009) hypothesize that social networking can assume an important role in learning in informal environments, such as museums, libraries and galleries. They contend that social media provide young people with opportunities previously unavailable in informal

learning environments to examine complex responses to, and engage with, cultural content. The writers explore the evolution in digital literacy and the processes by which young learners can connect with knowledge in informal learning settings to become active cultural participants.

5.3.4 5.3.4 Informal Learning via Games

According to Powell (2013), play is a well-documented educational tool, but one that has begun to decline in schools and early childhood education due to the increased pressure for cognitive-based school readiness programmes. However, video games engage children and help them to develop literacies and competencies outside the classroom. Cohen and Uhry (2011) describe symbolic representation in block play in a culturally diverse suburban preschool classroom. Block play is multimodal and allows children to experiment with materials to represent the world in many forms of literacy. Combined qualitative and quantitative data from 77 block structures were collected and analyzed. The observed frequency of symbolism used for three levels of symbolism (1) pre-symbolism, (2) first level symbolism, and (3) second level symbolism was investigated. The results indicated significant differences for first-level symbolism or real-world objects. Students reported making homes for Webkinz, indicating an ability to encode multimodally the Webkinz computer game played at home in their school block play. The implications from these findings suggest educators should consider both a sociocultural perspective on play and children's out of-school experiences on learning. A research agenda that includes multimodality as performance is critical to early childhood education.

5.3.5 5.3.5 Mixed-settings Studies

McTavish (2014) re-examined traditional notions of literacy by documenting a second-grade child's literacy practices in school and out-of-school contexts. Data collected included field notes, interviews, observations of school and out-of-school literacy practices, as well as artefacts (such as worksheets, constructions and computer screenshots) from school, home and community contexts. In analysis, literacy practices were traced to show how meanings travel across contexts and switched modes. The findings show that the focal child recontextualized school literacies in out-of-school spaces and changed them in flexible, playful and technologically contemporary ways. The study offers new knowledge of how school literacy may impact on some children's out-of-school literacies and recognizes that these out-of-school spaces may serve to prepare children more appropriately for the future.

McTavish and Streelasky (2012) investigated the ways in which contemporary childhoods are being shaped by a range of multimodal communicative practices. They discuss two case studies set in different urban Canadian contexts that seek to privilege the voices, lives and meaning-making experiences of two young boys by involving them as active participants in research. Drawing on sociocultural and multimodal theories of learning, the purpose of this research was to investigate the complexity of the everyday communicative practices utilized by young Canadian children, in and out of school, in an attempt to inform the future direction of literacy curricula for children. Although many researchers advocate that children's "voices" be taken into account in educational research, few report evidence of engaging children in the research process. In these two cases, the data collection methods provided opportunities for the children to express themselves and reveal the meaning-making practices that they valued. The findings also show how practices valued and promoted in the

focal children's classrooms generally reflect traditional and narrow modes of communication, specifically, print-based and teacher-directed practices.

5.4 Summary

Informal learning is increasingly important in the rapidly changing knowledge economy, though there is a lack of consensus on how to define informal learning and how to distinguish it from formal learning (Van Noy et al., 2016). Research has shown that 24 million Europeans have participated in non-formal learning activities in libraries, while 4.6 million have accessed the Internet for the first time in a library. Two hundred and fifty thousand people have found new jobs by going online. Libraries are invaluable to the 23 million people who are currently unemployed on our continent (Libraries empowering Europe! – The Netherlands EU Presidency, 2016).

As informal learning venues and through their learning programmes libraries and museums support the community of young children, thus adding quality to their early learning experiences. They provide spaces for children and families to play, engage with each other and with the community, learn, be creative, trigger curiosity, acquire learning and digital skills and "create seamless links across early learning and the early grades" (Howard, 2013, p.19). Some authors suggest that children's librarians are ideal media mentors because they are considered to be experienced curators in the evaluation of different types of electronic resources; they are experienced in developing early learning programmes; they support lifelong learning, promote reading and equity of access; they have attractive facilities for parents and caregivers who choose them to spend quality time with their children; they maintain close collaborations with community organisations and technology-oriented partners to facilitate their projects (Campbell and Kluver, 2015).

This review is a first attempt to document the role of libraries, museums and other informal spaces in the digital literacy domain of children from 0 to 8 years old. Libraries and librarians have a long-standing tradition of offering information literacy programmes and also engaging the community with various other programmes as aforementioned. It is evident throughout the literature that libraries and museums as well as information professionals are at the intersection of children, families, schools, teachers and the wider community. This research further helps to identify research exploring the behaviours and preferences of children (0-8 years) in relation to where, what, when and how they use informal learning spaces; to identify research on the behaviours, attitudes and preferences of children in relation to why they select and use informal learning spaces; to enable evidence-based decision-making in the

development of informal learning spaces; and to inform the design of informal learning spaces.

6

Conclusion

In this review of research, three lines of enquiry have been brought together to examine the relationship between official early childhood education and informal learning settings and the new digital communications order. Two key research questions posed in the Agenda of COST Action 1410 (Sefton-Green et al., 2016) have been examined: the need to identify (good) practice with regard to the teaching and learning of digital literacy in early-years settings and primary schools, and to discuss the role of informal learning spaces in shaping children's digital literacy practices. And the need to address also the centrality of teachers' role in pedagogical practice led to consideration in this review of issues of early-childhood teacher education and training, as well as teachers' attitudes and beliefs.

While conclusions on each thematic area were drawn in the separate sections above, in this last section, general remarks are made with regard to the ways these areas of interest collectively contribute to and help identify gaps in the knowledge on young children's literacy in the digital era. This discussion is framed and facilitated by the definition of digital literacy delineated in Sefton-Green et al. (2016) and focuses particularly on the ways in which the contexts of literacy (on micro-, meso- and macro-levels) are realised across research in three thematic areas: pedagogical practices, teachers and teacher educators, practices in informal learning spaces.

A first conclusion to be drawn from research reviewed across the three thematic areas centres on the multiplicity of dimensions and ways in which literacy in the digital era may be defined. Whether in studies on the pedagogical possibilities of new technologies in early-years and primary classrooms, teachers and teacher education programmes, or informal learning spaces like libraries, museums and others, literacy refers to reading, writing and multimodal meaning-making through the use of digital as well as non-digital means. Put differently, literacy involves engagement with and the production of digital and non-digital texts, in bounded, physical but also virtual spaces that facilitate, though may not necessitate, face-to-face and technology-supported communication and collaboration.

When locating this definition of literacy in particular contexts, literacy learning was found to occur on a micro-level in instances and studies across three thematic areas where children's (and teachers') competences, interests and identities are foregrounded. For instance, in studies of pedagogical practices, a micro-level context is recognised in researchers' assertions that digital literacy opens up spaces for children's curiosity, problem-solving, exploration, autonomy and print- and non-print skill acquisition, while it also expands their potential for meaning-making by extending their semiotic repertoires. Similarly, research on teachers has foregrounded how particular programmes increase teachers' confidence and digital skills through continual support and meaningful practice, as means for changing their attitudes towards the integration of digital technologies in childhood curricula. In studies of library programmes and informal spaces, skills that relate to the use of technology (i.e. operational and technical skills) combine with learners' competence in identifying and evaluating information, as well as collaborating with one another and with professionals (e.g. librarians, teachers, IT staff).

The connection of skills to criticality (on more of a personal, cognitive level rather than from a sociopolitical approach) but also to collaboration yields an understanding of literacy similar to that on the meso-level: as connected to and being shaped by the sites where children live and move. In studies of pedagogical practices, the classroom itself is perceived as a social, multi-sited space, especially when arguments for technology-facilitated enquiry-based and collaborative learning pedagogies are made. In those instances, children are portrayed as negotiating complex social interactions around digital tools and texts, but also as being able to reframe literacy learning through expanded meaning-making resources, thus destabilising their position as potentially deficient learners. In teacher education studies, the connection to broader sites where literacy learning occurs is instantiated in the need articulated for continuous technical support and the provision of facilities to help teachers and children learn with digital technologies. With this also comes the need for learners to keep up to date with the changing digital and semiotic landscape and, accordingly, to design teaching and learning. Sites of literacy learning should also be flexibly designed and understood, as this is implied in research on informal learning spaces. Interaction with the community, as well as moving between virtual and physical spaces, appears to extend the notion of the classroom and to create opportunities for children to engage with different fields of knowledge. Such cross-fertilisation is also said to bridge the digital gap between social groups by offering resources to those for whom digital technologies might not be readily available.

This latter point is connected to discussions on equitable access, which is evident in studies of pedagogical practices, especially when those involve children whose social identities depart from the school norm. This is perceived to constitute a link to the macro-level, which refers to the wider influences of society, culture and the nation-state. In addition to the

assertion that digital and new technologies might enhance children's potential for social and other inclusion, the complexities of this are made evident in calls for understanding children as consumers of culture or restricted by well-established understandings of schooling and literacy. In teacher education research, these broader contexts are instantiated in the discussion of how teachers are influenced by external factors such as available resources, school and education policies and professional development models. Interestingly, across the three thematic areas, play is found to be a mediating practice that connects micro-, meso- and macro-levels. As an attitude, the discussion on "playing" with available means and resources started at the micro-level, but extended well beyond that to consider local social interaction and negotiation with broader emphases and discourses. In this sense, play traverses the very logic of schooling, as this is especially evident in non-formal practices and in informal learning spaces.

While collectively the research reviewed in this paper points to the integration of and destabilisation of binaries between notions of literacy, learning and space, there still is a need to design research that focuses more on these intersections: i.e. on the ways in which broader cultural, political and socio-economic contexts might influence formal and informal learning practices of young children and their teachers. More research is also needed to explore how learning is constructed and negotiated when spaces are virtually and physically traversed, as might be facilitated through the collaboration of different professionals who connect with young children's learning (e.g. teachers, librarians, museum curators). A further gap is also identified in the representation of different age groups in the literature, with younger children (0-3 years old) being mostly absent from research on pedagogical practices in formal learning settings and comparatively less visible in studies on informal learning

spaces. Finally, there is a need to consider locally situated research, as this might help to expand how digital literacy in the early years may be understood on a macro-level. While this might be possible by broadening the selection criteria of future reviews to include research published in languages other than English, it might also hint at the value of promoting comparative studies to explore convergences and divergences in the conceptualisation and enactment of digital literacies within and across contexts.

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