International Perspectives on
Early Childhood Education and Development 22

Susan J. Danby
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Digital Childhoods

Technologies and Children's Everyday Lives

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International Perspectives on Early Childhood Education and Development

Volume 22

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Foreword

Digital technology is not an issue that springs immediately to mind when one thinks about early childhood. Understandably, the first 8 years are a stage of life that largely escapes the hype and mania that tends to accompany 'new' technology. Yet digital technologies and digital systems are now a significant part of the lives of young children and those who live/work with them. Therefore, this is a topic that is growing in importance for anyone seeking to make sense of contemporary childhood.

Even before they have ever swiped a screen or prodded a keyboard, most infants (in industrialised countries) are already living profoundly digital lives. This is an era when ultrasound scans are routinely shared on social media by expectant parents. Similarly, various data profiles and online accounts will have been set up well in advance of a baby's birth. Thus, the cliché of millennial children being 'born digital' might perhaps be updated to 'preborn digital' (Leaver 2015).

Thereafter, young children's dealings with significant others – from close family members to health, education and welfare authorities – are increasingly mediated through digital technologies. At the same time, a variety of digital products and applications are on offer to support play, learning and other developmental processes. For all these reasons, it is important to pay close attention to the part that the digital now plays in childhood.

Yet this is not as straightforward as it might appear. So before readers progress through the chapters of this book, here are a few opening observations that might be of use. First is the need to remain mindful of the inherently social nature of digital technology. Digital technology is *not* an autonomous force that leads to changes beyond our control or comprehension. Instead, it is helpful to conceptualise digital technologies as being *socially shaped***.** From this perspective, the nature and form of any device or application is subject to continual interactions and 'negotiations' with the social, economic, political and cultural contexts that it is embedded within.

Approaching digital technology in sociotechnical terms, therefore, allows us to question the many factors that influence the design, development, production, implementation and 'end use' of technology. It also prompts us to look beyond simplistic descriptions of digital technology somehow having inherent 'effects' or 'impacts'. Put bluntly, one can only make full sense of digital childhood by paying attention to the social arrangements and organisational forms in which technology use is situated.

This latter point highlights the importance of *context* in any discussion of digital technology. As will be evident throughout this book, there are no 'one size fits all' explanations of what technology 'is' or what technology 'does'. Instead, the specific activities and practices that children undertake with digital technologies are embedded within a variety of different contexts. These can include institutions (e.g. households, families and pre-school classrooms), social structures (e.g. intersections between race, gender and social class) and cultures (e.g. neighbourhood and national cultures). As such, there is much more to young children's engagements with digital technology than the device or application being used.

Indeed, early childhood constitutes a very specific context within which digital technology use takes place. Infants and young children are distinctive technology 'users' in a number of ways – from their limited physical capabilities to nascent emotional and cognitive development. Moreover, it is important to remember that young children are subject to very distinctive institutional conditions. For example, young families and pre-school households are markedly different domestic settings to those experienced by older children and young people. Similarly, child-care crèches and early years' classrooms are very different educational settings in comparison to primary or secondary classrooms. At the same time, the legal conditions surrounding young children also have specific implications for how digital technologies are used.

For all these reasons, then, exploring digital technology and early childhood is highly complex but also highly rewarding. On one hand, this is something that researchers working in the area of early childhood can approach with a degree of confidence. For example, it could be argued that researchers working in this area have been well ahead of the curve in addressing key aspects of recent technological innovation. Studies of young children have long made sense of interactions *with* digital technologies that are not primarily keyboard- and text-based, but instead based around touch, gesture and visual content. These now dominant ways of interacting with smartphones and tablets across the life course are well familiar to early childhood researchers.

Moreover, early childhood research has a rich history of exploring issues of interaction *around* devices. Rather than engaging with digital technologies as solitary 'individual users', young children often cooperate and collaborate with others.

Most recently, early childhood has also been one of the first areas where the much-anticipated 'Internet of Things' has actually come to fruition. Internet-enabled 'smart' toys are now a burgeoning market for brands ranging from Barbie to LEGO. This has meant that early childhood researchers are now leading the way in investigating the millions of devices that now constitute the worldwide 'Internet of Toys' (Holloway and Green 2016).

In all these, early childhood might justifiably consider itself an area in which cutting-edge technology-related research is taking place. On the other hand, however, it is wise not to become *too* complacent. Much early childhood research and writing remains woefully underdeveloped in its methodological and theoretical treatment of the digital. For example, there is a pressing need for more sophisticated empirical approaches in making sense of digital childhood. Clearly, many of the issues already highlighted cannot be understood by studies reliant wholly on non-participant observations and/or interviewing. Instead, new methods are required to properly interrogate the code, data and programmed architecture of the digital aspects of contemporary childhood. This means engaging with the computational social sciences, as well as exploring emerging fields such as digital ethnography and other forms of digital social research (see Marres 2017).

In addition to this is a need to broaden the scope of discourse and debate regarding digital childhood. While not in thrall to digital devices and gadgets, early childhood commentators often appear preoccupied with issues relating to 'the child' and their immediate environs. Instead, some of the most pressing questions that need to be asked of digital technology are macro-level issues of political economy, societal ethics and environmental sustainability. Thus, discussions of digital childhood need to be cognisant (and critical) of the billion-dollar industries that operate in this space, as well as the effect that digital products and practices are having on societal values and ecological systems. These issues and consequences certainly need to be foregrounded in our discussions of digital childhood.

A final challenge is the need to look ahead to upcoming technological developments and innovation. What are the issues that will present themselves in a decade's time when people will struggle to remember back to what an 'iPad' or 'Minecraft' was? What are the issues likely to arise from the emergence of post-digital technologies in society – for example, biotechnology, cognitive technologies and various forms of pharmaceutical technology? This is an area of inquiry that will never stand still.

So, while *Digital Childhoods* marks a great start in addressing some of these issues, this is clearly no time to be complacent. There is much work remaining to be

done in this area. Rather than constituting the final word, this book needs to be seen as the start of a number of long-running (and perhaps difficult) conversations. These are issues and ideas that need to be discussed and developed in early childhood research for many years to come.

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February 2017

Neil Selwyn

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Chapter 1
Digital Childhoods Across Contexts and Countries

Susan J. Danby, Marilyn Fleer, Christina Davidson, and Maria Hatzigianni

1.1 Introduction

There has been growing interest in how communities engage with and take up digital technologies. For instance, in Australia, approximately 90% of children aged 5–14 years access the Internet (ABS 2014) with 46% of children using mobile devices such as tablets and phones. Across the North American continent and in the EU, there is a similar engagement with digital technologies (Donohue 2015; EU Kids Online 2014). With fast broadband becoming more readily available in many countries, even greater online uptake is expected in the coming years (Livingstone et al. 2011).

What is known is that digital technologies are evident in almost every aspect of children's everyday lives, and these technologies are available at anytime. As Selwyn (2014) stated, many are now "'always on'" (p. 155). Technologies are now so commonplace that it is often taken for granted. Technologies are used to search for information, to communicate, to document and to navigate – plus more. Digital technologies, as they become more accessible and more mobile, are increasingly

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crossing the contexts of home, school, workplace and communities and offering an increasing range of educational and social affordances (EU Kids Online 2014). As a result of this increasing access and the ongoing changes in home, school and work-based practices, it has become increasingly important to take stock of how *digital childhoods* are being socially and virtually constructed. This chapter and those that follow, seeks to bring together the most recent research into young children's experiences with digital technologies, the contexts in which these e-affordances are experienced, and the conceptualisation of how childhood is now being constructed within digital spaces and with digital devices and resources.

1.2 Four Guiding Principles Underpin the Theoretical Framework

Digital technologies are being used in everyday contexts of home and school, and community, and across diverse activities from play to web searching to talking to family members at a distance. With an international readership, the book aims to encourage understandings of diverse practices as children make connections with digital technologies in their everyday experiences.

Four *guiding principles* underpin the framework of the body of work discussed in this book. They are designed for the reader to access major topics at a glance and to showcase the diversity of ideas and theorisations that underpin the chapters of the book. The *guiding principles* are discussed further below and are represented as broad interconnecting ideas as shown in Fig. 1.1. Related to the principles is a representation of the major topics located within the book. There are three major topics, each discussed in a section. In this way, each chapter stands alone in making a specific contribution and, at the same time, makes explicit its connections to the broader topics relevant for discussion of digital technologies in children's everyday lives.

Acknowledging that our social worlds are now saturated by digital technologies means that considerations of digital childhoods embrace the everyday experiences, the everydayness of digital technologies for children, for adults who figure in their lives and for their interactions as these contribute to those experiences. While there is a tendency to talk about young children's use of digital technologies as preparing them for the future (adult) world, what this book seeks to provide is a rich "album" of the many and varied ways that young children are currently experiencing, and constituting, their digital childhoods. This is the first principle that has framed the content and presentation of the research that underpins the book.

The second principle is the consideration of how digital technologies enter into digital childhoods in diverse ways and encompassing a wide range of purposes, not the least because children often use digital technologies for their own purposes. There is a propensity for considerations of young children and digital technologies to focus on the educational benefits of digital technology use for children's learning.

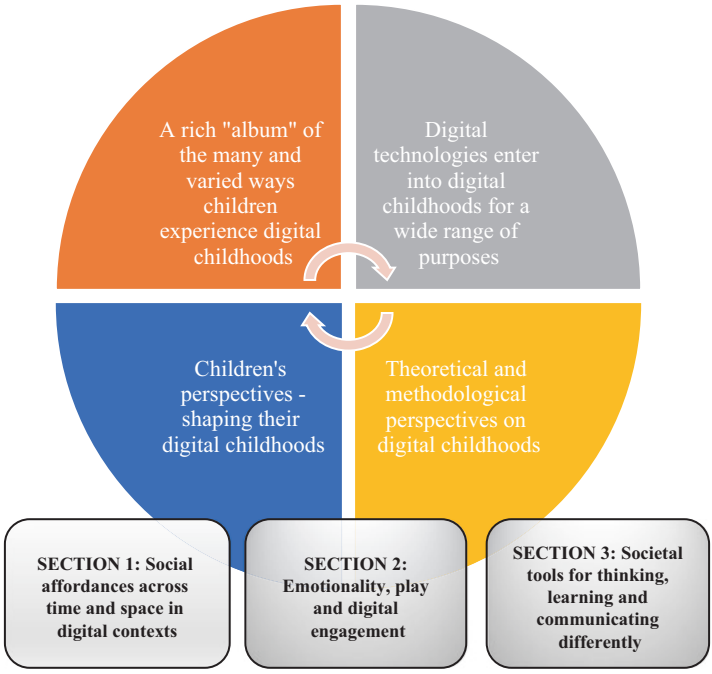

Fig. 1.1 The four guiding principles

This is evidenced in studies of teachers' use of digital technology in classrooms and in the production of guidelines for parents' selection of appropriate technology for children to use. Of course, while important considerations, this book encompasses a broader agenda of taking into account how digital childhoods are embedded through children's agendas and in daily family life where children experience, see and participate in the use of digital technologies as central to the many mundane activities that constitute "doing" everyday life.

The third principle is a strong focus on, and capturing of, children's perspectives to deliberately include work that documents and describes the use of digital technologies through the "eyes", words and actions of children as they produce their social lives across a range of contexts and settings. These activities include communicating with family members at a distance through Skype; engaging with learning activities in preschools through the use of digital technologies, as participants in interventions; and researching that seeks to understand their use of digital technologies.

The fourth principle responds to current critiques of educational technology research that discern limited considerations of theory and methodology and a tension in that field between rigorous research and "speaking to" practitioners (Selwyn 2012). For us, a book that addresses digital childhoods must be founded on theoretical and methodological perspectives that are sound and clearly articulated. The chapters encompass a diversity of theoretical and methodological perspectives, with

each providing a coherent and strong presentation of theoretical and methodological perspectives that have informed their take on a "slice of life" that constitutes digital childhoods. In this way, we seek to strengthen the field of digital technologies and young children, by drawing out the ways in which various theories and methodologies inform the overall "picture" and enrich understandings. This book is not a how-to guide for families, teachers and researchers; instead, the book presents empirical work to inform deeper understandings of the many diverse aspects of digital childhoods and thus is relevant to all adults who engage with children and contribute to their digital childhoods.

Taken together, the four diverse principles operate as a foundation for the context and framework of the book where the depth of discussion that features in each chapter locates itself within theoretical orientations of digital childhoods.

For the ease of the reader, the book is divided into three parts, where each part addresses a major topic within the field of children and digital technologies. The focus of each part is now discussed, along with a brief discussion of the chapters that align with that topic. Of course, the individual chapters could sit across one or more topic parts, and we have chosen to be pragmatic to include them in a part where we think they fit well.

1.2.1 Part I: Social Affordances Across Time and Space in Digital Contexts

Perhaps the most important shift in perspectives on young children's use of digital technologies has encompassed understanding the importance of the social. Early fears about the "lone" child user have gradually been replaced by knowledge of the ways the social figures prominently in enabling young children's digital activity; in particular, digital technology use promotes social interaction rather than hindering it (Plowman and McPake 2013). Further, children are increasingly able to access digital technologies that afford "the possibility of new forms of dialogue and communication" (Conole and Dyke 2004, p. 117). These support and enable children's social interaction and social lives in diverse ways and challenge us to look closely at how digital childhoods are shaped by, and shape, particular contexts.

Social interaction increasingly has been foregrounded as an important reason that children's digital technology use should be understood as beneficial. Early on, some studies discerned the importance of social interaction as a consequence of computer technology use in classrooms (e.g. Muller and Perlmutter 1985), and numerous studies have established the importance of interactions with young children particularly during use of eBooks (e.g. De Jong and Bus 2002; Hoffman and Paciga 2014; Shamir and Korat 2007, 2008; Smith 2001), playing with apps (Danby et al. 2013), web searching (Spink et al. 2010) and digital games (Davidson 2010; Sjöblom and Aronsson 2012). However, little is known about how social interactions are actually accomplished when children engage with digital technology.

What is new in this volume is work that considers how social interaction during digital technology use accomplishes aspects of family life. For example, Busch (Chap. 2, this volume) describes and explicates the interaction methods and procedures that family members draw on during intergenerational Skype sessions and how they assemble social orders. Powerfully, a young child is shown to use interactional resources at certain points to avoid family members visible on the screen and to continue his own activity offline. This focus emphasises the doing of the social when digital technology is involved.

How families do family life now encompasses considerations of the digital – even if considerations result in little or no use by children. Roos and Olin-Scheller (Chap. 4, this volume) address digital participation by children in a rural Swedish community and show how many family members, including children, actively work to minimise use of digital technology in their homes. This chapter challenges conceptions of children as digital natives but also suggests questions about adults' perceptions of their children's daily lives. Digital technology is viewed as potentially disrupting safe rural childhoods, when clearly within the community some children are experiencing significant exclusion, both offline and online.

Fleer (Chap. 3, this volume) addresses how everyday digital table technology is part of a young child's social system at home. In particular, family members were shown to engage with their child through a pedagogy that encompasses time and space in relation to person. The family's development of a conceptualisation of the world shows how they recruited digital technology in their interactions with their son in order to understand a world that was not easily visible to him. What is new in Fleer's work is the emphasis on how everyday technologies in their own right are part of the child's social system and social relations; in this case, promoting inclusive practices across preschool and home environments is framed by the concepts developed by the boy and family members accessing digital technology.

For some children, digital technology use is encompassed within the regular, almost daily shift, between home and preschool or home and school. Differences across the contexts (Yamada-Rice 2010; Wohlwend 2010) make a case for how institutional contexts, in particular, can change so that digital experiences are more consistent with those experienced at home. Davidson et al. (Chap. 5, this volume) emphasise how young children encompass the varied ways that they encounter the use of digital technologies. What is new is the emphasis on the ways that social interaction constitutes a young child's everyday use of the same digital activity differently in his home and preschool contexts.

Understanding the everydayness of digital technology use in children's lives should not be taken to signal sameness, however. That is, what may be considered to be usual and mundane varies. Roos and Olin-Scheller (Chap. 4, this volume) show how paying bills and viewing YouTube by some families in a rural community may be contrasted with web searching in a preschool or home or developing a young child's conceptual understandings through a music app at home. What is common across these practices is the ways that digital technology is domesticated for particular purposes by people in ways that take account of their own circumstances. What

is new are the ways that people's social interactions, including those of children, constitute the everydayness of digital technology use.

Chapters in this part have much to say about the ways that social phenomena are socially organised across time and space during and through digital technology use. They remind that "social phenomena do not exist by themselves. Collective phenomena emerge through the work of participants, extend as far as the actors carry them, and last as long as they keep them up" (Venturini and Latour 2010, para. 6). We see this in the Skype interactions (Busch, Chap. 2, this volume) where a young child works interactionally to encompass his mother's interactions in his home, his grandparents' interactions with each other and with his mother and himself. Through this interaction in the call, the child's previous experiences must be brought into the present and produced offline and online through the Skype call. Fleer (Chap. 3, this volume) considers how supportive interactions in the home flow onto those that occur in the preschool, while Davidson et al. (Chap. 5, this volume) argue the need for children's competencies to be understood as socially produced across contexts of home and preschool. The consideration of digital participation in a rural community in Sweden shows how parents, educators and children collaboratively organise their social selves offline and online over time in ways that are consistent with their perspectives on their rural life and their attitudes to the influence of digital technologies in their lives.

Together, the chapters in this part contribute to understandings of how spaces are "continually constructed" (Burnett 2013, p. 192) through interaction. Contributions of chapters also highlight that we still have much to learn about the numerous and complex ways that this is done by children with each other or in concert with adults during digital technology use.

Taken together, the chapters in Part I point to new directions and the new needs associated with digital childhoods. These topics included:

- Accomplishing the location of the digital in the fabric of family life
- Doing everydayness of digital technology use across varying contexts
- Interactional organisation of social phenomena across time and space using digital technology

1.2.2 Part II: Digital Play and Engagement

Part II centres on emotionality in the context of play and digital engagement. A lot is known about the use of apps and digital devices across a broad range of contexts (Ernest et al. 2014; O'Hara 2011; Verenikina and Kervin 2011; Zevenbergen and Logan 2008; Verenikina et al. 2016). However, where researchers have examined the value of tangibles (embodied interaction, tangible manipulation and physical mediation of digital data, see Abele et al. 2012), little is known about how these technologies create, support or negate (Verenikina et al. 2010) the conditions for children's play. In fact, we know a relatively small amount about the nature of

children's digital play in the contexts of the home (Kervin et al., Chap. 8, this volume) and the preschool or school (Wohlwend, et al., Chap. 10, this volume). What has emerged and noted in this volume is a stretched zone between what might be called digital play and digital learning. For example, educators using digital media and tangibles during preservice education and in the field with children have pushed against print-centric worldviews of learning literacy (Wohlwend, et al., Chaps. 10, this volume). Conceptions of what is making, hacking and remixing emerge as popular media toys are hacked (e.g. cutting, sewing, crafting, etc.) and reconstituted in the development of new play narratives in digital puppetry. Similarly, Fridberg and Redfors (Chap. 7, this volume) also foreground these stretched zones, but in contexts of playful representations of real-life science phenomena. Digital animations capture scientific phenomena and make conscious to children new ways of interpreting, reflecting and playing with everyday life events in digital format. This is in line with other studies that draw attention to how the creation of digital animations helps children to model their conceptual understandings (Fleer and Hoban 2012). What is new is the need for reimagining and re-theorising these symbiotic relations, because tangibles and digital tools are coming together in early childhood contexts and teacher education courses in completely new ways. Studies such as that of Wohlwend et al. (Chap. 10, this volume) and Fridberg et al. (Chap. 7, this volume) exemplify the need for new ways of thinking about children's experiences, new ways of conceptualising early education and new theorisation of what is digital play and learning in early childhood settings.

As a fast-paced changing context, digital play is continually moving ahead of research into this area. Despite this, we know from the broader research that children's engagement with digital devices can make a positive contribution to children's capacity to imagine (Singer and Singer 2006), to support interactions where gestures and interface design (tap, drag-and-drop, slide, pinch, spread, spin/rotate and flick) on touch screen applications are used (Aziz 2013) and support creative expressions in play (Verenikina and Kervin 2011), because a variety of modes are now available for making new meaning (Kjallander and Moiian 2014). Yet many worry about what might be the impact of digital technologies on children's learning and development.

Some authors have sought to disrupt what they believe is a technologically deterministic perspective that has recently emerged in discussions about digital childhoods (Gibbons 2015, p. 119). Determinisms have focused on the belief that "technological society is here to stay, so we just have to get on with making the best of it"; or "digital literacies are a new source of inequity, and so all children must have the same opportunities to develop such literacies"; and also "the child needs to be protected from the addictive nature of new media in order to engage with their natural world" (Gibbons 2015, p. 119). This perspective has played out strongly in the context of families.

Families create new zones of possibilities because of what digital tools allow and where new conditions for children's development (Vygotsky 1998) are created for children (see Chaudron et al., Chap. 9, this volume). Families and teachers worry about choices of applications for children because they have no guidance on what is

valuable or not for their children's development (see Kervin et al., Chap. 8, this volume). What has tended to dominate in the context of digital play and digital learning has been the negative dimensions of digital technologies (e.g. American Academy of Pediatrics 2011; Healy 2000) (see also Olin-Scheller and Roos, Chap. 4, this volume). Most of this research raises concerns about screen time (see Ernest et al. 2014; Kervin, et al., Chap. 8, this volume), the reduced opportunities for social interaction and development (see O'Hara 2011) and the reductions in children's physical activity (see Plowman et al. 2008).

More recently, though, research is now showing some of the benefits of digital play, and the American Paediatric Association has recently revisited their guidelines to reflect a more flexible approach to digital play and the valuable role of parents and others in developing language and social skills (American Paediatric Association 2016). Walker, Danby and Hatzigianni (Chap. 6, this volume) show through their longitudinal study of Australian children that digital play of up to 240 min per week is associated with better scores in literacy and mathematics thinking of children aged 10 and 11 years. This evidence is groundbreaking for the field because it is the first longitudinal study done of a population at a national level. What they also found was that lower levels of play (120 mins) did not show achievement gains – this is in direct contrast with the literature that has negated the effect of digital tools. But in line with screen time concerns, Walker, Danby and Hatzigianni noted that higher levels of play (421 mins) were shown to raise problems for children's cognitive self-regulation, academic performance and emotional development. What is new for the field is the strong evidence for digital play, with evidenced-based guidance on the amount of screen time that affords the best outcomes for children's emotional and cognitive development.

It is through a better theorisation of what now constitutes digital play and digital learning that the zone of concerns around how children are positioned in digital contexts can be better understood. For instance, Chaudron et al. (Chap. 9, this volume) and Kervin et al. (Chap. 8, this volume) each found that although families generally were positively predisposed to their children using technologies, they either did not feel confident or did not have the knowledge needed, for the selection of high-quality apps and websites to support their children's home use of technologies. Chaudron et al. (Chap. 9, this volume) found that, although families felt they had created conditions to keep children safe, and to monitor or restrict access through passwords, many children either did not understand the changed conditions or they had sufficient technical competence to bypass the technological restrictions imposed. What was new was how children's competence to access and use the digital technologies went beyond what families expected, and as such limited safeguards for safe access resulted.

The theoretical concept of motives (Hedegaard 2002, 2012, 2014) draws attention to how societies, communities and the institution of the family or preschool/school orient children to new practices, such as digital technologies. The rules of engagement with technologies in the home were captured by Chaudron et al. (Chap. 9, this volume) in their seven country study of how families generate rules on access and the use of digital technologies for 6–8-year-olds. The rules of engagement with

the technologies featured time, places and situations. Families adopted a range of approaches to mediate children's use of the technologies. Further, Kervin et al. (Chap. 8, this volume) also noted children's motivation towards digital technologies where variability in children's responses to technologies was noted, such as interest dwindling over time, self-regulation of use by children or an intensely time absorbed orientation. What is new here is the nature and diversity of the orientation of children to digital technologies. How families orient their children and engage or restrict access to digital technologies has until now not been fully explored on an international front. The study by Chaudron et al. (Chap. 9, this volume) represents a new line of inquiry, and the outcomes contribute to better understanding how families involve themselves, engage and restrict children's digital access.

Taken together, the chapters in Part II point to new directions and the new needs associated with digital childhood. The themes that are discussed include:

- Stretched zone between what might be called digital play and digital learning
- The need for reimagining and re-theorising the symbiotic relations between digital play and digital learning
- Strong evidence to support digital play, with guidance on the amount of screen time which affords the best outcomes for children's emotional and cognitive development
- Diversity of orientations to digital technologies by families internationally, who orient their children and engage and motivate them towards digital technologies in particular ways

1.2.3 Part III: Societal Tools for Thinking, Learning and Communicating Differently

The third part of the book concentrates on the use of new technologies as societal tools to enhance thinking, learning and communicating in new, alternative ways. Different types of technologies and transformations in institutional perspectives are being shown to facilitate and enhance children's learning and thinking. Consistent with the progress in cognitive sciences, moving away from information processing theories to a sociocultural approach with an emphasis on "situational, institutional and cultural" contexts (McGuiness 1993, p. 313), learning and thinking are not considered personal, internal, mental actions any more. They are rather "activities with objects and situations", emphasising cooperation with peers and interactions with people in achieving the "awakening of learning" (Vygotsky 1978, p. 90).

Children carry fertile collections of everyday social and cultural experiences, and in these collections experiences with the widespread technological media are also included (Plowman et al. 2010; Robinson and Sebba 2010). In this part, children are seen as active members of their society, and the interplay between technologies gives them the power to co-construct meanings, extend and reflect on their thinking and communicate dynamically. Children are seen as competent with the new tools,

whatever form they may have, tablets, smartphones, electronic games or even applications of augmented reality (Han et al. 2015; Yannier et al. 2016). In line with research in this field, children from a very young age see the tools as part of their world, and they use them to communicate with others, to understand social roles and to enhance their sense of belonging to this digital world (Geist 2012; O'Connor and Fotakopoulou 2016). The creation of their own "digital narratives" in an Australian kindergarten project by Garvis (Chap. 12, this volume) and the mastery of a young girl's pretend telephone interactions (Scriven et al., Chap. 17, this volume) show how technology plays a significant role in helping children understand the complexity of their social worlds. Children are adapting to new social realities, by increasingly mastering their technical skills (e.g. the use of tablets or accessing online videos) and by making links and new meanings of a combination of tools. The interplay of technologies makes possible ways to empower children and offer opportunities for leadership and agency in learning (Hatzigianni and Margetts 2012; Palaiologou 2016). Such opportunities to engage with open-ended, constructive tools are proposed by Highfield et al. (Chap. 11, this volume) who offer vignettes on how young children take control of their learning and how their parents become co-learners beside them. These chapters underline the importance of holistic development for children. It is as if children work inside a circle, the circle of technology, where their thoughts, knowledge, social skills and feelings are interconnected and valued so that the whole child is benefited.

Although changes in in institutional practices and in education in particular generally have been slow (Cuban 2001), the advent and widespread use of mobile, portable technologies is altering everyday practices (Enonbun 2010; Karsenti and Fievez 2013; Shippee and Keengwe 2014). Pedagogic shifts are explicitly valuing the wide choice of communication tools and a collaborative approach to empower educators and children (McLean 2013; Dryden 2014). Woods and Doyle (Chap. 14, this volume) show how collaboration and pedagogy work to move from print to a combination of print and digital literacies in an Australian kindergarten class (5–6 years). Similarly, new possibilities for creative engagement and enhancement of aesthetic perception are explored under the integration of technology in teaching Visual Arts by Kalamatianou and Hatzigianni in a Greek primary school (Chap. 13, this volume). Creativity plays a pivotal role in learning and is tightly linked to problem solving and decision making and is more peer based and collectivistic when technology is integrated. However, creative uses of technology are scarce in schools even though gains from such use are well-documented (Craft 2012; Fabricatore and López 2013; Hatzigianni et al. 2016).

The value of digital games for children's development and learning offers new instruments of play to "constitute a new, innovative field" (Méndez and Del Moral 2015, p. 212). Nikiforidou (Chap. 16, this volume) shows play-based learning within digital game-based learning in early childhood education. This chapter offers rich insights for educators on how to carefully conceptualise and plan the use of video games by taking into consideration the design and the content of the games.

The use of digital tools brings fundamental changes in children's language development too. Adults use language to enhance children's knowledge in direct and

indirect ways, and there is an array of digital tools to support this task (Dryden 2014; Goouch and Lambirth 2010). When difficulties arise in oral communication and in language development, technology can assist. A team of renowned researchers in the field (Wren et al., Chap. 15, this volume) show how the use of technology has the potential to support children's speech, language and communication skills. Their approach is innovative in proposing a synergy between the digital tool and the social environment, pivotal for capitalising on the potential of technology.

Taken together, the chapters in Part III point to new directions and the new needs associated with digital childhood. The themes that are discussed include:

- How the expectations of learning are changing with the use of technology. Knowledge is less instrumental, linear and hierarchically organised. Knowledge becomes fluid and open to interpretations, new meanings are negotiated and new challenges are strategically managed by children themselves.
- Nurturing a holistic image of the child, to embrace a construction of the child as competent, flexible, multidimensional and multifunctional.

1.3 Conclusion

This book is an international publication that presents a diversity of chapters where different theoretical approaches and a broad range of countries are represented. Each author's work stands alone and also stands within the broader body of international work on digital childhoods. The concept of digital childhood represents what is happening now and also propels new thinking about children's digital lives.

The conceptualisation of digital childhood frames knowledge construction in relation to personal, institutional and societal perspectives (Hedegaard 2012). This conceptual frame speaks directly into research, policy and practice. The constructions of the child and childhood within this book give voice and agency to children, families, policymakers and to the community at large. Rather than a deterministic perspective, the authors of the various chapters show how children contribute to, and shape, the contexts in which they interact digitally.

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Part I
Social Affordances Across Time and Space in Digital Contexts

Chapter 2
How Families Use Video Communication Technologies During Intergenerational Skype Sessions

Gillian Busch

2.1 Introduction

With increasing access to home computers and the affordability of Web cameras, video calling is becoming a more common practice adopted by families to maintain familial relationships between children and their grandparents. Research confirms that family members are employing the use of such technologies, which require the deployment of a range of interactional practices in response to the contingencies afforded by the technology. This chapter contributes understandings about the interaction methods and procedures family members draw on during intergenerational Skype sessions and how social orders are assembled.

For extended families separated by geographical distance, technologies such as Skype are often replacing audio-only technology to maintain and facilitate family relationships (Ames et al. 2010; Raffle et al. 2010) and appealing to families as very young children find audio-only conversations more difficult (Ballagas et al. 2009). The take-up of video communication technologies occurs within a context of families becoming increasingly mobile and separated by geographical distance. While the relocation of families has led to grandparents increasingly being separated from their children and grandchildren, grandparents want to continue relationships with their grandchildren and to see them "grow up" (Judge et al. 2011, p. 1).

Researchers have identified a number of advantages for the use of videoconferencing technologies between family members. First, the development and affordability of videoconferencing technologies for use within family contexts means that family members, including young children, have access to a visual on the screen. The visual capacity of the technology enables children to "show their ideas" (Follmer et al. 2010, p. 3398) and affords them the opportunity for expression

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through multimodal interaction including gaze and gesture. This sharing of activities has the potential to contribute to sustained conversation (Vutborg et al. 2010). Second, videoconferencing technologies support the development of closer relationships between grandchildren and grandparents living apart. Researchers note that familial relationships between grandparents and grandchildren contribute to the well-being of all members (Moffatt et al. 2013), with some grandparents reporting that grandchildren who seemed shy when they visited appeared less shy when communicating over distance (Vutborg et al. 2010).

While generally viewed as positive within the literature, some technical challenges associated with using Skype have been reported, including distortions or poor picture quality (Kelly 2013; Rintel 2013), connection problems (Kelly 2013), and the design of the technology limiting what can be seen by interactants. Usually in Skype or FaceTime interactions, only the head or upper torso is visible as a kind of "talking head" (Odour et al. 2013, p. 1). While designers have worked to make modifications that afford users greater flexibility in how Skype is used, the technology is "made at home in the world that has whatever organization it already has" (Sacks 1995, p. 549) with, for example, families simply moving laptops/iPads devices to enable interaction that includes more than a head and upper torso (Kelly 2013).

Existing practices adopted by families with young children using video communication technologies have been examined (Judge and Neustaedter 2010; Kelly 2013), though there is a paucity of research that adopts an ethnomethodological approach to examine interactions involving grandparents and grandchildren. Previous research has suggested that Skype interactions are often prearranged, rather than impromptu, with callers checking the recipient's availability prior to the call using their Skype availability status and text or email messages (Judge and Neustaedter 2010). In some instances, the video call may stay open for an entire day. One family reported that they routinely connected during breakfast on a Saturday morning because the grandparents loved watching the grandchildren eat breakfast acting a little like a "fly on the wall" (Judge and Neustaedter 2010, p. 657). When using Skype some families adopted strategies to ensure aspects of their privacy were maintained, which required the altering of the angle of the camera to capture only that which the person is happy to have captured.

An ethnographic study of how grandparents in the United Kingdom used video-supported technology to maintain contact with their grandchildren living in Australia highlighted a number of key findings pertaining to family Skype activity (Kelly 2013). First, "adults scaffolded" children's use of Skype, and, second, the child exercised their agency to involve the grandparents in her play (Kelly 2013, p. 6). There remains, however, a paucity of fine-grained research that adopts an ethnomethodological approach (Garfinkel 1984) to examine how family members accomplish interaction between grandparents and grandchildren using video communication technologies, such as Skype, and how the interactions with distant family members contribute to children's social worlds.

2.2 Data and Method

The data presented in this chapter is part of a larger study examining how intergenerational family interactions are accomplished during family Skype sessions. Participating families recorded their Skype sessions using screen capture technology and a video camera located on a tripod. The recordings were transcribed using Jeffersonian transcription, a system that records not only the words spoken but also fine details of the talk such as overlaps, gaps, pauses, sound elongation, and intonation (Jefferson 2004). (See Appendix A for examples of transcription symbols and explanations). Pseudonyms have been used to ensure the anonymity of the family members. Family members include the grandparents (Mar and Dar), the mother (Alexandra), Jonty (4 years), and Meggy (2 years).

Informed by an ethnomethodological perspective, the focus was on how the social activity of a Skype session is produced and organized (Heritage 1984a, b) and how the social order is accomplished. Social order is a "locally produced arrangement (and rearrangement) of identities and relationships organized around and through activities" (Danby and Baker 2000, p. 91) accomplished through "interactive practices" (Goodwin 1990, p. 1) and, as such, is an in situ moment to moment accomplishment. Conversation analysis (CA) (Sacks 1995) provided the tools for fine-grained analysis as it examines the sequential organization of "talk in interaction" (Sacks 1995) to reveal how actions are accomplished and understood (Pomerantz and Fehr 1997).

Analysis draws also on membership categorization, also developed by Harvey Sacks (1995). Membership categorization analysis examines the membership categories, membership categorization devices, and category-bound activities that members use to achieve social action (Hester and Eglin 1997). Combined, CA and MCA provide a rich analysis to show how social activity is accomplished (Butler 2008; Hester and Eglin 1997). An extended sequence (Psathas 1995) of Skype talk has been selected for analysis. For the purposes of analysis, the sequence is broken up into four extracts at important junctures in the sequence.

2.3 Analysis

This first section of Skype interaction begins with the children and their mother located on the floor in the lounge room with the laptop positioned on the floor in front of them. The positioning of the children, mother, and laptop enables the grandparents to have a wide-angle view, rather than see "talking heads" (Odour et al. 2013, p. 1). As the interaction reveals, Meggy and her mother have been to a fair and have brought some things home for the other sibling, Jonty. Jonty received a slinky from the fair. This section of analysis highlights how both the child's talk (Jonty) and physical activity are used by the grandmother as a resource for talk, particularly as a resource for the introduction of questions that orient to the child and his

interests. Also highlighted is how the mother works to support interaction between her son and the grandmother and how family activities are used as a resource for talk during intergenerational Skype sessions. The way in which the child comfortably moves his orientation from the screen to those colocated with him in the lounge room is also explicated.

Extract 2.1

```
Mum     01  Meggy (.) show dad ((children's Dad is in
        02  the background - in the room))
Mar     03  Where did this [all come from Jont]
Jonty   04                 [This is a medal   ] (.)
        05  ((bends down to be level with the screen))
Mar     06   ooh
Jonty   07  This is a medal ((holding it up to the
        08  screen))
Mar     09  What did you get a medal for did you
        10  run a race
Jonty   11  No::: I got it from  the fair (.) °bah°
        12  I stayed at home because I was sick
        13  ((moves very close to the screen but Mum
        14  pulls him back a little))
Mar     15  Oh darling I am so sad to hear that but
        16  Mummy membered you and brought something
        17  home for you that was good of her
        18  ((using a sympathetic voice))
Mum     19  Do you want to tell Mar what happened
Jonty   20  ((turns his head towards his mother))
        21  ↑What Meg.hh Meg .hme (.) .hhorh Mummy
        22  ↑you tell it
Mum     23  (>no no<) What happ[ened] in mass
        24  when we were tried to go to mass
        25  ((Mum leaning forward with her face
        26  very close to Jonty))
Mar     27                      [hehe]((smiling))
Jonty   28  hhh no you tell.
Mar     29  was it a bit sad was it
Mum     30  was a bit sad we got to the top of the
        31  stairs (.) and little cough nd then
        32  what happened
Jonty   33  hh I sicked ((pulls a slinky from the
        34  packet))
```

```
Mar     35  You were si[ck]
Mum     36              [you sicked]
        37  what did we see? (.) we saw
        38  your porridge again didn't we ((Mum is very
        39  close to Jonty – gently touching his arm
        40  while Jonty pulls apart the slinky))
        41  Or Mum ((screws up face a little))
Jonty   42  (Yip/jip)
Mar     43  do w(hh)e (h)need(hh) to(h)[go(hh)] in?
```

2.3.1 A Story to Tell: Past Events Recalled to Tell Grandmother

The grandmother begins with a question which is directed to her grandson asking "where did all this come from" (line 3), showing how she is orienting to the things that she can see on the screen. Jonty, sitting very close to the screen, does not provide an answer to the question about where he got the objects with which he is playing, instead, he holds up a medal and announces, "this is a medal" (line 4). Using a candidate answer question (Pomerantz 1988), the grandmother suggests that Jonty got the medal in a running race and, in so doing, displays her knowledge of how one usually acquires a medal. In packaging her turn as a candidate answer, she provides Jonty with an opportunity to confirm her guess or to "provide the correct answer if the guess is wrong" (Pomerantz 1988, p. 366). Additionally, the question format guides Jonty to "respond in a particular way" (Pomerantz 1988, p. 367), endorsing the candidate answer as a "likely possibility" (Pomerantz 1988, p. 369) for how he got the medal.

Rejecting the proposal that he won the medal in a race with an elongated "no," Jonty instead explains that he got the medal from the fair (line 11). Pausing slightly, Jonty leans closer to the screen and continues his turn explaining that he did not actually go to the fair because he was sick.

With the particle "oh," the grandmother receipts the information delivered by Jonty and marks also that she has undergone a "change of state of … awareness" (Heritage 1984b, p. 299) as to how Jonty acquired the medal. Mar proceeds to provide a formulation of her feelings in relation to Jonty being sick as "so sad" (line 15), packaged using the term of endearment "darling" (line 15) which contributes to building an empathetic stance.

Mum takes a turn (line 19) inviting Jonty to tell Mar what happened. The child orients to his mother by turning his head toward her. He responds to mum's suggestion with a question and then vocalizes (what appears to be) his sister's name three times indicating some kind of trouble in the talk (Schegloff 2007), which may account for the next part of his turn being a direction for mummy to tell (line 22). Thus, in this one turn, we see Jonty orienting to his mother's request, beginning to tell his grandmother about what happened, and then moving to request that his

mother tell. His orientation to the different members of the interaction is synchronized with movement of his head and gaze toward his mother, to his grandmother, and back to his mother. This shows how he moves between engaging with people with whom he is colocated, to his grandparents on the Skype screen seamlessly.

While Jonty focusses on moving his medal in his hands, mum requests that he recall what happened when he tried to go to mass/church (lines 23–24). Mar responds with a little laugh and smiles in an encouraging manner (line 27). Again, Jonty rejects the proposal instead suggesting that mummy tells. Orienting to the absence of a telling, Mar proffers a candidate answer question asking if it was a bit sad (line 29). Her proposal orients to the delicate matter to which mum and Jonty are negotiating about who is telling. While Mar did not select a next speaker, mum self-selects as the next speaker providing confirmation that the story is a bit sad. Extending her turn, mum commences the story about what happened when they tried to go to mass. She presents her telling as a sequence of actions (Sacks 1995). The storytelling is ordered temporally and produced with the use of "and" followed by "and then" which ties each event to the one prior (Butler 2008). In this way, mum supports the telling of the delicate story for Mar.

Prompted by mum's request for what happened next, Jonty provides the next action in the sequence of the story, telling that he "sicked" (line 33). In providing a formulation of Jonty as sick (line 35), Mar "furnishes the gist" (Garfinkel and Sacks 1970, p. 350) of what happened, which shows her ongoing orientation to the telling of what happened and to Jonty. Mum repeats the information of Jonty as sick and then continues to request Jonty to provide further details (line 36). Jonty does not supply the information requested; instead, the mother extends her turn and provides an account of what happened, that is, "we saw your porridge again." She then requests agreement from Jonty with a tag question, "didn't we" (line 38).

This story about Jonty getting sick on the way to mass is presented as a shared experience between mum and Jonty and is recalled interactively. The family event is recounted to tell distant family members who are viewed on the screen of the computer. Thus, the telling of past events is a resource for doing family Skype sessions. A range of tools were deployed to accomplish the shared telling, including directions and requests to tell proffered by mum, questions from mum to prompt recall, and the provision of a sequence of actions forming the beginning of the story by mum. Also provided by mum is the repetition of responses and candidate answers that require agreement from Jonty. Mar's ongoing orientation to the screen and her smiling also support the ongoing interaction.

2.3.2 *Orienting to the Object (the Slinky) the Child is Manipulating*

The following extract continues on from Extract 2.1. It highlights how the capacity to see the activity of family members on the screen supports intergenerational interaction. Also highlighted is the role of the mother in supporting the interaction between the grandchild, Jonty, and his grandparents.

Extract 2.2

```
Jonty   44                                [jip    ]
        45  ((pulling apart the slinky))
Dar     46  What's that Jont ((standing behind Mar))
Mar     47  [Whoo]↑
Jonty   48  [jip]
Dar     49  Jon↑ty what's that you've go[t ] there
        50  ((Jonty pulls apart slinky and Dar
        51  moves closer to the screen and Mum
        52  looks towards Dar))
Jonty   53                                  [jip]
Jonty   54  Jip (.) jip ((pulls slinky apart and
        55  orients to the screen))
Mum     56  yit is it called a joppy jopp[y Do   ]
Jonty   57                                  [hihihi ]
Mum     58  you know what it is actually called
Jonty   59  Jumpy jumpy=
Mum     60  =Dar might know (.) Dar what are these
        61  called ((points towards Dar and then
        62  gestures across towards the slinky))
Mar     63  O or I'll put Dar on so that he can
        64  how you=
Dar     65  =Yeah:::: (or) Show me okay it's
        66  [got a(.)   ] ((moves and sits in front
        67  of the screen))
Mar     68  [What is it]
        69  called a um
Dar     70  °Ar ar° Are they called a slinky (.)
Mum     71  That's right?
Dar     72  Is it are=
Mum     73           =[out of that one]
        74  ((Jonty and Mum lean forward))
```

```
Dar     75  It's it goes down and Alexandra
        76  it will go down the stai::rs end over
        77  end over end ((Dar demonstrates
        78  the action of the slinky))
        79            [right]
Mar     80  Well I th[ink]
Mum     81            [(out of a show bag )]It's
        82  a plastic one so it might not be:: (.)
        83  as [good a quality]
Dar     84      [Well it's called] it is called
        85  a slinky
        86  (0.2)
Mum     87  °There you go Jonty [a slinky it's
        88  a slinky° ]
Mar     89                      [Hey (.)] Jonty
        90  Jonty
Jonty   91  Yeh=
```

Orienting to Jonty and the object that Jonty has been playing with during the Skype session (beginning line 44), Dar, who had been seen standing back from the screen behind Mar', initiates interaction with his grandson asking "What's that Jont" (line 46). Following nonreceipt of his question, Dar repeats the question, though on this occasion he positions the address term in turn initial position (Lerner 2003). The "pre-positioning" (Lerner 2003, p. 184) of the address term is important here as it establishes who Dar is addressing. While Jonty does not receipt the information seeking question verbally, he orients to the screen through his gaze and the slight repositioning of his body to face the screen. Additionally, he pulls the slinky in and out, with his verbalizing (Jip, Jip, Jip) synchronized with his actions. Thus, he orients to the screen and *shows* his grandfather what the slinky does. Explicated here is how Jonty utilizes the affordances of Skype to share or show rather than speak what his toy does.

Mum leans forward to be closer to Jonty and poses a question to Jonty asking if it is called a Joppy Joppy (line 56). Jonty acknowledges the question with a little laugh in overlap with mum continuing her turn asking what it is actually called. In reformulating her question, mum makes salient that the object's name is not a Joppy Joppy; however, Jonty replies naming it as a Jumpy Jumpy. Mum's next turn (line 60) suggests that Dar knows the real name of the object. She directs her turn to Dar asking if he knows what it is called. This request for knowledge invites Dar to talk with Jonty and defers to his greater epistemic knowledge (Raymond and Heritage 2006) about the matter of slinkies. Also important in the construction of mum's turn is her close physical proximity to and touching of Jonty and her use of gesture, particularly her pointing toward Dar. The use of pointing is important because Dar is not sitting in front of the screen. Additionally, the design of mum's turn to include the use of the third-person reference term (Schegloff 1996), Dar, makes relevant the

grandfather–grandson relationship within the categorization device "family" (Sacks 1995) and makes salient for Jonty that Dar will be speaking with him.

Mar moves from her position in front of the Skype camera, accounting for her move as to "put Dar on" (line 63). Thus, mum's previous turn, while directed to Dar, is consequential also for Mar's actions. Receipting the request with "yeah," Dar then requests that Jonty show him (line 65). This request is synchronized with his move to sit in front of the screen, thus accounting for the need to have a closer look. Then in question format, Dar proposes that it is called a slinky, a turn that is designed to seek confirmation. Mum provides confirmation that it is called a slinky (line 71), making salient that she knew what it was called. Thus, mum's request to Dar to name the slinky is used as a resource to support Dar's entry into talk with Jonty as an expert and someone who knows about the toy Jonty is playing with. Mum's intervention in facilitating the interaction is important here, particularly given that Dar had proposed previous questions to Jonty that did not receive a verbal reply. Additionally, Dar not being proximate to the Skype screen initially had implications for the interaction.

While Dar was invited to tell Jonty the name of the toy, he directs his turn to his daughter, providing an explanation of what a slinky does (lines 75–78). His talk is synchronized with the movement of his hands as he demonstrates what the slinky does. Mum orients briefly to Dar but then moves her gaze and body to something in front of Jonty as she manages Jonty and Meggy's activity. Following mum's explanation of the capacities of the slinky and in partial overlap with his daughter, Dar begins his turn with "well" (line 84), reasserting that it is called a slinky irrespective of its composition. While Jonty continues to orient to his slinky, mum, with her turn directed to Jonty, restates that it is called a slinky (lines 87–88).

Explicated in this extract is how the features of the technology, particularly access to visuals to see what is occurring, and the capacity to use demonstration to accompany the talked activity, are accessed by the members during the Skype session. Also highlighted is the way the mother supports the interaction between Jonty and his grandparents. As shown in the analysis, the mother reshapes or redesigns questions for Jonty and invites the grandfather into the interaction, appealing to his epistemic authority about the toy which builds on Jonty's current interest in it. Also highlighted is mum's use of gesture and her close physical proximity to Jonty.

2.3.3 Initiating Talk with Jonty and Pursuing Interaction

Following on from the previous extract, in Extract 2.3 we see the grandmother, Mar, introduce a new topic which orients to a drawing of a sunflower drawn by Jonty at Kindy. A photo of the sunflower drawing was sent to Mar by her daughter. The introduction of a new topic in this way is referred to as boundaried topical movement (Sacks 1995; Schegloff and Sacks 1973), which is evident here as we see the closing of the previous talk about slinkies (line 92). The analysis highlights what the introduction of the new topic is "being used to do" rather than "what it is being used

to talk about" (Schegloff 1990, p. 52). In addition, it highlights the grandmother's consideration of who she is speaking with "categorically speaking" (Speier 1973). Also explicated is how the mother supports intergenerational interaction.

Extract 2.3

```
Mum    92   °There you go Jonty [a slinky it's
       93   a slinky° ]
Mar    94                       [Hey (.) ]
       95   Jonty
Jonty  96   Yeh=
Mar    97                       [Hey (.) ]
       98   Jonty
Jonty  99   Yeh=
Mar    100  =I really loved your drawing of the [su
Jonty  101                                      [(I saw
       102  this bug)((playing with the slinky))
Mum    103  hey Jonty Mar and (Dar ) is telling
       104  you something
Mar    105  Mummy sent[(   )]
Jonty  106             [yeah ]
Mar    107  Mummy sent you a photo sent me a photo
       108  of you:r (.) sunflower that you drew that's
       109  on the wall at kindy it's fan↑ta::stic
Jonty  110  ((gaze moves to screen on word your))
Jonty  111  (0.2) ((purses his mouth as if pleased))
Jonty  112  ↑Ah ( Harold ) ((pulling the slinky))
Mum    113  Were you proud of it ((moves so as she
       114  is very close to Jonty))
Dar    115  Were you pro
Jonty  116  (Aooo/hello)
Dar    117  Jonty were you proud of it
Jonty  118  (  ) jumpy jumpy
```

Mar shifts to be visible again on the Skype screen, standing beside Dar and leaning forward; she summonses her grandson with "Hey Jonty" (lines 94–95), making an answer conditionally relevant. Jonty receipts the summons with "yeh" (line 96), which gives Mar the go-ahead to continue. However, Jonty's gaze remains on the slinky. Mar, nonetheless, begins her turn telling Jonty that she loved the drawing, though stops her turn as Jonty begins a turn in overlap (line 101). Mum orients to Mar's aborted turn and directs a turn to Jonty, telling him that his grandparents are telling him something (lines 103–104). Jonty receipts the turn with "yeah" in overlap with Mar (line 105), and Mar continues telling him about the sunflower drawing that he drew and the photo of his painting that she received from his mummy. He orients momentarily to Mar's talk, lifting his gaze toward Mar as she says "your" (line 108). Mar, based on her epistemic rights to provide an assessment of the painting

(Raymond and Heritage 2006), furnishes an assessment describing it as "fantastic," which is produced with emphasis and rising inflection (line 109). The prosodic shape of Mar's turn establishes the specialness of Jonty's drawing and of Jonty. While Jonty does not furnish verbal acknowledgement of the assessment, he purses his lips (line 111) as if pleased, orienting to the praise from Mar. Jonty then speaks as he pulls the slinky (line 112).

Mum takes a turn (line 113), asking Jonty if he was proud of his painting. Her turn orients to a perceived absence of response from Jonty following Mar's assessment. Jonty makes sounds but doesn't receipt mum's question; instead he turns away from mum and the screen. Dar orients to the talk about the picture and the idea introduced by mum of being proud, asking if he was proud of it, though he doesn't complete his turn as Jonty commences to speak. With the address term in initial turn position, Dar makes another attempt to engage Jonty (line 117), but again Jonty doesn't receipt the question, instead continuing to play with the slinky and vocalizing "jumpy jumpy."

2.3.4 Embodied Actions Used to Facilitate Jonty's Interaction with His Grandfather

This final extract shows how mum's intervention accomplishes the furnishing of a positive response from Jonty.

Extract 2.4

```
Mum    119  Jonty did you hear what Dar wants to
       120  talk to you about= ((Mum tries to turn
       121  his body to face the screen - has her
       122  arms around him))
Dar    123  =Jonty
Meg    124  (A what)
Dar    125  Were you proud of your painting Jont
Jonty  126  (0.4)eee dododod ((playing with slinky))
Mum    127  No listen this is not (funny) Can you
       128  tell asking about ( ) °were you proud
       129  of your painting°
Jonty  130  ( no I want)
Dar    131  Were you proud of your painting Jonty
Jonty  132  Yeah ((hand in a plastic bag))
Dar    133  I think it's very good (.) very good indeed.
       134  And what are you doing Meggy? what is
       135  Meg up to oo:: chips (.) where did you
       136  get the chips Meg
```

Moving her arms gently around Jonty (lines 121–122) in a cuddle formation, mum moves Jonty's body toward the screen and asks if he heard his grandparents. The physical movement of Jonty's body by mum is referred to as "parental shepherding" (Cekaite 2010, p. 2) with the shepherding of children enacted to accomplish a particular goal. In this example, the shepherding of Jonty's body is an attempt to orient his body to the screen and to his Dar.

Jonty does not receipt the request and maintains his gaze away from the screen. Latching the previous turn, Dar repeats the question asking Jonty if he was proud of his painting. In this turn Dar uses the address term in first and final position to solicit Jonty's attention (lines 123 and 125). Jonty, however, does not provide a response, instead making sounds and pulling the slinky apart (line 126). Mum takes a turn (line 127), moving even closer, and moves her hand toward the slinky. She then moves to lean toward Jonty, and with her head toward his ear, she begins her turn "no" and then moves to provide a formulation of his behavior as "not funny." She moves then to ask her question "were you proud of your painting" (lines 128–129). Jonty, provides a dispreferred response with "no I want" (line 130). Mum has moved a little away from Jonty and repeats her question. Dar repeats his question. Jonty receipts the question with a preferred response "yeah." Dar provides an evaluation of the painting as very good which aligns with Mar's evaluation. Dar moves to direct his turn to Meggy.

Explicated in this last extract is the adult's (mother and grandfather) pursuit of a response from Jonty and the mother's role in facilitating an answer. Also illuminated are the resources Jonty uses for not doing Skype talk with his grandparent, Dar. This includes moving his gaze away from the screen and continuing to play with his toy and not responding to questions proffered.

2.4 Discussion

The analysis presented in this chapter illuminates the array of interactional tools deployed by the members to accomplish an intergenerational family Skype session.

The members orient to the affordances of the technology, particularly the visual capacity of the technology which enables interactants to be viewed. Thus, the spatial arrangement of the children and their mother in relation to the screen was important in that it enabled the grandparents to see the grandchildren (Meggy and Jonty) and mum on the screen and vice versa, forming a kind of wide-angle view. The physical arrangement of members altered during the Skype session so that we see adults and children move to be closer to the screen in order to be foregrounded on the screen and to engage in interaction. The affordances of the technology also enabled the child's home environment to be visible and thus shared with the grandparents. Such visibility enabled the grandparents access to what was happening in the room so that Meggy's activity of sorting *fair loot* (materials from the fair she attended with mum) and Jonty's medal and slinky were visible. Seeing what the

children were doing became a potential resource for future interaction. This was evident as the grandfather concludes his talk with Jonty and initiates talk with Meggy using what he can see Meggy doing as a resource. Also explicated is how moving one's gaze away from the screen was utilized to not participate in the interaction and not furnish a response to questions. This was evident as Jonty moved his gaze away from the screen and did not provide a response to questions posed by the grandparents.

Both the grandparents and the mother support the interaction between the adults and the children and the progressivity of the intergenerational interaction often when some kind of interactional troubles surfaced (Stivers and Robinson 2006). As evidenced in the analysis, the grandmother proffered candidate answer questions, waited for the child to respond, maintained her gaze toward the screen, and employed facial expressions including smiling that showed interest in Jonty and his activities. Additionally, the grandparents orient the topic of talk to the child, that is, they show consideration to who they are communicating with "categorically speaking" (Speier 1973) and proffer recipient-oriented topics (Schegloff 2007). Thus, the talk introduced links to what they observe the children doing or to something that is shared between the families, such as the sunflower painting.

As shown, the mother adopts an important role within the interaction. She invites Jonty to tell about being sick, and then using a sequence of actions (Sacks 1995), she enables the collaborative retelling of a shared family experience, that is, Jonty being sick and unable to go to the church fair. Also explicated is mum's role as a kind of pivot "expanding opportunities for participation" (Larson 1995, p. 293), particularly sharing information about Jonty's experiences for his grandparents. She also proffers questions to expand the talk and, through the design of her talk, invites the grandfather into talk because of his expertise on the matter of slinkies. Additionally, her close physical proximity to Jonty affords her the capacity to use touch as an interaction tool, evident as she gently places her arms around Jonty to shepherd his orientation to the screen. Also accomplished though the close location of the mother and Jonty was that gaze direction was emphasized due to this close location.

Evidenced throughout the interaction is the in situ co-construction of social order as members oriented to and adjusted to the "peculiarities of the context" (Mondada 2009, p. 559), particularly the technology. Also consequential for the construction of social order is family knowledge including the grandfather's expertise with slinkies, enabling him to be brought into the talk with his grandson. The findings of this research highlight the potential of video communication tools for family interaction, showing that parents have an important role in supporting the interaction between young children and grandparents extending beyond technical support. In fact, this research points to the need for further research to examine how interaction between young children and other family members or friends might unfold and how interaction might occur using more mobile technologies such as mobile phones.

Appendix A

The transcription system developed by Gail Jefferson (2004) is used in this chapter.

[	A left bracket indicates the overlap onset
]	A right bracket indicates where the overlapped speech ends
=	No break or gap between turns
(0.3)	Number in second and tenths of a second indicates the length of an interval
(.)	Brief interval (less than 0.2) within or between utterances
So:::rry	Colon represents a sound stretch of immediately prior sound with increases in the number of colons indicating the longer prolongation
↑	Shifts into high pitch
↓	Shifts into low pitch
hey?	A question mark indicates a rising intonation
here,	A comma indicates a continuing intonation with a slight rise
did.	A full stop indicates falling, final intonation
<u>boots</u>	Underline indicates stress or emphasis via pitch or amplitude. The longer the underline the greater the emphasis
°soft°	Softer, quieter sounds
.>quick<	Talk is speeded up
.hhh	A dot prior to h indicates an in-breath
hhh	Indicates an out-breath
( )	The talk is not audible
(house)	Transcriber's best guess for the talk
together!	An exclamation mark indicates an animated tone
Dr.-dirt	A single dash indicates a noticeable cutoff of the prior word or sound
((walking))	Annotation of nonverbal activity
he he	Laughter particles

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Chapter 3
Digital Bridges Between Home and Preschool: Theorising Conceptually Inclusive Practice in Digital Environments

Marilyn Fleer

3.1 Introduction

In drawing upon Vygotsky's writing on inclusion, Gindis argued back in 1995 that societies have already developed many different technologies to support children's development, such as the Braille system, sign language, lip-reading, finger-spelling, etc., and these various symbolic systems act as special psychological tools which in a digital age is "now more compelling than ever" (p. 79). What Gindis predicted, but which Vygotsky could not have conceptualised in his time, was how tablet technologies have become an everyday way of mediating, communicating and accessing learning in communities. The everydayness of digital technology (Danby et al. 2016) has allowed children with a range of abilities to not only be included in day-to-day life and learning, but has made their use not "special", but rather as part of everyday social practice. In the area of inclusive education, this conceptualisation represents a significant shift in practices and thinking for inclusive education.

In this chapter a case study of one child with visual impairment who uses a digital tablet as an inclusive tool at home and in preschool to navigate his way around these environments but also as a tool for the development of his higher mental functions is detailed. Links between home and school through technologies (Danby et al. 2016) have been shown to generally support learning (Stephen 2015), where increasingly greater understandings of digital childhood has emerged (see Plowman et al. 2010; Stephen et al. 2013). This chapter seeks to make visible the specific psychological characteristics and pedagogical practices afforded through the use of digital tablet technology where inclusion is foregrounded. To achieve the goal of

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this chapter, an expansive presentation of data from both the home and the preschool is needed to show both digital environments.

3.2 Cultural-Historical Conceptions of Inclusion

In drawing upon cultural-historical theory, this chapter conceptualises digital tablet technologies as part of the child's social system of relations. A cultural-historical conception of inclusion argues against focusing on an actual physical disability, such as visual impairment, and seeks to examine the social and physical conditions surrounding the child's development. Vygotsky (1993) argued that *disability is a social construct*. The concept of disability has traditionally focused on this phenomenon as a property of the child. Specifically, Vygotsky (1993) suggested that children with additional needs in pedagogical contexts should be thought about as nothing other than having "the absence of one of the means of forming conditional ties with the environment" (cited in Gindis 1995, p. 79). Visual impairment, for instance, reduces only one form of connectivity from a system where other forms of connectivity with others exist (e.g. hearing and touch). Changing the social conditions in which the child operates allows for other pathways and developmental trajectories to organically emerge. Therefore, visual impairment does not have to impede the child's overall development.

A cultural-historical reading of inclusion also draws upon pedagogical theories that suggest that visual impairment "by itself does not make a child handicapped; it is not a defective condition, an inadequacy abnormality, or illness" (Gindis 1995, p. 79). In suggesting that *disability is a social phenomenon*, Vygotsky (1993) paved the way for focusing on the "child's social milieu, [and] not the organic impairment per se" (Gindis 1995, p. 79). Vygotsky (1993) argued for a *positive differential approach* in which he conceptualised the child from the point of view of his or her strengths. Here the cultural development of the child becomes central for framing the pedagogical system of support. Gindis (1995) in referencing Vygotsky stated that the common biological compensatory model was a deficit model and was limited in what it could achieve. In the context of the study and the literature discussed in the next section, it will be shown that the use of digital tablets should be viewed not as compensation but rather as a social device that supports inclusion.

3.3 Conceptions of Inclusion and the Use of Technologies

Technologies have traditionally been conceptualised within a compensatory framework in inclusive education (Kelly and Smith 2011; Shamir and Margalit 2011). What most studies have traditionally put forward is what Rosas et al. (1997) call computer-assisted mediation. Through forming a conceptual triangle of the child, the educator and the expert system, it is argued by Rosas et al. (1997) that technology mediates learning for children with visual impairment through specifically designed software.

Although tablet technologies form an important part of young children's lives (Edwards et al. 2016), there is surprisingly little research attention directed to the relations between children with visual impairment and digital tablet technology in inclusive settings that goes beyond a compensatory model (Bouck et al. 2007; Zhou et al. 2012). As such, it is important to look across a range of research into inclusive education where technologies are used.

What is known is that studies of children with additional needs have tended to examine if the use of technologies has an impact, such as, on self-regulation of the child. For example, Moore et al. (2013) have shown that video-based packages on iPads are suitable for autism spectrum disorder learning: how to write their name, to develop self-help skills (Shrestha et al. 2013) and promote toilet training (Qi Lee et al. 2013). The use of iPads as a video modelling tool for teaching numeracy has also featured (Jowett et al. 2012) in recent years. Yet as Jowett, Moore and Anderson explain, that "Despite the success of video-based interventions, gaps remain in the knowledge base regarding the effectiveness of VM [video modelling] with complex behaviour" (p. 304), and significantly in the educational context, where "little is currently known regarding the effects of video modelling with novel tasks such as early academic behaviour" (p. 304) in inclusive contexts.

Research following Vygotsky's (1993) theoretical approach asks different kinds of questions and therefore gives different insight into inclusion. For instance, Mendez et al. (2008) argue that traditional approaches to inclusion have focused on *the person* rather than concentrating upon creating the conditions for *increasing the child's participation* in life and learning. In their 3-year cultural-historical and activity theory study of a single case study of Maria with additional intellectual need, they found increased participation in the curriculum over time, identifying a set of pedagogical and theoretical principles where the social use of knowledge was achieved when teachers designed scenarios where the content served to solve real problems of interest to Maria. They noted that a cultural-historical model of inclusion presents a credit model that was realised in practice by Maria's teachers who supported her learning and development.

Even in technology-aided instruction researched by Passerino and Costi Santarosa (2007), doubt has been raised about compensatory model of inclusiveness. For instance, in their study of how technology could be used to support the social interaction of individuals with autism aged 15 to 28 years, they noted the need to rethink how technologies were conceptualised. This cultural-historical study examined social interactions in digital learning environments, such as the use of non-verbal cues, shared attention in social situations and asking for help and carrying out tasks. Mediatory action formed the unit of analysis, where the subjects, the intersubjective relationships and the cultural context were studied together. The findings suggest that not only were the individuals able to interact and participate in the digital environment, but that their social interactions developed over the course of the 3-year study. However, they noted that digital tools on their own were not as effective as digital learning environments with suitable "mediation strategies, adapted to the subjects['] needs" (p. 402). Thus digital environments conceptualised as part of child-adult interaction is a key feature of the findings.

What these studies point to is the need to conceptualise the digital tools as part of the social relations between the child and their social and material world and not

as a compensatory device. Another key dimension in the literature on inclusion is that of the congruence across home and school settings for children. In drawing upon Vygotsky's conception of inclusion, Bottcher (2010, 2012), in taking the child's perspective, argues that any constraint faced by a child is heightened when there is a lack of congruence between the child and the social practices surrounding the child and their developmental trajectory. Dammeyer (2010) has shown in his research of children with Usher syndrome, that congruence creates a platform for children's development. Through a network of professionals and the child's parents, children's development is better supported than when there is incongruence between the cultural practices and the physical needs of children in inclusive settings. Fragmentation of services also has been noted by Underwood et al. (2012) in early childhood settings as being a central problem in Canada for supporting children and families in inclusive settings.

Recent research by Dixon et al. (2015) into the use of iPads for children with autism spectrum disorder in both homes and schools showed the importance of the device for connecting home and school. Through taking photos of children learning at home or at school, these data were used for sharing across contexts, for identifying what work had been done at school, for motivating children's positive behaviour at home and school and for motivating and engaging children with learning activities. They argued that "all families and teachers saw the need for increased collaboration and had a clear desire to improve in this area" (p. 203). These findings were different to those reported by Edwards et al. (2016) in mainstream contexts, who argued against viewing the preschool-home relations as a digital disconnect, and to rather consider these as digital differences because the beliefs of teachers and families about the use of ICT were different rather than disconnected from each other. In considering the research of Dixon et al. (2015) and others in the context of inclusive settings, the review shows that across the different settings, it is the child's additional needs that bring together families and teachers to genuinely look for ways to support the child, and technologies have been shown to support the congruence rather than difference across contexts.

How digital tablets support the congruence of professionals with families and the child as well as how everyday technologies in their own right are part of the child's social system and social relations represents new lines of inquiry in the literature that are worthy of further research attention across a broader range of inclusive contexts (Dixon et al. 2015).

3.4 Study Design

In following the methods used in previous studies, the research is conceptualised as a single case study of a 4-year-old child (4.1 years; pseudonyms Li Lei) with albinism who was in a rich digital environment at home and was given access to an iPad when attending preschool. The condition known as albinism causes visual impairment, reducing visibility to a 10 cm span. This congenital disorder is characterised

by a lack of pigments in the skin, hair and eyes. Li Lei is of Chinese heritage and was adopted at aged 16 months. He is an only child. The study sought to specifically examine how does the digital tablet support the pedagogical practices of the family and the preschool to support Li Lei's conceptual understandings of his world?

Digital Context at Home In the home context, Li Lei used the program *GarageBand* on both an iPad and on a personal computer. The iPad was for the exclusive use of Li Lei. GarageBand on the personal computer was used by the father. However, the father and Li Lei did also use GarageBand together on the personal computer.

GarageBand is a software application for creating musical recordings, drawing upon a range of instruments for the design of single instrument performances or orchestral performance pieces. It can record and playback, where it is possible to easily add musical tracks. The app allows the user to visually show musical notation, but also gives sound waves and digital timelines whilst the music is being played or created.

Digital Context at Preschool The preschool was given two iPads to use as part of their involvement in the study, which the children and teachers used to make a digital animation using the software called MyCreate (2016).

Video Observations A period of 4 weeks constituted the observation period that formed the basis of the data collection. A total of 74 h of video observations was made by a team of research assistants. Specifically, 9.3 h of these data came from explicitly following Li Lei in the centre. All data were put into iMovie format.

Process of Video Recording Data gathering commenced from the beginning of the day and concluded at the end of the preschool session. One camera with a directional microphone followed Li Lei around the centre as he (1) used the iPad; (2) as he played by himself, with other children, and when interacting with the teachers; (3) and as he participated in group time with all the other children and the teachers.

Observations of Li Lei were also made in the family home by two observers and one camera, generating an additional 9.7 h of video observations. Li Lei is an only child, and during the observation period, no other child was present during data gathering in the home.

Video Interviews at Home During the observations at home, the observer informally asked questions about the child and the activities being observed (e.g. Does Li Lei use GarageBand on his own or with others?). This constituted approximately 2 h of the 9.7 h.

Video Interviews in the Centre Interviews were conducted with two of the teachers in the centre. Interviews were video recorded because questioning was in situ as the teachers explained special features of the pedagogy or the activity related to Li Lei (e.g. showing the researchers visually how close things could be observed by Li Lei). Nearly 1 h of data from the total data set constituted teacher interview time.

The total interview time in both the home and the centre was 2.9 h of the 74 h of data gathered.

Analysis A standard protocol was developed as a proforma and used to document each iMovie project. Each protocol contained the following:

1. Video log of all activities
2. Overview of all observations in the project
3. Transcripts of conversation, with still photos taken from video data
4. What the observer was doing in the context of observations

Each project was then analysed in relation to a cultural-historical conception of inclusion as discussed above, where the categories of family and centre practices, routines and transitions were used in the first level of analysis of all the data (Hedegaard and Fleer 2008). For example, practices included routines, such as group time, transitions included such activities as entering preschool and inclusion activities were things that intentionally supported access, such as walking with Li Lei to experience any change in the centre layout. The cultural-historical concept of the social situation of development (Vygotsky 1994) was used to understand the social and material environment of the home and preschool in relation to Li Lei's development and what he brought to each context and across these contexts. This was realised through examining Li Lei's intentions in the activity settings, where the dominant categories of spatial, conceptual and embodied orientations were determined in the analysis. Examples are shown in Table 3.1.

To achieve this dialectical cultural-historical analysis, all projects were duplicated and the original was stored with the protocol links. The duplicate was then digitally cut into segments within iMovie as separate video clips following these core cultural-historical concepts of inclusion (Level 1) and the social situation of development (Level 2). This analysis was operationalised through examining all the video clips (see Hedegaard and Fleer 2008) for (1) individual everyday representations of the concept in action (e.g. parent introduces cooking experience using mathematical concepts to say how far a measurement cup is filling or Li Lei uses software and an iPad to understand distance to an object), (2) categorised as situated practices and analysed in relation to what was afforded for inclusion (e.g. a motive for a conceptual rather than a visual orientation is developed through the family

Table 3.1 Analysis framework drawing on the social situation of development

Spatial orientation	Conceptual orientation	Embodied orientation
The position of the adult and the child during everyday interactions	What were the many ways that the iPad supported the child to conceptualise activities?	What routines were created in the centre to provide consistency for independent navigation?
Positioning of child in relation to the iPad	How was mathematics used to orient the child to a particular situation or activity that couldn't be seen?	How was role-play used to give a sense of distance or abstraction?
How the adult gestured or drew attention to aspects of learning and vice versa	How was number used to give meaning and sense of a particular situation that could not be easily observed?	How did knowledge of the iPad and software drive interactions in real world contexts?

practices) and (3) data studied for themes across video clips (e.g. mathematical concepts support inclusion across a variety of activities). Because a mathematical orientation was noted during the first level of analysis in the home, a specific category associated with maths generally, and number specifically, was used to organise the data across both the home and the preschool (spatial, conceptual and embodied orientation). Video data not involving or referencing Li Lei sat outside the analysis framework, and although logged and categorised into routines and transitions, it was not used for the analysis discussed in this chapter.

Ethics Informed consent from the families and staff for involvement in the study included sharing the visual images with other families and for additional permission for particular images to be published in a variety of formats. Li Lei's family consented to identifiable images of him being published, as did the teachers.

3.5 Inclusive Digital Cultural Practices at Home

As introduced earlier, Li Lei is reported to be able to see within a 10 cm span and as such must position himself in close proximity to things and people. In the family home, this affords a range of practices, including the way adults regularly sit at his level so that facial expressions can be easily read and learned; the close study of digital tools and software; and an explanation of the social and learning contexts through digital means.

An analysis of home observations showed that Li Lei's family interactions were often centred around the symbols found in GarageBand as interfaced through an iPad (on his own) or a standalone computer (with his father). GarageBand and the mathematical symbols as shown in Fig. 3.1, particularly timelines, emerged as a central conceptual framework for thinking and acting when encountering new things and when revisiting previous understandings. The mother and father explained during interviews how Li Lei was very interested in timelines because this particular conceptual sign was a feature of GarageBand.

The family had inclusively framed Li Lei's day-to-day interactions in his social and physical world by referencing time and space numerically. In Table 3.2 are some examples of the home contexts where inclusive practices were evident, such as positioning for interaction, neck support when using an iPad but also special reference to mathematical concepts by the family when supporting Li Lei to conceptualise a world not easily visible. Understanding the world through number, measurement and GarageBand symbols meant that Li Lei could more easily navigate around his physical world. Gaining a mathematical conceptual understanding of time and space also allowed Li Lei to conceptualise, rather than see, his environment. Mathematics was being used for a real social purpose, and this in turn allowed Li Lei to imagine, rather than see, what was distant and not visible.

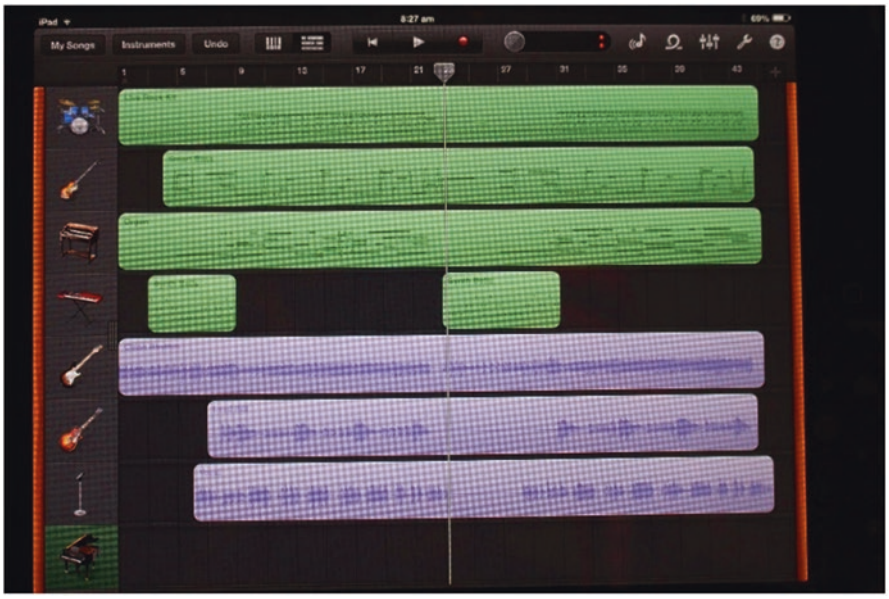

Fig. 3.1 GarageBand software screen dump showing the range of ways music can be documented across time

Table 3.2 Inclusive family practices

Context	Inclusive everyday home practices
Cooking	Mother discusses percentage of content needed when filling up measurement cups (60% full, we need 80%). For example, preparing falafel
Craftwork	Magnifying glass is available for detailed craftwork that is jointly done between mother and Li Lei
Positioning of adults for maximum facial reading	Mother and father sit or kneel on floor when interacting for extended periods so Li Lei can more easily see facial expressions. For example, when playing with a doctor set, where the father role-plays being the patient
iPad viewing	Sofa with cushions as neck support are deliberately suggested so that Li Lei's neck is not compromised when looking closely at the iPad for extended periods of time
Book reading	Seek and find games in picture books are actively promoted as a strength in the family during home play, where Li Lei's ability to closely study detail is supported
Studying images of the solar system	The mother reads with Li Lei the distances that planets are away from the sun. Together they role-play the revolution and relative distances in the family room physically, to give an experiential understanding of the solar system that is numerically framed
Encouraging the expression of specific needs to adults	The mother asked Li Lei what he should do if he cannot see something, to which he replied "Ask if he can sit closer"

3.6 Inclusive Digital Cultural Practices in Preschool

It was found when examining all the data gathered from the centre that the digital experiences of Li Lei at home with the iPad and GarageBand software were noted in both the traditional preschool activities and when using technological tools in the centre. A summary of how Li Lei conceptually fused traditional practices with digital activities is shown below in Table 3.3 and elaborated further below. The mathematical symbols and images in GarageBand were evident not just in drawing of a beanstalk (fairy tale of Jack and the beanstalk), but also featured in his play with puppets, with his investigation of technological tools (e.g. iPad, CD player, video recorder), and during the creation of an animation using stop motion software. Not only was Li Lei's point of reference mathematical through the symbols in GarageBand, but it was used for interpreting, navigating and conceptualising everyday activities in the centre. That is, he framed beanstalk growth in terms of scales found in GarageBand, he discussed the height of Jack's beanstalk in terms of numbers, and he deliberately inquired about time in a way that related to GarageBand. Li Lei's representations were numerically oriented (Tables 3.2 and 3.3), and this orientation formed an important part of his centre experiences and digital environment. Table 3.3 shows examples of the activities identified in the analysis that were routine to the traditional practices in the centre (Column 1), as well as how the digital technologies supported this emerging orientation (Column 2). Finally, Column 3 shows examples of how the practices across the home and centre were conceptually aligned, and together supported an inclusive environment for Li Lei.

Table 3.3 Examples of data – digitally framing and navigating the everyday world in preschool

Traditional practices: *Making meaning in traditional centre practice*	**Digital activities:** *Making meaning through technology*	**Conceptual alignment:** *Fusing digital and traditional forms of representing*
Drawing on whiteboard – set up on a table to encourage groups of children to draw together	Linking drawing to symbols in GarageBand software and iPad	Using GarageBand symbols whilst drawing the beanstalk. Discussing growth of beanstalk
Storytelling, role-playing and free play of "Jack and the beanstalk" fairy tale to groups of children	Animation using MyCreate – to reproduce bean growing (Jack and beanstalk fairy tale) and the making of a "movie"	Climbing the beanstalk. Discussing height of beanstalk in measurement terms during free play
Drawing	Making links to content of drawing to music "Here Comes the sun" (home digital music and vinyl records and player) whilst drawing the sun (in context of growing beans)	Drawing the sun on the whiteboard, discussing *GarageBand* and singing
Growing beans in the centre: asking "How many days?"	Timer on CD player, video recorders and MyCreate on iPad: "how many minutes?"	Using number to determine speed of the animation in the context of beanstalk growth: "*Every picture* [of the beanstalk growth] *is going for one second"*

An overriding finding of this study was how Li Lei's experience with his iPad and GarageBand significantly shaped his development. In drawing on the concept of the social situation of development, it is possible to see how the same social and material environment can be interpreted differently based on what each child brings to the situation. Li Lei interpreted the home and centre practices spatially and made a conceptual reading of his environment, rather than interpreting it visually, as might be expected of preschool children. GarageBand and the iPad gave the inclusive conditions to allow Li Lei to experience his world meaningfully through concepts rather than images. To illustrate this, the following expansive example is introduced as evidence of how Li Lei's digital experiences at home shapes Li Lei's conceptual framing within the centre for beanstalk growth (*Jack and the beanstalk*).

Whiteboard drawing: Li Lei is sitting at a small child sized table that supports a whiteboard. A collection of thick felt pens are available. Li Lei picks up a black felt pen to draw a beanstalk and later a sun on the white board. Li Lei draws very detailed marks across both the images of the sun and the images of the beanstalk. The marks are equidistant and are neatly presented in half centimeter marks. Using self-talk, he briefly discusses the lines in relation to numbers. Li Lei adds horizontal lines, which are representative of the musical scales that he uses in GarageBand. Tamara (his teacher; pseudonym has been used) joins Li Lei and asks about his drawing (Fig. 3.2)

Tamara: You're drawing the beanstalk (referencing the whole image)?
Li Lei: No, I'm drawing a part of how tall is the beanstalk and what level (height) the beanstalk is going to.
Tamara: Yeah, ok. What are you writing here? (points to numbers on his scale)
Li Lei: Those numbers give you an idea of what level… what level (meaning height of the beans) the beanstalk is up to.

Tamara who understands Li Lei's mathematical conceptual framing states to the researcher that these marks relate to musical notation found in GarageBand: "…he plays lots of songs on his iPad at home and he can see the, um, song notes things (as shown in Fig. 3.1). How loud it goes and how soft it is".

Li Lei rubs out the images he has drawn and then begins drawing another image, as shown in Fig. 3.3. He states:

> I get that one song from garage [GarageBand] (*Here comes the sun* by the Beatles). Here comes the sun. It has to have a line in it…

Li Lei begins humming the tune for "Here comes the sun" as he draws a line of connecting circles. He continues to draw circles. Some children gather around and ask what he has drawn. As he draws he explains to Tamara that what he has drawn is not a snake but rather a song. She asks about what the circles are. Li Lei responds by saying "They are circles for gaya band. Meaning its gaya [GarageBand]".

Tamara: You are talking about the music.
Li Lei: I can record music.
Tamara: What type of music are you recording?

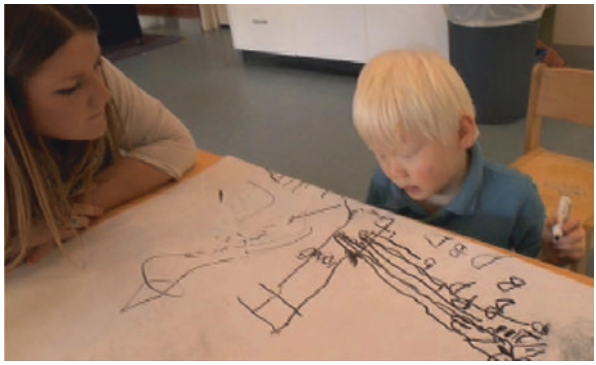

Fig. 3.2 Li Lei drawing a beanstalk with scales to represent growth

Fig. 3.3 Li Lei draws *GarageBand* notations for the song "Here comes the sun"

Li Lei: Here comes the sun. That's how long the sun is (gesturing with felt pen). This is how big the circles is for it. I can draw a circle for you. This is a line (see Fig. 3.4).

Tamara: I am not sure how to do it. I have not seen it before. Can you draw one down here and I will have a try.

Li Lei demonstrates how to draw the GarageBand musical lines. Tamara draws inside the circle in the manner shown to her by Li Lei [see Fig. 3.5]. As she draws Li Lei instructs her further:

Li Lei: That's a half line. It's only a half line. You start from the beginning of it. Then you have to stop. Because you can't do it all in one go.

Tamara: What number are we up to? How many minutes is this song?

Li Lei: That (what she has drawn) plus 4 minutes I think.

Tamara: Can you write 4 minutes (signalling to half way across the musical line), so we know this part is four minutes?

Li Lei: Why?

Tamara: So we know that this amount (signals to area in the song) is 4 minutes?

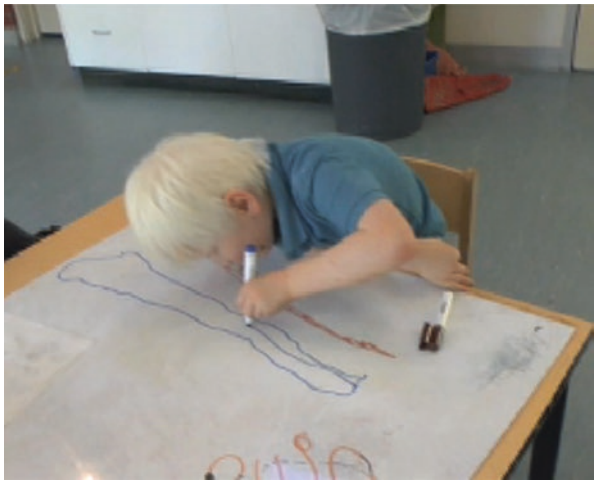

Fig. 3.4 Li Lei draws a circle and a line as the musical time line

Fig. 3.5 Li Lei instructs Tamara how to use GarageBand symbols

Li Lei:	I am pretending that is a 4. And can you then keep going of the song.
Tamara:	Another 4 minutes.
Li Lei:	Yes. You need to tell me when you get to there, to the end of the line. . .
Tamara:	There (signals she is at the end of the musical line)
Li Lei:	How long is it?
Tamara:	I think that was another 4 minutes. It looks like this part (points to middle of musical line) because it is half way.
Li Lei:	I am going to cut it into two parts. To cut it into 2 songs … That is 2 songs. But here comes the sun is one song, but it is divided into 2. It is one song divided into two songs…

This expansive example illustrates how the conceptual orientation supported at home through the use of GarageBand carried over into the digital and everyday activities of the preschool. In the preschool, the symbols learned in GarageBand acted as a tool for documenting the growth of the beanstalk, where conceptualising the relations between time and space were discussed during the drawing on the

whiteboard. Li Lei's heightened sense of representation of reality through symbols to document time and space gained at home was drawn upon in the preschool. The digital environments afforded opportunities for Li Lei that together with the adults who mediated them, represented an inclusive context for Li Lei both at home and in the preschool. That is, GarageBand on the iPad was embedded in an inclusive pedagogy at home and in the centre (Table 3.3). Understanding the social practices in families and the pedagogical approaches of preschool teachers is central for knowing how digital tablets can support or otherwise, inclusive education.

3.7 Conclusion

The findings of this cultural-historical study are threefold. First, the research has shown how digital tablets can support the congruence of professionals with families and the special needs of a child. The everyday technologies in their own right were shown to already be a part of the child's social system at home. The digital technology was embedded in the child's social relations in ways that supported Li Lei's inclusion in everyday practices (Dixon et al. 2015). Cultural-historical theory foregrounded the social and digital relations in this study, and as Bottcher (2010) reminds us, these digital sites need a "dynamic understanding of the child and the environment as dialectically interdependent" (p. 5). Digital technologies studied from a cultural-historical perspective foreground the whole social and material environment in relation to child's intentions and the teachers and family's practices. This allowed the study design to determine the alignment or not between home and centre practices.

Second, the study found that socially framed digital mediation was central for how technologies supported an inclusive digital context for Li Lei. It was determined that the interdependence between the adults, Li Lei and the technology was significant for understanding how GarageBand afforded new ways of making meaning of Li Lei's social and material world. The social practices surrounding the use of digital technologies to support everyday life at home and learning in preschool (Danby et al. 2016; Plowman et al. 2008, 2010; Stephen et al. Stephen et al. 2008, 2013) were expanded, giving insights into broader and holistic inclusive contexts not previously studied in relation to everyday digital technologies.

Finally, it was found that through employing the concept of the social situation of development for making sense of the child's intentions in their socially mediated digital and material environment, it was determined that Li Lei navigated conceptually rather than visually. That is, the relation between the real world and the child's abstraction of the world was supported through the use of the digital tablet. The cultural development of Li Lei took another pathway to that of his peers in the preschool. That is, the preschool practices and activities were interpreted, and meaning was made by the other children visually, whilst for Li Lei this same situation was imagined through drawing upon mathematical concepts developed through GarageBand and the mathematical orientation built into everyday family practices

in the home. In line with cultural-historical theory, the digital tablets and GarageBand acted as an auxiliary device for Li Lei's cultural development. As first introduced by Vygotsky, in a cultural-historical reading of inclusion, the digital tools became an important auxiliary device for navigating conceptually rather than visually, thus creating a different but rich developmental pathway for his cultural development.

Overall, the study identified a new form of inclusive family pedagogy not yet seen in the inclusion literature. The family developed a pedagogy for examining time and space in relation to person through the digital tool and through mathematics. That is, the family specifically encouraged a conceptualisation of the world that focused on abstraction as understood through mathematical concepts. In abstraction practices, such as, drawing attention to the percentage of liquid and solids in measuring cups, it is easier for a child with visual impairment to conceptually, rather than visually, determine how much more is needed to fill a cup. This kind of mathematical framing also supports growing competence and an orientation towards a conceptually motivated way of navigating in everyday life. The study found this conceptual overlay dominated the interactions observed in the family home that flowed over in the use of the digital tools and preschool activities, offering a new way of thinking about inclusive pedagogical practices.

Although the findings of this study are unique to the characteristics of Li Lei, they do offer new possibilities for conceptualising inclusive pedagogy in early childhood settings more broadly for formally organised settings, such as child care centres, and informally through how families set up the conditions for supporting young children's social and physical engagement with their environment. Through an inclusive pedagogy, Vygotsky (1993) suggested that "the task is not so much the education of … children [with visual impairment] as it is the reeducation of the sighted [community]" (p. 86) thus moving the lens from the child and to the social conditions that support the child's active participation in everyday life. But as Plowman et al. (2012) remind us, in depth case studies enable researchers to "see beyond the headline findings of … surveys [and other broadly based studies] to gain more nuanced understandings of the ways in which children, families and technology interact in the home" (p. 36). The study reported in this chapter contributes to a better understanding of inclusive education in digital environments for children with visual impairment where new ways of navigating everyday life become possible because of digital devices and software applications, such as GarageBand.

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Chapter 4
Digital Participation Among Children in Rural Areas

Carin Roos and Christina Olin-Scheller

4.1 Introduction

With focus on digital participation, this chapter describes and problematizes the experience of growing up in rural areas. Today children and young people often are described as *digital natives*, a concept used more than 10 years ago by Prensky (2001) to mean that digitality is a mother tongue and that children are online constantly. In Sweden, the Swedish Media Council annually publishes reports on young peoples' usage of digital media (cf. Swedish Media Council 2015). Figures in this report show that there is a big increase in usage by the very young children. The figures also indicate that children aged 9–14 use the Internet very frequently and that almost every 16-year-old teenager in Sweden uses the Internet on a daily basis. However, no regional perspectives are taken into account in the Swedish Media Council report, and consequently there is a lack of knowledge of the digitalization among young people living in urban and rural areas.

In contrast to studies showing a rapid increase of young people being online, studies also show that groups of children and young people, even though they have access to digital tools, make little or marginal use of the Internet (Helsper and Eynon 2010). Olin-Scheller and Roos' (2015) study found that a majority of children living in a rural area in Sweden relegated digital tools and the Internet to the periphery in school as well as in their spare time. The study also showed that interactions in the school setting, as well as between the children and their parents, seldom included digital tools such as computers, smart phones and tablets. Thus, digital engagement must be considered as varied in practice across urban and rural communities, and therefore it is problematic to view young people as a homogeneous group of digital natives.

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There are problems with making a clear distinction of age and describing young people as a homogeneous group. Some young people that are more active than others found that the largest single factor to be active on the Web is confidence – not age (Helsper 2010; Smahel et al. 2012). Instead, digital usage patterns and activities are better indicators of children's digital engagement, regardless of considerations of age (Helsper and Eynon 2010; van Dijk and Hacker 2003). Moreover, a number of factors frame the process of developing and maintaining young people's digital participation in their everyday life. The aim of this chapter is to problematize social inclusion between children in rural areas in relation to the factors that affect participation in digital usage patterns. Our specific focus is on how digital participation among children in a rural area is socially framed and constructed by the children themselves, parents, teachers and prevailing notions of childhood in their small-sized community.

4.2 Media Panic and Communities of Practice

In Sweden, as well as in other Nordic countries, research on life in rural regions often has centred on development issues, work and regional identity creation with an emphasis on the lives of young adults and adults (cf Skolverket 2000; Weiner and Örhn 2009), while studies of children in early childhood that emphasize children's perspectives are rare. Rural perspectives therefore are likely to be regarded as *the other* in relation to urbanity (Andersson and Jansson 2012), and there is a risk that urban children's circumstances will dictate the norms of people's ideas regarding the well-being of all children. As early as 1983, Brice Heath showed in her classic study that different social communities prepare children for school very differently and that language socialization is closely connected to communication patterns at home. Today's communication patterns also involve digital tools. The values and attitudes towards digital tools as well as digital user patterns in children's homes are likely to have an effect on how children are socialized into digital participation.

In this chapter we discuss digital participation among rural children in relation to notions of childhood and digitalization. The idea of childhood here, as well as everywhere else, is loaded with emotions and images about the ideal way of growing up (Trondman 2003). The fact that young people grow up and become adolescents earlier than before (Trondman 1999) also affects the concept of the ideal childhood where children are looked upon as happy and carefree can be said to be challenged. The question of digitalization and the role that digital devices play – and should play – are now intertwined with views on childhood (Drotner and Kobbernagel 2014). Sometimes the concept of *media panic* (introduced by Drotner 1992) is mentioned when issues about what, where, when and for which purposes young people use tablets, computers and smart phones pop up. Media panic is a phenomenon that occurs in connection with the emergence of new media and the reactions, often closely related to morality, when a new mass medium is spreading (Drotner 1999). Adult experts, such as teachers and social, cultural critics and politicians often

define the new mass media as a social, psychological and/or moral threat to the young (Drotner 1999). Media panic is driven by a strong demarcation between high culture and low culture, where the new media are considered to belong to low culture. Reactions against young people's rapidly increasing use of smart phones can be described as an expression of media panic (cf Lim 2013; Olin-Scheller and Tanner 2015). The new medium is considered to be a danger to the young and "innocent" children; for example, violent video games are believed to lead to violence in reality (Drotner 1992, 1996).

In an earlier study conducted in the same rural area as the study presented here (Olin-Scheller and Roos 2015), we found that all staff at the school had a lack of basic digital experience and obvious negative attitudes towards digitalization. There were hardly any digital tools present in the classrooms, and most of the children displayed low digital capability based on circumstances as well as very little interest for digital communication. The user patterns among those who stated they were online occasionally were concentrated to a few characteristics with little variation (listening to music on YouTube and sparse computer gaming).

On the whole, the usage patterns and the attitudes towards digitalization among children, parents, teachers and other grown-ups in the studied rural area can be described as relatively homogeneous. The school functions as a centre in the community where many parents, grandparents and other grown-ups are involved professionally as volunteers and their engagement for the benefit of the school can be described as significant. In line with Lave and Wenger's (1991) notion, the studied group of people could be described as belonging to a *community of practice*. A community of practice involves the incorporation of knowledge and skills that shapes the lives of individuals and is a social process that takes place through participation in a particular context. In a community of practice, relationships are formed by individuals acting and integrating with each other, and over time, shared stories and specific ways of doing things develop. These common experiences exist in terms of common values and attitudes towards people belonging to the community of practice and to those outside.

4.2.1 Inclusion and Exclusion in the Digitalized Daily Life of Children

Children's participation is described as a social process made possible in interaction – in this case, digital participation. The underlying mechanism for participation can be described as recognition mechanisms, an individual seeks and gains acceptance from others (Piškur et al. 2014; Rogoff 1995). It involves being a member of a peer group, as consumers of participation in social activity and with the aim of inclusion (Koster et al. 2009). The concept of participation ultimately may be established and defined by the UNCRC's argument that a child's views should be given due weight.

However, this is not always a fact, either in research or in educational practice (Cremin et al. 2011; McIntyre et al. 2005).

We use the concepts of inclusion and exclusion in the sense of equity, with the aim to make a difference for children, as Ainscow et al. (2012) write: "the wider policy context within which schools operate; the family processes and resources which shape how children learn and develop; the interests and understandings of the professionals working in schools" (p. 198). Within these important arenas, the mechanisms of inclusion and exclusion work. One such mechanism is the impact of digitalization on the possibility of being included, or not, in peer relations, whether they are online or offline.

Digital participation is not only about being online – it also involves knowledge about the digital world and *how to* participate. In relation to the appearance of Web 2.0, digital participation requires competences that sometimes are called digital literacy (Casey et al. 2009) or information literacy (c.f Besser 2001). Literacy is understood as a social practice – something people do together that shapes their doings according to norms and cultural beliefs related to specific contexts. Digital participation is about capability in relation to digital technology, and even more important is knowledge about the *new ethos stuff* (Lankshear and Knobel 2008). The new ethos, according to Lankshear and Knobel, is more participatory, because it includes interaction, in comparison to conventional reading and writing. They mean a broad notion of digitality, including contexts, thoughts, actions and functions not represented in the traditional text landscape. Users become active producers of content rather than passive consumers – or as Jenkins (2006) and Tapscott (1996) call it, prosumers. This means that activities are more collaborative and can easily and rapidly be shared and distributed (van Dijk 2009). In relation to digital participation, van Dijk and Hacker (2003, p. 315ff) point to four barriers to inclusion and participation:

1. *Psychological access*, when there is a lack of basic digital experience because of no interest or aversion to digital techniques
2. *Material access*, when neither computer nor the Internet is available
3. *Skills access*, when there is a lack of knowledge or digital capability based on circumstances
4. *Usage access*, when there is no variation in user patterns

In our former study (Olin-Scheller and Roos 2015), we found that all these barriers were present for the children in relation to school. The staff at the school had a lack of basic digital experience and obvious negative attitudes towards digitalization in general. There were few digital tools present in the classrooms. Most of the children displayed low digital capability based on circumstances, and there was very little interest in digital communication. When they were online, children only listened to music on YouTube and sparsely played computer games. There was, in other words, little variation and little time online. The aim of the present chapter is to further discuss and analyse inclusion and exclusion mechanisms in relation to van Dijk and Hacker's (van Dijk and Hacker 2003) four barriers as well as in relation to the experience of digital participation and growing up in rural districts.

4.3 Method

The study has an ethnographic approach with observations, interviews and visual methods. The data collection took place during 2 years in a school (preschool to grade 6) in a rural area in Sweden. The target group consisted of qualified educators and other staff and their students aged 1–12 (45 children in primary school and 20 in preschool, their parents and 15 adults working in the institutions). In this chapter we use a sub-corpus of data consisting of *photo-elicitation interviews* with the older children and *semi-structured interviews* with parents.

4.3.1 Participants and Context

The families lived in a small rural village in the middle of Sweden. The village has 700 residents of which the majority have lived here for generations. The area is rural with lakes, forest and farms around. Teachers at school grew up here and some had also been students at the school. The school consists of three buildings: one gymnasium, one with classrooms and one with a dining area and spaces for after-school activities. There is a fourth adjacent building, housing a preschool and a kindergarten.

There were 31 interviews with children and 2 interviews with parents. We include the parent interviews as they mirror the notions and reflections of many community members. The children were aged 7–12 years of age (17 boys and 14 girls). The interviews with the parents occurred in their family home. One was conducted with a young couple (aged in their 30s) with two young children in preschool and the other with a single mother in her 40s with two teenage children at school. The older daughter went to school in the nearest bigger municipality 25 km from the village, and the younger attended sixth grade at the village school. In this text all names are anonymized.

The *photo-eliciting interviews* (Harper 1986, 2002) were a method originating from anthropology in the 1960s (Lapenta 2011). Harper writes: "Photo elicitation evokes information, feelings, and memories that are due to the photograph's particular form of representation"[1] (Harper 2002, p. 13). Harper used photos taken by the researcher, but our study provided a camera to each child to take pictures of their own choice for a week. They were asked to take photos of important persons, animals, events or things in their lives. On the return of the cameras, we transferred the photos to our computer and then met every child individually for interviews using the children's own photos as a concrete point of reference. In this way it is possible to move from the concrete to "the socially abstract" (what the objects in the photograph mean to the individual being interviewed) (Harper 1986, p. 25). Richards and Lahman (2015) describe the potential of decontextualizing photos as graphic

[1] The original text is in italics.

portraits of situations and feelings, thus stimulating people to see the photos as metaphors of meaning, i.e. representations of inherent meaning, which gives a sense of empowerment. In our case, the photos helped the child to concentrate on what they wanted to describe and to express exactly that. It gave the child the "leading role" (p. 20), which we found very important as we wanted to take the children's point of view. The content of the photos and what the children chose to tell us about them decided the content of the children's interviews, and we asked very few follow-up questions.

In the interviews with parents, the photos helped us to understand the children's views on their everyday lives as well as base our analysis on their point of views. We asked parents questions about their own and their children's digital use at home and about the digitalized home environment, for example, whether their children had their own computer, for what purposes and when do they use it. We also asked about usage habits of their own concerning social media, for example, how often they were active, on what kind of media platforms and with whom they interacted. Moreover, we asked them about their family life, work and what they perceived as important in their lives.

The data analysis involved stories about each photo in the children's tape-recorded interviews. Almost all children interviewed either took photos of computers in their homes or told stories about how, when and by whom they were used. They also took photos of people or things important to them. The children told us why the photos were taken, what choices they made when deciding to take a certain photo and what they felt now when looking at them. In the interviews we also asked who the children played with during the school day and who they preferred to play with. In the same way we asked them who they actually played with at home and would like to or preferred to play with at home. This allowed us to analyse children's actual peer relations in relation to popularity. The children's stories were transcribed and analysed by using van Dijk and Hacker's (2003) four barriers to inclusion and participation and Harper's (1986) description of procedure of photo-eliciting analysis. We analysed the narratives as *new social realities* (Harper 1986) that the children constructed during the photo-eliciting session.

From the two sets of data, the interviews with parents and with children, and our analysis of children's peer relations, a picture emerged of social relations and the use of digital media.

4.4 Data Analysis: Inclusion, Exclusion and Access

The interviews showed that the popular children met online to a greater extent than less popular children did. Children who had low use of digital social media experienced loneliness at school, home and on the Web. Conversely, those children with high use were found to be popular and have many peers. While parents' statements showed their low interest and, in some cases, deprecation of digital use, some of the children met online despite discouragement of digital use. According to the

children, the parents mainly encouraged the children to meet after school face to face. The exclusion mechanisms seen on the playground at school were visible also in the children's online activities in their spare time at home. The children stated that they preferred playing outdoors and with things other than computers, and most children did not describe online activities as a top interest; rather, computers at home were used by the parents for paying bills or mailing friends.

4.4.1 Children On- and Offline

Most of the children lived far from each other, and only a few lived close to the school. They arrived and left school by the school bus. They could seldom go to see each other on their own, which meant that the parents had to drive them to the homes of their peers by car or arrange in advance so that they could get off the school bus together.

The children who had many peers at school continued a high rate of social interaction with classmates and other friends in their spare time on- and offline. William was a popular child. His home had a study with a computer, and William (aged 12) met the same group of boys online that were his friends at school. These boys were the friends he preferred to play with at school and if possible at home too, as he said in the interview. William's little brother James (aged 9), however, had no friends at all. When asked about friends in the interview, he said that he "prefers to play alone". This boy had difficulty pronouncing words correctly, and he attended special lessons to work on that problem. When James' classmates were asked about friends, only two girls mentioned him as someone to play with at school. No one said that they played with him in the evenings or weekends. He did not interact with any peers online either, even though he displayed competence using a computer, and his brother William was highly active online. These two boys are examples of the striking findings – that having friends at school and at home to play with go along with having friends online and vice versa. We call this the *popular digital users* versus the *lone non-users*.

Another popular digital user child was Jasmine (aged 10). She walked relaxed into the room, to meet the researchers preparing the interviews. She had her mobile in her hand even though mobiles were not allowed at school, according to the teachers. She looked up, saw us, put the mobile in her pocket and left the room. Later, we looked together with her at her photos taken of a room at her home with books, papers and a stationary computer as well as photos of her own iPad. Jasmine was the centre of a group of girls who always played together, in and out of school. In contrast, Rachel (another 10-year-old girl), in the lone non-user group, told us that her family had a computer at home but that she was not that interested in it. She used the Web to find pictures of artists and she did not use it in any other way. Rachel wanted to be best friend with Sophie (aged 10), who seemed to prefer other friends. In our data, we found that Sophie was in the peer group of girls with Jasmine. Rachel was alone, and no one chose her as a friend even if she occasionally went to visit Sophie

at her house, since they lived quite close to each other. When asked who she preferred playing with in the evenings at home, she replied thoughtfully:

Rachel: [5 sec] I think it is Sophie.
Researcher: Sophie to play with [3 sec] And at school?
Rachel: Sophie too [laughter]
Researcher: [laughter] Are you best friends?
Rachel: No, well I don't know [4 sec] No, I don't think so.
Researcher: You don't think you are?
Rachel: No [whispering]
Researcher: But you rather play with her?
Rachel: Yea.

Liam, one of the 12-year-olds, was often on the Web. He was a member of the popular group of digital users at school, like William, mentioned above. Liam played games online with the other boys his age. He had problems with his computer, which had become slow, so he did not "play that much anymore, but the others do", he said. However, he was on his computer first thing after arriving home after school. He also knew how to edit photos on his computer, photos that he took with the project camera that he'd had for a week. Additionally, he used his computer to play games on the Web with peers who did not attend his school.

Thus, a discernable pattern among the children interviewed was that some children showed a regular usage pattern of digital devices and these children can be described as the ones that are included in the peer group. The excluded children were more likely to describe computers and online activities as something not so important in their everyday life.

4.4.2 Parents' Views on Digitalization

The interviews with the parents illustrated the attitudes and digital experiences in the families. The interviews were conducted with a young couple with preschool-aged children and with a single mother with teenagers at school. Both families emphasized the countryside way of life as very important – in fact, as the only possible way of living! The husband's view was:

> The longest distance I can think of going to is Town [the nearest and a small municipality 25 km from the village], I guess. But most of what we need is in the Village too, like the children's after-school gymnastics classes and other things.

Both families described discomfort and unwillingness to use digital devices even though they had fibre net installed in their houses and computers at home. They described themselves as technically unskilled. The couple said they had chosen not to introduce computers into their children's lives (girl aged 1, boy aged 4) yet. The single mother said that her daughters (aged 16 and 12) were digital users and felt comfortable on the Web despite the fact that she could not guide them herself. She

said: "Well I am not … I am not so technical … but I manage. I manage". She also tried to minimize the daughters' online time and felt she wanted to have control over their digital use. She radiated discomfort and unease, despite having completed a 2-year-long Internet-based education mostly in front of the computer.

On the topic of their own and their children's need of and use of computers, the couple's perspective was that they did not need any more computer time:

Mother:	No
Father:	Nah, not me anyway.
Researcher:	When you are on the Web, what are you doing?
Father:	Paying bills and checking the evening paper *Aftonbladet*.
Researcher:	Are you on the Web every day?
Father:	Oh, no, no!
Mother:	But I'm online a little bit more often. On E-bay [Blocket] and Facebook and the News. But very briefly and always via my smartphone.
Researcher:	But in your private firm? Do you use the Web there or?
Father:	No.
Mother:	But YOU used to, writing the bills and so on.
Father:	Oh yeah. First I wrote the bills by hand and then on the computer and then I gave them the handwritten bill.

In terms of van Dijk and Hacker's (2003) four kinds of access, both families were low in the psychological, skills and usage accesses. It seems regarding skills access in some cases was a perceived shortage rather than a real one. The parents show disinterest in, or aversion to, digital techniques; they show lack of knowledge or digital capability and we found few variations in usage. The father says "only to pay bills" and the single mother's utterance "only when school demands it" (the older daughter attending school in the nearby town). Regarding the fourth barrier, material access, all families in our study seemed to have at least one desktop computer at home. There were few laptops and tablets.

In the interviews with their children and others, we found that every home had computers, and they were used on a daily basis. The children were not much interested and often told us they preferred to play with other things, often outdoors. They also said that parents set up rules to limit the use of computers. Here we have the impression that children and parents – and also school – together created common attitudes in relation to digital devices. The children were rarely in opposition and, in many aspects, loyal to what they understood as the overarching values in the community. They took every chance during the interviews to state that they liked their school and their way of living in the rural environment. By doing so, they created the community as a strong community of practice where consensus – as far as we can see – ruled in relation to images of idealized childhood as well as the role that digital devices and online activities played in the everyday lives of the children.

4.4.3 Digitalized Community: Threat Versus Possibility

The analysis of the parents' perspectives, as well as the children's, revealed an adult view on the digitalized world as threatening a safe environment and disturbing learning at school. Evelyn (aged 9) has difficulty in explaining why she was not allowed to take the mobile with her to school. She thought for several seconds and then answered:

Evelyn: Because eh [3 sec] I think you are not allowed because someone could mess with it and so on.
Researcher: Someone could mess with it [3 sec]. What do you think about that?
Evelyn: Eh [4 sec] that it is a pity.
Researcher: You would like to have it with you?
Evelyn: Mm
Researcher: Mm [4 sec]. What would you do if you had it – with you?
Evelyn: [4 sec] Maybe play during school breaks.

When discussing this topic and other matters regarding the digitalized community, the husband said that he did not think he was the only one in the village thinking of computers or mobiles as a threat to the good rural life, but his wife was more open-minded and not afraid. She thought that even the TV may be a threat if their children spent too much time in front of it. Her point of view was that it is not the technology in itself that is the threat, rather how you use it.

Mother: He [father] sees it as a threat to mankind [laughter]. Or do you not see it as a competitor?
Father: As a matter of fact, yes.
Mother: You are a common reactionary (laughing).
Father: Yea, but I go my own way. And, hell yes, it is so much more fun to sit here than in front of Facebook! One gets more out of social contact this way.

As the parents and children described the good life, it was clear that the contact with nature and animals around them meant a lot. Every single child described the life in the village as safe and good. The life in the city seemed, however, scary. When asked why, most children mentioned stress and traffic as especially threatening. Parents talked about how everyone knew each other and noticed each other, for instance, the postman reacting if someone did not appear to pick up the mail. They described people talking and saying hello when meeting and children biking on the small safe gravel roads through the forest landscape to see and play with each other. They argued that digitalized community, however, was impossible to grasp and to protect the children from, once you had let it be a part of your family life.

Many children declared that their parents used computers at work but not much at home. It seems that the use of computers for Web searching and for social media was peripheral to their lives. Seeing each other in person, being close to animals and being outside in the surrounding forest or fields seemed to be much more interesting for both children and adults. A typical answer from the parents as well as the

children of all ages was that they enjoyed living in this village. To the question of what is good and bad about the village, Emy (aged 7) answered:

Emy: Well ...[giggles] it's eh … mmm … The good anyhow is that there are not many, eh such, eh streets and such. And you may be outside playing and such. And cuddle the animals.

It was apparent that it was difficult for the villagers to say anything negative about the village. The respondents usually had to think for a while before answering, as Emy did:

Emy: But hey … eh … I do not know anything bad … eh..
Researcher: Do you think you are going to leave the village sometimes?
Emy: I think … I really don't know. I don't think so.
Researcher: You like it here? It is good to live here?
Emy: Mm
Researcher: So what are you going to do when you are grownup?
Emy: Hm Yea … building a house here, or there is, there is one where no one lives.

The overwhelming impression was that people in this village lived a life they wanted to live and they felt safe. They also described computers as intruders in their way of living and that everything is safer and stronger if digitality was left out of their lives.

4.5 The Barriers Summarized

In our chapter, we used van Dijk's and Hacker's (2003) four barriers to inclusion and participation: psychological access, material access, skills access and usage access. However, the barriers could also be used in a positive sense as opportunities or potentials, for example, feeling comfortable using computers, mobile phones and the Internet (psychological access), having access to digital assets (material access), knowing how to use them (skills access) and using them regularly and in varied ways (usage access). Below we summarize how these barriers and opportunities may influence the usage in this community.

4.5.1 Comfortable Using Computers: Psychological Access

Most parents felt discomfort in using digital devices and tended to avoid them at home even though they were digital users on a regular basis at work. They did not want their children to use them, preferably never, as they found other things that children may do much more important. The parents had built barriers to keep their children out of the digital world. When children did not use digital devices, it was because they were not that interested and it could be said to be in the periphery of their lives.

4.5.2 Having Access to These Digital Assets: Material Access

As parents did not want their children to use computers and teachers restricted the use of digital devices, the children lacked access to them. At the same time these devices were actually present in every home, although they were put to the periphery of their lives both by parents and the children.

4.5.3 Know How to Use Them: Skills Access

Both parents and children knew how to use computers, mobile phones and other digital devices even if they didn't regard themselves as users. Additionally the children did not seem to stress digital devices as important in their lives. This perspective may be due to parents' and teachers' lack of support as well as their attitudes of not enhancing the development of digital skills. Thus, the values of digital devises were reduced and perceived as unimportant and peripheral in life.

4.5.4 Use Regularly and in a Varied Way: Usage Access

A few children used computers, mobile phones and other digital devises often with friends and in a varied way. These children had many friends at school and also met peers online after school. On the other hand, those children with few or no friends at school had no contact with peers online. Digital devices can therefore be described as important means for including and excluding peers and thus, both in a positive and in a negative way, acted as both central and peripheral in these children's lives.

Inclusion and exclusion mechanisms work in the peer group on par with these access factors where the psychological access is overshadowing the others. These mechanisms become visible as factors affecting the positioning of the digital usage as peripheral in life in the case of children and parents in this community.

4.6 Conclusion

On a group level, the community where the children and the families lived can be described as a community of practice (Lave and Wenger 1991). In relation to notions of childhood and digitality, the attitudes were relatively shared, which united the group. As a result, the barriers against digital participation (van Dijk and Hacker 2003) were connected to aspects relating to a number of societal factors where the school and the families together formed the terms of digitalization. The children and the families had material access and partial skills access to digital devices. Their

usage habits, overall, showed low uptake and value of digital practices. Only a few ways of interacting and communicating via digital devices are apparent, and there is a lack of basic digital experience because of indifference or aversion to digital techniques. Psychological access is therefore a great obstacle, which in turn contributes to creating additional barriers.

The attitudes of the adults seemed influenced by the pursuit of an idealized childhood, where the teenager period with its traditional demands for independence and emancipation from parents was temporarily postponed. Thus, this period can be seen as threatening to the parents as well as to the school environment, as it imposed other ways of growing up. Digitality and digital usage in this particular community of practice is clearly connected to youth and teenagers, not to something that children use for communication and interaction. The children were active participants in the process of establishing the environment and themselves as safe and happy. Thus, notions about the use of digital devices within the community of practice can be linked to what we earlier described as media panic (Drotner 1992) where the Internet is viewed as something threatening and dangerous. Here the studied rural area appeared in sharp contrast to urbanity, where urban areas were viewed by the children and adults as being unsafe and insecure. Insecurity is something that everyone in the study to a great extent wanted to avoid.

In our chapter we saw that the children in the studied rural area were being included and excluded in ways that probably can be found in many places and schools. Some children had a wide social network and were in contact with many other children of the same age; others are rarely chosen and contacted by classmates and had few close social relations. Our study showed that inclusion and exclusion among the children were closely associated with digital usage patterns and out-of-school practices. The patterns we found showed that the children with a high social interactivity in and out of school also used digital devices as a resource for maintaining, expanding and deepening social relations. Conversely, the children with few social contacts and low social interactivity showed quite the opposite pattern. They rarely used digital devices for creating and maintaining social relations, either with classmates or with other children. The children with high social interactivity developed digital usage patterns in their spare time *in spite of* considerable parental and school objections to implementing digital devices in the children's everyday lives.

Our result findings showed that the children with a high social interactivity somehow managed to use digital devices and overcome the common attitudes to digitality within the community of practice and without support from grown-ups and are at least at the start of their journey towards digital participation. However, for the children with low social interaction, lack of psychological access is a big barrier towards inclusion and participation online. The exclusion corresponded with their offline activities, and digital devices did not offer these children more opportunities to become participants in same-age relations in and out of school. Since psychological access also contributes to creating other barriers, these children were not only socially excluded, but additionally not given the opportunity to develop

digital skills and usage patterns either in school or at home. By extension, this may jeopardize their ability to participate as citizens in an increasingly digital society.

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Chapter 5
Producing Contexts for Young Children's Digital Technology Use: Web Searching During Adult-Child Interactions at Home and Preschool

Christina Davidson, Susan J. Danby, Lisa M. Given, and Karen Thorpe

5.1 Introduction

Many young children are engaging with digital technologies in their homes in rich and complex ways. For example, Yamada-Rice (2010) established the range of digital activities of 11 4-year-olds, including attaching visuals to emails, using mobile phone camera devices, communicating through webcams with family members living overseas, regular use of websites designed for children, playing digital games and watching television, DVDs and videos. Davidson (2009) examined Web searching practices of two young children in their home, where one child, not yet three, engaged in meaningful conversations with his older brother and father about information that resulted from their Google search. Similarly, Danby and her colleagues (2013) investigated how a father and two young children communicated about what they were doing as they played games on mobile devices. Findings from home studies such as these frequently inform arguments for the need for changes to approaches with digital technologies in preschool and schools (Zevenbergen and Logan 2008).

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There is recent recognition, however, that home contexts vary substantially (Stephen et al. 2013). Since not all young children share the same access at home to digital technology, preschools and schools have an important role to play in addressing digital inequity (Marsh 2010). However, digital technology studies in preschools and the early years of schooling suggest limited uptake of digital technology by educators or, at best, an uneven uptake. Wohlwend (2009) found that young children had limited access to digital technologies in a kindergarten in the USA. In that kindergarten, children compensated for a lack of access to digital devices through imaginative use of objects in their play; for example, a carrot "became" a mobile phone. These studies suggest scope for incorporating innovative uses of digital technology into classrooms through educators' practices (Marsh 2006; Wohlwend et al., Chap. 10, this volume).

There are mixed perspectives regarding the relationship between young children's use of digital technology across both home *and* preschool/school contexts, but overwhelmingly home contexts appear to offer more diversity of digital practices and more adult support. Plowman and her colleagues (2010) identified the range of technology available, and the potential for accessing human resources were two important differences between home and preschool. Specifically, home contexts provide young children with more readily available access to help and exposure to a wider range of digital technologies (Plowman et al. 2010). There are decreased options for young children's learning with digital technology in educational settings compared to home settings (Hill and Mulhearn 2007; Marsh 2009, 2010). Levy (2009) showed that young children's understandings of what counts as reading narrowed – from reading of digital images and symbols at home to a more focused view of reading in preschool as reading print. Preschool teachers do not always harness the digital experiences of young children and the knowledge of a range of technologies that children bring to preschool (Arrow and Finch 2013). Marsh (2009) reminds, however, that it is possible to find excellent practice in some preschools and that not all children experience access to a wide range of digital technologies in their homes.

An emerging position is that "technology use might be more similar than disconnected" across home and school (Gronn et al. 2014, p. 439). This position encompasses notions of fluidity rather than that of a "digital-disconnect informed by generational assumptions about children and technologies" (Gronn et al. 2014, p. 439), particularly through idealised versions of home computer use. Gronn and colleagues showed that the three primary-aged siblings in their study used technology in both settings in ways that suggested mutual influences of practices at home and school rather than separate practices.

This chapter examines the ways that social interaction contributes to similarities and differences in a young child's Web searching at home and preschool. Web searching presents a perspicuous setting (Garfinkel 1984) for examining adult-child interactions since many young children require help to complete Web searching activity due to their emergent literacy skills (Spink et al. 2010). The focus on inter-

actions during the same digital activity enables comparisons to be made. The analysis addresses two questions (1) what are the interactional features of the young child's Web searching with peers and adults and (2) what practices of Web searching are produced? We conclude that young children must learn to participate in the range of practices with digital technology that homes and preschools provide, including when particular digital activities are accomplished rather differently.

5.2 Approach

The chapter draws on data from a larger study of young children's Web searching in homes and preschools. In that study, there were 170 h of videorecorded classroom data and 29 h of videorecorded home data. Analysis employed ethnomethodology (Garfinkel 1984) and conversation analysis (Sacks 1995), related approaches that share an interest in the local production of the social order through interaction. Talk is taken to index aspects of contexts (such as home and preschool) made relevant as participants talk and do things together. Accordingly, participant talk produces the social context (the social order) and becomes an interactional resource for the talk that follows (Schegloff 2007). Ethnomethodology and conversation analysis have been employed in numerous studies to understand differences between ordinary conversation and institutional talk, especially in relation to the methods used in talk to situate activity in particular social contexts (Heap 1990). In this chapter, we explore the differences in institutional talk in a classroom and talk at home.

We draw on two video recordings of a single child engaged in Web searching. The child was almost 5 years of age at the time of recording. One recording was made at home by the child's mother, and the other was made by a researcher at his preschool. Recordings were selected because of the child's involvement in Web searching in each context. Data were transcribed using Jefferson notation (Atkinson and Heritage 1999) and analysed using the methods of conversation analysis. All participants were given pseudonyms.

5.3 Comparison of Interactions During Web Searching

The analysis considers five phases of Web searching at home and in the preschool: (1) producing the purpose for the Web search, (2) orienting to the Google search, (3) providing the search question, (4) keying in the search question and (5) refining the Web search. For each phase, the home example is presented first, followed by the classroom example.

5.3.1 Producing the Purpose for Web Searching

Henry (H) is seated at a desktop computer. His mother (M) is behind the camera that she has just set up to record Henry's activity. Talk between them forms a question-answer sequence that highlights Henry's own purpose for Web searching.

Extract 5.1a: What Do I Want to Find Out Mummy? (Home)

```
1    H:  what do I wanna find out [Mummy?
2        ((looking at M))
3    M:                           [you wanted t- you
4        asked me
5        (0.4)
6    M:  um how do they make paper and how do they
7        make it whi::te
8        (0.8)
9    M:  if it comes off ↓bark on the trees how do they
10       make it white?
```

Henry's question is directed to his mother and makes apparent his understanding that she knows the purpose for his search (1). His mother's answer is produced over several turns (3–10). The first part of her response is tied to Henry's question through her use of "you wanted" but she breaks off this talk abruptly and produces an answer that contains a number of questions. When the first two questions (6–7) do not result in a response from Henry (8), his mother offers additional information ("if it comes off ↓bark") and next repeats the question ("how do they make it white?").

This kind of talk between the mother and her son is two-party talk, where their talk is constituted by alternate and sequential turns between them (Schegloff 2007). Later, Henry's father helps him continue his search, and their talk is also two-party talk. This talk at home contrasts with much of the talk that occurred in preschool during Web searching, which alternated between two-party talk, multiparty talk and talk that formed parallel conversations. In Extract 5.1b, we see this interactional complexity in the classroom talk.

In the classroom, the children have been watching a teacher assistant (A1) physically assemble parts of a model skeleton. The teacher (T) initiates talk that foregrounds her need to see how veins work. The extract begins with Henry and the other children (C1, C2 and so on) sitting on the floor in front of the teacher. The teacher assistant is sitting at a computer to the side of the teacher.

Extract 5.1b: I Want to See How Those Veins Work (Classroom)

```
1    T:     o:↑ka:y↓
2           (0.5)
3    T:     Miss Le::sa (0.3) I[: want to see:        ]
4    C1:                       [>and it comes up your<]
```

```
5          (0.4)
6    T:    how those veins work >please↓<=
7    C1:   =and it comes up °you:r°
8    Cs:   ((talking))
9    C1:   [[and] it moves your blood ((touching
10         underside of wrist))
11   A1:   [[so:]
12         [[((turns to screen and uses mouse))
13   C1:   wrist
14         (0.7)
15   C1:   a↓round
16         (0.8)
17   T:    a:h boys and girls I:: want to [kno↓w↑
18   C8:                                  [(and it
19         moves your blood)=
20   T:    =SHH (0.3) liste::n↑ (.) knees cro::ssed↑=
21   C5:   =your ↑hear::t
22         (0.7)
23   C5:   your hear:t will=
24   T:    =I want to know how (0.2) >how this<
25         (0.8)
26   T:    >this is going to work<
```

Initially, while the teacher directs her talk towards the teaching assistant (3 and 6), it is obviously designed for the overhearing audience of children seated on the floor. The teacher provides an account of what she needs to know. One child can be heard to pursue talk about veins (7, 9, 13 and 15) and other children are heard to talk at once (8), perhaps to each other. The teacher assistant also makes an utterance (11), perhaps receipting the teacher's comment to her.

Following talk by numerous children, the teacher addresses them all (a:h boys and girls). Her talk works to draw their attention and to cohort them as a single group of children. The teacher makes salient that she is about to tell them what she wants to know (17), but her talk is overlapped by a child (18). The teacher upgrades her attempt to quieten the children by directing them to listen and cross their knees, again attempting to cohort them into a single listening audience, although one child continues to talk (21 and 23). The teacher finally articulates what she wants to know. Her talk illustrates how she manages the numbers of children present so they interact with her as a single group, and how she makes her need for information focal to Web searching.

5.3.2 Orienting to the Google Search

At home, Henry's parents immediately direct him by naming the Google search engine. At preschool, teacher questioning leads to the children suggesting Google, and Henry is nominated to type in a question.

Extract 5.2a: Show Me How to Get to Google (Home)

```
18  M:  so go into Google
19      (0.2)
20  H:  °just look at the camera°
21      ((H randomly moving fingers above keys))
22  M:  Google
23  D:  yeah you might wanna (0.2)you might wanna (0.2)
24      sit up on your knees so you can see the computer
25       properly
26      (1.0) ((H sits up))
27  D:  okay now you show me how to get to Google
28      (9.0) ((H moving mouse around and then clicks))
29      ((Google search page appears))
30  D:  okay no::w ask the question
```

Henry's mother directs him to go into Google. Henry does not do this directly, but rather he comments about the video camera that is recording him, and he runs his fingers across the keyboard. These actions prompt his mother's repetition of the word "Google". Henry's father aligns with the mother's comments ("yeah") and provides directives about how he should sit to see the screen. Although these are couched as a suggestion (you might wanna), Henry responds directly by sitting up (26). Dad acknowledges Henry's response with "okay", prefaces some next action to come ("now") and directs Henry to show him how to get to Google. Henry responds by moving the mouse and making a selection that produces the Google search page. Again, Dad acknowledges Henry's actions with "okay", signals some next action to follow ("now") and directs Henry to "ask the question" (30).

The directives used by Henry's parents indicate expectations that Henry knows how to locate Google, and his actions confirm this. In the classroom, the children's orientation to Google in the Web search is brought about through whole-class talk constituted by the teacher's question and children's responses.

Extract 5.2b: How Can We Find Out? (Classroom)

```
27  T:   how can we find ou::t?
28  M:   .hhh!
29       ((children raise hands))
30  R:   Google!
31  C5:  Goo:gl:e!
32  C1:  Goo:gle!
```

```
33  M:   bugle!
34       (0.4)
35  C1:  Inter[net!]
36  T:        [Hen:]ry↑ go and type in a question
37       (0.5)
38  T:   a::ll by ↓yourself
```

The teacher's question (27) results in several children producing the answer "Google". Some respond with hands in the air. Others call out an answer (30–35). The teacher names Henry and directs him to type in a question. Her formulation of "all by yourself" and its particular production (lengthening of "all" and a pitch drop on "yourself") marks that what Henry is being directed to do is notable. There is no mention of Henry finding Google as the teacher assistant has already located it.

5.3.3 Providing the Search Question

At home, the father's talk leads Henry to come up with his own question. In preschool, the teacher's talk requires Henry to type in a question that addresses what the teacher says she wants to know. The differing ways that "the question" is oriented to by the adults shapes Henry's next actions in quite different ways. At home, Dad refers to "the question" and "your question"; at preschool, Henry has to find "a question" that aligns with what the teacher has been talking about (i.e. veins and how they work).

Extract 5.3a: Okay What's the Question (Home)

```
45  D:  okay what's the question
46      (6.0)
47  H:  what
48      ((H standing on chair and leaning towards
        screen))
49  H:  [how
50  D:  [what is the question
51      (1.0)
52  H   I see my favourite ↑so::ng ((in sing song
        fashion))
53  D:  okay but you're not
54      (0.6)
55  D:  you're not worrying about the song at the moment
56      you want to answer your question okay
57  H:  what do I how they make paper
58  D:  it's part of your homework
```

```
59        ((D leaning over to look at H))
60   H:   how do they
61        (1.0)
62   H:   how they make paper (    ) get white=
```

The father signals his transition from finding Google to now finding a question by using "okay" which suggests moving onto new business. He now directly asks Henry to state his question. In two turns (47 and 49), Henry produces the first words of possible questions ("what" and "how"). After beginning with "what", he pauses and looks closely at the screen. As he produces "how", his father repeats his previous question, which takes into account Henry's failure to provide a complete answer.

There is a gap (51) and a noticing from Henry – he can see his favourite song (52). His father acknowledges this ("okay") and attempts to return Henry's focus to the question. The father's use of "but" signals opposition, followed with a formulation (55) about what Henry should not be doing ("worrying about your song"), and then an account of what he should be doing. The use of "okay" as a tag (56) requires Henry's agreement. Henry responds over several turns (57, 60 and 62) and eventually provides his question. His father's focus on Henry's actions continues with his reminder to Henry that answering his question is part of his homework (58).

In the classroom context, the teacher nominated Henry to type in a question that would enable her to know how veins work, and Henry begins to walk over to the laptop and table.

Extract 5.3b: I Want a Question in There (Classroom)

```
50    T:    I want a question [in ↑ther:e
51                            [((H begins walking))
52          (0.8)
53    T:    that's gonna solve (.) our (.) problem
54          (1.0) ((H walks over to teacher))
55    H:    I ↑can't wemember what we were talking
56          abou::t
57          ((A1 clicks mouse to open Internet and
58          types))
59    T:    °we're talking about° (.) the vei:n:s=
60    H:    =[the= ((lifting up underside of wrist))
61    T:    =°and how they wor::k°=
62    C6:   =there!
63          ((H pointing to veins on his wrist and
64          walking to laptop))
65    A1:   °I want you to type into Goo::g↑le°
66          (1.0)
67    A1:   °your ↓question°
```

```
68          (0.5)
69     T:   ↑what ↓question (0.3) would [you: a:sk?
70                                      [((A1 using mouse
71     H:   u::[::m   ]
72     R:      [abou:t] [the vei:↑ ]ns=
73     C7:             [how ma↓ny↑]
74     H:   =>how ↑does<
75          (0.5) ((T points to H))
76     H:   how do your 0.2) [vei:ns wor::k?
77                           [((Google homepage appears))
78          (1.0)
79     T:   ((raises palms)) I love that ques↑tion↓
```

Henry makes his way from the back of the seated children to the front where the teacher is seated (51 and 55). The teacher states that the question she wants will solve "our problem" (50 and 53), though Henry points out later that he can't remember what they were talking about (55–56). The teacher's displayed agenda is to key in a question that she wants addressed as a problem that they all share (needing to know about veins). After Henry announces (55–56) that he cannot remember the focus of their talk, the teacher responds with the formulation that they are talking about veins and how they work. Henry indicates understanding by pointing to the underside of his wrist and then walks towards the teacher assistant, still indicating the veins on this wrist. Both the teacher assistant and the teacher address Henry, with the assistant wanting Henry to type his question into Google (65 and 67), and the teacher directly asking Henry what question he would ask (69).

Henry acknowledges the teacher's question with the hesitation marker ("um"). As he does, another child speaks but is overlapped by a third child. Both children provide candidate answers for Henry, and Henry begins his response. The teacher draws the children's attention to Henry by pointing at him as he now articulates the entire question. The teacher provides her positive assessment of the question (79), which is marked by changes in pitch, use of "I love" and a dramatic gesture that emphasises that Henry has produced the teacher's sought-after question. Meanwhile, the teacher assistant has found the Google search page (77).

5.3.4 Keying in the Search Question

Extract 5.4a is taken from the home recording where talk is about what Henry knows and does not know about spelling the words in his question. Henry's father, claiming knowledge of what Henry can do by himself, requires that Henry type in the question. In the preschool recording, Henry is directed by the teacher assistant to press certain keys. In these two examples, we see different expectations and different levels of understanding of what Henry can do in relation to using the keyboard and spelling words.

Extract 5.4a: Yeah Sound It Out (Home)

```
77    D:   I'll leave that with you and be back in a
           second
78         ((D leaves room))
79    H:   ((looking at screen)) e::wh
80         (1.0)
81    H:   who:: ((raising himself up on chair))
82         (59.2) ((H clicks key four times then taps
83         other keys and looks at screen))
84    H:   ho::w ((presses space bar))
85         (5.3) ((looking at keyboard and presses key))
86         (14.4) ((looks at screen and then at keyboard))
87         (4.7) ((hits a key and looks at screen))
88         (1.4) ((D enters room))
89    D:   howya goin'
90         ((D sits))
91    D:   can I check
92         (0.6)
93    D:   okay (0.2) how do
94         (0.6)
95    D:   keep going
96         (3.9) ((H presses a key and looks at screen))
97    H:   ((reading)) how do
98         (0.6)
99    H:   they ((looks at D))
100   D:   yep type they in
101   H:   I don't know [how
102   D:                [yeah sound it out
103        (0.6)
104   H:   't' and I don't know the other things
105   D:   well you know how how to say the
106   H:   I don't (    )
107   D:   the::y
```

Henry's father, as he walks out of the room, indicates that Henry can key in the question by himself (77–78). Henry begins to key in the first word and talks aloud as he does that. He looks at the screen, says "who" and keys in letters (81 and 83). He then says another word ("how") and presses the space bar. He begins keying in the next word ("do") by looking at the keyboard to find a particular letter, pressing that key, looking at the screen and then repeating all those actions again to key in the second letter of the word (85–87).

Upon his return, the father checks and endorses the correctness of Henry's progress (89–95). He does this over a series of turns, maintaining Henry as the producer

of the question and himself as knowing the correctness of what Henry is doing through seeking permission to check (91), endorsing what Henry has done ("okay"), reading the words that he has keyed in and directing him to "keep going". Henry's response is to key in more text and read it, indicating that he has completed the word "do". Following the absence of a response from his father (98), Henry says a word out loud ("they"). He looks at his father seeking endorsement of the "candidate" next word. The father confirms the word is correct and directs Henry to type the word.

Following recognition of the next word, Henry asserts his lack of knowledge (101). His father, however, does not align with Henry's stance; instead, his use of "yeah" and the directive "sound it out" counters what Henry has said and provides a way to work out the spelling of "they". Henry names the first letter of "they" but claims that he doesn't know "the other things" (104). The father provides further help, with the information that Henry knows how to say "the". On Henry appearing to deny knowing again (although not all his utterance is discernible), the father repeats the word "they" to insist, and emphasise the sounds in the word.

In the preschool Web search, Henry's question is keyed in rather differently. Physically, he stands at a laptop beside the teacher assistant who uses the mouse and directs his activity.

Extract 5.4b: Halloween (Classroom)

```
134          ((A1 points to 'o' on keyboard))
135          (0.5)
136    R:    that's because it's Hall=
137    C2:   =and Christmas!
138    C4:   Hallowee::n
139    R:    owee::n↑
140    C4:   (↑and)
141    C2:   and [look at it (.) that's Hallowee::n↓
142              [((H keys 'o'))=
143          =((search suggestions appear))
144    T:    [a::↑::h↓
145          [((A1 points to key))
146    C4:   °Hallowee::n°
```

In this extract, the classroom interaction "splits" or schisms (Sacks 1995; Schegloff 2007) into two different, but related, activities. Henry keys in the word "how", with the teacher assistant pointing to particular letters on the keyboard. Their interaction forms a directive-response sequence (Schegloff 2007) consisting of the teacher assistant pointing to direct Henry to a particular key, followed by Henry's tapping of the same key (134 and 142). As Henry and the assistant jointly key in the question, other children engage with the teacher (136–141) about the topic of Halloween (introduced by the teacher's previous noticing of Halloween images on the Google search term box). The teacher-sanctioned talk about

Halloween illustrates, in particular, the teacher strategy for other children to be participating in some way, while the process of keying in the question is slowly completed.

5.3.5 Refining the Web Search

Henry's father suggests a way to provide new information – to find a video – potentially developing Henry's knowledge of Web searching. In the preschool, the Web searching arrives at a YouTube site as a source of information after numerous question-answer turns.

Over the course of Web searching, Henry and his father have conversations about what Henry knows. In this particular extract, the father makes prominent Henry's understanding.

Extract 5.5a: You Can Remember This for Next Time (Home)

```
417  D:  what would  make it easier for you to
         understand
418      something
419      (1.0)
420  H:  do you know
421      (0.4)
422  H:  how do (0.2) how you make paper white maybe
423      that that might be a video actually
424  D:  okay well done so how would you find a video
425      for your answer
426      (0.6)
427  H:  just how you
428      (1.0)
429  H   how you
450      (0.6)
451  D:  can I [give you
452  H:        [how you make something
453  D:  can I give you a hint and you can remember this
454      for next time?
455  H   yeah
456  D:  ((pointing)) see over here? ((finger moves down
457      screen))
458  H:  yeah
459  D:  you've got all categories do you know what
460      category is?
461  H:  yeah
462  D:  okay and you can find
```

```
463        (0.6)
464  D:    um ↑answers for your question (0.2) in these
465        types of categories ((pointing)) now is there
466        something that you would like to choose from?
```

The father directly questions Henry about what would make it easier to understand something (417–418). Henry's response encompasses a number of attempts to produce his question, hearable as an answer to his father's question, followed by a more probable or high-grade answer (marked by "actually") that a video would make it easier. The father accepts Henry's response and closes down his line of questioning with "okay" and an assessment ("well done"). This now makes possible the beginning of this new action, that of finding a video online. The father's questioning (424–425) requires Henry to tell how he would find a video. Henry's incomplete responses and silences lead to his father's offer to provide some information that will enable Henry to know for himself on the next occasion of Web searching. The offer is initially overlapped by Henry's continuation of his question. His father stops and then repeats the first words of the offer. He then completes his utterance indicating that the information to come is for "next time". In other words, Henry's next search can draw on this new information.

Once Henry accepts the offer of a hint from his father (455), the father proffers information given through actions that draw Henry's attention to a place on the screen (456–457). His father first tells ("you've got all categories") and next checks for understanding ("do you know what category is"). After telling Henry that he can find answers in the types of categories, the father returns control back to Henry (464–466).

In the preschool classroom, the teacher orients to a movie. Her question results in numerous responses from children. Concurrently, Henry and the teacher assistant continue keying in the search question at the computer.

Extract 5.5b: What Do We Look at for Movies? (Classroom)

```
271  T:    o::↑kay↓ (0.3) [is there o↑ne (.) that
272                         [((A1 points to screen))
273  T:    could give us maybe::] a:::
274  A1:   ((undiscernible talk with H))
275        (0.5) ((H puts hand on mouse))
276  T:    maybe::
277        (0.5) ((A1 points to screen))
278  T:    like a movie about it?
279        ((A1 points to screen))
280        ((H moves mouse to first result in
281        search list))
282  T:    what would we look i::n?
283  C1:   um (.) [that one! (0.2) the one about
284               [((H clicks to select first result))
```

```
285  C1:  skeltens
286  T:   yeah but (.) what
287       (0.5)
288  T:   what do we look at (0.2) [for movies?
289                                [((webpage loads))
290       ((A1 scrolls down and clicks backspace key
291  R:   a::h
292  C5:  one about brai=
293  C6:  movies
294  R:   mo::vies!
295  C1:  it's movies of (.) of [(skeletens)
296                             [((results page loads))
297  C1:  about skeletons!
298  A1:  >let's try YouTube<
299       (0.5)
300       ((A1 points to screen))
301  A1:  >can you click on this one h↑ere?< (0.2) can
302       you click on YouTube?
303  T:   You::Tu::be
304       (0.5)
305  A1:  this ↑one ((points to screen))
306  T:   [if you wanna see a video↑ (0.2) go
307       [((H puts hand on mouse))
308  T:   You:Tu::be
```

Initially, the teacher's talk shifts children's attention through signalling conclusion of some previous action, followed by questioning that topicalises a movie (271–278). The teacher's words are tentative ("could give", "maybe", "like"). At the same time, the actions of the assistant and Henry show their attention to the search results visible on the screen. Although what the teacher assistant said cannot be discerned from the video recording, Henry takes the mouse and she points to something on the screen. Henry responds by using the mouse to shift the cursor to the first item on the search list (280 and 284).

The teacher asks the class another question (282) that is focused on naming something that can be "looked in". One child responds ("that one!"), indexing her response to something that is visible (283 and 285). The teacher acknowledges the talk ("yeah") but does not accept it as the answer to her question. She asks another wh-question (288), this time referring to "looking at". Various children respond (292–297) with "movies" and C1 specifically refers to movies about skeletons. As this talk has proceeded, Henry has made a selection from the search list on the screen (284).

The teacher assistant suggests to Henry that they try YouTube. She points to a place on the screen, drawing Henry's attention to it and suggesting that he should click on YouTube (301–302). While the assistant helps Henry to select YouTube,

the teacher informs the children that they go to YouTube if they want to see a video. Thus, the teacher finally names YouTube herself, since her previous questioning has not resulted in children producing YouTube as an answer.

5.4 Discussion

There were numerous similarities between the interactions at home and at preschool that produced the Web searching activities. Both sets of interactions were accomplished through a series of five phases, as shown above. As well, Henry had to take account of the actions of adults at home and at preschool and was accountable for his own actions; he was not free to do whatever he liked. He sought the assistance of adults in each situation, and assistance was co-produced requiring the young child's interactional competence in order for help to be accomplished. To illustrate, he indicated videos as a possible easier way to understand something, and he indicated veins in his wrist. Both responses enabled further actions by adults.

There were important differences between the home interactions and the classroom interactions. The father oriented to what Henry knew and understood, and this was made salient in their talk at certain points. The father sometimes gave information about Web searching, but at other times he insisted that Henry display knowledge. The father attributed Henry with competence, such as knowing particular technology skills (e.g. able to Google). He presumed Henry knew about print so his talk required Henry to draw upon that knowledge. Sometimes, he disputed Henry's assertions that he did not know something and so claimed to know more about what Henry knew or could do than Henry himself. What Henry knew was not talked about at preschool, although the teacher's selection of him to provide a question suggests she attributed him with the competence to do so. In the classroom, there did not appear to be an orientation to what Henry already knew about entering in a search question or conducting a search.

To some extent, the lesson had to be progressed in order to manage both what was being taught and also the large cohort of children participating in the activity. The teacher's interactions show the necessity for managing the involvement of all children as the Web search was being produced as whole-group activity. The teacher's talk was sometimes specifically addressed to Henry and the teacher assistant, or was designed for their overhearing, in order to progress the search. The participation of most of the children in the classroom was as "audience" to the actual use of the computer for Web searching. The teacher-led talk guided the process that eventually provided information about courses of action (such as going into YouTube).

Although the teacher assistant's interactions with Henry were two-party, as were Henry's interactions with his parents, there were differences in the types of turns that the assistant and Henry produced. While most of the parents' actions were verbal, in the classroom the adult interactions were often non-verbal (such as the teacher assistant pointing at a key and then Henry pressing that key) or they were

directive-action sequences (where the teacher assistant indicated "that one" and Henry pressed the key). The production of the classroom sequences did not require or assume Henry's competence with the keyboard or with print.

5.5 Conclusion

This study extends previous work that sought to tease out the distinctiveness of home and preschool digital technology practices (Marsh 2006; Plowman et al. 2010). The particular contribution of the chapter is its detailed delineation of the ways that talk and non-verbal actions situated Web searching at home and at preschool and, consequently, created different opportunities for the child. At stake was how Henry's competence as a technology user was managed in the home and classroom contexts through social interaction. We conclude that young children must learn to participate in the range of practices with digital technology that the social contexts of homes and preschools provide, including when the same digital activity is accomplished rather differently.

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Appendix

Transcription Conventions

[[	Utterances that begin at the same time.
[	Overlap in speakers' talk.
]	Point where simultaneous talk finishes
=	Talk between speakers latches of follows without a break
( )	Indicates length of silence e.g. (0.2)
:::	Indicates that a prior sound is prolonged e.g. li::ke
-	Word is cut off e.g. ta-
> <	Words enclosed within are said at a faster pace than surrounding talk
?	Rising inflection
.	Stopping fall in tone
,	Continuing intonation
!	Animated tone

↑	Marked rise in pitch
↓	Marked fall in pitch
no	Underline indicating greater emphasis
CA	Upper case indicates loudness
°	Softness e.g. It's a °secret°
.hhh	In-breath
(it is)	Words within are uncertain
( )	Indicates that some word/s could not be worked out
(( ))	Verbal descriptions e.g. ((sits down)) (Adapted from Atkinson and Heritage 1999)

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Part II
Emotionality, Play and Digital Engagement

Chapter 6
Electronic Gaming: Associations with Self-Regulation, Emotional Difficulties and Academic Performance

Sue Walker, Maria Hatzigianni, and Susan J. Danby

6.1 Introduction

The digital worlds of children are advancing at a rapid pace. With the relatively recent shift to mobile devices, children are having increasing capacities to engage with digital devices because mobile devices are more portable and because they are more affordable and thus more accessible. The ubiquitousness of digital technologies in children's lives has also been associated with an increase in the use of electronic games (Brand and Todhunter 2016; Martin and Murray 2006). In fact digital devices and electronic games have become so entrenched within everyday life for pleasure and education that the question is no longer whether children should access digital worlds but how best to support them in their use.

6.2 Electronic Games and Development

Electronic games (or otherwise called 'computer' or 'digital' games) are now used in more than nine out of ten households in Australia. The majority of homes (98%) with children have electronic games, and 65% of game households have three or more game devices (Brand and Todhunter 2016). To date, however, research that concentrates specifically on the use of electronic games and outcomes for

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young children's development and learning has yielded mixed findings (Kafai and Burke 2015).

The use of electronic games in education has grown significantly in recent years (Mayer 2014; McClarty et al. 2012; Salen 2008; Young et al. 2012). Logan and Woodland (2015) highlight the broad use of electronic games, beyond entertainment, and their impact on forming an out of school, informal education. Advantages in children's developing literacy skills have been identified by the ground-breaking work of Gee (2003, 2005), and more recently the need for revisiting literacy definitions and for the inclusion of multiliteracies/multimodal texts in the school curricula has been underlined (Apperley and Beavis 2013; Beavis 2013; Beavis et al. 2012; Wohlwend 2009). Researchers in this area agree that electronic games can promote 'new literacies practices' based on "co-construction, collaboration and active participation" (Steinkuehler 2010; Wohlwend 2009, p. 131). Electronic games also provide opportunities for students to be "critical makers and users of these multimodal forms" (Beavis et al. 2012, p. 2). As SteinKuehler (2010) explains, electronic games are different from books and any other traditional media in that they enhance a non-linear approach to literacy, working "back and forth between reading the game's meaning" (p. 1).

Electronic games have also been associated with supporting mathematical skills (Ormsby et al. 2011; Steinkuehler and Williams 2009) and fostering positive attitudes towards mathematics by reducing mathematical anxiety (Van Eck 2015). Mathematical learning is enriched by the use of electronic games, and crucial skills are further developed such as problem-solving and reasoning (Calvert and Wilson 2009; Fregola 2015), decision-making about characters and situations and development of engagement in spatially and visually rich environments (Bossomaier 2015). Fregola (2015, p. 190) summarises the advantages of playing electronic games for mathematics in two categories: the first one includes skills (counting, exploring space, solving problems, calculations, etc.), and the other focuses more on abstract thinking and learning processes which are equally important for progressing in mathematics.

Research has also noted positive influences on metacognitive skills and executive functions from engaging with electronic games (Fregola 2015; Thorell et al. 2009; Van de Sande et al. 2015; Wernholm and Vigmo 2015). When playing electronic games, children are continuously in the process of solving problems and practicing their working memory and their reasoning. The playful scenarios often mean that children need to solve a problematic situation in order to help their hero or achieve a task. Players carefully observe in order to comprehend the situation and their task. Then they make estimations and attempt to forecast what they need to do in order to solve the problems, and they move to planning and monitoring their performance. Finally, they are able to assess and conclude which strategies/actions were successful and which ones they have to amend in order to achieve their new goals in the future (Fregola 2015).

The use of electronic games can support children's social-emotional development, by promoting primary students' autonomy, cooperative and conflict resolution skills (Infante et al. 2010; Zhao and Linaza-Iglesias 2015). As well as providing opportunities for problem-solving, games such as Minecraft enable digital and social participation for children to explore their identities (Dezuanni et al. 2015). McDonald and Kim (2001) found that children identify closely with screen characters and that the use of electronic games significantly influences the formation of their 'social self' and the development of self in general. The same researchers recommend considering electronic games in relation to their sociocultural context and further investigating the social interactions and their impact on children's personality. Increasingly, games are being recognised as affording occasions for supporting children's social and cognitive learning.

As well as affordances associated with electronic games, there are concerns. Electronic games have attracted negative attention, and there are legitimate concerns especially around their impact on aggression (Anderson 2004; Anderson et al. 2008), mental health issues (Blake and Hamrin 2007), health problems (e.g. obesity, sleep, see, e.g. Cain and Gradisar 2010) and sedentary behaviours (Granich et al. 2010). For example, a German study found that boys were more likely to be involved than girls, and there were significant relationships between violent electronic games and hostile behaviours and physical aggression (Krahé and Möller 2004).

Even though most of the research focused on older children, there are a small number of studies that suggest there may be some negative effects of electronic games on primary school-aged children. For example, Hastings et al. (2009) in their study with 70 parents and children (6 to 10 years old) used parent reports of their children's electronic game use (type and time of use), school performance and behaviours. The parents reported that their children used electronic games for an average of 3.4 h per week, with boys spending more time gaming than girls. Children spent most of the time playing electronic games alone (44%) or with their siblings (33%) and rarely with their parents (10%). A negative impact of this game use on school performance, aggression, attention and externalising behaviours, especially for boys, was reported. Increasingly being recognised is the role of parental involvement in how children use electronic media. A 2013 study of US families (Loprinzi et al. 2013) and a 2009 Australian study (Okely et al. 2009) each found that preschool-aged children from families who had higher education engaged in less screen time. Both these studies found that boys and girls were no different in the amount of time that they spent on screen time and that both groups were more likely to engage in active play at the weekend.

Although the number of studies around the use of electronic games and their influences has significantly grown in the last decade, empirical evidence is often mixed and inconclusive. Additionally, there are few systematic reviews of the literature in this area to help us draw a more comprehensive picture (Ritzhaup et al. 2014).

6.3 National Health and Education Guidelines for Use of Electronic Games

Recent national health and education guidelines continue to take a cautious approach in advocating how much time children should have with technology. While previously national agendas addressed how much time children spent on devices, now guidelines are beginning to focus more on the quality of what children and young people are doing when using technologies, the interactivity of games, active hands-on approaches and the involvement of adults to socially interact with children while engaged in digital activities.

Australia's Physical Activity and Sedentary Behaviour Guidelines (Australian Government Department of Health 2016) recommend no screen time for children aged 2 years and younger and no more than 2 h per day of screen time for children aged 2 years and older. These guidelines are similar to the American Academy of Pediatrics (AAP) guidelines that were in place until late 2015 (Brown et al. 2015). The more recent American Academy of Pediatrics guidelines have been revised to be more reflective of actual practices (Brown et al. 2015). The guidelines encourage the significant role that parents play in supporting their children's growth in virtual environments. The single strongest message is that parents should play with their children, be good models in the use of technology and encourage social participation when engaged in virtual environments. The Academy also recommends that parents consider the quality of the content of the media, saying that "the quality of the content is more important than the platform or the time spent with media" (Brown et al. 2015, p. 54). In other words, parents are being asked to recognise that their children's use of media should involve applications and programmes that demonstrate the 'quality of the content'.

Also in the USA, the National Association for the Education of Young Children (NAEYC), in conjunction with the Fred Rogers Centre for Early Learning and Children's Media (NAEYC 2012), recommends that choices be made in terms of choosing quality programmes, including the use of interactive media as found in electronic games. In their guidelines, they propose that what should be considered is both the amount of time that children spend with technology and how they use that time to engage with the technology. The guidelines value the use of interactive technologies where children are active and creative users and where there are opportunities for hands-on use and engagement and interactions with others. All these guidelines value the role that responsive interactions play in supporting young children's use of technologies.

There is increasing interest in high-quality forms of digital gaming. Known as sandbox games because players bring their own creativity and ways to manipulate the activity, Minecraft is an example of this type of game as it allows gamers to choose whether they want to play independently or with others, online or offline, or in easy or hard mode (Niemeyer and Gerber 2015). Minecraft brings together gamers who engage in collaborative actions and draws on knowledge of their everyday worlds as resources to play the game. A recent Swedish study showed how this

game encouraged the gamers to engage in language use with each other; this meant that they have to know the concepts of the game and to be able to draw on a range of physical artefacts, as the gamers use Skype, computers, earphones and smart phones to communicate with each other (Wernholn and Vigmo 2015). Gamers are required to draw on their own experiences, which are regarded as resources with which to play the game, and to apply them within the virtual world of Minecraft (Wernholn and Vigmo 2015). The Minecraft communities are ideal contexts for collaborative learning opportunities (Niemeyer and Gerber 2015). Games involving parents and children gaming together often occur in the public spaces of the home, such as in the office or playroom (Aarsand and Aronsson 2009). Games where children can participate in collaboration, problem-solving and critical thinking show the value of digital games for pleasure and also for classroom use (for a more detailed discussion, see Niemeyer and Gerber 2015).

We now have strong indications that electronic games can be educationally useful (Gee 2008). There is some evidence to show that children tend to be motivated to play electronic games more broadly because they are fun, reduce stress and encourage social interaction with others (Olson 2010). There is an urgent need for more research of the game development process ('formative research': testing prototypes with the help of children as participants) and also for theory-driven and longitudinal research exploring the multi-mix of experiences and mediums and the impact on children's development (Lieberman et al. 2009). The availability of 10 years of data from the Longitudinal Study of Australian Children (LSAC) (Soloff et al. 2005) provides an opportunity to examine the impact of interactions with electronic games in early childhood on children's outcomes both in terms of attentional ability (e.g. cognitive self-regulation) but also social/emotional development and academic outcomes. The current study explored children's use of electronic games at 8 to 9 years of age and child outcomes 2 years later when children were 10 to 11 years of age.

6.4 Method

6.4.1 The Longitudinal Study of Australian Children (LSAC)

LSAC is a population-based study consisting of two cohorts of children with approximately 5000 children in each cohort. The birth cohort includes children who were birth to 1 year old at recruitment, and the kindergarten cohort includes children who were 4 to 5 years old at recruitment. This study uses data from the birth cohort. Recruitment involved a two-stage clustered sampling design, stratified by state and clustered by postcode within each stratum. Study design and sample are described in detail by Soloff et al. (2005). The sample is broadly representative of all Australian children (as compared with the 2001 Census data from the Australian Bureau of Statistics 2012). The analyses presented in this paper used parent report and data

from teacher questionnaires for the birth cohort collected from Wave 1 (2004) to Wave 6 (2014). For the current study, the sample was restricted to children for whom teacher report data were available. There were 3090 children who had teacher reports of their cognitive self-regulation, emotional difficulties and academic achievement at 10–11 years of age (Wave 6). Teacher reports were completed in the second half of the school year. It should be noted that in the LSAC dataset, there is only one child in each classroom; therefore these data do not have a nested structure of multiple children within a classroom. Thus, a multi-level approach was not appropriate for analysing these data.

Key socio-demographic variables considered in the analyses included child age, sex and temperament and socio-economic position. At Wave 1, the children were aged between birth and 1 year (M = 8.8 months; SD = 2.6 months). At Wave 6, the children were aged between 10 and 11 years (M = 10 years and 9 months; SD = 4.1 months). The sample included 51.1% boys and 48.9% girls. For the majority of the children, the primary language was English: 10.8% of the children spoke a language other than English at home, and 4.5% of the children were identified as being of Aboriginal and/or Torres Strait Islander background. A measure of family socio-economic position (SEP) has been constructed from the LSAC data (Blakemore et al. 2009). The SEP variable combines information on three elements of a family's socio-economic position (parental education, family income and occupational prestige). Although these different elements can be considered separately, these indicators are interrelated (Lynch and Kaplan 2000; Willms 2003).

6.5 Measures

6.5.1 Cognitive Self-Regulation

The child's self-regulatory behaviour in the classroom was measured by teacher ratings collected at Wave 6 of six items adapted from the Social Skills Rating Scale (SSRS) (Gresham and Elliot 1990) as used in ECLS-K (National Center for Education Statistics 2002). The items in the scale rate attentiveness, task persistence, eagerness to learn, learning independence, flexibility and organisation on a 4-point scale (never, sometimes, often and very often). Internal consistency on Cronbach's alpha was 0.91.

6.5.2 Strengths and Difficulties Questionnaire (SDQ)

Teacher ratings on the emotional symptoms scale of the Strengths and Difficulties Questionnaire (SDQ) (Goodman 1997) were used as a measure of social/emotional adjustment. Participants are required to respond to five questionnaire items on a

3-point rating scale, ranging from 'not true' to 'certainly true'. Internal consistency on Cronbach's alpha was 0.72. In these analyses the emotional symptoms scale was used as a dependent measure at 10 to 11 years of age. Higher scores reflect more emotional symptoms. Example items include 'often seems worried', 'often been unhappy or tearful' and 'nervous or easily loses confidence'.

6.5.3 Academic Achievement

Academic outcomes at 10 to 11 years of age were measured using two subscales of the Academic Rating Scale (ARS): Language and Literacy Scale and Mathematical Thinking Scale (National Center for Education Statistics, NCES, n.d.). The ARS Language and Literacy Scale rates performance in oral and written language over nine items (e.g. 'conveys ideas when speaking', 'reads fluently'). The ARS Mathematical Thinking Scale rates performance on ten items relating to numeracy (e.g. 'creates and extends patterns', 'recognises shape properties and relationships'). Both scales use a 5-point scale (not yet = 1, beginning = 2, in progress = 3, intermediate = 4 and proficient = 5). There was high internal reliability for the ARS Language and Literacy Scale ($\alpha = 0.96$) and the ARS Mathematical Thinking Scale ($\alpha = 0.94$). A higher score equates to a better result on these two scales.

6.5.4 Temperament

At Wave 2, toddlers' temperament was assessed by adapted items from the Short Temperament Scale for Children [STSC] (Sanson et al. 1994). The adapted STSC scale used in the current study is a 12-item parental/carer report inventory. Responses are on a 6-point scale where 1 = almost never to 6 = almost always. The STSC is composed of three subscales: persistence, reactivity and approachability. Higher scores reflect higher persistence, reactivity and approachability.

6.5.5 Use of Electronic Games

The total number of electronic game minutes for an average week was assessed when children were 8 to 9 years (Wave 5). This measure was categorised into quartiles (<120 min per week, 121–240 min per week, 241–420 min per week, >420 min per week) and dummy coded. The lowest 25% (<120 min per week) is the reference category in the regression analyses.

6.6 Analysis

Descriptive statistics are presented in Table 6.1. Four ordinary least squares regression analyses for the outcome measures at 10 to 11 years of age of cognitive self-regulation, SDQ emotional symptoms, ARS Language and Literacy and ARS Mathematical Thinking were constructed in a hierarchical framework, with variables entered in three steps. Each subsequent step included all variables in the previous step. The first step included child and family demographics (gender, age, SEP); the second step incorporated children's Wave 2 temperament scores on the subscales of persistence, reactivity and approachability; the third and final step incorporated the study child's use of electronic games. Table 6.2 presents results from the hierarchical regressions.

6.7 Findings

6.7.1 Descriptive Statistics

Parent report of the time their child spent playing electronic games at home at Wave 5 when children were 8/9 years of age is presented in Table 6.1.

6.7.2 Regression Analyses

6.7.2.1 Cognitive Self-Regulation

Results for the full model explained 13.3% of the variance. Child sex ($B = 0.380$, $p < 0.001$), SEP ($B = 0.106$, $p < 0.001$), toddler persistence ($B = 0.064$, $p < 0.001$) and reactivity ($B = -0.071$, $p < 0.001$) remained significant predictors in the full model. The use of electronic games for more than 420 min per week was also a significant predictor in the full model ($B = -0.086$, $p = 018$). Being female, coming from a high SEP family, more persistent and less reactive toddlers predicted better cognitive self-regulation at 10 to 11 years, while the use of electronic games for more than 421 min per week was associated with poorer cognitive self-regulation. Child sex made the strongest contribution to children's cognitive self-regulation at 10 to 11 years of age.

Table 6.1 Child involvement with electronic games

	<120 min	121–240 min	241–420 min	>420 min
Total number of electronic game minutes	1341 (33%)	786 (19%)	950 (24%)	969 (24%)

Table 6.2 Regression analyses

	B	95% CI	β	*p*
Cognitive self-regulation (Adj R^2 = .133)				
Sex (female)	.380	.328, .432	.280	**<0.001**
Age in months	−.004	−.014, .006	−.015	.436
SEP	.106	.080, .133	.150	**<0.001**
Approachability	−.023	−.050, .003	−.034	.083
Persistence	.064	.030, .099	.071	**<0.001**
Reactivity	−.071	−.098, −.045	−.100	**<0.001**
E games 121–240 min	.061	−.010, .133	.036	.093
E games 241–420 min	.015	−.053, .082	.009	.665
E games >420 min	−.086	−.157, −.015	−.053	**.018**
SDQ emotional symptoms (Adj R^2 = .019)				
Sex (female)	.126	−.021, .273	.035	.092
Age in months	−.004	−.032, .024	−.006	.769
SEP	−0.111	−.186, −.036	−.059	**.004**
Approachability	−.048	−.122, .026	−.026	.202
Persistence	−.022	−.119, 0.074	−.009	.649
Reactivity	.174	.099, .249	.093	**<0.001**
E games 121–240 min	−.148	−.349, .053	−.033	.149
E games 241–420 min	−.119	−.308, .071	−.028	.220
E games >420 min	.225	.026, .425	.053	**.027**
ARS mathematical thinking (Adj R^2 = .117)				
Sex (female)	−.044	−.113, .024	−.026	.203
Age in months	.019	0.006, .032	.057	**.004**
SEP	.266	.232, .301	.293	**<0.001**
Approachability	.007	−.028, 0.041	.007	.710
Persistence	.110	.065, .155	.095	**<0.001**
Reactivity	−.075	−.109, −.040	−.082	**<0.001**
E games 121–240 min	.148	.054, .242	.068	**.002**
E games 241–420 min	.057	−.032, .145	.028	.209
E games >420 min	.000	−.193, .093	.000	.995
ARS language and literacy (Adj R^2 = .131)				
Sex (female)	.254	.192, .315	.159	**<0.001**
Age in months	.004	−.008, .016	.013	.486
SEP	.230	.199, .262	.275	**<0.001**
Approachability	.017	−.015, .048	.020	.297
Persistence	.111	.070, .151	.103	**<0.001**
Reactivity	−.074	−.106, −.043	−.089	**<0.001**
E games 121–240 min	.093	.009, .178	.046	**.031**
E games 241–420 min	.021	−.059, .100	.011	.607
E games >420 min	−.043	−.127, .041	−023	.313

Note: Only final models presented here; reference category is E games <120 min

6.7.2.2 SDQ Emotional Symptoms

Results for the full model explained 1.9% of the variance. SEP ($B = -0.111$, $p = 0.004$), toddler reactivity ($B = 0.174$, $p < 0.001$) and child playing electronic games for more than 421 min per week ($B = 0.225$, $p = 0.027$) remained significant predictors in the full model. Being a more reactive toddler and playing electronic games for more than 421 min per week predicted higher rates of emotional symptoms at 10–11 years of age. Higher SEP predicted lower rates of emotional symptoms at 10 to 11 years. Toddler reactivity made the strongest contribution to children's emotional symptoms at 10 to 11 years of age.

6.7.2.3 ARS Mathematical Thinking

Results for the full model explained 11.7% of the variance. Child age ($B = 0.019$, $p = 0.004$), SEP ($B = 0.266$, $p < 0.001$), toddler persistence ($B = 0.110$, $p < 0.001$) and reactivity ($B = -0.075$, $p < 0.001$) and playing electronic games between 121 and 240 min per week ($B = 0.148$, $p = 0.002$) remained significant predictors in the full model. Being older, coming from a high SEP family, more persistent and less reactive toddlers and playing electronic games between 121 and 240 min per week predicted better ARS Mathematical Thinking scores at 10 to 11 years. SEP made the strongest contribution to children's ARS Mathematical Thinking at 10 to 11 years of age.

6.7.2.4 ARS Language and Literacy

Results for the full model explained 13.1% of the variance. Child sex ($B = 0.254$, $p < 0.001$), SEP ($B = 0.230$, $p < 0.001$), toddler persistence ($B = 0.111$, $p < 0.001$), toddler reactivity ($B = -0.074$, $p = 0.001$) and playing electronic games between 121 and 240 min per week ($B = 0.093$, $p = 0.031$) remained significant predictors in the full model. Being female, coming from a high SEP family, more persistent and less reactive toddlers and playing electronic games between 121 and 240 min per week predicted better ARS Language and Literacy scores at 10 to 11 years. SEP made the strongest contribution to children's ARS Language and Literacy at 10 to 11 years of age.

6.8 Discussion

The study found that, despite numerous concerns and frequent negative coverage from the media, more than half of Australian children use electronic games up to 4 h per week (less than an hour per day). The other half (48%) use electronic games for up to 7 h per week (1 h per day). These results are consistent with the Australian

findings of Brand and Todhunter (2016), who reported an average of 60–100 min of playing video games per day for children from 5 to 14 years old (with boys playing more than girls at this age range). This amount of use is considered 'average' and not harmful according to the American Academy of Pediatrics (2014).

The findings indicated that very high use of electronic games (more than an hour per day) was associated with poorer cognitive self-regulation and may increase emotional difficulties at 10–11 years of age. This finding is consistent with the American Academy of Pediatrics reports proposing that more than 3 h of daily use of electronic games may have detrimental effects on children's psychosocial adjustment (Przybylski 2014) or on school performance and attention (Hastings et al. 2009; Swing et al. 2010). High use may be a cause for concern, as also noted by Przybylski (2014).

Low to moderate use of electronic games was found to have a positive effect on academic outcomes. The study's findings were that children whose parents reported that they used electronic games for a period between 121 and 240 min per week at age 8/9 years had better outcomes on both Language and Literacy and Mathematical Thinking at age 10/11 years than children who rarely used electronic games or who used electronic games for more than 240 min per week.

A close examination of children's experiences in situ of using electronic games in home contexts points to some clues for why electronic gaming may offer better outcomes for language and literacy opportunities for learning. Davidson's (2009, 2011) Australian study found that parents supported young children's learning about digital and non-digital texts and literacy practices as they engaged with online search engines, online reference sites and reference books. In the UK, Plowman and colleagues (2010) found that children's use of technologies in home situations promoted possibilities for learning, including learning about technologies and learning to learn. Also in the UK, Marsh et al. (2015) explored parental reports and observations of home digital literacy practices to show that family members scaffolded children's digital literacy experiences. These studies all highlight the value of parent and child social interaction and its role in contributing to young children's understandings of print, language and literacy practices. These studies of home life recognize the value of children's digital experiences of home and their role in supporting children's understandings of literacies practices. These studies, however, took a broad view of digital technologies and did not look specifically and solely at electronic gaming activities and their role of furthering academic and behavioural outcomes. Further studies are suggested to look at how family contexts may support literacy and language learning through electronic games in the preschool years and in the early years of schooling for children aged 5–9 years.

Researchers have underlined the need for more research on how to 'informally' support mathematical skills for young children outside school (Rothschild and Williams 2015). Consistent with previous studies (see, e.g. Calvert and Wilson 2009; Fregola 2015), this study also found positive associations between mathematical thinking and the use of electronic games at home. The current findings provide a fertile ground for more research around the use of electronic games in informal environments.

Previous studies have underlined the overall value of parental involvement in children's engagement with electronic media (Krahé and Möller 2004; Okely et al. 2009; Plowman et al. 2008). While studies do show that parental involvement does involve regulating and limiting opportunities (O'Hara 2011), other studies highlight the influence of parents on children's participation when parents are actively involved in the activities with their children. For example, in one study of children aged 8–18 years in the Netherlands, parents were found to be more likely to participate with their children as a co-player in electronic games when their child was younger and when their expectation was that the gaming activity would be a positive social-emotional experience (Nikken and Jansz 2006). In a study of one family's engagement, Danby and her colleagues (2013) investigated their social interactions as they played digital games at home to show how the children both managed their individual activity with mobile devices and accomplished interactions with each other. Parental involvement supported children's access to knowledge and offered learning opportunities. In a larger study Stephen et al. (2013) also found that home contexts were important sites for children's learning and for building social relationships. They identified a number of dimensions in how families support their children's engagement with technology at home. While they noted that children's experiences with electronic media varied according to family cultural practices and contexts, parents did use similar sets of practices to pedagogically support their children. In these studies of family interactions, which included playing games with their children, parental involvement was recognised as significant for children's participation.

Finally, it is important to note that the links between the use of electronic games and children's developmental outcomes were small, albeit statistically significant, explaining only around 1% of the total variance. Being female was the most significant predictor for cognitive self-regulation and children's socio-economic background (SEP) was the most significant predictor for emotional development, mathematical thinking and language and literacy. As previously noted, parental education (a contributor to SEP) has been linked to screen time with children from more well-educated families spending less time with digital technologies (Okely et al. 2009). Taking into consideration the importance of context and the type of electronic gaming that is involved, it is likely that the relationship between the use of electronic games and child outcomes is far from straightforward.

6.9 Limitations

While the use of data from the Longitudinal Study of Australian Children (LSAC) has provided a valuable opportunity to explore the associations between children's use of electronic games and child outcomes longitudinally with a large sample size, there are limitations attendant on the use of secondary data. Most importantly, the data available for analysis regarding children's use of electronic games provided us

with a measure of total time spent using games but no detail with respect to the type of games being accessed. Given the growing awareness of the importance of quality in electronic media (e.g. Brown et al. 2015), further research which explores time use by type of media is clearly needed. It is also evident that previous studies and the study reported here have predominantly relied upon parent or teacher report and researcher observations to make their findings. Less is known about children's perspectives on how they understand and participate in electronic games.

6.10 Conclusion

Based on the importance of parents' involvement in children's electronic gaming from previous studies, it is likely that social interactions are important in supporting children's engagement with electronic games. This study makes a significant contribution to knowledge by providing evidence on the positive and negative impacts of electronic gaming on children's academic outcomes and psychosocial development. These findings are worthy of further research to explore in more detail the ways in which the quality of electronic games may be related to child outcomes.

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Chapter 7
Children's Collaborative Learning in Science Scaffolded by Tablets

Marie Fridberg and Andreas Redfors

7.1 Introduction

This chapter discusses the role of emerging technologies, i.e. tablet computers or tablets, in preschools to scaffold reflection and collaborative learning of real-life science phenomena. The importance of this stems from a 'west world' problem, which many scholars describe as the failure of current educational systems to respond to the needs of modern western societies. Educational systems are still in many aspects in need of reform (Dede 2010; Fullan 2007; Thulin and Redfors 2016; Tytler 2007).

Preschool is, compared to school, a less formalised learning environment and the obvious starting point for development of practices enabling a lifelong development of innovation and problem-solving capacities. Here we exemplify this by reporting on the potential of ubiquitous technologies to support collaborative inquiry-based science learning in preschool.

An increasing number of studies suggest that students' learning is enhanced when they create digital artefacts, such as representations of science concepts. Prain and Tytler (2013) state that constructing representations of scientific phenomena supports many different forms of reasoning. These include imagining processes, suggesting explanations and outcomes or to test whether a verbal explanation seems reasonable also in 2D or 3D. When choosing how to represent a phenomenon, students are challenged in their understanding and thinking of the particular concept, and they must learn how to select appropriate solutions for the representation. In this study, we therefore make use of time-lapse photography and 'Slowmations', short for 'Slow animations' (Hoban 2007).

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Time-lapse photography is a technique that shows a slowly changing event in accelerated speed, and this is accomplished by photographing the event at certain intervals, such as every other second, every 5 minutes or once an hour, and when played at normal speed, the event seems much faster. This may give a pronounced overview of natural science phenomena such as the sun, moon or clouds moving across the sky, flowers blossoming, etc.

A Slowmation on the other hand is a stop-motion animation played in slow motion to explain a science concept (Hoban 2007). Models can be made in 2D and/or 3D, and many different materials can be used, such as playdough, drawings and natural materials (e.g. leaves or rocks). Students manually rearrange the materials and then use digital cameras and free movie-making software. Fleer and Hoban (2012) describe how Slowmation creation offers a window of opportunity for children and their teachers to become aware of scientific concepts, and they point to two key features, making Slowmations suitable in early childhood settings. The first is the wide range of materials, such as plastic toys and felt cutouts, already existing in preschool, and the second key feature concerns the stop-motion technique itself. It can be halted anytime, thus allowing the children and teacher to interact and discuss ideas at any step of the animation (Fleer and Hoban 2012).

The scaffolding potential of Slowmations (Fleer 2013; Hoban 2007) combined with time-lapse (Fridberg et al. 2017), in developing children's understanding of science phenomena, was a special focus. At the core of the reported work is a synthesis of the two domains discussed by Eshach (2006) for children's science learning, content (concepts, explanatory models) and investigations (hypotheses, problematising, questions, experiments). We discuss the communication during children's work with science activities scaffolded by tablets. We will highlight that there is still much to be learned about how young children talk and interact around a science phenomenon and to what extent the reasoning and learning can be supported, or hindered, during the work with tablet computers and children creating time-lapse and Slowmation movies.

7.1.1 The Swedish Setting

During the last years, the pedagogical task for Swedish preschool has been gradually reinforced. Preschool is since 1996 part of the Swedish educational system as a voluntary form of school for children of 1 to 6 years. It is a separate school form and its activities are regarded as education and teaching. Municipalities are obliged to provide preschool for all children from age 1 to 6 years, and the cost for parents is subsidised. Activities in preschools are directed by the national curriculum with learning goals to strive for, and the preschool teachers plan pedagogical activities enabling children to explore, create and learn. A large percentage of Swedish children (83% of 1–5-year-old children in 2014) attend preschool.

Preschool teachers (3.5-year university exam) are pedagogically responsible. They plan pedagogical activities enabling children to create, explore and learn. The

activities take place, for instance, through playing, cooperating with others, painting, building and singing. In connection with the revision of the national curriculum in 2010, science was explicitly defined through its subdisciplines, and the pedagogical task now includes covering chemical processes and physical phenomena (Swedish National Agency for Education 2011).

7.1.2 Theoretical Framework

The described project was based on the idea of design-based research (Barab and Squire 2004), a way of bridging the often-disconnected worlds of theory and educational practice. The iterative and participatory philosophy of design-based research can foster the development of sustainable, empirically tested practices and ensure successful future implementation. This chapter discusses the analysis from the perspective of a theoretical framework primarily based on phenomenography and variation theory (Marton 1981; Marton 2014; Marton and Booth 1997) focusing on developmental pedagogy (Pramling Samuelsson and Asplund Carlsson 2008). The analysis leads to the development of a category-based framework that can be used for future analysis of science learning processes scaffolded by tablets in preschools (Fridberg et al. 2017).

Studies of small children have shown that learning presupposes an object as well as an act (Marton and Booth 1997; Pramling 1990) and in preschool, the object of learning has often been less in focus. Developmental pedagogy (Pramling Samuelsson and Asplund Carlsson 2008) takes into consideration the importance of a teacher who supports and encourages the child's willingness to make sense of the world, a teacher capable of tuning into the child's world for mutual communication of the learning object. In order to help a child develop its perception and understanding of the world, the teacher should look towards variation (Marton 2014). For example, for a child to understand the concept of flowers, the child must discover what critical aspects separate a flower from grass or a tree. The child needs to experience a variety of flowers in order to distinguish the critical features constituting a flower. Then, he or she will gradually become able to understand what defines a rose, as compared to other flowers (Pramling Samuelsson and Asplund Carlsson 2008). Developmental pedagogy defines learning as the variety of ways in which one child produces variation and the variety of ways a group of children think about one and the same phenomenon or concept. According to this, the teacher should use variation as a strategy to make a particular phenomenon possible to experience for a child. As children think in various ways about a concept or phenomenon, comparing and discussing these thoughts may make different meanings and features appear to the group (Pramling Samuelsson and Asplund Carlsson 2008).

The intention of science is to predict and describe real-world phenomena by explanations utilising theories and theoretical models. In the scientific research process, empirical and theoretical work is intertwined leading to construction, confirmation or modification of theories and theoretical models. It is an interactive process

of discussions, experiments and observations within the science community. However, different views of science are possible (cf. Erduran and Dagher 2014). The science perspective in this work is a semantic view of models focusing on the explanatory power of theoretical models (Adúriz-Bravo 2012), where theoretical models are viewed to link theories with experiments and practices (Thulin and Redfors 2016). Therefore, underlying the discussions in this chapter is a view that synthesising the two domains discussed by Eshach (2006) is beneficial for children's science learning, content (concepts, theories, theoretical models) and investigations (hypotheses, problematising, questions, experiments).

As Fleer (2009) concludes, studying the dynamic process as opposed to the child's definitions of a particular concept, or 'end product', offers a new direction for science education research, especially for researchers who, like ourselves, are interested in young children's communication about scientific phenomena (p. 282). This chapter discusses the analysis of children's communication during learning activities concerning the different water phases, contrasting different learning contexts with and without use of computer tablets. The detailed results of the study are presented elsewhere (Fridberg et al. 2017).

7.1.3 Design of the Research Project

A set of science activities was developed together with the teacher. The researchers acted also as the science experts. The activities were multi-faceted and aimed to start from the children's prior experiences. The teacher and one of the researchers in a dialogue with the children, chose phases and phase changes of water as the science content. The activities were planned for collaborative groupwork and uses of tablets through time-lapse and Slowmations. The idea was to introduce a science phenomenon in varied ways and make it ubiquitously available to the children through the use of time-lapse photography. Thus, the children's experiences could be brought forward in discussions and challenged during the subsequent production of Slowmations.

7.1.4 Children's Experiences of Evaporation

From a design-based perspective and guided by the theoretical framework described above, the project started with the teacher and one researcher interviewing the children in small groups looking for a science phenomenon from the children's everyday world to study and to capture the variety of ways the children thought about that phenomenon. Children's ideas about tablet computers and nature of science were discussed, and the children were asked what phenomenon they would be interested in working with. Water, in terms of water you can drink, snow melting, etc., was mentioned repeatedly. It soon became clear that the idea of water evaporating did

not exist among the children. When asked about what happens to the rainwater in water pools, the children answered that the water sinks into the ground. When asked what they believe happens with rainwater on, for example, asphalt or paving stones, the children believed the water disappears downwards through cracks. Children's progression of understanding evaporation and condensation has previously been described as (Driver 1989; Galili and Bar 1997; Lindner and Redfors 2007; Tytler 1998, 2000) water disappearing, absorbed into surfaces, transferred upwards or dispersed in the air, associated with a phase change (Tytler 2000).

7.1.5 Method

7.1.5.1 Data Collection, Participants and Setting

The research adheres to the ethical guidelines of the Swedish Research Council (2011). All participants and children's caregivers are informed about the video recordings and analysis and have agreed to voluntary and anonymous participation with a right to abandon participation at any time. Pseudonyms are used in analysis and reports.

The project followed a mixed-methods approach with both qualitative and quantitative data analysis measures, and the empirical material in the analysis came from video and audio recordings of eight science activities in a preschool in a small town in Sweden. A group of nine children (aged 3 to 6 years, six girls and three boys) and their teacher were engaged in a water project where focus was on evaporation. During the discussions and activities, the children worked in different constellations. The group size varied between two and seven children at a time, and the data have been collected in four different learning contexts:

- Group discussion
- Experimentation, without and with time-lapse photographing
- Stimulated recall in group
- Production of Slowmations

One typical observed activity lasted between 0.5 and 1 h and started with a group discussion between the children and the teacher. The discussion was followed by a teacher-led experimentation/demonstration, involving situations where the children participated practically and 'hands-on' in varying degrees. The children were, for example, practically involved when investigating ice, melted water in room temperature or condensed water on the lid over a boiling kettle; see Fig. 7.1.

These experimentations/demonstrations were performed with and without time-lapse photographing (software: Lapse It 2.2, Interactive Universe) with the tablet (iPad). Another typical activity started with a group discussion or a stimulated recall, where the children watched a time-lapse movie or Slowmation with focus on evaporation, made previously or at the same occasion, by them and the teacher (software: myCreate 2.0.11, iCreate to Educate). These group discussions/stimulated

Fig. 7.1 Children experiencing the boiling of water

recalls were typically followed by either another experimentation/demonstration or a Slowmation production, where the children used playdough or LEGO© to recreate the evaporation situation just visualised in the time-lapse movie in the creation of a Slowmation; see Fig. 7.2.

7.1.5.2 Data Analysis

Audio and video recordings of child-child and child-teacher communication have been analysed with an aim to produce qualitatively different and hierarchically structured categories. The categories came to describe the quality of the talk from the perspective of the two types of science knowledge (content and investigations) discussed by Eshach (2006). The categorisation was then used to quantify the distribution of the categories for the different learning contexts.

7.2 Results and Discussion

When we started this project, we were interested in investigating the tablets' potential as a tool in children's learning about science phenomena. We aimed at studying how the children reasoned with each other and with the preschool teacher during work with water phases and whether this was supported by the use of a computer tablet. The project continues, but so far we may conclude a few things

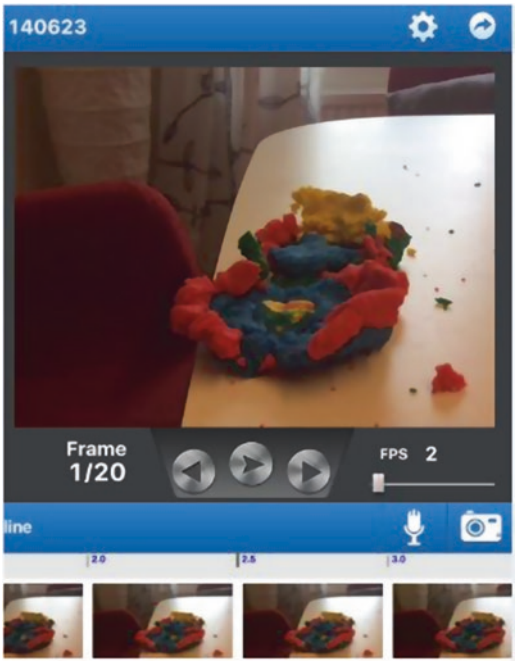

Fig. 7.2 Children using the software myCreate to produce a Slowmation of evaporating water

about the children's communication and about the role of the tablet, the teacher and the child group.

In the next section, the four different learning contexts and the distribution of the identified communication categories within them, their content and boundaries, will be closely presented.

7.2.1 The Categories

The following categories emerged from the analysis of the empirical data (cf. Fridberg Et al. 2017). Categories 1–5 form a hierarchical order, with more advanced statements or reflections belonging to category 1 or 2. Category 6 captures all statements mentioning the tablet.

1. Synthesising reflections, including more than one aspect of the phenomenon, or representations

   This category includes the most advanced reflections and statements where more than one aspect, concept or representation related to the phenomenon or practical work is considered.

   One builds a kettle and then one can put some water in it, then throw some fluff or so like smoke. (Johanna, 5 years)

2. Reflection including hypothesis
   This category includes reflections and hypotheses concerning processes or explanations connected to the science phenomenon or to practical work, e.g. with Slowmation production.
   It (the water) melted into the plate. (Hanna, 4 years)
3. Process
   This category includes statements connected to processes of practical nature with or without explicit reference to the phenomenon and is therefore further divided into:

   (a) *Phenomenon*
   Talk of processes related to the science phenomenon and theoretical explanatory model. Utterances regarding something the children experienced during the experiments, with or without sequential character.
   There were bubbles. (Amanda, 4 years)

   (b) *Practical*
   Talk of doing something practical. Statements with or without sequential character.
   We boiled water. (Frida, 5 years)
4. Concepts, mentioned or briefly described
   This category includes statements where concepts related to the science phenomenon are mentioned or shortly described.
   Water (answer to teacher's question 'What was in there?'). (Ellie, 4 years)
5. Other
   This category includes statements not connected to processes or the studied phenomenon and 'don't know' answers.
   I have to go to the bathroom. (Simon, 3 years)
6. Tablet
   This category involves statements about the tablet and includes talk about settings, photo angles, Slowmation names, etc. The category may or may not be combined with any of the other categories, depending of the nature of the statement.
   We should probably turn it. (Amanda, 4 years)

7.2.2 Comparison of Communication Categories in the Different Learning Contexts

The children were more or less physically active during the different learning contexts. The group discussion and stimulated recall in group represented the two less physically active contexts, while experimentation and Slowmation production represented the more active contexts. When these four different learning contexts were compared, patterns in the communication were emerging. *Process* was the most common category in all of them, and during the group discussion, stimulated recall

and experimentation contexts, these 'process statements' were evenly divided between the two subcategories 'phenomenon' and 'practical':

There's water underneath (the lid). (Johanna, 5 years)
First they made a drawing and then they made a film of it. (Johanna, 5 years)

When producing Slowmations, the children focused their 'process talk' around practical issues, and this could also be seen in the experimental situations where the tablet was included and time-lapse movies are produced; talk about the tablet was most often heard in the Slowmation context.

The children's talk during experimentation, with and without time-lapse photography, generally mirrored their talk during Slowmation production, in terms of most and least prevalent communication categories. During these learning contexts, children were occupied with 'hands-on' activities, which resulted in the major communication topic to be process oriented as described above, but interestingly, the second most common category was *reflection*. The reflective statements differed somewhat in character between experimentation and Slowmation production in that reflections in the experimental situation were exclusively about the phenomenon, while when making Slowmations, the children focused mainly on purely practical issues, such as which colour of playdough to use for the bowl, etc. See Fig. 7.3.

Also, practical and phenomenon statements coincided in this context, since it was the phenomenon the children staged in the Slowmations:

We can create smoke. (Markus, 4 years)

In addition, the statements belonging to the most advanced communication category described by us, synthesising reflection, were most prevalent when the children were active, creating Slowmations or experimenting. During the Slowmation context,

Fig. 7.3 Children creating a Slowmation movie on the topic 'boiling water'

the children reflected about how to illustrate different features of the phenomenon in playdough or LEGO©, and during experimentation, their most advanced remarks were exclusively about the phenomenon:

I see, then the water disappears! When the bubbles disappear, water disappears. (Johanna, 5 years)

The following dialogue between the teacher and two children took place after they had just concluded that there was smoke in the boiling kettle and on the glass lid:

Teacher: Then I removed it (the lid) from the kettle and then there was…?
Johanna: Water.
Teacher: Then there was water.
Johanna: So smoke is actually water!
Johanna: Okay, then there's water around us!
Emilia: Invisible water.

The stimulated recall context also promoted reflective communication. Most reflective statements during stimulated recall with the time-lapse movies involved the phenomenon itself, while when the stimulated recall was by use of Slowmations, the reflective remarks concerned more practical issues. Reflections of a joint practical and phenomenon kind were observed also in the stimulated recall context, where the children watched and talked about the content and practical solutions for illustrating the phenomenon, in the time-lapse or Slowmation movies produced by them. During group discussion, as during experimentation, the reflective remarks were focused around the phenomenon itself.

The communication categories classified as the least advanced by us, *other* and *concept mentioned or briefly described*, were more common during group discussions compared to the other contexts. The latter of the two was distinctly unusual in other contexts.

In summary, of the four different learning contexts, *group discussion* and *stimulated recall* can be seen as representative of the two less physically active contexts, from the children's point of view. Experimentation and Slowmation production on the other hand formed the more active 'hands-on' contexts. Our analysis shows that the active contexts contained more statements of a reflective character, that is, the more advanced communication categories were observed more often when the children experimented or created Slowmations, compared to when they were sitting at a table discussing without any material in front of them. During both the experimentation and the Slowmation production, the focus was on the series of events and the phenomenon, perhaps a natural observation one might add, since the Slowmation production 'forced' the children to reason about explanatory models and representations. In the same way, there were more statements about the tablet, its settings and placement, during time-lapse and Slowmation making.

7.2.3 Representation of Evaporating Water in Playdough and LEGO©

Worth mentioning are the non-verbal representations which were abundant when the children were creating the Slowmations and interacted with each other. There were a lot of discussions about how to illustrate the actual phenomena but also non-verbal representations. The first experiment was ice melting in a bowl in room temperature. Interestingly, the children's initial idea about what would happen to the melted water if it was left in the bowl was that it eventually will sink into the bowl or into the table underneath. This notion was 'supported' by a time-lapse movie they made, where the water was 'seen' to sink quickly. The objects needed for representing this during Slowmation production were according to the children a playdough bowl and playdough water. When Emilia and Johanna (both 5 years old) were illustrating the time-lapse, the water sinking into the bowl was represented by small pieces of blue playdough (water) being removed from inside the bowl and put aside on the table, outside the eye of the camera and in between every photo taken. When Hanna and Ellie (both 4 years old) were making a Slowmation about the same event, they instead chose to represent the water sinking into the bowl by removing small pieces of blue playdough and put it underneath the playdough bowl:

Hanna: *Now I know, one can put it under (points to the bottom of the playdough bowl).*
Teacher: *One can put it under, how do you mean? That you…?*
Hanna: *One moves it like this, underneath (takes some blue playdough (water) from the bowl and shows how she plans to put it under the bowl).*

To develop the children's thoughts about evaporation, we continued by boiling water in a kettle, interested in how the visible water steam would affect the discussion. On three occasions thereafter, Slowmations about boiling water were created. In two of them, the children were representing the events in the boiling kettle time-lapse in playdough, while in one of them, the children recreated the same time-lapse in LEGO©. In all three observations, the children chose to illustrate the kettle and the water bubbles. In two of the observations, the children also chose to illustrate the lid and the 'smoke' (the children's word for water steam), and in two of them, the children chose to include and represent water in the bottom of the kettle, before it starts to boil and bubble. When the smoke was represented, this was accomplished by either holding up playdough water bubbles in the air in front of the tablet camera to photograph or by holding grey LEGO© sticks over the kettle:

Teacher: *What happens now? Is the smoke staying there (refers to the water steam seen in the kettle)?*
Amanda: *No.*
Hanna: *Goes up in the air.*
Teacher: *It goes up in the air. How are we going to show that?*
Amanda holds grey LEGO© sticks above her head as high up as she can.

Amanda: Hold up.
Teacher: Yes, but the kettle is over there?
Amanda: Ehm. It flies around in the whole room.

The children's sequential thinking was observed when they took time to remove small pieces of 'water' at a time, in between taking photos, creating the water evaporating from the glass bowl. During one observation, Emilia and Johanna took time to add a few playdough bubbles at a time in between the photos, when they represented the water boiling a little at first, then more. To the contrary, when the children in one observation produced a Slowmation about the same series of events, they did not focus on pre-existing water in the kettle or on their own conclusion that more and more bubbles turned up when the water started to boil. They instead chose to construct a kettle, take a photo of it and then add all bubbles at once before taking the next photo.

7.2.4 The Role of the Tablet

The advantage of the tablet as a tool during work with preschool children and science was clear to us when we analysed our video material. The tablet had the children's immediate interest, and they were comfortable with handling it; the touchscreen technology makes it easy for young children to use. The advantage of the time-lapse movies was observed in the discussions these movies supported during stimulated recall sessions of experiments. When the children re-experienced the activities, there was a clear focus on the different aspects of water phases, while they discussed the content of the time-lapse. Also, when the tablet was used during the production of Slowmations, there was an obvious pedagogical advantage: When the children recreated the evaporation phenomenon, this process 'forced' them to reflect about the explanatory model they needed to represent. One could argue that the creation in playdough or LEGO© itself would have been sufficient to promote the discussions about explanatory models, but the documentation in terms of a Slowmation movie framed the activity in a positive way. The children were proud of their products and to have something to show their parents.

During the work with evaporation in this study, our main focus was not on the children afterwards being able to give the correct scientific explanation. The children's and the preschool teachers' work should be considered a beginning of a project about evaporation, where the experiment with the boiling water raised thoughts about the water disappearing upwards. However, the children did not connect the evaporated water at room temperature in the water bowl with the boiling water, so the water being able to evaporate 'by itself' would possibly be the next step to continue with. This could be done by producing time-lapse movies and comparing the amount of water in a glass without lid where the water level will sink to the water level in a glass with lid where water drops will condense on the lid after evaporation without the water level sinking noticeably. The resemblance with the boiling water

and the rising 'smoke' could promote the discussion and the learning. In the projects' initial phase, our main interest was in studying how the work method affected the children's reasoning, reflection and their communication about the phenomenon, regardless of whether the explanatory model was right or wrong. Worth mentioning, after our experience of the time-lapse movie with the ice cube rather enhancing the children's misunderstanding about the water sinking into the bowl, is that different natural phenomena could be more or less suitable to work with, in the making of time-lapse movies and Slowmations. Rapidly occurring natural phenomena are perhaps better envisioned in a slow-motion movie where the event is slowed down, while slow events, such as decomposition, shadows moving, etc., are best considered from a time-lapse movie where the series of events is accelerated.

7.2.5 The Role of the Teacher and the Size of the Group

When we analysed the material, it was evident that the activities where several children participated were more stressful, compared to when only two children were involved in Slowmation production, for instance. When two children worked, the atmosphere was calmer. The children spent more time reasoning about and creating the Slowmation. When they worked in pairs, more time was used to discuss how the camera should be able to 'see' into the playdough kettle, to put two playdough bubbles in the kettle at the time so that the event with increased heat and boiling was captured. The children were more concerned with details, and they had time to discuss with each other and the preschool teacher. When four children created a Slowmation about the boiling water, it was a more stressful situation. The children competed, put all the bubbles in the kettle at once, took a picture, poured all the bubbles out of the kettle, etc., unless the teacher asked them to calm down. Here, more time was used by the teacher to control the situation. Johansson and Pramling Samuelsson (2006) acknowledge the teachers' need for room for improvisation, communication and interaction with the children and how this is easier accomplished in smaller groups. Our results confirm theirs but also raise new questions about how learning contexts in preschool should be arranged, both from a pedagogical and structural perspective.

Worth reflecting over is also teachers' role as an intermediary of the phenomenon. There is a benefit in knowing the right answer as an adult but a challenge in holding back in presenting this knowledge to the children. The results from this study show the preschool teacher sometimes leads or 'pushes' the children's answers in the correct direction, at the same time encouraging them to have their own ideas and hypothesis. This is a balance act that is perceived as difficult by experienced preschool teachers, to guide the children successively. The challenge is to rest in the, for the moment, wrong hypothesis and in recognising the value in the children discussing a phenomenon together from different points of view. The next step is then to plan new activities with the aim to guide the learning process further.

7.3 Conclusion

Our study shows that the children's work with creating time-lapse and Slowmation movies supported them in the mutual discussion and reflection around a natural phenomenon. While the time-lapse movies helped the children notice details and characteristics in the phenomenon, the benefit from the Slowmation production was the children being 'forced' to reflect around explanatory models for the same phenomenon. We therefore share the view of Fleer and Hoban (2012) that Slowmation creation generates a purpose to explore natural phenomena. When the children in an imaginative way work with the animation in material such as playdough, their ideas and creations turn into a concrete and visible product they are proud of.

To conclude, our study points to time-lapse and Slowmation production as beneficial and efficient tools to unite the two knowledge domains within science (Eshach 2006), that is, content (facts, explanatory models) and investigations (observations, problem-solving) in the work with young children's learning in science. The software needed is easy to obtain to no or a low cost, and the work model described by us can therefore be used in most preschools. Our wish is that the use of technology in preschool is integrated with content and children's everyday experiences.

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Chapter 8
Digital Play and Learning in the Home: Families' Perspective

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8.1 Contextualising Digital Play in Young Children's Homes

Early childhood is a precious and sacred time when learning and developmental foundations for future success are established. It is widely acknowledged that parents are the child's first educators (Stephen et al. 2013) and that families "play an important role in providing children with opportunities to access and use digital tools at home, which in turn influences their learning" (Neumann 2014, p.112). The home environment is often the first context where children access and experience digital technologies. It has been the focus of research (e.g. Pahl 2010; Marsh 2006) with strong argument for the need to continue to examine these contexts to understand how technology can "enrich rather than hinder children's play experiences" (Johnson and Christie 2009, p. 285). With increased access to the Internet in many homes, comes increased variety in the types of technological activities available to children. The importance of the decisions made by families regarding digital technologies is clear. Indeed, "it is parents who 'are the real experts in their toddlers' use of screen technologies" (Holloway et al. 2015, p.1). Additionally, it is noteworthy to mention that when we talk about families, it is not only parents who influence young children's experience with digital technologies but also other family members such as older siblings (e.g. Matsumoto et al. 2015).

There are reported concerns about screen-based technologies in children's lives. Byron (2008) refers to this "fiercely polarized debate" (p. 1) that cites issues such as social isolation and obesity on one hand and the richness of creative opportunities technology offers on the other. Parents are the recipients of often-conflicting messages as they are encouraged to restrict screen time, consider where and when

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screen time occurs and be appropriate role models for their children (Holloway et al. 2015; Plowman et al. 2010).

Parents appear under pressure to make choices to best position their children for success in educational contexts. Recent Australian research on playgroups (McLean et al. 2014) indicates that families value both formal and informal opportunities to enhance their children experiences in the early years. Early childhood is acknowledged as a time where stimulation is essential for cognitive development, and these foundations play an integral role in a child's later success (e.g. Melhuish et al. 2008). The vulnerable position of families is clear when these perspectives are coupled with warnings about the irreversible changes in human biology that technology brings (Alliance for Childhood 2004) and the alarm of the addiction that comes with "digital drugs" (Bruner and Bruner 2006).

Regardless of such cautions, as digital tablet technologies become more available, accessible and affordable, children from very young age are using these technologies in their homes (e.g. Neumann 2014; Holloway et al. 2015; Verenikina and Kervin 2011). Recent research has found that children as young as 2 years of age proactively seek regular experiences to play with applications (apps) for their leisure (Huh 2014). This puts additional pressure on families in making decisions about what technology to use, when to use these technologies and how they are used. Yet, when selecting apps, parents were found to use intuitive criteria such as attractiveness for children and presence of educational features (Howard and Wallace 2016). As suggested by Yelland and Gilbert (2011) there is a need for the development of "realistic, evidence-based guidelines for parents/carers regarding very young children's engagement with digital technologies" (p.5).

Research on parental mediation of children's use of technology has reported mixed findings (e.g. Lee and Chae 2007) where some families "value more traditional activities" while others "provide and embrace computers at home and seek to maintain a balance between digital and non-digital activities" (Neumann 2014, p.110). Some parents are cautious and concerned that "apps could be detrimental to their child's cognitive or emotional development" (Howard and Wallace 2016, p. 8), while others embrace the collaborative opportunities onscreen environments offer (Kervin et al. 2015).

The role of parents in making decisions about access to technology for young children is a relatively new research focus (Valcke et al. 2010). What is consistent though in the findings is that families face several challenges as they make decisions in response to growing complexities evident in digital technologies. Livingstone and Helsper (2008) identify that little is known about the strategies parents employ in making decisions about technology. Stephen et al. (2013) identified four contexts which influence young children's use of digital technology at home: parents' perspectives about "the value of play with technology," "their understandings about how learning should be supported," "their typical ways of interacting with their children" and children's "individual interest" in using particular types of digital technology (pp. 160–161).

There is some indication that parenting styles can contribute to the ways children engage with technology. For example, Rosen (2008) found that there was a

relationship between the parenting style and the child's Internet behaviour. Valcke et al. (2010) talk about "Internet parenting styles". They identified that "parental control" and "parental warmth" are two major factors in parenting styles that affect children's technology usage. A permissive parenting style enables less restricted Internet use, while a strong controlling parenting style is associated with greater control. Of most importance has been "support, enriched with talking" (Valcke et al. 2010. p.457) and conversation about the technology use, with modelling of appropriate technological behaviours. This poses interesting considerations for how it is that applications are sourced and engaged with on mobile devices.

8.2 Introducing Our Project

This chapter represents data from our Australian Research Council (ARC) funded study that captured three interrelated perspectives of digital play – families, educators and children (Verenikina et al. 2013). In this chapter, we draw upon data collected from our family participants as we explore their perspectives on the role and place of the tablet technologies in their children's educational and recreational activities. Using a snowballing sampling technique, 17 families with children aged between 3 and 5 years who regularly used various tablet technologies in their homes were invited to discuss their children's experiences with these technologies. Our interview data includes the perspectives of 16 mothers and 3 fathers across 17 families. Both the mother and father from two families chose to be included in the research.

Through initial semi-structured interviews, we sought individual family's perspectives about digital play. A researcher conducted these interviews with a parent(s), and most often, the focus child (aged between 3 and 5 years) was present during the interview. There were occasions when other siblings were in attendance too. Interviews lasted between 19 and 53 min (averaging 37 min).

The children were involved in a series of digital playgroup sessions (with 2–3 families present each time) where observations were taken by the researchers. In the later sessions, five separate focus group interviews were conducted. Parents were invited to talk with a researcher in a space removed from where the children were playing, separated by a two-way mirror. Two parents did not participate in the focus groups as their children requested they stay with them. The parents who did participate were able to see their children during the focus group interviews as their children engaged with the playgroup with another researcher. These discussions provided opportunities to explore emerging themes from the initial interviews.

8.3 Exploring the Perspectives of Families

In what follows we aim to share the perspectives of the families who participated in our study as they offered response to our questions about:

- Practices of using the tablet technologies with young children
- Choices of appropriate applications for their children
- The ways that they monitor the use of these applications in their families

After exploring the responses to these questions, we were able to identify themes within the individual and focus group transcripts that we now report.

8.3.1 Practices for Using Tablet Technologies with Children

All the parents were able to talk about "ideals" for digital practices in their homes. Our analysis of the transcripts revealed that conversation tended to focus on the importance of their children having technological expertise and the important role siblings play in guiding tablet use.

8.3.1.1 Technological Expertise as a "New Basic"

As per our selection criteria, the children all had access to tablet technologies. Discussions with the parents revealed a range of technologies (in addition to tablets) were available in their homes. Parent 7 listed the technologies available in their home, "…we have iPads, iPods, smartphones, computers …what seems to be the basics these days". We were interested to note that those families that listed the technologies they had often spoke in plurals indicating that they had more than one of each type of these technologies in their home. The families we spoke with overwhelmingly acknowledged their belief that these technologies were commonplace amongst families. Parent 5 described, "everyone's got these devices … in our family, cousins, and friends ... they all have them and they all use them".

All but one family positioned access to and use of technology as essential experiences, or a "new basic", for their pre-school aged children. Parent 8 spoke explicitly about her wish for her child "… to have the basics", she elaborated on this to describe "… they should have the basics of how to operate [the technology] … I don't want him left behind".

For many parents, it was their observation of other children in social contexts that motivated their desire to provide their own child with similar opportunities. Parent 2 described, "…I used to still bring colouring books … No one brings stuff like that anymore … you just bring your iPhone, iPad, whatever and it's easy". Parent 4 described her observations of her child stating "I think he's on par, I'm hoping he's on par".

Other parents sought advice before providing their child with access to technologies. Parent 7 described, "I was talking to some colleagues and my husband about it and in the end I thought, why am I stopping her from getting this as this is the generation that she's in". Comments like this revealed the sense of entitlement parents felt their child had to access to technology.

8.3.1.2 Role of Siblings

Although children aged 3–5 years were the focus of our research, parents did not focus just on these children when talking about digital play. Rather, in families where there were siblings (15 of our 17 families), parents spoke about interaction patterns between and amongst their children. Twelve families spoke about positive interactions, and three families spoke about negative interactions amongst siblings.

Older siblings were identified to be powerful in the apps that were engaged with in the home. Parent 6 described, "…his [older] brothers dictate what they're playing…" The use of "dictate" by this mother was interesting in that it suggests that it is the older children who direct the digital play with younger siblings expected to follow and conform. However, parents also identified that younger siblings observed their older siblings; they were aware of the apps they chose to play and in the most wanted to be included. Parent 11 described that while her younger daughter wasn't interested in playing a particular app, she did "watch [older sister] and attempt to have a play with it herself". Parent 8 shared, "[older child] showed her how to use the iPad and I thought it was so cute. [older child] was being very motherly ... because [younger child] wanted to play ..." This mother expressed her feelings "… this is really nice, they're playing together". Parent 7 observed, "she's seen her sisters playing. She just wants to be like them".

Older siblings appeared to play a mentoring role with younger children. Parent 7 described "… she realises, you know, sometimes mum's pretty useless" and shared that her younger daughter often turns to her older sisters for advice with apps. Parent 3 shared that her younger son often turns to an older brother to get him through "tricky bits" of an app, further describing "he'll [younger child] give the iPad to [older child] to try and get him up to the next level because [older child] can do that for him and they get extra points". It appears that in many families, it is the older sibling that has the most knowledge of the platform and the apps and this is acknowledged and relied on by younger children.

These previous examples, and others, suggest that digital play is a collaborative activity across families where siblings were present. Parent 14 described, "the older boys tend to work together". Likewise, Parent 7 explained, "they'll sit together and you can see them giving feedback to one another to get through whatever they're doing". Parent 18 shared the conversations she'd heard her children engaging with that in her opinion, "enhanced their relationship because they've had to actually talk about [the play]". Opportunities for collaboration seemed to foster positive and purposeful interactions between and amongst the siblings. However, parents also discussed a negative side of such interactions. They focused on disagreements that

sometimes occurred between siblings during episodes of digital play. Parent 18 described, "[Child 1] had actually gone in and killed [Child 2's] something and [Child 2] was very distraught about it and so then [Child 2] retaliated and we had like this cyber war happening". It appeared that the ability for siblings to network with each other in some of the apps they encounter facilitated a virtual play space that was more difficult for parents to monitor.

8.3.2 Parental Choices for Applications for Their Children

Parents were asked to describe how the apps on their family's devices were selected. Their conversation tended to focus on the selection processes, parents engaged with, with particular emphasis on their attention to educational apps.

8.3.2.1 Selection of Apps

The cost of the app was identified as a contributing factor for ten families. Parent 2 shared, "I have never paid for an app", and Parent 6 explained, "I tend to look for the free games". Interestingly, some parents identified they would investigate an app more carefully if they had to pay for it. Parent 8 described, "... If I had to pay for them I would suss out whether it was worth paying that money". Parent 3 described "It creeps up on you… $1.69 [is the limit]... I've bought ones that have been $5 but it's pretty rare that they're that expensive".

All parents identified that they sought additional information about apps when making decisions about what to put on their family's tablet. Seven parents identified that they sought recommendations from friends to help make app selections. Three parents identified they engaged with Internet search engines (such as Google) to help them find appropriate apps. Parent 7 described, "I googled initially top 10, not top 10 but just top apps for – … children in an age bracket". Four parents identified that they sought out ratings or reviews for apps before providing their children with access to them. Parent 1 described, "The rating … if it's only got 1 star, no, and if one got 5 we'll try that one". Parent 6 described, "I remember reading the reviews".

The children appear to assume a powerful role in directing choices of apps in their families with 13 families identifying that it was their children who directed the apps on tablets in their homes. Parent 7 described, "…if she wants an app, she can look on iTunes for it but then she'll come to me and say, 'Mum can I have this?'". Parent 3 shared, "The kids come up every day, 'Can we buy this? Can we buy that?'". Two parents identified that they examined all apps carefully before giving them to their children. Parent 3 described, "Obviously before they get it I always do. Sometimes you have to buy them to actually see what they're like and sometimes they're duds and sometimes they're really good". Similarly, Parent 9 described, "I have a play with everything that I download for her or that I try out for her just to see if it's worth it". There did seem to be reference to the challenge of time across

the families when making app selections. These investigative processes take time, and while these might be the ideal, are not always the realities in the busyness of family life.

Overwhelmingly, the parents indicated their need for guidance with the selection of apps. Parent 1 questioned the apps that their child accessed saying, "it's my lack of knowledge of what is out there". This same parent shared "If someone could give me a list of really good apps that did a whole bunch of different things, not just, you know, letters and numbers or whatever, I would be very interested".

8.3.2.2 Attitudes to Educational Benefits of Apps

The majority of parents expressed their preference for educational apps. Parent 6 described, "... Ideally, we got this [iPad] for the fact that you can use it for educational things and things that are going to help [the child]". Parent 8 when discussing her app preferences described, "I prefer there to be some education factor in there". However, parents also acknowledged that these apps could prove problematic in terms of continued engagement for the children. Parent 8 described, "…some of those with storybook type ones … once they've used them a couple of times the story is old. They don't open them again so I just deleted them".

The parents were able to identify learning gains from their child's interactions with apps. Parent 11 described that many of the apps were too advanced for her younger daughter; however they provided opportunity to talk with her older sister "about what she's doing on there". Further, parents identified specific skill development such as "spatial awareness from that [Minecraft], from creating structures" (Parent 18) and three families identified specific letter and number knowledge. The ability of apps to expand content knowledge was explicitly identified by two families. Parent 18 described her young son's content knowledge had been enhanced by an app focused on bugs describing, "he can name a whole range of different bugs and he has looked for those in our back garden but we don't necessarily have the same bugs … that's been a lot of conversation around that which has been interesting". Parent 11 shared the example of her young daughter, and her grandfather exploring a fishing app "which shows all the different fish and every time he comes around, [child] asks to have a look at that app and they sit together and talk about the fish".

However, the parents shared that their child's interests were also a determining factor in the apps loaded onto devices. Parent 9 described, "I went looking for the puzzles … she really likes to have puzzles and I thought it's a great way to have puzzles and she can't lose the pieces, you can do them over and over again…another way that I put games on here for her is the TV shows that she likes". There appeared strong connections to popular culture with children drawn to apps that were connected to television programs, movies and favourite characters.

While there may be an intention that the tablet and apps be used for educational reasons, this was not always the case. Parent 5 described, "My husband and I prefer things that are educational for the kids but that doesn't always happen". Parent 14

described that there needed to be a balance between educational apps and recreational apps as he explained "It can't be just school, school, school all the time because they'll get over it". It appeared parents may have tried to use potential educational benefits to rationalise their child's time spent with apps. However, they appear open-minded about a wider range of benefits that digital technology might provide for their children. For example, apps were seen as a way to expand the experiences of children. Parent 4 described, "they need to open their minds up to a different world". Opportunities for apps to engage their children in creative processes were favoured. Parent 2 spoke about the movies her children made and uploaded to "HomeTube" for family viewing (a family designed compromise to YouTube where the family gathered together to watch created videos). This same parent identified she found it difficult to explain the type of learning that occurs. As example, she shared asking her child about her familiarity with an app and noted that even with new apps, her daughter "knew" what to do describing, "they intuitively know what to do so there's obviously some sort of learning. It's not like maths or English learning but something in their brain…" Children's ability to intuitively know what to do seemed to provide rationale for parents that access to technology was a contemporary requirement.

8.3.3 Monitoring the Use of Digital Technology

Overwhelmingly, the parents spoke about the management strategies they use to monitor their children's use of tablet technology. While parents acknowledged that their child(ren) were motivated to use tablets, conversation often seemed underpinned with a sense of worry about their child's exposure to technology and the need to control their appropriate use. In particular, issues of motivation, observed behavioural patterns and screen time were discussed.

8.3.3.1 Children's Motivation and Behavioural Patterns

All parents identified that their children were strongly motivated to engage with digital play. More than half of the families described their child's eagerness to engage with tablet technologies with descriptions like "…he is right into the iPad" (parents 5 &1) and "…they play on it for hours" (parents 3 & 5). The majority of the families spoke about the children's interest in tablet devices. Parent 8 described it as "…all-consuming …", and another stated "they would play on them all day" (Parent 3). Parent 5 shared "he's on it every day".

Interestingly three parents spoke about their child's initial attraction to the technology but noted that this had dwindled over time; another five spoke about their child's interest to technology as being self-regulated and not intense. As example, Parent 9 described, "…she is quite happy to leave it and come back to it". Parent 7 shared, "it can be played some days and then there's most of their full week and it

hasn't been touched". Parent 4 indicated their child was happy to move from the tablet to outdoor activities explaining, "Sometimes I say give it a break but most of the time I don't have to say that, he just gets off it. He's an outside kid …"

However, four parents spoke explicitly about difficult behaviours observed when their pre-school aged child interacted with the tablet, identifying the device as being all-consuming. Parent 1 shared, "I can't get his attention … when he's on the iPad … he's just not with me. Just so intent on what he's doing". Parent 6 observed their child ignores their requests for them to put the device down with another parent reflecting their child "…can get a bit agitated" when using the tablet for extended time. These children seemed to become quite engrossed in the apps they are using. Parent 3 shared their child responds "I just want to finish this game" when asked to turn off the device. Another parent commented that the open-ended nature of the apps and lack of specific goals could make it difficult for children to see an end to the play (Parent 10).

8.3.3.2 Uncertainty About the Screen Time

All but one family spoke about screen time yet, there seemed some confusion about screen time, recommendations and consequences. Parent 8 questioned, "… how much time is too much time? I don't know, I saw something the other day about … how much screen time, apps and all those [is appropriate]". This was echoed by Parent 5 who shared "I worry because you always hear leaving young children on devices for too long is not good for them … I don't know why it's not good for them". For most of these families, conversation centred around their knowledge of how much screen time was appropriate and guilt when this was exceeded. Parent 8 acknowledged their child "gets more than they recommend", and Parent 5 shared "…I feel guilty sometimes because he spends so much time on it". While the parents knew there were recommendations, they did not identify exactly who made these recommendations.

There was a feeling across the families that too much of screen time was "not good" for their children. Concerns seemed focused on the developmental needs of young children. Parent 6 commented, "…because their minds are still growing, aren't they?". Parent 2 talked about information that she had accessed – "There's some study I read that said there should be no screen time …" However, for some families there was little understanding about why extended screen time wasn't recommended. For example, Parent 5 shared, "I don't know why it's not good for them. I've never thought about why but I guess that I've got that in the back of my head".

Some parents spoke about their responsibility in ensuring appropriate use of tablets. Four families spoke explicitly about the need to put limits on their preschooler's use of the tablet. Many families identified time periods that were appropriate for digital play; for two families 20 min was a sufficient time period (parents 7 and 5); other families decided children should be on the device for less than an hour (parents 10, 1 and 12). Others were noncommittal to an exact time period but knew there needed to be boundaries (parents 18 &11). Further, the time of day for digital play

was important to some families. As example, Parent 2 spoke of the need to "… be ready to go to school before anything goes on" (in reference to preschooler and older siblings); another identified the children were too stimulated to sleep if played in the evening (Parent 11).

However, three families disagreed with the concern for screen time. Parent 7 noted that in her house managing screen-based technologies "…isn't something that I found as really being a big deal" citing that her children did not regularly use the technology and often needed to be reminded that they had it. Parent 9 pushed back against concerns about children being exposed to screens all day dismissing "children-as-zombie" concerns saying, "clearly, that's not the case". Parent 2 described "I think they get more out of playing on the iPad than sitting watching a program on TV where you're just tune out" (interestingly, this was the same family who had created "HomeTube"). Parent 7 felt there wasn't any need to impose time restrictions on tablet use as the children in that family were able to self-regulate interactions. In this family, it appears that the tablet was not a play activity that the children selected regularly or for extended periods. Parent 1 described they have "… no rules, no time lines" as the need had not arisen.

8.4 Tensions and Contradictions for Parents

The parents were aware our research was focused on digital play and were recruited accordingly. Both individual and focus group interviews provided opportunity for us to co-construct understandings with parents as we problematised digital play which revealed tensions and contradictions. While parents accepted that play (including digital play) is integral to the lives of their children, they seemed to continually justify and validate the decisions they made about digital play in connection with screen time, behavioural observations and their desire to make the "right" decisions for their child.

While parents feel that digital technologies are an important part of their children's current and future life, our research concurs with others (Holloway et al. 2015; Plowman et al. 2010) that there appears a degree of uncertainty in parents' thinking, and even concern about the best ways that these technologies should be used. Three central areas appear at the forefront of their minds: the nature of the knowledge that digital technologies provide to children, choosing apps and the benefits and potential detrimental effects of the technologies on children's learning and development. The parents seem to reveal tensions and contradictions as they make sense of each area in their own homes for their own children. Figure 8.1 identifies tensions and contradictions in parent response for each area as parents work to discuss and question digital play within their home contexts.

1. *Practices: What knowledge do digital technologies provide?*

All parents identified access to tablet devices was important for their young children. They felt that access provided children with experiences that led to new

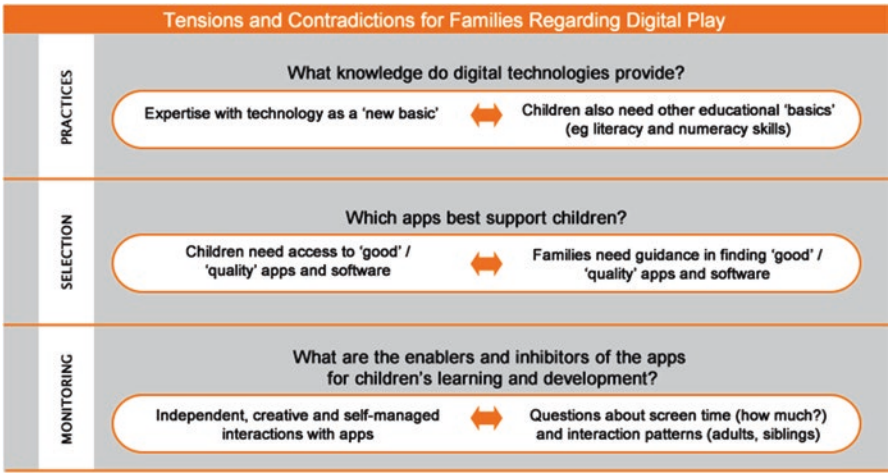

Fig. 8.1 Tensions and contradictions in parents' thinking about the role of digital technologies in their children's lives

knowledge that is valued and important within their communities, specifically in relation to children's future. The children all had access to other technologies too, in addition to the tablets that were focused on in this research. There did appear to be some nervousness about access with the desire that their children would have sufficient experience and opportunity in these foundational years.

The parents acknowledged the importance of early learning for their children's future academic success, with digital play providing "basic" knowledge that children should experience prior to formal schooling. This emerging knowledge from digital play was positioned alongside other educational "basics" such as literacy and numeracy with "digital knowledge" being learned concurrently with knowledge of letters and numbers. However, this "digital knowledge" in parents' minds appears to be something elusive and not clearly defined. There seemed to be tensions and contradictions in these parent's understandings and justifications of the knowledge children need. On one hand, they acknowledged that expertise with technology was necessary however and concurrently argued that children need other educational "basics" (such as literacy and numeracy). As Fig. 8.1 depicts, the parents seemed to find it difficult to rationalise the place of these more traditional expectations alongside new, emerging technological expectations in the lives of their preschoolers.

2. *Selection: Which apps best support children?*

The parents identified strategies they used to make choices about the "best" apps to provide their preschooler. Pretextual information about the apps served important roles as parents made decisions in consultation with affordability, reviews, ratings and recommendations from blogs, other websites and word of mouth. Interestingly, the children themselves seemed to have the most powerful voice when making

decisions about apps on the devices as they made requests and demands for what was available to them.

There appeared a preference for educational apps amongst the parents, substantiated by the need to position their preschooler for academic success in formal school. However, while this was the preference, their children's chosen activities didn't necessarily match this desire with many more leisure-like apps taking preference. While most parents accepted their children's preferences in selecting engaging applications, they seemed to also recognise the potential for engaging in apps that encouraged imaginative play. There also appeared a degree of peer pressure amongst the parents as they worked to ensure their child had equitable access across what was observed in other families.

While there was clear agreement about the importance of having quality apps, none of the interviewed parents were sure about the criteria in selecting software applications beyond common-sense criteria described. Presented in Fig. 8.1, there appeared a plea from these parents for more guidance on how to select apps for their children.

3. *Monitoring: What are the enablers and inhibitors of the apps for children's learning and development?*

Our findings reveal that siblings play an integral role in how pre-school children learn and play with the apps. The use of digital technologies enables older siblings being powerful in directing the app preferences of younger family members. Our research showed that as preschoolers observe app use, they often want to replicate these interactions, thus influencing the apps that preschoolers want and request to use. Further, older siblings seem to play a modelling and mentoring role as they guide preschoolers through apps and troubleshoot accordingly. It is older siblings that appear to be most powerful in directing digital play within the home setting.

The use of technologies in home environments was underpinned by parenting styles (Valcke et al. 2010). In the most, these parents encouraged creative outlets for app use. Parents shared the complex interactions that devices allow when networked as children play the same app together in a shared physical space. However, alongside positive interactions, some negative interactions were shared too as children networked in a space that was both unfamiliar and unobservable to parents. While the parents had reservations about their children contributing to public forums (such as uploading videos to external audiences), families did facilitate creative outlets (such as "HomeTube") to provide their children with a sense of both audience and purpose for their creations.

All interviewed parents appreciated the opportunities that tablet technologies provide for enhancing their children's experiences of learning and play. They particularly emphasised the importance of their children's engagement with these technologies in an independent and self-managed way. However, some parents expressed concerns about the duration and frequency of screen time that their children are exposed to (as illustrated in Fig. 8.1, bottom row). Across the parents there seemed to be awareness of the concept of "screen time", clouded with confusion about whom and for what purposes these regulations serve.

8.5 Concluding Comment

Parents want to make the best choices they can about tablet technologies in their children's lives. However, while the opportunities these technologies offer to children are acknowledged, there is confusion about how to best facilitate these experiences in the home setting. On the one hand, parents projected understanding of the role of technology within contemporary society and emphasised the need for their children to have access to this, while at the same time they were unsure about the place of digital play in their child's day-to-day lives. Further, the parents valued "quality" digital play experiences yet seemed unsure about the diversity and range of available resources and which ones were most appropriate for their young children. Our research points to the need for parental knowledge of digital play to equip them with informed confidence to make choices about digital practices, selection of apps and the monitoring of this in their homes.

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Chapter 9
Rules of Engagement: Family Rules on Young Children's Access to and Use of Technologies

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9.1 Introduction

Research on young children's digital lives conducted over the past decade has demonstrated that their engagement with technologies represents a significant change in the way children interact with each other and their environments (Marsh et al. 2005; Plowman et al. 2008; Rideout 2013). These new practices reflect a "participatory culture" (Jenkins et al. 2006) in which many children create local, national and global links online with others and act as creators and not simply consumers of media texts. Yet despite the growing number of children aged 8 and under who are

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accessing and using a wide range of technologies, little is known about how far parents mediate this use or what responses children have to parents' interventions and rules that guide their use of digital technologies (Holloway et al. 2013).

This chapter reports on a study funded and coordinated by the Joint Research Centre of the European Commission (Chaudron et al. 2015) which aims to explore young children and their families' experiences with digital technologies such as smartphones, tablets, computers and games. The project involved seven countries: Belgium, Czech Republic, Finland, Germany, Italy, Russia and the United Kingdom. In each country, interviews and observations were undertaken with ten families in their homes, each with a child aged between 6 and 7 and many with younger and older siblings. The project sought to examine young children's access to and use of digital technologies and to explore how parents mediated this use.

This chapter reports on the findings of the study that relate to the rules that parents do, or do not, impose in relation to children's access to and use of technologies, reflecting on the effectiveness of parents' mediation of children's online practices, and their awareness of the risks/opportunities balance. In addition, the chapter considers children's understanding and management of parental rules, analysing the kinds of negotiations they undertake with various family members that shape their engagement with technology. The chapter concludes with a consideration of the implications of the study for policy for this age group.

The study is located within the field of new literacies (Lankshear and Knobel 2011) which is itself informed by new literacy studies (NLS) (Street 1995). NLS identifies literacy as a social practice that takes place in situated contexts, in contrast to models that view literacy as a technical and neutral skill, such as those approaches embedded within school curricula. New literacies draw on key tenets of NLS but emphasise the multimodal and multimedia nature of contemporary communicative practices. In the digital age, children draw on much more than alphabetic print to make meaning as they are engaged in reading, writing, designing and producing on screens of all kinds.

The study also is informed by the work of Bronfenbrenner (1979), who developed an ecological model of child development. He argued that individuals exist within

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overlapping ecological systems that are "a set of nested structures, each inside the next, like a set of Russian dolls" (Bronfenbrenner 1979:3). The first of these structures is the microsystem; this is the immediate environment in which the child or children under study are located at any point in time, which can be home, early years setting, community group and so on. The mesosystem links two different microsystems together, for example, the home and classroom. The third level, the exosystem, involves contexts in which children are not active participants but which impact significantly on children's lives. For example, parents' workplaces might have an impact on parents' approaches to child rearing. Finally, the macrosystem is the larger cultural and social context that impacts on the way in which children live, such as the political system or cultural values of the society in which they live. In relation to the use of technology, Bronfenbrenner's model emphasises that attention should be paid to the interrelation of a range of factors which shape individuals' engagement with technology. This includes their interaction with parents and siblings, which is the focus of the discussion in this chapter. In addition to being informed by new literacies and ecological model of child development, the study also drew on parental mediation theory (Clark 2011), outlined in the following section.

9.2 Parental Mediation of Children's Technology Use

Research focusing on children younger than 8 has established that digital technology is an important part of family life, with children's uses of a range of software and hardware shaped by family values. Ethnotheories are culturally shaped systems of beliefs within families (Kenner et al. 2008), and inevitably, these ethnotheories inform how parents mediate children's use of technologies (Marsh et al. 2015b; Plowman et al. 2008). The effects of parental mediation in turn impact on family values and ethnotheories. As Livingstone and Helsper (2008, p. 582) suggest, "Parental mediation both results from processes of family dynamics and child socialization and contributes to the shaping of family values, practices, and media literacy".

Parental mediation theory relates to the way in which parents enable children's access to technologies and then mediate their uses of it (Clark 2011). Initially, the theory was applied to television, and early studies suggested that there were three main types of parental mediation: restrictive mediation, instructive mediation and co-viewing (Nathanson 1999; Warren 2003). Restrictive mediation refers to practices which include restricting the amount of time children can view television or only allowing specific programmes to be watched. Instructive mediation includes discussion about the content of programmes, which might be negative or positive in nature. Co-viewing consists of shared viewing, which might be undertaken for a variety of purposes, including having fun. In a study of parental mediation of pre-schoolers' use of television, Warren (2003) found that most co-viewing was co-incidental and both restrictive and instructive mediation were more commonly found, with the greatest use being made of restrictive practices.

Whilst some studies have found similar patterns in relation to parental mediation of other technologies, such as videogames (Nikken and Jansz 2006), there is evidence that a wider range of strategies are employed in relation to parental mediation of the Internet. Livingstone and Helsper (2008) identified four factors that characterised parental styles of mediation of the Internet, in relation to the online lives of pre-teens, teenagers and young people: active co-use, interaction restrictions, technical restrictions and monitoring.

Active co-use integrates the previous separate categories used for television, co-viewing and instructive mediation and includes parents and children talking about Internet sites and the rules involved with using the Internet. Livingstone and Helsper (2008) argue that the very nature of co-use of the Internet means that conversation is more likely to occur than when co-viewing television. Interaction restrictions are another specific feature of Internet use, given the features of social networking sites that facilitate interaction. Technical restrictions include the use of firewalls and privacy settings, and monitoring involves parents checking up on children and young people's use of the Internet either whilst present (over the shoulder) or through the use of the history feature of web browsers.

In a more recent study, Nikken and Jansz (2014) drew on data from a survey of 792 parents of Dutch children aged between 2 and 12 to develop a tool to assess parental mediation of young children's Internet use, building on the categories developed by Livingstone and Helsper (2008). They found five styles of mediation that could be reliably measured: co-use (using the Internet together), active mediation (e.g. helping children to understand what to do when being harassed online), restrictive mediation (general restrictions, such as time limitations), restrictive mediation (content restrictions, such as banning certain sites) and supervision (parents monitoring children's Internet use when nearby). Nikken and Jansz (2014) found that parents did use antivirus programmes but rarely used child-orientated safety features, such as time limiters. Mothers were found to engage in parental mediation strategies more often than fathers, and those parents who went online less often than others were more likely to restrict their children's Internet use.

Whilst the study reported in this chapter focused more broadly on young children's use of digital technologies, there was an emphasis on examining how parents mediated children's use of the Internet. Both aspects are considered in the discussion of the data.

9.3 Research Design

In each of the seven countries that participated in the study, the original aim was to recruit ten families, 70 in total, who would be diverse in terms of children's ages and gender, ethnicity, family composition and socio-economic status. Families were recruited that had children aged under 8, with at least one child who used a digital

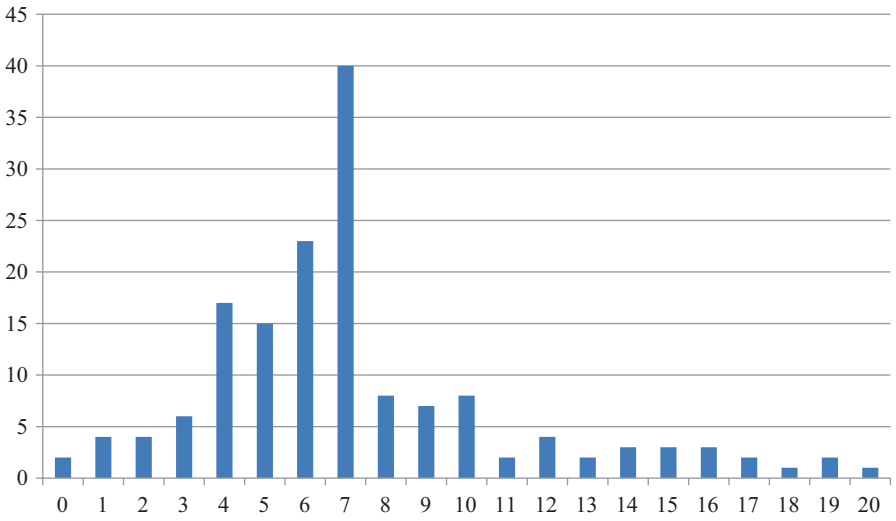

Fig. 9.1 Ages of children who lived in families that participated in the study

technology regularly, i.e. once a week. Each national sample was constituted to try as much as possible to provide variety both in terms of habits in the use of digital technology (distinguishing users of digital device in their frequency of use: "low users", at least once a week; "medium users", at least two or three times a week; "high users", at least once a day) and in terms of family structures (including single-parent families, families with an only child and families with siblings both younger and older than the target child). Across the seven countries, this diversity was achieved, although participation of families in low socio-economic groups was limited within some countries because the time constraints of the project meant that participants were identified through contact with schools that served more affluent communities. In other countries, sampling also took place via day-care or social services centres or through snowball sampling, which is a non-probability sampling strategy in which existing research participants suggest new participants based on their circle of existing contacts.

Whilst children aged 6–8 were the focus of the study, other children in the household also participated in interviews where this was feasible. Figure 9.1 indicates the range of ages of children who lived in the families that participated in the project.

All interviews followed an observation protocol (see Chaudron et al. 2015), but because of the exploratory nature of the study, each research team had the freedom to adapt it according to specific interview contexts and needs (e.g. country, culture, family context and so on). The interviews were conducted in the home of the participants, with the exception of one Belgian interview, which was conducted in the community service centre where the family was recruited.

The interviews generally had a common structure and were divided into four parts. A short family introduction took place in which the children and parents took part in a joint discussion. Subsequently, parents had a short interview with one of the researchers, whilst a second researcher discussed digital technologies separately with the child/children using age-appropriate tools such as card games. A concluding session gathered the family back together, along with the two researchers, for a final discussion. In some interviews, a digital technology tour of the house was undertaken. All interviews were audio-recorded, and, where possible, visual data were collected in the form of still images or videos.

Data analysis was undertaken utilising a thematic approach (Braun and Clark 2006), based on grounded theory (Corbin and Strauss 2008) in that an inductive approach was employed. The following codes emerged: type of technology/toys; time spent with technologies; property of technologies, who uses them and where; activities of children and parents; game type (characteristics and notes); digital skills; favourite technologies; favourite offline activities; interconnection of online and offline; current perceptions; perceptions of the future; active mediation (behaviour and rules); and perceptions related to mediation (opinions about parenting and values). In the following sections of the chapter, we draw on the data to address in particular the following questions:

- What rules did parents have about children's uses of digital technology?
- What was parents' awareness of the risks/opportunities balance in relation to children's uses of digital technology?
- What was children's understanding and management of parental rules?

9.4 Parents' Rules About Technology Use

Across many of the families, rules were in place with regard to children's use of a range of devices. The emphasis was not focused primarily on the content of the devices but on the times, places and situations in which they could be used. Rules regarding time were pervasive across all countries. In many families, screen time of all kinds was temporally restricted, either by limiting children to using technologies at certain times of the day (e.g. before or after dinner) or, in some cases, using timing devices to ensure children stopped using the devices after a certain period. As has been found to be the case in previous studies (e.g. Lee 2012), restrictive rules appeared to relate to concerns about media effects, with those who expressed the most anxiety about the use of media being most restrictive in terms of time. In some families, it was not considered necessary to set rules regarding time use at all, as the children were viewed as managing this well themselves:

> *I know that in some families it is a given that, for example, you can play every day; but it is not like that in our family, because they do not use technology like that, so that we, adults, don't need to limit them; we feel that it is OK – in inverted commas – "the time spent using technology"* (Czech Republic, Family 5, Mother)

For a number of families, access to some technologies was more limited than others. For example, smartphones were considered more delicate and prone to accidents than other hardware, and so, in some families, access to these was closely monitored.

Rules were shaped by parents' ethnotheories, and attitudes to digital technologies formed one aspect of this belief system. In many families across all seven countries, access and use of technologies was frequently used as a reward or punishment:

> *When he is allowed to play with the smartphone and I catch him doing other things, I take it away from him. I try to keep the consequence connected to the cause. In my opinion, children have to recognise that doing wrong is connected to the penalty directly.* (Germany, Family 5, Mother)

Parents who adopted a more permissive parenting style were more likely to also adopt a permissive approach to media-use rules and vice versa.

Some rules were quite creative and idiosyncratic to families – in UK, Family 3, a parent noted that "On Sunday the internet shuts down at 6 o'clock" and the children are told that since the computers are all networked together, "What you can see in your computer… I can see on mine". In Italy, a family placed devices and controls out of reach of the children:

> *When they want to use the iPad and other technologies they have to ask us because they are located in places they cannot reach [laughing].* (Italy, Family 2, Mother)

In Italy, Family 2, two children (5 and 6 years old) owned an old smartphone with pre-installed games and connected to the domestic Wi-Fi network, but, in order to use it, they had to request their mother's battery because the smartphone had an old battery which no longer functioned. These various strategies all discouraged autonomous uses of devices.

Parental mediation was also affected by parents' own knowledge of, and confidence with, technology, as has been identified in previous studies (Clark 2011). In Finland, for example, the father in Family 10 was a university-educated engineer, who worked in computing. He was able to set up technical restrictions and was also very aware of the potential hazards of Internet use. It also appeared to be the case that parents who were not confident with technology themselves were sometimes stricter in terms of access to media, perhaps because they did not understand how to control its use.

Rules were rarely static; rather they appeared to evolve over time. They were often set up in response to problematic situations, rather than being a pre-planned strategy to minimise risks and maximise opportunities. For example, in Russia, Family 1, the mother reported that she set rules about the use after noticing the negative effect of using devices on the son's behaviour, commenting that "He was like a zombie".

In some cases, parents differed in their attitudes to technology and, thus, had different approaches to mediation. Fathers tended to be more *laissez-faire* or more involved in facilitating than restricting children's engagement with technology for fun. As was the case in Nikken and Jansz's (2014) study, mothers appeared more

often to guide, manage, limit and control their children's use of technology, although a few fathers did undertake this role (e.g. UK, Family 7). Because some children accessed technologies across a range of homes, either their own and grandparents' houses or the different homes of divorced parents, they found rules differed across households in the same family. Grandparents tended to be more permissive in terms of use than parents, whilst divorced parents could set very different rules about the use of the same devices. Children appeared to navigate the differences across spaces with ease.

Other aspects of rules also seemed to be fluid in nature. Rules were often subject to negotiation, which was particularly the case for older children. Different rules were constructed for individual children within the family, in some cases. For example, some children were identified as being likely to use technologies more often than other children in the family, and so specific rules had to be set for them. In a few families, it appeared to be difficult for parents to stick to the rules, and they seemed overwhelmed by the challenge of mediating children's access and use of technologies. Rules would, some parents felt, limit their own use:

> *We don't have any strict rules about who will use technology and how. It would be difficult to follow …, the rules… it's not worth setting them up because we would ourselves be slaves.* (Czech Republic, Family 8)

There was evidence of the mediation strategy of monitoring (Livingstone and Helsper 2008) or supervision. In many families, the computer used to access the Internet was placed in the living room, so that its use could be monitored. For example, the mother in Belgium, Family 1, suggested that she did not feel the need to intervene too much in her children's media use because she felt that they did not have the urge to explore inappropriate content, yet, nevertheless, she sometimes passed by, "…as unnoticeably as possible to check the site the children are on". For other families, monitoring was more direct. The mother in Finland, Family 8, for example, spoke about how she could monitor her daughter's online play by viewing her phone at any time.

Monitoring takes different forms. In the examples above, monitoring took place through the practice of looking at screens to see what children are doing, either overtly or covertly. In some cases, monitoring took place through checking the game played or sometimes through reading the game's review:

> *When I see that there is a game I don't like – some fighting – I tell him that we won't play. Because I'm trying not to make it aggressive for the kid… I come to have a look, what is there, if I don't like it, the game is over.* (Czech Republic, Family 9, Mother)

In other cases, parents could monitor sites accessed because children required help accessing sites:

> *They're both still at a point where they maybe have to check what the spelling is. So that's another way we're always checking, able to monitor what's going on. Although I would say when Gary gets to high school, he'll have his own room, he'll probably have his own computer in the room, and that's really where parental locks will be coming into play. At the moment, they don't – there's no need for it.* (UK, Family 10, Mother)

Most parents appeared to be unaware of how easy it was to access undesirable content on YouTube if filters were not applied. For example, one parent suggested that there was no need to check up on their children as they felt that they could anticipate what would be available for them to see:

> *I no longer check on them [while they use YouTube], because we more or less know what they are doing… They go on the YouTube app… Luckily YouTube's account suggests for them what they already like. My account is now all about the Winx and My Little Pony, even when I access it at work [laughing].* (Italy, Family 2, Mother)

This permissive approach was especially surprising when it became clear that parents did not always know how competent their children were at using technology:

> *If he logs in the open application and sees names and surnames of my adult friends whom he knows and communicates with, e.g. my best friend, he can freely type a message and send her kisses, smileys and so on from my account. Or he can get up early in the morning when I am still sleepy and call his granny. Several times he has taken pictures of his room and published them on my Facebook page. I logged in the day after he did this and saw a few comments from my friends like, 'Oh, Hey, Michail!'* (Russia, Family 1, Mother)

Livingstone and Helsper (2008) identified technical restrictions as one of the strategies used by parents of older children and young people. However, few of the families in this study employed technical restrictions. Some used filters on smartphones but not on laptops and computers or vice versa, with very few reporting the use of filters on all devices. This was similar to the findings of Nikken and Jansz (2014) who reported that software intended to improve children's online safety was rarely used by the Dutch parents they surveyed. It may be the case that parents are unaware of the software, or do not feel that it is necessary to use it, given other findings about their perceptions of relative online safety.

The EU Kids Online project identified, in relation to 9- to 16-year-old children, that the more online opportunities children enjoy, the more risks they face (Livingstone et al. 2011). Parents' general awareness of the risks and opportunities presented by the use of technologies varied across the families in the present study, as discussed below.

9.5 Parental Awareness of the Risks/Opportunities Balance

Parental mediation of children's use of technology is informed by their understanding of the risks and opportunities offered by its use. Although the majority of parents discussed risks associated with digital technologies, they seldom believed that these risks applied to their young child(ren), as they felt that they were too young to access inappropriate content online. However, in a few isolated cases, it was clear that children had occasionally accessed undesirable material.

The majority of parents did not appear to be concerned about contact and conduct issues, assuming that since their children did not appear to access online sites independently, these were not significant. In addition, scant attention was paid to

commercial risks, despite some children reporting being able to download games without having to use passwords:

Child: *I found the dog [app Talking Ben the Dog] and then there was something on top [of the screen] and then if you clicked there [on an icon that said 'free'] you got this game [app Talking Tom].*
Interviewer: *So you first got the dog, then you clicked on the dog and that's how you got to Talking Tom [App]?*
Child: *Yes.* (Belgium, Family 6, girl, aged 6)

Families reported that free to download apps frequently include in-app purchases that can be accessed by young children, but parents may be unaware until they see the bill (as in Finland, Family 1). In a UK study of pre-school children's use of apps, parents reported that one in ten children had purchased apps without parental permission (Marsh et al. 2015a). In a small number of families, parents actively managed the accounts for in-app purchases, such as keeping the password for the iTunes store secret or concealing the password for the set-top box, in order to prevent children renting paid movies on their own. Unusually, Family 10 in Italy allowed their 7-year-old daughter to use the Apple Store password to download free apps, and the child did not abuse this trust by purchasing apps.

In contrast to this lack of concern about current risks, parents expressed fear about the future media habits of their children, especially when they became teenagers. The risks they identified for this imagined future focused on health (e.g. harm to eyesight) and what they perceived as addiction to technology and a lack of social skills. This displacement of concern to some imagined future meant that very few parents reported actively using devices alongside their children in order to teach them safety strategies. Only in the few cases where children had been exposed to perceived risky or harmful content, such as violence or sexual content, did parents intervene and discuss the content with their children. For instance, the mother in Belgium, Family 1, saw her 6-year-old son watch a cartoon in which, according to her, one of the characters was being tortured. Her son did not seem to perceive the cartoon in the same way, however, and he found it funny. So, instead of forbidding her son to watch the cartoon, she attempted to explain her point of view with regard to its content.

Active mediation strategies took place in response to requests from children for help whilst they were trying to operate a device or play a game. Other instances of co-use were embedded within regular family activities, such as using Skype or Facetime to contact distant family members, parents and children sharing interests on YouTube and families using social networking products such as Facebook and WhatsApp. These activities provide opportunities for children to discern implicit rules with regard to the use of the sites and apps, even if parents do not teach such skills explicitly.

The opportunities offered by the use of technologies were appreciated by parents, who commented on the significance of technology for communication, for future schooling and employment and for leisure. This led to positive mediation in terms of providing access to the technologies parents' felt would be beneficial, but

there was little evidence of positive parental mediation in terms of guidance to specific programmes, apps, online sites and experiences, including educational sites. Indeed, one of the surprising aspects of the study was that children did not appear to use many of the devices for educational purposes, reporting instead widespread use of tablets and smartphones for games and social networking. This is in contrast to research with younger, pre-school children, which suggests that parents are keen to purchase educational software and apps (Marsh et al. 2015a; Plowman et al. 2008).

Whilst there have been a few studies of parental mediation of young children's access and use of technologies (Nikken and Jansz 2014), there are few reports of young children's responses to the rules and strategies imposed by parents. In the next section, reports made by children in this study on parental mediation are discussed.

9.6 Children's Understanding and Management of Parental Rules

The data from this study indicate that on the whole, children in this age group are fairly compliant with parents' rules and do not tend to challenge them. They know that if they are well behaved, they may receive a reward in terms of being allowed to use technology and if they are not well behaved, they may well be deprived of its use. In the Czech Republic, for example, a child in Family 1 stated: "For example, when I am naughty, mummy forbids me to use the MP3 player for four days, until I behave in a nice way".

Some children are unaware that rules have been set. The rules appeared to be internalised as a set of practices that are not experienced as constraints. For example, one girl (Italy, Family 1) hated videogames because she stated that they make you stupid, a view also espoused by her mother; a boy (Italy, Family 7) thought videogames could be used to relax yourself once in a whilst, exactly as his father had said during the interview. This normalisation of parental discourse may lead to the adoption of rules without further need for adult intervention.

In some contexts, children are not fully aware that parents are limiting their use of technologies. For example, they see changes in their tablet's configurations, discover that apps they like are no longer on their devices or that a device is not placed where it used to be, but they don't know why. Parental efforts to regulate their media use, in this case, are not understood by children, and so they are less likely to be interiorised. An interesting example of this dynamic emerged during an ice-breaker activity with Italy, Family 6, when all the family was gathered together. The mother told the interviewers that she gave her son two old smartphones to play with but changed her mind about this because of his behaviour. At that point the child stated, "I cannot find them anymore", as if it was his responsibility, but his mum had hidden the smartphones and not told him until that precise moment.

Children in general had an understanding of how parental rules were age appropriate, recognising as legitimate that older siblings could do more, use different devices or play different games because they were older, even though they might complain about this on occasion, or lack understanding of the full extent of their siblings' practices:

Child: *[At home] we are not allowed to use Facebook. Only the oldest ones (…) I have four brothers and a very big one, he is 20, I think. He is all the time on Facebook. But we [younger children] cannot go on Facebook.*
Interviewer: *And do you know what Facebook is?*
Child: *There you can find a girlfriend and look at pictures. And then you can choose which girl you find the prettiest…And you can fall in love and then the girl doesn't know that. And then he is sending [text]. Then the girl knows. And then they send to each other.* (Belgium, Family 9, girl, aged 7)

There were some exceptions to the general compliance, from children who did overtly attempt to get around rules:

> *I am very cheeky around [the] Nintendo…I always try to get [the] Nintendo at snack time. Sometimes I try and sneak [it] in under the table.* (UK, Family 2, boy, aged 5)

Technical restrictions (e.g. passwords) were easily bypassed by some of the children without their parents' awareness. For example, one of the mothers outlined how she ensured that her children could not access devices independently, as she protected devices with passwords. However, one of her 6-year-old twin daughters entered the password for the family iPad when asked by the researcher to demonstrate her use of the device. Her mother was surprised to see her on the device when she entered the room, and the child blamed her mother for revealing the password when she herself used the iPad:

Mother: *How did you get on to that?*
Child: *I don't know.*
Interviewer: *She put a password in.*
Mother: *Oh! Have you…?*
Child: *It's straight up the middle.*
Mother: *So you figured it out. Right, we've got to change that again now.*
Child: *Well it's your fault 'cos you're, like, showing us.* (UK, Family 5, Mother and girl, aged 6)

It tended to be the older children, aged 5 and above, who were able to challenge and resist parental rules in this way; younger children were more compliant. Finally, there was evidence of child-to-child mediation of technologies, with older siblings sometimes being given the role of monitoring young children's access and use. A number of the older siblings were protective of their younger brothers and sisters and appeared to realise that some content was inappropriate for them.

9.7 Conclusion

This study has provided a range of significant insights into the parental mediation of young children's use of technologies and online activities. Parents appeared to use a narrow range of strategies to mediate their children's digital practices due to their feelings that their children were not at risk. Parents tended to think that they would only need to actively mediate children's online use in the future. However, this appeared to be misguided, given that children demonstrated a wide set of digital competences and some were obviously able to access the Internet without the direct supervision by their parents. In addition, children would have benefitted from more active involvement by parents in their choice and use of media – parents could helpfully support young children in accessing good quality material online.

The study has also highlighted how children themselves either did not notice the strategies used by parents, or accepted them passively, which can be attributed to their young age. As Bronfenbrenner's (1979) ecological model indicates, children are influenced by a complex set of practices that impinge on their everyday contexts, and in this study, the impact of the micro-, meso- and macro-contexts on their digital practices could be traced. Further, the data indicate the new literacy practices associated with digital technologies are situated in specific contexts (Lankshear and Knobel 2011) and cannot be understood fully without paying sufficient attention to children's own perspectives.

The study has a number of implications for further research. Very little is known about how young children develop an understanding of online safety matters. Further studies are needed which explore this issue in depth, utilising participatory methodologies that place the child's voice and agency at the heart of the research project (Sefton-Green et al. 2016). There is also a need to undertake further research on the parental mediation strategies employed by families dispersed in some way, such as by divorce, given the complexities thus experienced by children as they attempt to navigate two domestic arenas. In addition, longitudinal studies are required that trace individual children and families over time, as this would enable the gradual changes and developments in parental mediation and its effects to be studied.

The study also has a number of implications for policy in the area. Previous studies have indicated that most children undertake a range of activities across a typical day, with technology playing as one, albeit important part (Marsh et al. 2005; Plowman et al. 2008). The present study confirmed this. However, whilst many parents did manage effectively children's access to a range of screens, some parents did not maintain boundaries and seemed unsure of the strategies they could adopt to ensure that their children did not over-use technology. Guidelines could be provided for parents on the positive ways in which children can be encouraged to integrate digital with non-digital activities. These guidelines could be offered by health visitors, pre-school practitioners and the mass media.

Second, given the lack of understanding, many parents demonstrated how to use filters and software that are designed to protect children online; guidelines could be

provided at an early stage in a child's life, before he or she has access to the Internet, and such guidelines could offer basic advice on the use of safety settings, passwords, privacy protection and content filters. Parents would also benefit from the provision of guidelines on communication strategies that could be used to talk to young children about managing online risks. As above, such guidelines might be best distributed by both professionals who come into contact with parents who have young children and by the mass media.

Finally, the study has implications for guidance on positive parenting in relation to the use of technology. Many parents recognised the positive value that technologies had in their children's lives but did not necessarily have sufficient knowledge to point their children to valuable resources, such as high-quality apps and websites. Support could be offered for parents in this area, in order to ensure that they can offer their children appropriate scaffolding. Not to do so runs the risk of children failing to maximise the opportunities presented to them in their future digital lives.

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Chapter 10
Hacking Toys and Remixing Media: Integrating Maker Literacies into Early Childhood Teacher Education

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10.1 Introduction

We are long overdue for a retooling of early literacy education to accommodate widespread fast-paced technological innovation. Despite growing evidence of a global shift from print to video on social media (Sargent 2016) and digital communication, literacy instruction in early childhood classrooms remains stubbornly print-centric. In schools, young children under 8 years old rarely have a chance to meaningfully engage, produce, or share their own original multimedia. In a 2012 survey (Wartella et al. 2013) of 1457 US early childhood educators, teachers reported that if school literacy involved technology, it primarily involved low-level basic operation of digital media: viewing television, listening to e-books, or clicking through computer task practice (Herold 2015). These limited instructional tasks not only underutilize the potential of these tools, they represent a gross underestimation of the significant semiotic and cultural work that young children accomplish through their play and design with emerging technologies in their increasingly digitally mediated lives.

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10.1.1 Digital Technologies and Makerspaces

The networks and practices for participating online are constantly evolving, but some throughlines include playful innovation, purposeful exploration, multiplayer collaboration, and digital media production. This is particularly true in makerspaces (Peppler and Bender 2013) where digital computing combines with manufacturing technologies (e.g., sewing, crafting, robotics). Making and makerspaces reflect a grassroots movement to technology, tapping into growing trends in independent inventions and entrepreneurial start-ups and do-it-yourself (DIY) cultures. The global maker movement has moved into education as schools and libraries provide makerspaces, focusing primarily on science, technology, engineering, and math learning through robotics, 3D printing, and computer programming (Halverson and Sheridan 2014). However, making also supports a range of creative opportunities that develop children's imaginative storying through filmmaking, animation, and puppet making that enable playing and crafting, with innovative technologies.

10.1.2 Maker Literacies

Literacies are expanding rapidly along with new technologies and innovative communication. Important to the early childhood focus of this piece, the small size, icon-based navigation, and intuitive interface of mobile technologies are highly accessible for young children and open new avenues for storytelling that are not dependent on a young child's abilities to read and write print. For example, using wordless digital puppetry apps and iPads, children can create live-action videos with smartphones to record their own play with friends or toys or create their own avatars as e-puppets in cartoons or stop-action films (Burnett and Merchant 2013; Marsh 2010).

What counts as text has changed from static to interactive in this digital revolution (Mills 2016). Writers/makers and readers/viewers of twenty-first-century texts need to be proficient at both producing visual imagery and artifacts and critically analyzing embedded texts in videos and everyday objects like toys. In this chapter, we ask: How might teacher education expand to update early literacy teaching to integrate new technologies and maker literacies? We use the term *maker literacies* to describe sets of practices for making and remaking artifacts and texts through playful tinkering with materials and technologies. Maker literacies include:

1. *Collaborative play* creates "action texts" (Wohlwend 2011, p. 3), stories enacted collaboratively with bodies, toys, props, and puppets rather than written with print on paper. During play, players agree upon pretend scenarios and revise the meanings of realities, bodies, materials, and actions (Thiel 2015; Vygotsky 1978). Through dramatic pretense, children collaborate to craft stories together and must decide who's playing whom (e.g., "You be Elsa; I'll be Anna").

These embodied live-action videos or animated cartoons are recorded using digital tools, such as tablets and smartphones, and then polished with video editing that enables trimming and rearranging film clips, dubbing voices, or adding an overlay of color wash, music track, or print (e.g., titles, captions, credits).

2. *Toyhacking* redesigns toys' materials but also their embedded texts. Toys come prepackaged with anticipated identities (Wohlwend 2009), that is, companies produce toys and games with particular consumers in mind, selecting tactile materials, color schemes, and designs, all manufactured to appeal to a particular demographic. Toys carry these sedimented identities (Rowsell and Pahl 2007) or histories of prior meanings, identities, and social practices as embedded identity texts (e.g., characters, toy consumers, film narratives, histories of use) deposited in the toy. Toys are played into significance in classroom peer cultures, accruing additional meanings (e.g., whose turn it is to play with which toy; which roles or actions a toy enables) over days and days of shared pretense with friends (Wohlwend 2011). Finally, popular media toys signify powerful emotional attachments (Marsh 2005; Pugh 2009) as well as multiple media platforms, children's experiences, and peer friendships.
3. *Digital filmmaking* saves a played story, making text durable and shareable (Buckingham 2003). When smartphones combine with popular media toys, digital storytelling captures powerful identity texts embedded in toys, providing a way to recognize and build on children's media knowledge as well as their funds of knowledge about digital technologies in use in their homes and communities (Burnett 2010; Marsh 2006; Nixon and Comber 2005).
4. *Video editing* remakes filmed texts by altering particular modes (e.g., color, animation, music, sound effect) (Kress 2003). Video editors trim clips to remove unwanted footage, dub or add voiceovers, music, or sound effects, and rearrange clips to alter the sequence of time to create montages, flashbacks, or other filmic devices. Apps make it possible to easily combine modes (Flewitt et al. 2014) or sync and edit multiple film clips to run side by side in the same shot. For example, the Acapella app provides a windowpane grid with 4, 6, 8, or more slots for individual clips simultaneously.
5. *Remixing* combines texts to create new meanings, popular in fan fiction, parodies, and mash-ups in social media (Ito 2007). Texts for remixing include not only verbal dialog or film scripts but also material messages embedded in toys' materials, histories of use, and user identities sedimented over time (Holland et al. 1998; Rowsell and Pahl 2007; Wohlwend 2012). For example, a small plastic Barbie doll in hot pink packaging tucked into a fast-food meal can be read as a toy for girls (only), an ideal of teenage fashion, an inducement to buy a hamburger with french fries, a fan identity in peer culture, and a preassigned role for doll players. In this way, popular media dolls, action figures, and stuffed animals are artifactual texts full of film narratives and songs, character traits and actions, manufactured materials and commercial uses, and child roles as players, fans, and shoppers but also as producers.

In this study, maker literacies included making puppets and amateur digital videos as well as remaking and remixing toys and the commercial narratives associated with children's favorite popular media characters from shows, films, and video games. This exploratory project integrated maker literacies through *literacy playshop* (Wohlwend et al. 2013), a curricular approach to early childhood literacy that merges dramatic play, collaboration, storytelling, crafting, and digital media production. This approach draws upon early literacy research (Marsh 2005, 2010, 2014) that shows popular media is tightly interwoven into the fabric of play, peer friendships, and ways of belonging in digital cultures. Literacy playshop builds upon children's media interests and play narratives, providing opportunities to invent and collaborate while also developing their literary and technical abilities to produce digital texts.

10.2 Introducing Maker Literacies in Literacy Teacher Education

Teacher education classes are an obvious place to respond to the paradigm shift from writing print-and-paper texts to producing digital video. To introduce preservice teachers to the potential of play and making as literacies, we developed a digital storytelling module that incorporated popular media toys, digital video production, and video editing in a makerspace. Excerpted from a 5-year study on literacy play, the data document a digital puppetry module in PK-3 early literacy methods classes for two semesters at a US Midwestern university (4 instructors, 140 university students). In this article, we focus on two classes, each with 20 university students, one instructor, and one researcher/facilitator. In each class, small groups of preservice teachers engaged in toyhacking by cutting up, gluing, combining, and decorating inexpensive commercial mass media toys followed by filmmaking live-action videos with the toys, video editing, and sharing. In a second session in their roles as literacy tutors at a local elementary school, the preservice teachers used the toys to create a film with an assigned kindergarten or early primary grade student, finishing the project with reflective blog posts.

Preservice teachers first read instructors' assigned readings, including classroom studies of literacy playshop (i.e., Wohlwend et al. 2013) and articles about the maker movement (i.e., Fleming 2014; Peppler and Bender 2013). During the next 3-hour class meeting, an instructor gave an overview of two maker literacies, toyhacking and digital storytelling, with video, photographs, and examples of hacked toys.

Toyhacking: Following this short PowerPoint presentation, preservice teachers began the toyhacking portion of the project; one of the two focal classes worked in the university's newly dedicated makerspace; the other class worked with a portable makercart (McKay and Peppler 2013) in the literacy methods classroom. Both the makerspace and the makercart provided craft materials and tools: craft foam, beads, fabrics, and fake fur as well as handsaws, hot glue guns, and

X-Acto knives. Participants were given about 40 minutes with the supplies to change/enhance inexpensive fast-food promotional toys and their associated popular media narratives.

Digital Filmmaking: Participants worked in small collaborative groups for about 40 minutes to create a single story with their hacked toys. They used the toys as puppets as the stories were acted out and filmed using the cameras on class iPads, sometimes augmented by mobile apps or sound effects played on smartphones.

Video Editing: In the final 40 minutes, after reviewing the raw film footage, the preservice teachers worked cooperatively to edit the clips into short films using the iMovie app on the iPads. Frequently, students spontaneously began browsing and downloading elements to add layers of music, sound effects, photos or video clips, voice dubbing, or other elements. After completing the editing process, students shared their films with the entire class.

The literacy playshop module concluded with the preservice teachers conducting a one-on-one filmmaking session with a 6-, 7-, or 8-year-old student in a local school, using the hacked toy to inspire children to create an original script. Following these sessions, these university students posted blog posts of reflective writing on the entire playshop experience.

10.3 Documenting Playshop Learning Through Video Data Nexus Analysis

Data sources include video of preservice teachers' toyhacking and filmmaking/editing, the collaborative videos they made with hacked toys, and their reflective writing. The research team worked together to catalog and summarize the events in each video clip, using Excel fields to tag the video data with identifier codes such as student IDs, materials, tools, toy names, and commercial franchises. In a next pass through the data, the team interpreted patterns of maker/player actions among participants in the video data, identifying a set of emergent codes. Through discussion, the team discussed differences and resolved these through consensuses to agree on common codes for this content analysis stage. Coded data within each maker literacy stage (i.e., toyhacking, digital filmmaking, video editing) were examined for further questioning and discussion within the team. For example, initial codes identified makers/players, their actions, toys, added materials, and attached meanings such as character names. We then followed the objects to track any changes in a toys' meaning or maker's/player's participation.

Nexus analysis (Scollon and Scollon 2004; Wohlwend 2014) provides a way of tracking seemingly intuitive digital literacies that are actually a learned nexus of practice (Scollon 2001) of tacit expectations, social practices, screen conventions, and computer navigation. In this study, we analyzed crafting and film production as assemblages of players, actions, materials, and texts to track collaborative meaning production and shifts in participation. Content analysis tracked maker literacies and

their patterns of meanings and participation as assemblages developed, from toyhacking to video editing. Nexus analysis of student films showed traces of prior texts (e.g., commercial music videos or amateur viral videos that inspired imitation) or tools (filmmaking template apps such as Acapella). We identified moments of collaborative transformation (e.g., agreements to change characters' texts, storylines, students' roles). Patterns in the video data were cross-checked with students' reflective blog posts for resonances and tensions.

10.4 Maker Literacies in Two Films by Preservice Teachers

For preservice teachers, the literacy playshop provided an opportunity for creativity and collaboration. This began with toyhacking in the makerspace, where they physically hacked toys to alter their commercial characters and narratives, embedded in the colors and materials of these artifacts. The preservice teachers chose familiar toys from popular culture franchises such as My Little Pony, Barbie, Hot Wheels, and Peanuts and then manipulated these with tools and other artifacts to create new puppets and toys that reflected the maker's own voices in addition to their sedimented meanings. For example, one university student chose to alter the identity of a Smurf figurine by adding flowing hair made from a My Little Pony mane and a red carpet made from felt. This participant altered the identity of his puppet by combining multiple narratives that included a Smurf and a diva. He called his hacked toy, Smiva, the Smurfalicious Diva. Smiva was primarily hacked by adding decorations and costuming. Another example of a hacked toy included a more physically mobile pony, which included a unique hybridization of several popular culture toys. The participant joined two halves of a My Little Pony toy with a slinky as the body using tools such as a hacksaw and a hot glue gun.

After this initial session in the makerspace, preservice teachers began filmmaking in small groups to plan and film a story that featured the hacked toys. The stories created by the preservice teachers reflected an amalgam of identities and genres that demonstrated collaboration, imagination, and current student agendas and influences. The storymaking process of the playshop included time for students to gather raw film footage using iPads, edit using digital apps such as iMovie and WeVideo, and present final productions to the class. Once filming began, they shifted the toys' original characters further, building upon the decisions made in the toyhacking process. Their changes to the toys' identities became more apparent once the preservice teachers began to name their puppets for filming. Out of 12 films, we selected two to elaborate on below. These were chosen for several reasons, including consistency in visual and audio data, varied representation (i.e., the films come from sections taught by different instructors), and clear illustration of participants actively using outside knowledge to engage digital genres.

10.4.1 Film One: Viral Videos and Mobile Apps

Through toyhacking, one group of six preservice teachers altered identities and changed narratives by creating hybrids of two or more toys to make Smiva, Mermaducky, Franken-Mummy, Snoopy Centaur, Slinky Pony, and Basketball Linus. While planning and filming, the group drew on their social media knowledge for an organizing theme for their film. In seamless decision-making, they chose to mimic a Harry Potter Puppet Pals skit, The Mysterious Ticking Noise (https://www.youtube.com/watch?v=Tx1XIm6q4r4). Without much discussion, the group mutually agreed on using this viral video as inspiration for their film. Seeking popular culture and social media tropes that peers would easily recognize was evident across many of the filming groups in all classes during the literacy playshop.

The preservice teachers combined several digital resources to guide the new film production, using two apps that closely aligned with their vision for recreating the Potter Puppet Pals skit: Acapella and a metronome app. These participants used the Acapella app during production to precisely time the entrance of each character (see Fig. 10.1), mimicking the sequence of the characters in the Potter Puppet Pals skit. In essence, this group was actively editing while filming. The changing characters and repeated phrases were clearly influenced by the viral YouTube video. In the Potter Puppet Pals video, the characters entered the skit during specific times and repeated just one phrase. Throughout the skit, a ticking time bomb kept the characters' lines in sync. In order to recreate this, feature the preservice teachers used a metronome app to precisely time their characters' short phrases. In order to make

Fig. 10.1 Screenshot from preservice teachers' *Potter Puppet Pals*-inspired film

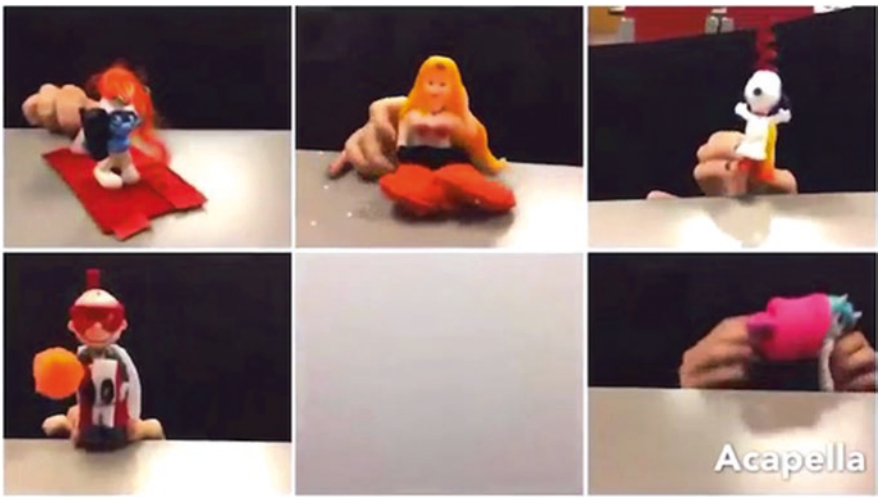

Fig. 10.2 Filming multiple characters with iPad App

their film closely match the viral video, they used a black backdrop to keep their own bodies out of the production (see Fig. 10.2).

10.4.2 Film Two: Playing and Singing in Music Video

Another group created a music video with hacked toys including a stuffed kitten wearing a construction hat and vest, various insect-mammal hybrids, and a Pegasus. To create this cast of characters, preservice teachers relied on cultural capital and knowledge about the children in their field experiences, as well as available resources and suggestions from peers. For example, one participant created an "American Pegasus" by gluing fringed duct tape feathers onto a toy horse and decorating it with red, white, and blue stars (see Fig. 10.3). She explained that her assigned student's father was in the US military and was currently deployed overseas. This creation was encouraged by other group members who made comments such as, "Aw, patriotic!" Other preservice teachers in this group also sought group feedback and approval to hack their toys, asking, "Should I put a skirt on [my toy]?" and "Do you think [my assigned student] will care that [the toy] is a girl?" Through these collaborative efforts and conversations, group members hacked toys such as the construction cat, a Despicable Me character with a lion head, and a horsefly that peers called "cute," "hilarious," and "creepy," respectively.

Toy descriptions also captured humor among group members that played on dominant narratives of disability, gender, and race. For example, when a hacked pony wobbled on the table, its maker laughed, "he just has a bum leg." Other group members laughed together when a student joked about the juxtaposition of a male

Fig. 10.3 Examples of hacked toys

toy's expression of anger and its hacked pink, sparkly costume. At times, jokes and narratives created by the preservice teachers during the toyhacking worked to maintain sedimented stereotypical meanings in the commercial toys rather than disrupt them. Though such parodies can be questionable or interrupt classroom decorum, the participants' responses were typical to those made by children whose comedy is squarely situated in their own culture regardless of notions of appropriateness (Grace and Tobin 1998). The preservice teachers frequently engaged in play themselves as they worked with the toys and exhibited behaviors such as zooming toys around their friends to make them laugh and slapping the table with gummy sticky hands.

After the session in the makerspace, the group took their toys outdoors to film. They quickly decided to create a music video of the song "Roar" by pop artist Katy Perry. This strategic decision allowed each of the toys to be featured via a cinematic introduction while also allowing players to collaborate together. For nearly half an hour, group members laughed constantly while shooting footage. The filming, as well as the editing, revealed that preservice teachers relied on genre in their storying and were motivated by humor. For example, characters were introduced through dramatically familiar scenes such as "rising from the ashes" via a large pile of leaves and suspensefully bursting out of a wooded thicket. Group shots were taken to create interesting camera angles from vantages on top of motorcycles or underneath cars. The rationale and decision-making were largely focused on producing an impression of randomness as students explicitly and implicitly worked to make their video humorous.

In one group shot, the preservice teachers placed their toys, headfirst, in a circle on the grass and used the iPad to capture an aerial shot of the figures that zoomed out creating a scene that a female commented was just like a "12-year-old girl's

soccer pic." Several group members also referred to media genres during filming. For example, one member commented, "this looks like a rap video" when the construction-cat's face was zoomed in on while the cat danced in front of the camera; others laughed immediately in response and recognition. Another member made suggestions such as, "take a classic, cool 90s shot, and just swerve in" and "we need another artsy shot" that were quickly taken up by the group. These examples indicated members' knowledge of film and video shots and demonstrate how filmmaking techniques such as camera angles, zooming, or panning transformed the surface appearance and dialog in hacked toys and narratives through deeper intertextual meanings. The final film was a reproduced, remixed, and wholly new story that drew upon multiple film genres, a megahit music video "Roar," and most importantly, students' own interests and engagement.

10.4.2.1 Preservice Teachers Responses to Maker Literacies

Preservice teachers' written reflections about the toyhacking and digital storying experiences overwhelmingly voiced positive attitudes toward maker literacies. However, this is not to say everything went smoothly. At times, we encountered pushback from the university students about the idea of critiquing popular media. One of the researcher's field notes described a discussion held in one group of female university students after a viewing of a Barbie commercial. One woman spoke out, "I know what they want us to say but… I loved Barbie and I never felt like I had to look like her." Similar sentiments expressing both defiance about critiquing dominant narratives and popular culture's place in the classroom were voiced by some participants. However, across classes, preservice teachers' written reflections suggest they feel it is possible to support young children's literacy understanding through play and digital engagement. The collaborative encounters with digital tools and hacked toys allowed preservice teachers an opportunity to engage with maker literacies in an unrestricted way. Using the artifacts to anchor the meanings of a media text opened the door for preservice teachers to investigate more progressive and innovative ways to explore literacy education.

Affirmations about using one's imagination, being creative, and "doing something different" were frequent, and preservice teachers described the sessions with comments such as, "It was a blast!" and "I was surprised by how much fun I had." One participant explained,

> *Meaning can be expressed in a thousand ways: art, literature, visually, music, etc. Why are these forms of literacy discounted? Why are they left out in the classroom? To me, this project helped me better understand the limited perspective of literacy and it gave me ideas of further use in the classroom. I loved the maker movement workshop because it widened the idea of literacy involvement.*

For this university student, the maker experiences legitimized an alternative conception of meaning making while causing him to question what is included and excluded from daily classroom work. The legitimating effect of this hands-on

experience was significant; many of the preservice teachers noted that they were initially hesitant about maker literacies and their place in literacy instruction. One preservice teacher reflected, "Had I seen [the makerspace] before this class, I would have probably thought that it seemed out of place [in a college of education]. After the assignment, however, I realize its huge potential." This potential, for literacy instruction, student engagement and involvement, and collaboration, was referenced by a majority of responses by participants and often was accompanied by reflections of surprise and transformed understandings. Many of the university students finished this project with reflections that expressed strong commitments to utilizing maker and digital literacies more comprehensively in their future careers.

The preservice teachers in this study largely demonstrated evolving conceptions of what it means to teach digital media production through their own experiences with playshop. Through collaborative play, hands-on explorations of maker literacies, and digital storytelling, the preservice teachers redesigned various artifacts and reworked media narratives to incorporate media literacy resources and expertise from their daily lives, including social media, popular culture, and social mores. They actively worked to manipulate the toys' sedimented identity texts to make them humorous or engaging to children or peers. In this way, media toys became puppets and avatars embedded with the voices of their makers.

Preservice teachers' post-project reflections revealed a) children's increased interest during elementary tutoring in filmmaking sessions with toys and b) university students' planning that considered young children's literacy strengths, funds of knowledge (Moll et al. 1992), and learner interests in popular media narratives and toys. A significant level of excitement and active participation, not visible at other points during the semester, was expressed through university students' maker literacies as well as their writing. There was palpable pleasure in participants' disruption and redesign of narratives and in the ease of creative storying provided by digital technology. Maker literacies afforded preservice teachers new ways of engaging student interest and engagement in classrooms.

10.5 Learning from Maker Literacies and Literacy Playshops

In this section, we look across the preservice teachers' literacy playshop experiences with maker literacies to generate several teaching points relevant for early literacy teacher education.

Maker literacies with popular media make children's literacy resources accessible and enable children to show what they know.

Interestingly, retro toys with nostalgic appeal to parents also appealed to the preservice teachers, providing literacy resources (e.g., potential characters, settings, storylines) for university students who remembered My Little Pony and Smurf toys from their own childhoods. A long-standing adage for composition is that writers

write best when they write about what they know. This is also true for digital filmmakers. The groups' shared film knowledge such as viral videos and hit songs or MTV and rap genres provided templates and techniques that the preservice teachers could draw upon to enhance the meanings of their films. In the same way, popular culture toys and media provide rich literacy resources for children who know the narratives and songs by heart. When children are able to play and film the stories they know best, their storytelling is more elaborate and engaging, with characters more likely to resonate with the audiences that matter to them.

Makerspaces allow students to bring their own maker literacies and media texts, and educators need to understand peer cultures in order to appreciate and understand the complexity of texts students produce.

We planned opportunities for preservice teachers to engage some maker literacies, but they also brought their own: remixing children's media narratives with viral videos, smartphone apps, and music genres. Their remixes merged in synergistic ways as when participants synced their voices to match the rhythmic ticking tempo of the Potter Puppet Pals viral video. Nexus analysis looks for thickenings of textual practices to see how merged practices strengthen meanings and participation among members within a nexus of practice. When this film is viewed from an outsider's perspective, we see a grid of characters chaotically popping in and out of view, accompanied by meaningless cacophony. From a perspective inside the preservice teachers' media savvy peer culture, we see their almost instantaneous agreement on a viral video as a template for their own production. Their shared recognition is the hallmark of nexus of practice as cultural insiders enact their membership through shared norms. In this way, the Potter Puppet Pals and Roar videos and rap genres were social markers that provided a way to create inside jokes that would entertain peers and acknowledge their makers as cultural insiders. In the same way, young children's play, media affinities, and humor create group cohesion, social boundaries, and insider/outsider identities in peer cultures (Dyson 2003).

Embedded texts in toys and media genres and narratives are both durable and fluid, creating an intertextual complexity that is engaging and challenging.

The identity texts in toys could be physically and digitally jumbled and recombined in remixing and other maker literacies. But this does not necessarily ensure critical response or rupture dominant discourses. We often saw that preservice teachers' play and making opened opportunities for them to reproduce stereotypical actions or jokes that went unchallenged in their groups. However, we also observed that toyhacking powerfully opened a way to make media character identities and narratives malleable and open to revision.

It may be that preservice teachers are more willing to revise media characters than children who have stronger emotional attachments to their favorite media characters (Marsh 2005). Children's attachments to media toys can be passionate, complicating their collaborations when the fluidity of play requires undoing the stories they know by heart (Leander and Boldt 2013). Data from playshop research shows that when children play, make, and revise popular media characters in literacy

playshop classrooms, intense debates often emerge around which revisions are appropriate and who can play with which toys (Wohlwend 2009, 2011; Wohlwend et al. 2013).

Play is unruly and engages us on an emotional level.

Playshops run on laughter and joy in imagining otherwise and escaping the here and now. The university students in both groups played throughout the activities, laughing as they tried on new personas as characters, makers, and players. Preservice teachers also played, in a way, at teaching as they imagined what their assigned student might think of or do with the hacked toy or imagined future selves teaching in their own classrooms, "I'm so going to do this!" But they also played to ease the discomfort of destroying toys. Toyhacking makes visible and visceral the destruction that happens when remixing a text. Remixing seems innocent, but when we ask students to deconstruct and critique media, we are really asking them to hack away cherished memories and the beloved characters of their childhood. This became clear when some students resisted changing the narratives of toys and expressed annoyance at the thought.

Finally, preservice teachers played and laughed together in ways that intersected with belonging, group friendships, and peer culture status. Inside jokes and humor assumed everyone shared the same nexus and thus shared an understanding of what's funny.

10.6 Conclusions/Implications

Multiple and fluid transformations occurred through maker literacies that altered toys' physical features but also character texts and thickened film scripts in on-the-spot improvisations. Preservice teachers negotiated and merged multiplayer ideas into plot threads during both collaborative play and digital filmmaking, remixing popular media characters and film genres (e.g., music videos, game quests) during filmmaking and video editing.

As teacher educators, we know that it is critically important to engage preservice teachers in the activities that matter to the children they will teach. Visiting a makerspace, toyhacking, collaborating creatively, and producing digital stories allowed university students to experience the value and potential of expanded literacies. These experiences were instrumental in helping these university students shift their definitions of literacy beyond print to include maker literacies. This shift involves engaging university students in activities where they can experience playing, crafting, collaboration, and technology, just as their students would. Opportunities to reflect remain key. Upon reflection, university students wrote about their surprise, excitement, and pleasure while creating literacy artifacts and producing digital stories, often noting that the playshop project significantly expanded their notions of literacy.

We close with some practical guidelines for teacher educators and classroom teachers interested in moving toward maker literacies and makerspaces:

- Expand what counts as literacy. What does literacy mean for children today and tomorrow? Children are reading the world in powerful ways that don't necessarily involve reading printed texts or even screens. Shifts in technology, society, and access to information have changed the boundaries around information and the ways that they understand the world. Consequently, our classroom curricula and practices must also shift (Sefton-Green et al. 2016).
- Accept students as creators and innovators. Innovation needs a classroom atmosphere that invites exploration and tinkering. In makerspaces, teachers empower children and allow noise, messiness, and freedom to decide and make and play. Recognizing students as capable includes positioning students as problem-solvers when inevitable glitches occur.
- Start small. We know the challenges of rethinking how we teach. Each technology offers fresh affordances and potential challenges. Taking on just one or two activities like this project provides teachers with time for planning and reflection as well as implementation.
- Be ready to mediate. A curriculum that runs on learner-generated ideas, characters, and stories will engage the children in intense ways. They may not care about a book that the whole class hears for read-aloud, but wait until they have a say in the creation of the narrative! When children care about the curriculum, collaboration brings contestation as well as cooperation.
- Consider and prepare for safety issues. In this class project, university students used real saws, X-Acto knives, and hot glue guns to hack their toys. Adult supervision is of course a necessary precaution when young children are cutting or using hot glue guns. We have observed preschools where young children use saws, hammers, and nails; with supervision and safety guidelines, they successfully used these tools. Teacher education classes should include safety discussions so that preservice teachers know how to provide young children with creative experiences with authentic tools, but with reasonable safeguards.

Maker literacies, toyhacking, and digital storytelling open up opportunities to update teacher education. This was evidenced by the participant's reflections, which detailed the fun, enhanced engagement, knowledge gained, and humor that they found within this project. By participating in a maker literacies playshop, the preservice teachers were able to visualize new possibilities for their teaching and to see dramatic play with toys and digital technologies as worthwhile and engaging literacy curricula.

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Part III
Societal Tools for Thinking, Learning and Communicating Differently

Chapter 11
Supporting Whole Child Development in the Digital Age

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11.1 Introduction

In 2012, a landmark text—the joint position statement on *Technology and Interactive Media as Tools for Learning in Early Childhood Programs*—stated, "When used wisely, technology and media can support learning and relationships". Moreover, "Enjoyable and engaging shared experiences that optimize the potential for children's learning and development can support children's relationships with adults and their peers" (National Association for the Education of Young Children [NAEYC] & Fred Rogers Center 2012, p.1). One key way to optimise this potential is through the use of technology tools that encourage collaborative learning. This chapter focuses on technology use within early childhood settings and STEM (science, technology, engineering and mathematics), examining potential for cognitive, social and emotional learning—development of the whole child.

We define a whole child approach as a focus on children's well-being, learning and growth across the social, emotional, cognitive and language developmental domains that empower children as creative and collaborative learners in the digital age. The International Association for Supervision and Curriculum Development (ASCD) describes their whole child approach as the promotion of long-term

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development and success of all children. According to ASCD (http://www.ascd.org/whole-child.aspx), in a whole child approach:

- Each child enters the school healthy and learns about and practises a healthy lifestyle.
- Each child learns in an environment that is physically and emotionally safe for students and adults.
- Each child is actively engaged in learning and is connected to the school and broader community.
- Each child has access to personalised learning and is supported by qualified, caring adults.
- Each child is challenged academically and prepared for success in college or further study and for employment and participation in a global environment.

In this chapter we describe a range of tools, including robotics and programming as technology-enabled activities, and others that layer into digital childhoods affording cognitive and social skills and emotional development with a focus on interactions, relationships, shared experiences and emotionality. This focus affords us opportunity to illustrate how young children have the opportunity to demonstrate an effective response to successfully completing their own technology-mediated tasks rather than focusing on rewards allocated by the technology as children move through levels of activities or games. The focus on interactions, relationships, shared experiences and emotionality also allows us room to highlight the ways educators or caregivers integrate technology to support whole child development.

Since the advent of the iPad in 2010, young children's engagement with media through mobile and tablet devices has grown exponentially. Numerous research projects report this increase including Rideout (2011, 2013), Kabali et al. (2015) and Marsh et al. (2015). Rideout (2013) reported significant growth, particularly in the use of mobile and tablet devices in the United States, with twice as many American children using mobile and tablet technologies compared to just 2 years earlier (Rideout 2011). A recent study of children in the United Kingdom shows similar trends and indicates that one in three children (31%) of surveyed children (aged 0–5) *owned* a tablet, with most children having regular access to mobile devices (Marsh et al. 2016).

When loaded with interactive content, these devices can be engaging, with research suggesting that children under that age of 5 years of age are likely to spend approximately 1 hour and 20 minutes each day using mobile devices and tablets (Marsh et al. 2015). In many ways mobile and tablet technologies can be seen as a toolbox, containing a huge variety of tools (Verenikina et al. 2016), enabling children to view, interact, play games, capture, create, communicate, collaborate, document and demonstrate their learning (see, e.g. Danby et al. 2013; Fleer 2014; Theobald et al. 2016; Verenikina and Kervin 2011). To continue the toolbox analogy, the number and types of tools these devices hold will depend on choices made by educators and parents (and children).

There are several ways we see these toolboxes and their tools already embedded in today's digital childhood—the children's cognitive and social agendas as well as

the sometimes mundane experiences that constitute their everyday lives—in ways that support whole child development. In the pages that follow, the focus is not on the toolbox (i.e. the mobile and tablet device), but on the tools themselves—the apps, simple robotics and tangible technology that are used as children engage in everyday activities and interactions with others. We attend to *how* these tools are used, with children's engagement being impacted by not only the tools they access but also *who* they are accessed with and *how* they're used and the *context* in which they are used. Tools that are often considered as one screen for one child offer invitations for interactions, relationships and joint media engagement with teachers, parents, siblings and peers when used intentionally to support social and emotional learning.

In 2012, NAEYC, the leading organisation for Early Childhood Education and Care in the United States, released a statement on technology use. This statement, developed after extensive consultation with academics, researchers, educators, allied health professionals and media developers, was designed to guide children's engagement with technology and media. Its bold statement—that technology and interactive media can be useful if used thoughtfully and intentionally—has been embraced by many but also criticised: many perceive mobile and tablet technologies to be socially isolating (e.g. Turkle 2015) or worry about screens and digital devices being seductive and addictive to children (e.g. Felt and Robb 2016). As a consequence, this statement can be somewhat challenging for many educators and parents.

If we are to arrive at a point in which the statement can be more wholly realised, it is critical that the 'tools', or apps and technologies, we choose for young children, are essential components in reaching these goals. Two areas of research are demonstrating increasing potentials in this area: apps that promote communication and collaboration and tangible technology including robotics. The following section presents an overview of current research in these areas.

11.2 Is There an App for Learning and Engagement?

Research in the use of mobile and tablet technologies with young children is increasing, with a specific focus on the use of interactive media. Research is indicating that these devices are enabling fine motor skills (Vatavu et al. 2014), communication (Myers et al. 2016) and opportunities for learning and cognitive engagement (Hirsh-Pasek et al. 2015). However, notions of screen time and changes to patterns of play with technology can also be linked to parental concerns about the negative impact on social and emotional skills, physical activity and development (Carson et al. 2014; Mascheroni 2014).

Some of these concerns can be seen as linked to the design of specific apps, where children are rewarded for extended play or where the interface promotes isolating, single user engagement. Hirsh-Pasek et al.'s seminal review called for evidence-based practice to impact on app design and development. They recommend

that educational app design should align research-based understandings from the science of learning to enable effective use of technology. The authors highlight four key pillars arising from this body of research:

> Humans learn best when they are *actively* involved ("minds-on"), *engaged* with the learning materials and undistracted by peripheral elements, have *meaningful* experiences that relate to their lives, and s*ocially interact* with others in high-quality ways around new material, within a context that provides a clear learning goal. (2015, p. 7)

In contrast to cognitive learning, social and emotional learning involves the processes through which children and adults acquire and effectively apply the knowledge, attitudes and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships and make responsible decisions. These intrapersonal and interpersonal competencies can be taught and measured, and research shows that students with these skills do better in school and in life (Collaboration for Academic, Social, and Emotional Learning 2012; Durlak et al. 2011; Goleman 2005; Greenberg et al. 2003; National Research Council 2009, 2012).

The development of these skills, be they cognitive, social or emotional, happens in a social context, and there is extensive research that highlights the importance of active, engaged, meaningful learning through social interaction in which 'sustained, shared thinking' is engaged as adults and children work together to explore and learn. Research such as the Effective Provision of Pre-school Education (EPPE) highlights the importance of the "quality of adult–child verbal interactions" as an essential component in effective early learning contexts (Sylva et al. 2004, p. 5). 'Sustained Shared Thinking' is defined as: "when two or more individuals work together in an intellectual way to solve a problem, clarify a concept [or] evaluate an activity … Both parties must contribute to the thinking and it must develop and extend the understanding" (Sylva et al. 2004, p. 6).

However, these concepts at times appear somewhat immolated when technology is introduced, with many mobile and tablet devices, with their small screen appearing to promote single user engagement, especially when smaller screens appear to deepen the single user's individual engagement (Roskos et al. 2012). Apps with a strong reliance on individual mastery and reward may contribute to this. In examining educational apps, Goodwin and Highfield (2013) found that while almost half of the top-selling 'educational' apps were developed for children aged 0–12, most (75%) tended to focus on being 'instructive', with drill and practice a dominant paradigm. Cherner et al. (2014) and Hirsh-Pasek et al. (2015) suggest that these sorts of apps may somewhat benefit the development of foundational skills.

Even though children do need to develop many foundational skills, setting them out to complete 'drill and practice' through an app may not be particularly meaningful to the child. In other words, this engagement with apps may not afford a purpose to developing the child's knowledge. Of particular resonance here is the notion that technology use should provide opportunity for meaningful learning and learning through social interaction. This reveals a tension between social learning and a more traditional approach to teaching and learning:

> …drill and practice may foster rote learning of facts, but it is not likely to promote deeper conceptual understanding (see Ravitch 2010). Similarly, exploration and discovery without any guidance or scaffolding may not provide enough support for learning (Mayer 2004). (Hirsh-Pasek et al. 2015, p.7)

Our understandings of engagement and the challenges presented by apps that provide feedback are further complicated by decades of educational research around the most effective forms of feedback. This research suggests that good feedback extends, is explanatory and focuses on improvement rather than merely verifying that a response is correct or incorrect (e.g. see Butler and Winne 1995; Ericsson et al. 1993; Hattie and Timperley 2007; Shute 2008). When we translate these understandings to engaging with young children, it causes us to question whether technology in and of itself can give appropriate feedback for young learners. Given some of these complexities, further consideration on how technology is used is needed and how we can select technologies that go beyond the screen.

11.3 Technology, Robotics and STEM Learning

In the last 2 years, there has been significant interest in research involving young children in the curriculum areas of science, technology, engineering and mathematics (STEM). This interest is evident in many countries, for example, in the United States and in Australia, there are a range of government-led initiatives developing. For example, in the United States, the White House Symposium on Advancing Active STEM Education for Our Youngest Learners in April 2016 convened a range of experts in this area and presented insights into a range of research and promising practices in early STEM learning. In partnership with the White House Initiative, the US Department of Education also convened a meeting to advance early learning and STEM, established research grants to improve early elementary science outcomes and has funded a website, tip sheets and other resources for families and educators. Other examples can be seen through priority grants and additional funding, such as the Australian Government's National Innovation and Science Agenda which sees approximately 14 million dollars allocated to STEM-related programmes (http://www.innovation.gov.au/page/inspiring-all-australians-digital-literacy-and-stem).

In many ways this research area is not new: for example, in mathematics education there is a long-standing history of programming and robotics including tools such as 'turtle' geometry or Logo programming language. Over three decades of research in this area suggests that these tools are beneficial in learning and in particular in the development of spatial concepts, directionality, measurement and geometry (Clements and Meredith 1993; Yelland 1994). Further, robotics and programming are seen as engaging for learners and as having potential to develop skills in problem-solving (Bers 2010; Bers and Ettinger 2012; Bers et al. 2013; Horn and Jacob 2007; Horn et al. 2008, 2009; Strawhacker and Bers 2015; Sullivan and Bers 2012).

Extensive research suggests that using robotics can promote collaboration for young children, with the tangible interfaces and simple interface enabling participation for younger children (Highfield 2010; Highfield and Mulligan 2009). Further, these tools have the potential to engage children in a range of tasks, with learning outcomes (Savard and Highfield 2015; Sullivan and Bers 2016). The applications themselves also have the potential to foster emotionality. Isbister (2016) discusses this:

> Actions with consequences—interesting choices—unlock a new set of emotional possibilities…because our feelings in everyday life, as well as in games, are integrally tied to our goals, our decisions, and their consequences. People go through a rapid and automatic set of evaluations as things happen to them, about what each event might mean for their goals and plans. (p. 2)

Given this and the growing body of research outlining learning afforded by apps and other technology tools in formal and informal learning and the potentials of programming, robotics and STEM curricula for young children, further research is needed into (1) how these tools and activities are used in context with children of various ages and (2) the ways humans support and scaffold one another in these types of interaction. In the following section, we look within the toolbox—at the tools, the apps and the learning afforded—and at the context for learning that extends beyond the screen to promote meaningful learning supported by human interaction.

11.4 Vignettes of Technology Toolboxes in Use

In the following sections, we present five vignettes from the collective authors' research and practice to illustrate how some tools—in certain contexts, supported by certain kinds of interactions, with other people—have potential for promoting communication and collaboration, cognitive learning and social and emotional development. We first describe each tool and the context for use and then share the vignette. Following the vignettes we discuss implications for research and practice.

11.4.1 Vignette 1: Robots and Apps

Tool Bee-Bots, Blue-Bots and the Blue-Bot App (Terrapin Software 2016a, b; TTS Group 2015). Bee-Bots are simple robots that children can programme to move in simple steps and 90 degree rotations. Children can programme up to 40 steps of movement on the Bee-Bots, but Blue-Bots are slightly more advanced. They can be used for simple programming, and they can also be connected (via Bluetooth TM) to the Blue-Bot app. The app has a range of options and allows the child to complete challenges (i.e. pre-set tasks) or to engage in open-ended exploration and problem-solving.

Context Lia is 4 years old. Her long day care centre has had Bee-Bots for several months, and children use them as a tool in free play. Children frequently add decorations to the robots and use them in dramatic play. In recent weeks the centre has also purchased two Blue-Bots, their app (for use on a tablet device) and a large interactive screen that can be used to project children's engagement with a range of technologies, including the app.

Vignette During free play Lia collected the Blue-Bot and tablet device from the shelf and with a friend began building a city with blocks for the robot to move around. The teacher came along and, after observing for a while, opened the Blue-Bot app on the tablet to check that the robot had connected and was ready for use. Lia became agitated and said 'No, no, no! I don't want that [*pointing to the tablet*]'. After discussion it emerged that Lia had previously explored the pre-made levels of the app, where children are set specific programming tasks and challenges. Lia stated, 'I want it [*the Blue-Bot*] to do what I tell it. I don't want the app to be the boss'. Lia played, with friends for 42 minutes, developing pathways and then programming the toy to move around them. While playing they created four different pathways and used problem-solving strategies including trial and error, drawing a plan, gesture and acting out movement to programme the robot. Only one of the pathways (a simple task of a short straight road with one turn) was solved on the first attempt. All other pathways required the children, with Lia leading the play, to develop and revise iterations of their programme.

11.4.2 Vignette 2: iDinosaurAR (Bringing STEM to Life?)

Tool iDinosaurAR is a paper-bound book and accompanying augmented reality app (Red Frog Digital Limited & Carlson Books Limited 2013) that allows virtual dinosaurs to appear and 'augment' the child's real world.

Context Harry, aged 6, is reading at home with his mother, while she cooks dinner.

Vignette Using the book and corresponding app 'iDinosaurAR', Harry explores the world of dinosaurs. While the text is too advanced for Harry to read, he is able to bring his toy dinosaurs to his play area and manipulate them, with the augmented dinosaur on his iPad appearing to play with his toy dinosaurs. Having had the book read to him before Harry uses his prior knowledge in this play scenario making comments such as 'Don't worry, Brachiosaurus won't eat you. He is an herbivore'. Harry's mother then joins in the conversation, and they recall information and discuss where Brachiosaurus lived before extinction. They then discuss a potential museum visit to explore the dinosaur exhibition, in the next school holidays, and compare the size of two dinosaurs in the book. Over dinner Harry told his father that Brachiosaurus was 23 metres long. Harry and his father then measure out how long this distance is in their yard and discover that the Brachiosaurus would be approxi-

mately twice the length of their backyard pool. Over the coming weeks, Harry and his family return to this discussion on the size of dinosaurs, with the 12 metre backyard pool used as a unit to compare dinosaur lengths too.

11.4.3 Vignette 3: Pokémon Go (Integrating Virtual Reality into Play)

Tool Pokémon Go app (Niantic Inc. 2016), combined with craft materials, was used. Pokémon Go is an app for use on mobile devices that allows the user to find virtual creatures, called Pokémon (animated pets). The app integrates the device's map/GPS system, and so users must walk and move around in the 'real world' to discover Pokémon in the 'virtual world'. The user catches and collects Pokémon and can collaborate on a team to win battles and collect more Pokémon.

Context Charlie (8) and Annie (6) went walking with their father and dog. They were capturing Pokémon in the neighbourhood, while their father explained the goals and objectives of the game. Charlie had previous experience playing a card version of the game. Over the next several weeks during family walks, their father shared his mobile phone with the children and allowed them to catch the Pokémon on the app. Occasionally, the children would ask to look at the Pokédex (index of all the Pokémon collected) or to try to transfer (get rid of duplicate Pokémon) or evolve (trade in points to get a stronger/better) their captured Pokémon. The vignette below happened after approximately 10 days of playing the app on the phone during walks.

Vignette Charlie and Annie were playing inside on a rainy summer day. Annie had been spending some time in the art area at home, and Charlie found her there with a piece of plastic that had been painted over with glitter glue.

Annie: I'm trying to make a Pokéball [*Pokéball is a tool used to capture Pokémon in the app*].

Charlie: Yeah! That'd be so cool. Then we can hunt the Pokémon in the house. [*Charlie picks up scissors and makes a cut through the entire sheet of plastic.*] Great. Now I ruined it and we can't make the ball.

Annie: It'll be ok, Charlie. Let's ask mom. Mom? Can you help us make a Pokéball?

Mom: Sure. Let's see, Charlie. I don't think you've ruined it. It's tricky to make a circle from a piece of rectangular plastic. Now that it's in a strip, we can bend it a little bit more and staple it until it's more round, like a ball. [*Mom bends, staples.*] Why don't you make another slit, Charlie, here on the plastic? [*Charlie does so. Mom staples.*]

Charlie: Leave it open at the end so that we can put our Pokémon inside the ball.

Mom: I don't see any Pokémon. Where are they?

Annie: They're all over. You just need my phone to see them.

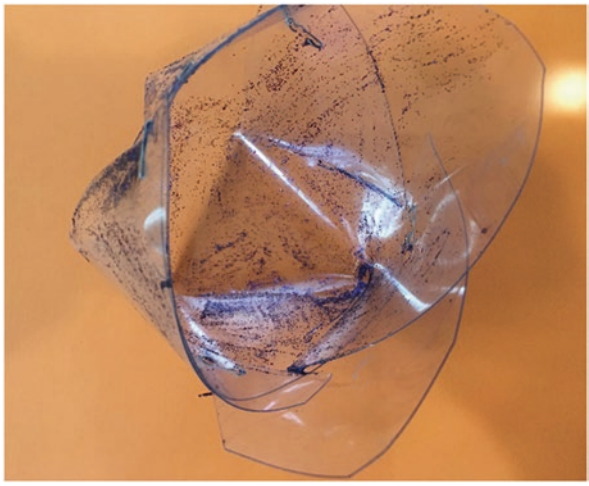

Fig. 11.1 Pokéball

Charlie: And we're going to need the map on the phone too, right Annie? (see Fig. 11.2).

Annie: Yeah. We have some work to do.
[*The children ask for another Pokéball and proceed to make materials for their Pokémon game* (see Figs. 11.1, 11.2, 11.3 and 11.4). *When they are finished making the map, Pokémon, and rewards (more Pokéballs, points, eggs, evolve tokens), the children hide the items throughout the house and then use the map and the play phone to direct their hunting.*]

Charlie: Annie, look! I just found the egg. You have to help me catch it. Quick. Don't move or it'll get broken. You're going to step…STOP! ANNIE!
[*Annie stops and sees the egg almost below her foot. She stops and puts her hands out like a backboard behind the paper egg. Charlie throws, Annie stops it and inserts the egg inside the ball.*]
Annie and Charlie: Yah! Boo-yah! All right! Got it! Yes. Let's go find another. Maybe let's go to that Pokéstop over there next to the pretend church we made [*he points to the representation of the Pokéstop on his map in* Fig. 11.2], I think there's a Pikachu nearby. You can catch that one, Annie.

Annie: Let me have it. Here. You hold the map now.

Charlie: Hold on. First we have to evolve this Squirtle. [*He flips over the card he's collected and reads about its powers.*] If we evolve the CP will go up. [*CP are points associated with Pokémon characters.*] I know it. It'll be better for the battle if we go to the gym. [*He pretends to press some buttons on the play phone.*] Oh look how happy he is, Annie.

Annie: Look Charlie! You earned another Pokéball and some points. [*She points to cards on the floor she's just dropped from her pocket as reward mimicking the kinds of rewards found in the app.]*

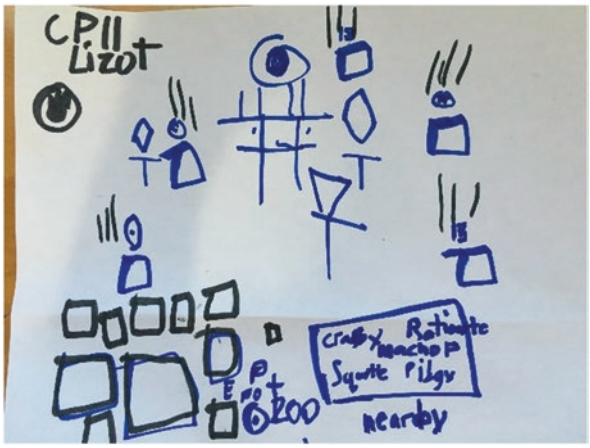

Fig. 11.2 Map

Fig. 11.3 Pokémon to collect

11.4.4 Vignette 4: e-Readers and e-Book Creators

Tool Book Creator (Red Jumper Limited 2016) is a simple app that allows children to create books using text, images and drawings. Children can also use a record function to record their voice. Books can be shared in a range of ways electronically.

Context Simon is nearly 5 years old. He is going to school in the new year and, with assistance from his pre-school teacher, has been creating a book to share with his new school teacher. Simon and his teacher were working together to write 'important information that school should know' as part of his move to school.

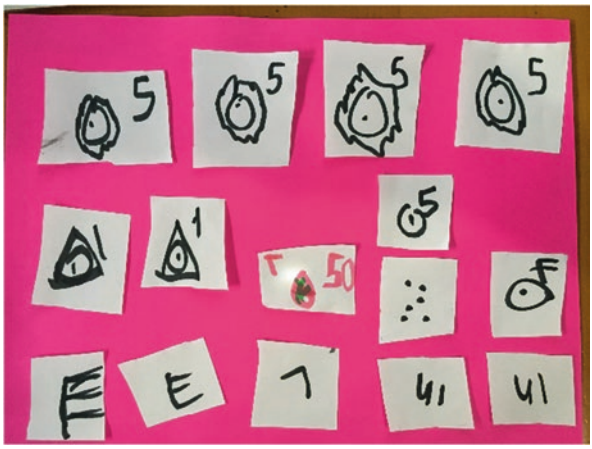

Fig. 11.4 Pokéballs, rewards, eggs

Vignette As part of a transition to school project, where educators in the pre-school classroom and families shared information with their child's new school teachers, Simon and his teacher had worked together to create a simple book. Among other pages the book included a photo of Simon, a page with a collection of letters drawn by him, with Simon identifying that his new school teacher needed to know that he 'knows some letters, 'cause you do letters and stuff at school'. As they were finalising the book, Simon's teacher asked if there was anything else they should include. Simon agreed, drawing two images of him, one happy and one sad. He then used the sound record function to say 'I'm excited about going to school and worried that I might not have my friends'. After the other children also created similar books, Simon's teacher placed copies of them both as printed and e-books in the library corner. This created opportunity to discuss their excitement and concerns and enabled discussions between the children. At the conclusion of the project, the teacher emailed a copy of Simon's book to both his parents and to his new teacher.

11.4.5 Vignette 5: Artists and Architects

Tool ChromaKids (Fred Rogers Centre 2015) is an app developed by early childhood educator, Brian Puerling, during his Early Career Fellowship with the Fred Rogers Centre. This simple app allows children to create drawings using a range of simple paint tools and a voice record function. Children can then send their drawings to a friend securely (assuming their friend also has the app and has been registered as a friend).

Context Michael is 4 years old. He is a happy and engaged child. He likes playing outside and fascinated with building using blocks and Lego but is reluctant to write. Michael's parents are concerned, as they perceive that he will need these skills when he transitions to school. Michael's teacher is keen to support Michael to develop

these skills, while also ensuring that his engagement in writing is meaningful and not 'pushing the curriculum down'. One day while observing Michael the teacher noticed that he was building a complicated tower structure.

Vignette Michael's teacher commented: 'Wow Michael, I don't think I've seen such a tricky tower. I don't know how to make such tricky things and I bet the kids that come to preschool on other days wouldn't know how to build this. Could you do some instructions so I could show them?' Using ChromaKids Michael and his teacher used the simple paint tools (and a stylus) to draw the structure and then using the voice record function to give some instructions. The teacher then helped Michael to send his picture and voice to a peer.

After watching Michael's video, his friend responded by drawing another picture, with drawn instructions to build a long block structure. Michael was excited to receive his 'Chroma mail' and diligently followed the instructions to build the structure drawn and described by his friend. Following this, Michael and his friend shared a range of pictures, some silly, some focused on building and plans for structures, some with sound recordings and others with just an image. While still an active child, Michael began to choose to use this app to extend his construction play and as a communication tool and in so doing meaningfully engaged with writing and drawing tasks.

11.5 Discussion

Each of the vignettes presented above describe technology use, where parents and educators have carefully selected technologies and ways of using technology that are intentional. Rather than simply leaving the technologies as a device for the child(ren) to use, thoughtful integration has occurred, where the educator or parent's role has been vital in extending engagement and learning.

Within the vignettes the children have each had agency and control of the technology, developing skills, directing and creating and communicating using the tools–rather than letting the tools direct their play. The exemplars integrate manipulable and constructive tools (Goodwin and Highfield 2013), where the child is controlling and creating using the technology rather than consuming pre-made content. Key to this concept is the notion of the child's agency. This is particularly evident in Lia's play with the robots, where she elected to programme the robot in an open-ended way, so it would 'do what I tell it,' rather than playing with pre-set levelled challenges.

Another concept evident here is one of motivation to maintain engagement and feedback. In many uses of technology, the app or game motivates children to engage by providing rewards and 'feedback', indicating if the player was correct or incorrect. Frequently this 'feedback' provides extrinsic motivation including praise, sounds, stickers and level progression. However, in these vignettes the feedback provided by technology was not the key motivator or provider of rewards.

Rather, educator and peer engagement or children's perception of the task provided feedback. The children's open-ended play resulted in the child and teacher or parent engaging and contributing to motivation to extend or maintain engagement. This feedback, generally provided by peers, a teacher or parent, promoted engagement and evidence of 'sustained shared thinking' in line with the work of Sylva and colleagues (2004).

E-reading and e-book creation is another way technology fits into the young child's life and potentially impacts his or her developing understandings of himself or herself, others and the world around them. Stories can provide unparalleled ability to foster empathy. Evidence of this is presented in Vignette 4, where Simon's discussion of excitement and concerns facilitated conversations between the children, as well as an opportunity to facilitate information transfer to school. Gaiman states:

> Prose fiction is something you build up from twenty-six letters and a handful of punctuation marks, and you, and you alone, using your imagination, create a world, and people in it and look out through other eyes. You get to feel things, visit places and worlds you would never otherwise know. You learn that everyone else out there is a me, as well. You're being someone else, and when you return to your own world, you're going to be slightly changed. Empathy is a tool for building people into groups, for allowing us to function as more than self-obsessed individuals.

If we consider STEM learning to be an "opportunity for children to engage with the curriculum pillars of science, technology, engineering and mathematics, building knowledge by integrating understandings in these areas in an iterative way" (Highfield, under review) then within the vignettes, we see several examples of STEM. Apps that support STEM often focus on only one content pillar or on pre-set levels for children to progress through. While these may be valuable in mastery of discrete skills, few respond to the definition of STEM. Further, the reliance on extrinsic reward structures may not afford opportunities for children to investigate or could have a negative impact on emotional well-being and children's perception of themselves as a capable and confident learner. Vignettes 1, 2 and 3 can be seen as examples of STEM, where motivation for extended engagement was not prompted by the technology's in-built reward system.

In Vignette 1, Lia's play and iterations of problem-solving appeared more focussed on completing the pathways she and her peers designed, with the only reward being the success of completing the path they chose. In this example, while the movement of the robot afforded learning opportunities in mathematics (measurement, counting, spatial awareness and position) and engineering (road and pathway construction and engineering habits of mind), the primary learning afforded was through problem-solving. Harry, in Vignette 2, explored a more specific range of STEM content pillars including mathematics (length comparison and measurement) and science (dinosaur classification and features). However, Harry's ongoing engagement in problem-solving and measurement with his father also enabled him to develop understandings in an iterative way. His ongoing comparison of dinosaur length and height (using the backyard pool as a unit of measure) provided opportunities to revisit learning and sustain engagement.

Vignette 3 also provides examples of STEM engagement. As with Vignette 2, play was sustained over time, and also as with Harry's engagement with the dinosaurs, parental engagement facilitated movement beyond the screen. While technology play in both contexts acted as a catalyst, the children and parents here sustained engagement and learning beyond what was provided by the screen alone. Vignette 3 provides examples of STEM learning, but it also provides particular evidence of social and emotional learning. For example: the children played collaboratively towards a goal, with teamwork playing a key role in moving the game along. The identification of issues and problem-solving occurred in prosocial ways, for example, the development of the Pokéball. Further, the two siblings in this example also explored emotional knowledge and empathy, with Annie identifying that Charlie was upset and stating 'It'll be ok' as they worked together to construct the Pokéball with their mother.

Vignettes 4 and 5 also focus on technology use to support learning and social and emotional development. The open-ended tools used in these examples promoted examples of and opportunity for communication and collaboration. While not the focus of Vignette 4, the children's discussion of shared excitement and concerns about moving to a school context enabled social and emotional development, empathy and prosocial discussion, with the technology enabling the children as communicators.

11.6 Conclusions and Opportunities for Research

Within this paper we have presented a collection of technologies acting as a tool to engage learning and promote social and emotional development. Key here is that the technology was not a tool used in isolation but was used collaboratively with examples of co-engagement, co-play and as an instigator for off-screen investigations. Our recommendation here is that educators and parents consider the goal structure and reward systems provided by technologies and examine their impact on children's knowledge and understanding of curriculum but also on their social and emotional development. Further research is needed examining the impact of reward structures used in technology and its impact on learning and social and emotional development.

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Chapter 12
Digital Narratives and Young Children

Susanne Garvis

12.1 Introduction

> Two children (aged four) are sitting on the floor with an iPad. They open the application 'photostory' and begin to narrate their own story, based on an earlier play episode in the morning around Robots. The children begin to import pictures they had taken and record their voices using the external microphone. Together the two children work together, editing the story until they are happy with the final product. Throughout the process they share ideas, create a shared meaning and (re)present their play worlds from a couple of hours earlier. The children then call the teacher "Come and see our story about the human robot."

The vignette above provides an example of how children engage and create digital narrations of their everyday lives. In this instance, the use of a narrative allowed the children an interactional forum for ordering, explaining and communicating their experiences (Ochs and Capps 2001). Children's worlds are filled with diverse narratives, representing many different types of experiences. "Narrative is an essential form through which children describe their own experiences and communicate their views of the world" (Ahn and Filipenko 2007, p. 279). A key feature of children's narrative is that they are often launched without knowing where the narratives will lead (Ochs and Caps 2001; Puroila et al. 2012). Examining children's narratives can therefore be seen as an important way to understand how children construct meaning about their worlds and their place in it (Ahn and Filipenko 2007; Kyratzis 2000; Miller and Mehler 1994; Puroila et al. 2012). I am in accordance with Ahn and Filipenko (2007) and Puroila et al. (2012) who understand children's narratives as dynamic places in which children's inner lives and their external worlds meet each other. Narratives are also spaces, allowing children to communicate their understanding.

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Digital narratives move the concept of children's narrative into a new research field, where digital technology and children's narratives combine to create a method as well as a product. Given that visual and multimodal texts have become a common component of early childhood education (Soundy and Drucker 2010), digital narrative provides the opportunity and flexibility in delivering support to children based on their own individual capabilities and understanding. Digital narratives therefore allow for the "use of still images, audio and music to create individualised videos… They are created using a variety of software such as Photostory, iMovie and Windows Movie Maker" (Fenty and Anderson 2016, p. 59). According to Garvis (2015, p. 3), digital narratives are also important for the early childhood context where:

> Learning to digitally narrate is an important skill since the narrative genre is a multi-functional cultural tool. Some functions well-served by narratives are to share experiences, the presentation of self, create continuity in learning through connecting the child's home with his or her early childhood settings, collective remembering and learning to attend to what the community, considers to be essential.

The majority of digital narrative research has been conducted with children aged between 5 and 18 years (see, e.g. Ranker 2008; Robin 2008; Vasudevan et al. 2010). Digital narratives have also been used with immigrant adolescents (Ranierim and Bruni 2013); adolescent girls with behavioural, emotional and social difficulties (Nind et al. 2012); and within interactive games with children (Wolff et al. 2007). Within early childhood settings, digital narratives have been implemented with children aged 3–5 years in the United States (Fenty and Anderson 2016; Skinner and Hagood 2008) and Australia (Garvis 2016). iPads have been the most common tool used with young children. More research however is needed within the research field. Digital narratives may be one possible way for answering this call for developing a critical orientation around technologies, education and the social and cultural experiences.

This chapter provides insights from an Australian kindergarten project where a group of kindergarten children (aged 3.5–5 years) co-constructed a digital narrative. A key finding is that bodily forms of communication come into play when co-constructing digital narratives that can be represented digitally. The final section discusses the importance of early childhood teachers having knowledge and understanding about implementing and embracing digital technology in early childhood settings to allow children to become active creators of their own digital narratives.

12.2 Young Children's Engagement with Digital Technology

A number of researchers have noted the potential of digital technologies to facilitate dialogue and collaboration, enabling young children's positive learning dispositions (Aubrey and Dahl 2008; Roberts-Holmes 2014; Stephen and Plowman 2008). Young children's use of digital technologies however has led to many debates

around the influence of digital technologies with young children (McLean 2013). They have largely focused on the types of digital technologies and the purpose of the technology. Within early childhood education, the notions of digital childhoods have also challenged the traditional notions of play (McLean and Edwards 2016). McLean and Edwards (2016, p. 155) suggest that:

> This is because through a sociocultural lens children's play is influenced by social and cultural contexts and the different forms of play that children engage in serve different purposes within these contexts (Wood 2009). Hence, as digital technologies are inherent in these contexts it follows that young children's engagement with technologies in their play will take on different forms and serve different purposes.

iPads are one device that has entered many early childhood learning contexts. Within the literature, however, there is limited empirical data regarding the ways in which tablet technologies can help children to learn via productive play, explore and investigate and facilitate sharing of their ideas and discoveries (communication) (Yelland 2016). Yelland and Gilbert (2012) report that young children have access to iPads from an early age in home environments. In Australia, iPads have been researched in preparatory classrooms (children aged five and six years) for literacy (Lynch and Redpath 2012). Findings suggested that the preparatory teachers had tension points between a preference for print-based literacies and digital technologies. Choices were made on which tool the teachers thought would best align with the curriculum. Gattenhof and Dezuanni (2016) write cautiously about the use of iPads in classrooms with preschool children, suggesting that iPads and apps should not be considered as replacements for storytelling. They suggest that since storytelling has a foregrounding in oral communication, it should still be encouraged. Teachers selecting apps should also allow a space for children's agency.

Yelland (2016) has also explored the potential of iPads for learning and meaning making with kindergarten (4-year-olds) and preparatory classes (5- and 6-year-olds). The teachers appeared surprised at the quality of the learning experiences possible and the response from the children when engaging with digital technology. The study highlighted how learning could still occur through productive play with digital technology. Yelland (2016) postulates that there is a "a lack of willingness by schooling systems to move away from traditional approaches towards promoting twenty-first century learning with new technologies". A transformation is therefore necessary within the schooling system for the true benefits of digital technology to become known. Further research however is necessary to help fill this current research void.

12.3 Narratives and Meaning Making

According to the cultural-historical perspective, "a narrative could be defined as a psychological tool formalising and unifying human thought and knowledge into thematic units- units of thought" (Hakkarainen et al. 2013, p. 215). Children organise

their experiences with the use of narrative form to create units of thought. As such, Bruner (1986) and Nelson (1998, 2007) suggest narrative is considered a 'form of thinking'.

A growing body of research literature highlights the importance of exploring young children's narrative because of a proposed connection between children's narratives and their development (Puroila et al. 2012). Researchers have been able to explore how children learn to narrate as well as how narratives can change depending on the children's age and development (Engel 2005; Nicolopoulou and Reichner 2007). Narratives with young children have also been linked to therapeutic goals (Bennett 2008) and language development (Vandewalle et al. 2012). Few studies have explored the everyday narratives created by children to show insights into their own experiences (Ahn and Filipenko 2007; Puroila et al. 2012). In a study of children aged 1–6 years, Puroila et al. (2012) explored the daily narratives of children in a day care centre, with a particular focus on younger children who were "often excluded from narrative research because their ways of expressing and sharing their experiences do not fit with the prototypical model of a good story or a well-formed narrative" (p. 194). A key finding was that all children (including the youngest) used a variety of communicative means to let others know what was going on. Puroila et al. (2012, p. 197) noted:

> For young children, *play* offers a significant way to make sense of their life-world, about themselves and about their experiences. In addition to *words*, children's narratives involve *other linguistic means* (e.g. tone of voice, style, stressing), *action* (e.g. moving, acting), *emotional expressions* (e.g. laughing, crying), as well as *facial and body cues* (e.g. glances, gestures, body language). *Arts expressions* (e.g. music, drawings, paintings, craft) are also modalities of meaning-making of children's lived experiences.

Their study shows the holistic and embodied nature of children's narrative and the active role of narrating. Another key concept was the collaborative action between the children as some participated as either 'telling' or 'listening' during the narration.

Only a handful of studies have looked at the concept of digital narratives representing everyday experiences that extends on current understandings about children's narratives. This chapter helps to fill this gap by reporting on a digital narrative created in a kindergarten about an everyday event.

12.4 A Sociocultural Perspective on Children's Learning with Digital Technologies

Sociocultural theory is commonly used in the early years as a theoretical approach to understand young children's learning with digital technologies. Sociocultural theory has been able to show how young children learn to use technologies through social interactions with each other as well as the teacher (Plowman et al. 2011),

how they use technology for contemporary play (Edwards 2014) and dialectical relations between technologies and children in social situations (Fleer 2013).

Within the sociocultural perspective, digital tools are considered 'cultural tools' (Vygotsky 1978). Cultural tools are used to help develop thinking and creating. The tools enable children to think clearly and plan, implement their plans as well as communicate understanding in a variety of ways. Vygotsky believed that the role of education was to introduce children to a range of cultural tools and show them how to use them to help them develop thinking. In this case, the iPad is considered a cultural tool to help expand children's thinking.

12.5 Method

The focus on children's digital narratives is based on the relationship between human experience (or lived experience) and narrative. Within research this space is examined through the method of narrative inquiry. Narrative inquiry is based on a view of human experience that is founded in John Dewey's pragmatic philosophy (Clandinin 2006). Connelly and Clandinin (2006) describe narrative inquiry as:

> People shape their daily lives by stories of who they and others are and as they interpret their past in terms of these stories. Story, in the current idiom, is a portal through which a person enters the world and by which their experience of the world is interpreted and made personally meaningful. Narrative inquiry, the study of experience as a story, then, is first and foremost a way of thinking about experience. (p. 479)

The study acknowledges that human experience emphasises the symbolic and socially mediated and shared nature of experience (Greene and Hill 2005). Building on from Riessman (1993), it is also acknowledged that children's experiences of their everyday life come in the form of narratives and stories. From this position, children's digital narratives provide opportunities into the children's experiences of the world around them. Narratives also usually start from something that creates 'trouble' (Bruner 1986). In this study, it was events that occurred in the children's daily lives – a trip to a public show and not being tall enough for certain rides.

The data in this study were spontaneously produced by four children in an Australian kindergarten while talking about a recent public holiday, for a public show in the area. The kindergarten was located in a suburban area, within a middle-class-income area.

Children were provided with access to five tablets and a computer throughout the day. The teacher showed small groups of children how to sketch on the tablets and insert sounds, words and pictures. The children could engage with the app Photo Story to create their own digital narratives.

Data were collected based on the research ideas of Puroila et al. (2012) about ethnographic study of narrativity as a procedural and analytical method. A key focus was exploring the digital narratives created by the children within their natural setting of the kindergarten. Conversations and actions were recorded as observations.

The observations were analysed with Riessman's (2008) dialogic analysis of narratives, where the dialogic analysis interrogates how the narrative is interactively (dialogically) produced and performed. The process requires a close reading of the context and circumstances around the creation of the narrative. As part of this process, the data was read multiple times to create meaning. The questions asked by Puroila et al. (2012, p. 196) about the data were also adapted for the study including:

- Who initiates the digital narrative?
- What is the narrating situation like?
- Who are present, and how do they participate in narrating?
- How do children express themselves in the digital narrative?

From these questions it was possible to identify key themes around young children and their digital narratives. The digital narrative 'Being tall enough for rides at the show' was chosen for this paper.

12.6 'Being Tall Enough for Rides at the Show'

Children's everyday situations in early childhood centres have a flowing, complex and layered nature (Puroila et al. 2012). The digital narrative began with four children sitting at a table, Chloe, Jake, Sam and Maxi. Chloe began to discuss a recent trip to the show and not being tall enough to join her older brother on a ride. She had wanted to do everything her older brother did at the show but was not allowed. Chloe's oral narrative provides the origins for the digital narrative. An iPad was in front of the children. Jake initiates the 'trouble' (Bruner 1986) in the narrative by asking the other children about height:

Jake: Who here is tall- put your hand up? My brother is tall.
The other three children raise their hand in the air.
Jake: I can't see who is the tallest. Let's take a photo and see.
Jake grabs the iPad and takes a photo of all the children standing. The children look to see who is the tallest in the photo. The children agree Chloe is the tallest.

In this example, the iPad is used as a cultural tool (Vygotsky 1978) to assist the learning about height. The action of 'looking' seems to take up Jack's indication that the photo will allow them to see who is the tallest. Sam however is still 'troubled' about what this new information means in regard to the height restrictions:

Sam: But why do you need to be tall for the ride?
Chloe: In case you fall out. The ride goes like this…woosh, woosh
Chloe shows the ride swinging up and down and at different speeds

Chloe attempts to answer Sam's question by explaining the ride's movement with her own body actions. The original narrative and the 'trouble' created of being tall enough continue to be made relevant by the children as they seek clarification together. The show continues to be relevant to the children's thinking. Chloe's

actions add further detail about the event and problem. Maxi continues the shared learning by questioning how tall one must be and how children are to know:

Maxi: But how will other kids know? I don't know how tall is tall. Maybe you have to be tall as a certain animal.

Jake suggests they create a movie to help communicate their co-constructed knowledge about height with others. Jake at this point indicates his understanding that a real narrative (in this case the show) can inform the making of a digital narrative by connecting the two in his utterance 'movie' and 'rides and tall':

Jake: Maybe we could create a movie about rides and tall?

Working together, the children begin to discuss their ideas for the video and try to understand the concept of being tall enough for a ride. The children open up Photo Story on the iPad and together they search for photos from the available images. Soon they realise some of the rides do not have pictures:

Chloe: We can make the rides with our bodies. Film us.

Chloe and Jake begin to demonstrate the rides with their body and use sound from their mouth. They show the 'woosh' and 'woo' the rides make, as well as the children screaming on the rides. Jake inserts the recording into Photo Story:

Maxi: Ok animals next.

The children create a list of animals that are tall enough or not tall enough for the ride. They find images of animals on the iPad. Realising they can't find all of the animals, they film themselves as they act out the animals with movement and sound.

Maxi again mentions animals as they are relevant to the digital narrative, drawing on earlier talk and thinking. Maxi incorporates this into the digital narrative, building the content.

As the children continue to work on their digital narrative in collaboration, Sam realises they need to have an introduction for the story to show the beginning. He takes the iPad and records his voice saying, 'once upon a time'. Sam begins to link his understanding of traditional narratives with the digital narrative, allowing the merging of knowledge. He also points to demonstrate the start of the narrative, but this was not recorded. Jake quickly adds on to the introduction by hitting the audio record button:

Jake: Don't forget the warning "Kids do not try this at home". (*Jake points his finger at the same time*).

Jack demonstrates his understanding of warnings for children and where they appear in media products for children. Again he draws on this existing knowledge and applies it to the making of the digital narrative.

Chloe realises that Jake's finger hasn't been recorded into the video. She highlights the problem with the other children. They have a short discussion before Jake suggests a solution to the other children:

Chloe: Where do we put that in the video?
Jake: At the start. Like this

Jake demonstrates how to insert the hand with the spoken test

Jake: Ok. We can find a picture of a hand.
He begins to search for a picture of hand.

After an hour the children have finished the 3-minute video that became the product of a digital narrative. The video has an introduction, a warning, a short clip of Chloe and Jake impersonating the rides, and images, sounds and impersonations of animals that are tall enough or not tall enough for the show ride.

In the final stage, the children realise that an audience is needed and call the teacher for help:

Chloe: Let's ask Miss S to help us email it. We can then show the others over lunch.
The teacher helps the children email the video.

To the children, an audience can be both real life (presented to the other children in the group) and electronic (emailed to families).

12.7 Findings

From the narrative vignette, we can observe three key themes: (1) children's digital narrative allows multiple ways of meaning making, (2) children continually collaborate as they create digital narratives and (3) children continually learn from each other about using technology when engaged in digital narratives.

The first finding showed the multimodality of children's digital narratives, as both the process and the product. Children engaged in different ways of sharing their experiences with talk, words, images, body cues and bodily actions. The shared meaning created was based on understanding how tall a child needed to be for a certain show ride that had a height restriction. The children demonstrated their understanding of 'tall', for example, with words, photographs, movements and also used animals to develop a point of reference. Many of their choices were documented within the digital narrative, such as the use of animals that were suitable or not suitable for the ride. Likewise, two children described the show ride with movements and sound that was recorded within the digital narrative. The children were able to show an understanding that the ride went up and down at a fast pace, as well as moved in circles. Rather than explaining the meaning in words, the children were able to demonstrate their understanding beyond talk.

The concept of multimodality within children's narratives has been reported by Puroila et al. (2012) in a study of Finnish preschool children drawing about Santa. Building on this finding, this study suggests that multimodality is extended to digital narratives and allows children to express meaning in different ways. Multiple ways of narrating were involved in the narrative, providing a holistic and embodied nature about children's digital narratives. In this example however, the multimodality also became digital, with the children engaging with the different features within the iPad to share and create their meaning. For example, the initial photo taken on the iPad was to determine who was actually the tallest in the group. The iPad was also used as

a 'cultural tool' (Vygotsky 1978) for the creation of the meaning with the children recording different sounds, movements and their voices within the application.

Collaboration between the children also emerged as a key theme. Rather than have one dominant narrator, the role would change as the children took on multiple roles, ranging from both passive listeners to active co-tellers. The children would also ask each other questions to prompt the discussion. The narrative was created turn by turn within the everyday life interaction. Children shared understandings and built meaning from each other. The narratives also came from a shared interest amongst the children about a related incident that created 'trouble' – in this case the concept of being tall for a ride at a show.

The children's digital narrative appeared to be launched without any destination. In narrative research, everyday narratives are often launched with limited knowing of where they might lead (Ochs and Caps 2001; Puroila et al. 2012). While the children were present in the situation, Jake however had a significant role in initiating the interest in the digital narrative. While he initially used the iPad to take a photo of the group, he also suggested creating a digital narrative. The other children's reactions to Jake's request to make a movie created a crucial function in the continuation of the narrative and provided space for the other children to participate. They were eager to participate in the creation of the movie, given Jake's invitation on the topic.

The iPad involved in the narrative allowed the continuation and shaping of the narrative to continue. The integration of the iPad into the children's stories showed how it was positioned and used collaboratively to create shared meaning, aligning with the work of Garvis (2016) and Yelland (2016). For example, the iPad was used to take a photo, record voices, record movement, search for pictures of animals, create an introduction as well as provide an application that could create connections between all of the elements introduced by the children to tell and retell their understanding about being tall for a show ride. The iPad was used with a purpose by the children to create, seek or verify knowledge and to assist with their own structure of a story, positioning the iPad as a 'cultural tool' (Vygotsky 1978). The children were observed as competent users of the iPad, with little assistance needed from the teacher in the classroom. The children appeared to have a purpose for the iPad in their learning, and the iPad was shared among the four children.

The digital narrative also provided an example of how children's personal experiences and context meet within a digital narrative. Chloe came to the kindergarten with a personal experience with her family after visiting a local show. The sharing of the narrative at the kindergarten provided a particular kind of temporary and local context that enabled the children to create their mutual digital narrative. The digital narrative occurred within the kindergarten with an event that all the children knew about and could relate to. The event had also transcended from the children's home environment to that of the kindergarten centre, showing no boundaries around the content within the narrative. Rather than discussing events that had occurred that morning in the kindergarten, the children decided to discuss an event from an outside experience. The children however also wanted to share their digital narrative with their parents who were outside of the preschool context. In this instance, digital

narratives provided the opportunity for children to document their shared meaning making and allowed others to also be viewers within the narration (the parents). The digital narrative however provided the opportunity for the narrative to be viewed when the parent had time and perhaps allowed further possibilities of co-viewing and sharing with the child in the home environment.

12.8 So What Does This Mean?

Digital narratives with young children provide new ways for children to represent their understanding of their own experiences (Garvis 2016). The use of digital narratives provides a space and place for children to engage in multiple means of meaning making that can be recorded and linked within a digital application. In this example, digital narrative also allowed a space for collaboration between the children as they built their own movie together.

The role of the teacher is important for consideration. Rather than being active within the digital narrative, the teacher was absent, allowing the children to explore and create their own meaning together. She was not needed to help with the questioning and reflection of the narrative. While the teacher had previously showed the children how to use the iPad, the children did not need the teacher to continue the digital narrative or to provide digital support. She allowed a space for children to have their own agency when using the iPad. The only time the teacher entered the activity was when the children wanted to email the movie to their parents. This may be because of web restrictions within the preschool (i.e. children may not have an email account and require the teacher to email the parents from her account). The children knew however that the teacher was required for the digital skill of emailing within the classroom.

The teacher did not appear to have boundaries around the conversations children could share within the kindergarten. For example, while the children had engaged in a morning music activity, they instead choose to discuss one child's experience of being to a show and not being tall enough for a ride. While the content was not directly related to the learning programme within the preschool, it still provided learning opportunities for children, based on their own experiences. In this way, it is important for teachers to be open to allowing children to share their experiences from their own lives within the kindergarten. In this example, the teacher provided a space for the children to actively share and discuss their experiences. The children were engaged in oral communication as well as digital representation of the narrative.

Returning to the suggestions from Yelland (2016) that school systems need to move away beyond their traditional ways of working with technology, this example provides a glimpse of young children's learning and understanding of their world as they work together to create a digital narrative without the assistance of the teacher. The children were provided with freedom in their creation and engagement with the iPad, allowing the iPad to become an active part of the learning process. As such, the

teacher has moved outside of the traditional ways of working with digital technology and allowed the iPad to become a cultural learning tool within the classroom. The children support each other in their learning, supporting and developing a shared understanding.

Digital narratives provide many possibilities for children's learning within the classroom (Garvis 2016; Yelland 2016). Within the early childhood classroom, they have the potential to support young children's narration and provide opportunities for multimodal ways of meaning making. Digital narratives also provide the opportunity for recording, editing and re-editing as children confirm and change their understanding. The actual product of a digital narrative can also be shared with others in a time and space that is convenient for the audience member. In this way, digital narratives also have the possibility for connections between contexts (such as the kindergarten and home environment) as the documented meaning can be viewed and reviewed multiple times. The documentation of children's spontaneous narratives in their every life also provides new understandings to adults about the child's experiences and perspectives regarding events and situations. As such, digital narratives might serve as a potential meeting place for children and adults for the co-construction of knowledge. Further developing the ideas and usefulness of digital narratives in early childhood education may provide meaningful ways of learning within the twenty-first century.

12.9 Conclusion

Digital narratives appear to provide new opportunities for children's meaning making and allow children to become co-contributors when using iPads. As the engagement of digital technologies in early childhood classrooms continues, it is important for educators to consider their role in supporting children's digital narratives. For some educators, this means providing access for children to iPads throughout the day, as well as having a shared understanding about the purpose and possibilities with digital technologies.

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Chapter 13
Teaching Visual Arts with Digital Technologies

Maria Kalamatianou and Maria Hatzigianni

13.1 Introduction

The widespread use of technology and the contemporary social reality of multiple and ambiguous stimuli, particularly visual ones (Freedman 2003), have had an impact on the ways that the field of visual arts (VA) is taught. New frameworks underline the need of integrating digital technologies in visual arts (VA) from a young age in order for tomorrow's citizens to become critical image viewers (Anderson and Melody 2005) and creators (Raptis and Rapti 2006). In line with these new frameworks, this study will present an efficient way of incorporating digital technologies to further enhance children's learning and creative engagement with visual arts. Findings from this study are significant for future research in this area as the use of digital technologies grows rapidly and children are infused into a rich visual world from a very young age.

Few studies have investigated how primary school students' use of technology is incorporated into teaching visual arts. Older projects investigated the creation of graphic designs through program coding (Wohlwill and Wills 1988) or the use of special software (e.g., image processing, special effects, photo editing, etc.) in teaching visual arts (Chia and Duthie 1993). More recently, studies have examined the helpful use of computers in providing rich databases of digitized visual artworks of famous artists for older students to explore (Haydn and Counsell 2003) or as a virtual environment where students could virtually visit museums and galleries around the world (Gerlich and Perrier 2003). At the same time, studies in primary

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education have explored the effectiveness of computer use as a teaching visual aid (e.g., presenting famous artworks to young students) or as a storage means (e.g., notebooks, CDs, web servers) for saving students' pieces of art (Ngan et al. 2003).

A different line of inquiry (the interdisciplinary approach) examined the use of technology in VA in order to support other school subjects. Findings suggested positive learning outcomes, for example, learning foreign languages when virtual environments of sightseeing were visited or pieces of ethnic art were admired (New York State Education Department [NYSED], 2010). A positive impact on mathematics learning also was shown in activities that involve programming and designing geometric shapes of art culture (Hinshaw 2001). However, the use of a digital, educational application that involves interactive activities of viewing and interpreting artworks that aim at a more holistic and active engagement with VA has not attracted a lot of interest from the research community so far.

13.2 Visual Arts and the Benefits for Education

When students are involved in visual art projects, they understand the concept of visual literacy. Visual literacy has two expressions: children (a) communicate easily by creating visual and optical forms, and (b) they become active and critical image readers (Arnheim 1969; Mesa 2005). Visual literacy is particularly important in the context of contemporary visual culture (Freedman 2003), where communication has increasingly acquired a visual character. Visual literacy allows students to evaluate, interpret, and selectively use the abundance of visual information they receive daily. These are essential skills that, according to Eisner (2001), an individual must acquire in order to be an educated and functioning adult in society.

Studies show that pleasurable visual experiences of observation and critical art viewing, as well as visual art creation, strengthen the educational process, regardless of the age of the student. Rich visual, tactile, and kinesthetic experiences assist with developing and expanding students' physical and perceptual abilities (Zeki and Bartels 1999). These experiences also promote imagination, ingenuity, and creativity of students, who gradually realize the meaning of all those existing around them (Freedman 2003; Marshall and Vashe 2008). Finally, according to Gardner (2006), these experiences enhance the diversity of human thought, thus promoting the holistic development of children.

Engagement with VA has a positive effect on the development of cognitive abilities such as the promotion of critical and reflective thinking (Posner et al. 2008; Shanahan et al. 2010), aesthetic problems-solving skills (Murphy 2003), and creativity (Flood and Bamford 2007; Lu 2013). Language communication, reading comprehension (DeMoss and Morris 2002), and writing skills (Marshall and Vashe 2008; Sacks and Ayers 2003) also are enriched. Positive influences have been noted in the social domain, for example, on group work, on peer collaboration and com-

munication of ideas, and on social interactions between schools that run art programs (Hutzel 2007; Loveless 2006). Overall, the role of VA in children's learning is now more vital than ever as it can provide them with necessary skills such as critical thinking, observing, and interpreting visual information to better function as informed citizens in this technologically advanced era.

13.3 The Present Study

This study aimed to support the students' learning process and enrich the learning environment by integrating technology (a multimedia interactive software) into VA teaching. Technology was incorporated in designing and implementing digital visual activities to promote students' engagement in active and argumentative critical viewing and interpreting of artworks. It was hypothesized that learners' cognitive skills would be developed and that students would enjoy these experiences through processes of contemplative dialogue and creation of artworks. This study was not restricted to using the computer only as a teaching aid for supporting VA, for example, as a digital art base or a "virtual gallery" (Ngan et al. 2003; Trautwein and Werner 2001). Nor was technology used as a separate cognitive subject focusing on learning a processing application to produce digital art forms (Black and Browning 2011; Mayo 2007; Thatcher 2004). The main focus was on integrating technology to support the learning process of VA and to advance students' skills in visual literacy (critical art viewing, creative expressions).

13.4 Method

13.4.1 Research Questions

This chapter reports on a part of a larger study that addressed the following research questions:

1. Can the use of educational art software support the process of critical art viewing (aesthetic value and perception)?
2. Can the use of educational art software support the process of art expression?
3. Can the use of educational art software promote students' social skills?

To answer the above questions, an educational art software was designed and implemented during a three-month period. Observations of the students' interactions were completed during the intervention and analyzed both qualitatively and quantitatively. A "Visual Culture Test" with questions around students' performance (aesthetic value and perception, aesthetic expression) was used before and after the intervention. The test was analyzed quantitatively to identify possible correlations

between the use of the specific software (technology) and the enhancement of aesthetic value, perception, and expression in VA.

13.4.2 Design and Participants

The setting was a public primary school in Piraeus, close to Athens (a middle-class socioeconomic area), with a class of sixth year students, 21 students in total (7 girls and 14 boys) aged 12 years. The class teacher was a university graduate, aged 33, and a permanent employee with 5-year teaching experience. Apart from the intervention, the teacher participated also as a "co-researcher" and was involved in the process of checking the coding and interpretation of data. Consent forms from parents and the Principal of the school were obtained prior to the start of the study.

The study involved an intervention phase, where the teacher of the class, under the researcher's guidance, learned to use software in order to improve the learning process and his teaching techniques in visual arts. Through interactive activities and a process of thinking routines, students with the help of the teacher critically viewed paintings of the twentieth century. Students were encouraged to design and create their own artworks.

13.4.3 The Educational Art Software

The software was created with "Flash CS4 Professional" (2008). The title of the software was "Picasso searching for his favorite brush in his studio." The user's task was to help the painter find his favorite brush by gaining clues in activities concerning the most important steps of the painter's life and work until the first decades of the twentieth century. Using this approach, the user was encouraged to explore known and unknown painting periods, events, and artworks of this time (four sections: Blue and Rose Periods, Black Period, and Cubism). Along with references to Picasso, certain movements were presented (Impressionism, Fauvism, Expressionism, Modern Art) through the works of great painters who lived and worked before, during, and after Picasso, depicting the way Picasso was influenced by others and vice versa.

Apart from the four main sections of content, the software had utilities such as biography of Picasso, dictionary, timeline, activities for introducing the basic elements (color, line, and shape), and an introductory video of History of Arts from 15.000 BCE up to the middle of the twentieth century. Due to its nonlinear programming, the software gave opportunities to the user, teacher, and student to navigate it in their own ways.

In the digital environment, the activities of the critical viewing and interpreting of an artwork were mostly interactive and had different difficulty levels, starting from basic cognitive skills such as careful observation of artworks and then moving

Fig. 13.1 An example of an "easy" activity. Each group had to try to find a suitable title for each painting from Picasso's blue period. A hint was available by dragging the mouse over the artwork (Copyright note at the end of the chapter)

to the description and identification of key morphological elements of the work (e.g., the dominant color, the basic figure, the subject matter, and so on – see Fig. 13.1).

At the most difficult levels, activities required the participation of higher cognitive functions, such as the comparison and discovery of common and non-common characteristics among works of the same or different painters and generalizations and inferences about the common characteristics of artworks belonging to a particular movement or art period or other characteristics (see Fig. 13.2). Verbal or written activities of critical or creative thinking about the observed artwork, digital painting activities, and creating artworks with traditional means and materials, which complemented the viewing activities, are further explained in "The Intervention" section.

13.4.4 The Intervention

The intervention occurred over a three-month period (March–June 2009). It involved a three-hour, continuous session held every week. The session included interactive activities with the computer software, for students to become informed about paintings of the twentieth century. Teaching was framed within a socio-constructive

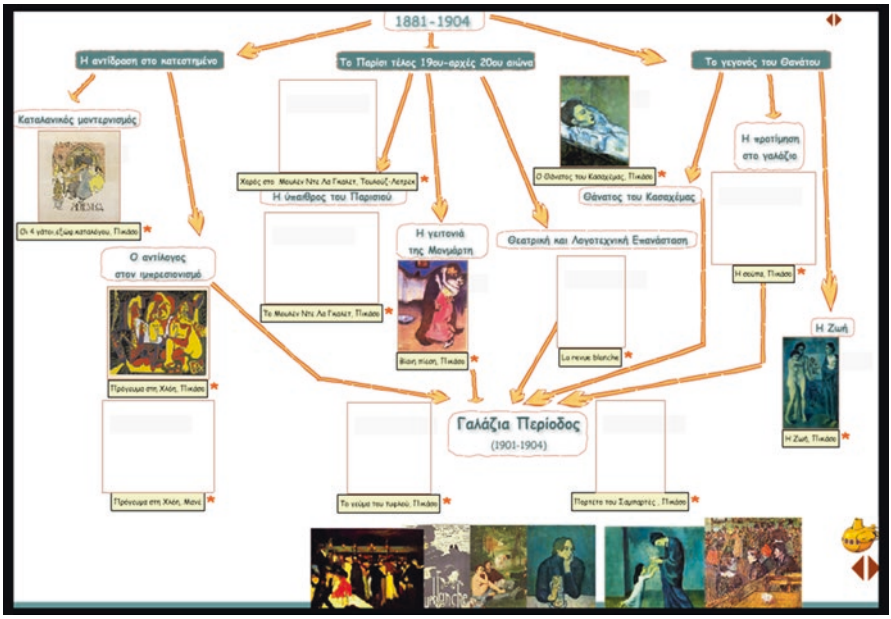

Fig. 13.2 An example of a "difficult" activity. Each group had to complete a mind map with paintings depicting Picasso's life and work from 1881 to 1904. Artworks were available at the bottom of the screen, and the user had to drag and drop the picture that matches each concept of the map (Copyright note at the end of the chapter)

learning context (Vygotsky 1978), supported by the digital environment of the specific application. Group work (five groups of four to five students) was adopted as the ideal framework for the promotion of social skills, cooperation, and positive learning climate (Burnaford et al. 2001; Matsagouras 2004). Additionally, teaching during the intervention was learner centered, providing scaffolding when needed. The teacher had a "mentor" role assisting students to construct their own knowledge. Students were encouraged to acknowledge the value of their own artworks, enhancing their self-esteem (Epstein and Trimis 2005; Ritchhart et al. 2011).

Worksheets accompanied the activities, and contemplative dialogues were included based on the model of "Artful/Visible Thinking" (by Project Zero of Harvard University). This approach encouraged children to express judgments, assumptions, or conclusions after critical viewing of artworks (Freedman et al. 2005; Sacks and Ayers 2003). Students were encouraged to write about the artworks they observed (e.g., narratives about the artwork's topic, short dialogues between the people who were portrayed in the artworks, poems around the topic of the painting).

Activities included digital painting activities (e.g., students repainting Picasso's artworks using color schemes like complementary, analogous, triadic on the computer) and activities with traditional painting materials, such as brushes and crayons (e.g., impressionistic painting, use of warm and cool colors). Traditional activities also involved children working on collages, mask making, and presentations of their artworks. These activities provided children with opportunities to use their experi-

ences, knowledge, and techniques. In this way, they were fulfilling both the role of the critical art viewer and that of the artwork creator (Freedman 2003; Marshall and Vashe 2008).

13.4.5 Measures

Videotaped observations took place during the intervention. Two groups were observed for four periods of time, during their engagement with each of the four main sections of the software, reaching a total of 348 minutes of observational data. Observations took place while groups were engaged with different artistic activities: critical viewing of a painting, critical interpretation of the painting, a piece of writing about the painting, digital artwork, and creation of an artwork with painting materials such as crayons and others.

To explore possible correlations between the use of the art software in the teaching of visual arts, a specially designed *Visual Culture Test* was created by the researcher and administered to the students pre- and post-intervention. The test was designed based on widely used visual art tests, including the Torrance Tests of Creative Thinking (Figural Form A and Verbal Form A, TTCT Torrance 1974) and the use of artworks as stimuli (Berlyne 1971; Limbert and Polzella 1998; Salmon 2001) in aesthetic measurements. With this test the performance of students was rated before and after the intervention in the areas of visual arts (aesthetic value, perception, and expression). The test consisted of 12 questions on aesthetic perception and 5 on aesthetic value and expression (Table 13.1: aesthetic perception questions, APQ0-APQ12; aesthetic value/expression, AVEQ1–AVEQ5). For example, some of the aesthetic perception questions were about classifications and comparisons of artworks based on their formal elements. In the aesthetic value and expression questions, students were asked to write a short story based on aesthetic criteria or special characteristics of an artwork or make a drawing and write about it.

13.5 Analysis

13.5.1 Quantitative Approach

SPSS statistical analysis software was used to analyze data from the scores from the *Visual Culture Test* before and after the intervention to explore whether the use of the software supported the process of critical art viewing (first research question) and art expression (second research question). The performed analysis was mainly descriptive (frequencies), and group scores were compared (one sample *t*-tests) to identify differences. Moreover, observations were analyzed quantitatively (descriptive analysis). Interactions among members of each group were categorized as

Table 13.1 Means, standard deviations, range, and one sample t-tests (*t*) for Visual Culture Test of students before and after the intervention

Before the intervention						After the intervention						
				Range				Range		Differences *t*-test		
Type of questions	*N*	*M*	*SD*	Min	Max	*M*	*SD*	Min	Max	*M*	*t**	*Df*
Aesthetic perception (APQ0-APQ12)	21	22,95	6,30	9	34	32,67	5,32	23	41	9,72	7,69*	20
Aesthetic value and expression (AVEQ1–AVEQ5)	21	12,95	2,89	7	17	13,95	1,77	11	17	1,00	2,53	20
Total visual culture (TVC: APQ 0–12 + AVEQ 0–5)	21	35,90	7,56	19	48	46,62	5,68	37	58	10,72	7,81*	20

*$p < ,05$

Table 13.2 Frequencies of the observed interactions on the computer, per category and quality, during the intervention

Interactions per category and quality	Group A								Group B							
	First observation		Second observation		Third observation		Fourth observation		First observation		Second observation		Third observation		Fourth observation	
Interactions with artwork/ computer	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N
	P2: 63	B7: 13	P2: 62	N7: 8	P2: 95	N7: 9	P2: 89	N7: 7	P2: 59	N7:11	P2: 31	N7: 6	P2: 71	N7: 7	P2: 84	N7: 8
	P3: 39	B6: 2	P3: 19	N6: 1	P3: 32	N6: 1	P3: 36	N6: 0	P3: 13	N6: 1	P3:12	N6: 0	P3: 15	N6: 1	P3: 51	N6: 0
Subtotal	102	15	81	9	127	10	125	7	72	12	43	6	86	8	135	8
Interactions with the group	P1: 31	N8: 10	P1: 25	N8: 8	P1: 53	N8: 8	P1: 15	N8: 3	P1: 24	N8: 10	P1: 12	N8: 5	P1: 33	N8: 7	P1: 13	N8: 2
	P4: 11	N5: 8	P4: 11	N5: 4	P4: 12	N5: 2	P4: 8	N5: 0	P4: 7	N5: 4	P4: 6	N5: 2	P4: 10	N5: 1	P4: 3	N5: 0
Subtotal	42	18	36	12	65	10	23	3	31	14	18	7	43	8	16	2
Total	**144**	**33**	**117**	**21**	**192**	**20**	**148**	**10**	**103**	**26**	**31**	**13**	**129**	**16**	**151**	**10**
Percentages of the total number of interactions in the first and last observation	**81.31%**	**18.7%**					**93.6%**	**6.4%**	**79.8%**	**21.1%**					**93.7%**	**6.3%**

Note: Subcategorization in positive (P) and negative (N) forms of interaction based on Bales' system categories of interaction (Bales et al. 1979)
P1–P4: Positive interaction (is friendly and gentle with others, seeks interaction, agrees with the other team members, directs the discussion, offers opinion, supports and rewards others, positive emotional state)
N5–N8: Negative interaction (behaves badly to others, making negative comments, disagrees with others, stops interaction, works alone, orders, refuses to share, negative emotional state)

"positive" or "negative," during the four periods of observation, and frequencies were explored (Table 13.2). This kind of analysis was combined with qualitative analysis to provide a rich description of the use of technology in promoting social skills (research question 3).

13.5.2 Qualitative Approach

To assess social skills, video-recorded observations were subjected to content analysis in accordance with the methodological approach of "Grounded Theory" (Corbin and Strauss 1990). The sequence of interaction used as the analysis unit in the video-recorded observations and interviews included significant portions of the dialogue as a whole (Mehan 1979). The thematic and semantic analysis involved searching for sets of key words, as well as suggestions concerning viewing, interpretation, artwork creation, and interaction with the software or the computer. Additionally, the students' interactive behaviors with each other were subjected to thematic and semantic analysis. Subsequently, the data were encoded into the following constructive (thematic) interaction categories:

(a) Interaction with the artwork (viewing of artwork/artwork creation)
(b) Interaction with the computer and software
(c) Interaction with others/collaboration

Specific observational categories included subcategories of related interactions with the one not excluding the other. The total of the recorded frequencies in each interaction category, per group and observation, was encoded in "positive" (P) and "negative" (N) forms of behavior, based on Bales' scale (Bales et al. 1979). Bales' "Interaction Process Analysis" scale describes interactions among others as, for example, being friendly with the rest of the group, agreeing with others, contributing to a friendly climate, offering help and their opinion to the group, behaving badly or aggressively toward others, disagreeing, and continuously asking questions and guidance (Bales et al. 1979).

To assess aesthetic expression, students were asked to write down on worksheets short answers or texts (story/dialogue/poem), based on aesthetic criteria or special characteristics of the observed artworks. Those texts were subjected to content analysis (see above) with recording unit the word and analysis unit ten lines of text per page. The frequency of words relevant to the subcategory "Viewing the Artwork" (elements of the artwork, aesthetic criteria, History of Arts' references, specialized vocabulary) was calculated and recorded. Creative texts were also assessed in four domains: the fluency and flexibility of ideas, their originality, and their quality. A three-point rating scale was utilized: 0, no response; 1, a random list of details or report of what is in the picture; 2, a simple problem or situation is defined; and 3, a structured, complex situation or problem with a clear beginning, middle, and ending developed (Macgregor 2002).

13.6 Results

Students' aesthetic perception, aesthetic value, and expression were assessed quantitatively by comparing the scores of the Visual Culture Test before and after the intervention. Additionally, students' aesthetic expression was qualitatively assessed through an examination of their written texts (such as stories, comparative reports, dialogues, poems, titles).

13.6.1 Aesthetic Perception

There was improvement of students' aesthetic understanding and skills regarding the active and careful artwork viewing. Skills such as thorough observation of artwork, recognition of basic morphological data, identification of similarities or differences between artworks, and specialized visual vocabulary were improved by 44% after the intervention (see Table 13.1, first line: Cognitive skills), which was statistically significant.

13.6.2 Aesthetic Value and Expression

Students were able to understand and take into account aesthetic value, such as the creative imagination of the artist or the original expression of the artist's actual or internal world. However, the scores of the posttest for these five questions, though improved, did not reach statistical significance. This finding suggests that students' opinions about the "beauty" of an artistic creation did not change significantly (see Table 13.1: line 2; improving performance 0.77%) after the intervention, even though the information that the students learned about the painting was enriched (see aesthetic perception). For the participants of this study, the aesthetic pleasure from the experience of critical viewing of artworks was drawn mainly by concrete concepts, such as understanding the content and interpretation of forms, and the symbolic use of colors or shapes that conveyed the painter's messages. Paintings that did not encompass these concrete characteristics remained less favorable among students, even after the intervention.

The qualitative analysis of the students' content of the writing texts, as a basis for reflective dialogue during the viewing process, showed important changes in student thinking. The level of students' visual expression shifted from a mere description of the morphological artwork elements (such as the dominant color, the kind of shapes, the number of the forms) to the operational understanding and usage of aesthetic concepts (aesthetic criteria, History of Arts' references, specialized vocabulary). Students composed creative pieces of writing transforming their aesthetic experiences (knowledge and feelings) to written word using their imagination, orig-

inality, and freedom of thought. Visual literacy (perception, values, and expression) prevailed in their writings.

Overall, the improvement in total scores of the Visual Culture Test in post-intervention was statistically significant (see Table 13.1, third line). Qualitative analysis of students' creative writing texts supplements this significant improvement and provides a more positive picture, as further explained in the Discussion.

13.6.3 Social Skills

Observations of students engaging with the digital and traditional activities were analyzed quantitatively and qualitatively. Results revealed that during the intervention, students' behaviors changed as they adopted a teamwork collaborative spirit working to achieve common goals.

Students identified the value of their interactions with the software, as it contributed to more effective cooperation and to the development of critical thinking through discussion and peer teaching. The cooperative behaviors and the active involvement of all members of the group in the software activities underlined the advantages of teamwork. These positive transformations are shown in Table 13.2, where students' interactions, following Bales' scale, are presented and compared. At the end of the intervention (see Table 13.2, fourth observation), both focus groups (A and B) developed positive interpersonal interactions. Children improved their social skills by adopting a collaborative learning culture, setting common goals, and cooperating.

Furthermore, the qualitative analysis of observations and group interviews provides more evidence of how the groups actively participated in an interactive process through the collaborative activities of the software. The following videotaped observation segment of Group A (the small letter defines the sex, boy or girl, the capital letter defines the group, and the following number represents each member/student of the group) referred to a digital painting activity where the team members were asked to repaint a Picasso's blue period painting using a complementary scheme of colors. The group had already decided to use the complementary blue and orange colors. The interactions among the students showed structures of mutual help that they had developed in order to accomplish their task, support and encouragement especially for the "weak" members, and opportunities to equal participation of all members (the original extract is in Greek – see Appendix A):

bA2*: I think that each of us should make his own choice, you don't have to do it alone, it is easy for all (he means each member to take the mouse and change the colour shades, not for him to be the one to move the mouse and execute the choices).*

gA1*: (She seems annoyed by what was proposed but gives the mouse to a classmate and asks him): N., Can you do it, by yourself ? You want it?*

bA4*: Where do I click? Here? (asks for help from the group)*

gA1: *(Points to the screen and explains the graphic and what the color slider does to orange and blue complementary scheme they have chosen): First, you have to choose the part you'll colour, and then pick the colour.*

bA4: *Which one is the 29 piece; Is this part on the Vase? I think it is this one on the vase, yes on the vase, it wasn't there before…I'll do it orange…*

gA1: *Do you want to do it orange? Nice, lighter or darker to the screen's model? (waits)…No you have to drag the mouse left…dark colours are at the left side (points to the screen). You see? Do you like this colour? Yes? Ok, it is nice… well-done!*

Both quantitative and qualitative results show that, after the intervention, students developed "positive" interpersonal interactions, such as the cocreating of digital works, promotion of peer support, and equal participation of members in discussing and sharing of ideas.

13.7 Discussion

The starting point of this research project was that there were few studies that investigated how digital technologies support the teaching and learning of visual arts, especially in primary school. In line with previous studies (Gregory 2009; Roland 2010; Stavridi 2015; Tillander 2011), results revealed that the use of interactive digital technologies had a positive influence on students' aesthetic perception, value, and expression.

Findings revealed that students' aesthetic perception skills were advanced significantly after the intervention. With the help of an interactive and pleasant environment, students observed artworks, engaged in thoughtful dialogue activities, and became capable of approaching, understanding, and interpreting great works of art through divergent thinking, problem-solving, and multimodal process (Li and Jiang 2015; Unrath and Mudd 2011).

Furthermore, students' aesthetic expression was facilitated and enriched by the use of technology. The friendly environment of the software gave students the opportunity to express fearlessly themselves (Wood 2004) when making their digital artworks (Murphy 2003) and also be creative and innovative with their own written or tangible aesthetic products (Ashford 2002; Macgregor 2002). Students exercised their synthetic abilities, combining information and imagery from a multitude of sources and transforming their artworks into something new and meaningful (an innovative story or a poem, a painting, etc.) (Eisner 2004).

The students' aesthetic value skills were least influenced by the digital environment and the instructional strategy. There was a small improvement, although not statistically significant, for this set of skills. Though no specific study was located by the researchers in this field and for this age group to help with a deeper understanding of this finding, the theory in the area of visual arts informed us that primary students mainly concentrated and understood the concrete depiction of reality

(Parsons 1987). As "naive" art consumers (Trautwein and Werner 2001, p. 256), they did not seem ready enough to change attitudes and perceptions about "beauty" of artistic creation relevant to their aesthetic development. The aesthetic pleasure from the experience of active and critical viewing of artworks was drawn mainly by being able to understand the content and the interpretation of forms as well as the impact of the favorite colors or shapes. In our study, the students' interest for the artworks and their ratings of the beauty of the paintings remained unaffected by the supportive multimedia application and the different viewing conditions, and this finding was consistent with previous studies with college students (Martindale et al. 1990; Trautwein and Werner 2001). More research in this specific area of visual arts with young children is necessary to shed more light into the reasons behind certain limitations and whether new technologies could (or not) assist in this field.

Finally, students' social skills were supported. During students' creative endeavors, positive interactions increased, and negative interactions decreased by the end of the intervention. The qualitative findings from the analysis of observations, consistent with previous investigations (Hutzel 2007; Loveless 2006), also concur that the use of digital technologies in teaching visual arts can offer students a rich cooperative learning environment. Through interactive viewing activities, problem-solving dialogues, as well as cocreation of artworks, teamwork and collaboration were promoted.

13.8 Conclusion

Despite the short duration of the teaching intervention and the small sample, this study further supports the use of technology in teaching visual arts effectively. This study makes a significant contribution to knowledge as has successfully integrated technology in the teaching of visual arts and has filled a gap in understanding the ways that digital technologies could advance visual literacy skills for young students. While new technologies do not, of course, replace traditional art processes, they do extend the possibilities of significant changes in aesthetic perception, art expression, and social skills within a constructive context (Phelps and Maddison 2008). Overall, findings from this study suggest that a constructive use of technology, more complex than just visiting a museum or an art gallery, can significantly contribute to the promotion of students' visual culture transforming them to critical viewers of art and imaginative creators.

Appendix A: Student's Transcript from the Observation in Greek

αA2: *Εγώ νομίζω ότι ο καθένας θα πρέπει να κάνει μόνος του την επιλογή του, δεν είναι ανάγκη να το κάνεις μόνη σου, είναι εύκολο για όλους (εννοεί να πάρει το ποντίκι και να επιλέγει ο καθένας μόνος τις τονικότητες του χρώματος, χωρίς εκείνη να εκτελεί τις επιλογές του καθενός)*

κA1: *(δείχνει ενοχλημένη από την πρόταση, αλλά δίνει το ποντίκι σε συμμαθητή της στην ομάδα). Ν…., θέλεις να το κάνεις μόνο σου; Μπορείς;*

αA4: *Πού πατάω; Εδώ; (ζητά διευκρινίσεις από την ομάδα)*

κA1: *(του εξηγεί δείχνοντας την οθόνη με το γραφικό σχέδιο και το μεταβολέα των δύο χρωμάτων, μπλε και πορτοκαλί που έχουν επιλέξει ως συνδυασμό για το συμπληρωματικό σχήμα) Πρώτα διάλεξε το κομμάτι που θα χρωματίσεις, και μετά το χρώμα.*

αA4: *Το 29, ποιο είναι; αυτό το κομμάτι, στο βάζο… αυτό έβαψε; Ναι, στο βάζο, δεν ήταν πριν… Θα το κάνω μάλλον πορτοκαλί…*

κA1: *Πορτοκαλί, θέλεις; Ωραία, ανοικτό ή πιο σκούρο από αυτό στην οθόνη; Όχι, αριστερά, πρέπει να το τραβήξεις, τα πιο σκούρα είναι από εκεί… (του δείχνει στην οθόνη). Βλέπεις; Σου αρέσει αυτό το χρώμα; Ναι; Ωραίο είναι! Μπράβο!*

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Chapter 14
Learning Literacy: Engaging with Print and Digital Texts in the First Year of School

Katherine Doyle and Annette Woods

14.1 Introduction

Literacy teaching and learning in schools in the twenty-first century involve a focus on both print and digital texts from the earliest years of schooling. Teachers are increasingly required to cater for a diverse range of students, each with individual experiences and ways of learning to read and write that they bring to their school learning. We know that for many children, poverty and disadvantage have implications for the access that they may have to digital tools and technologies. However, we also know that for many, prior-to-school praxis in reading and writing often encompasses exposure to both print and digital text forms. And not to overstate the facts, but young people's future life successes will be dependent upon opportunities that they have to develop skills, understandings and processes of literacy as a collective and multimodal practice. Indeed, a number of researchers have detailed how the academic, cultural and creative experiences of children in current society are increasingly digital, mediated and multimodal (see, e.g. Buckingham 2003; Dezuanni and Woods 2014). Recent international reports (see, e.g. Sefton-Green et al. 2016 for The European Cooperation in Science and Technology (COST); Rideout and Katz 2016 for The Joan Ganz Cooney Centre; and Burnett 2016 for The Cambridge Primary Review Trust) also demonstrate the vitality of multimodal and multimedia technologies and their links to rapid social change. For example, the 33 COST countries in Europe are currently working to link current knowledge about

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digital literacy and multimodal practices in what has come to be known as *COST Action*. The first report for this project, tabled by Sefton-Green et al. (2016), validated the position that young children from the first months of life experience exposure to digital modes of communication as well as traditional modes. So the point is to consider not only the impact of digital technologies on everyday life but also the impact of multimodality on *changing literacies*. Rideout and Katz (2016) focus on the impact of digital technologies on low- and middle-income families in the USA. While this report claims that many children growing up in low- and middle-income families do have access to multimodal devices at home or at school, the researchers also make it clear that there continues to be inequity in access to digital technologies through differences in the variety and range of devices available to children from families of different socio-economic status cohorts. Most parents (80% of the participants) who participated in the research reported that technology in education is a positive trend. The report stresses the need for innovative partnerships and commitments from social institutions including education. In 2016, Burnett highlighted the range of digital experiences that young children in the UK bring to the school setting. She also acknowledged the inequalities that can exist in children's experiences with technology. Like Rideout and Katz found in the USA that the diversity of hardware that some have access to remains an equity issue, Burnett found that in the UK, some children's access relies only on smartphone technology. Nevertheless, she also reported that most children use a range of digital media and the same is embedded into the social practices and routines in which they engage. Burnett also claimed that this is the case for young children as well as their older peers.

While there has been a great deal of research into young children's use of digital texts and technologies (Danby et al. 2016) as well as the inclusion of digital technologies into the literacy curriculum (Mills and Unsworth 2015), there has been less focus on the material effects of digital texts, technologies and tools on how young children are learning to read and write in current early years' classrooms. This is beginning to shift with increased interest into the materials used as children learn with and about digital technologies. As one example, Couse and Chen (2010) investigated the use of *tablets* as a viable tool for teaching writing in early childhood education. However, this research is restrictive in terms of our research reported in this chapter in that it fails to address the multiplicity of print literacies. What this research does tell us about is the viability of tablets as a way for young children to represent their ideas. On the other hand, the research of Beschorner and Hutchison (2013) described how iPads connect to the range of traditional print literacies, and Geng and Disney (2015) reported on the use of iPad apps in young children's literacy learning. This research has primarily concentrated on the quality and availability of apps for teaching literacy. However, Geng and Disney's study did show that young children were ready and able to engage with the technology and that using the apps encouraged interactivity between the children. It is fair to say that debates about the relevance of digital resources for early literacy learning continue (Burnett 2010). Writing and reading in a traditional sense continue to be an important part of the literacy repertoire required for successful participation in education and future lives; however, we need to better understand how this learning to engage with

print texts is changed when young children employ print and digital technologies together in classrooms.

In this chapter, we report data collected as part of a 5-year school reform project set in one school, in a community where many students' lives were impacted by poverty and disadvantage. The larger project aimed to investigate whether a focus on teacher professionalism, collaborative curriculum planning and reshaping pedagogy could have a positive effect on student literacy outcomes (Woods et al. 2014). Our point has been to provide positive stories about the possibilities that remain available for teachers and children to teach and learn together in rigorous ways even though current education contexts and opportunities are being narrowed (see Comber and Woods 2015; Comber et al. 2017). The student population was diverse, and there was a need, identified by teachers and researchers, to connect substantively with the outside school lives of the student cohort more effectively.

Here we detail a sequence of teaching and learning undertaken in one preparatory class[1] as the teacher and researchers worked to digitise the literacy curriculum. We provide a vignette of one child's learning progression to further investigate a focussed example of how young children can develop print and digital literacies at the same time. These new ways of implementing a curriculum through an increasingly digitised pedagogical approach led to the introduction of new texts, tools and technologies into the curriculum. The presentation of what was attempted and achieved also allows for a focus on the developing literacy capacities of the young students throughout the year. Drawing on socio-material understandings, we consider the tools, resources and technologies that were utilised as these students learnt about and with literacy. The findings provide insight into the positive impact of literacy teaching and learning that takes account of students' engagement with digital and print texts within early years' classrooms and enables collective teaching and learning.

14.2 The URLearning Project[2]: Digital Texts and Print Literacies in Preparatory

The research discussed in this chapter was undertaken by university and teacher researchers as part of a 5-year school reform project located in one school in the sprawling southern suburbs of one large Australian city. The overall framework and

[1] In Queensland, Australia, where this study was located, preparatory is the first year of school. Children generally attend in the year that they turn 5 or 6, with many starting the school year as 4-year-olds. While the prep year is officially a non-compulsory year of education, more than 95% of children in this age range attend.

[2] The URLearning project was an Australian Research Council-funded project, which supported the partnership of Queensland University of Technology, the Queensland Teachers' Union and the school in which the project was located. We acknowledge our research colleagues Amanda Levido, Michael Dezuanni, Allan Luke, Beryl Exley, Karen Dooley, Vinesh Chandra and John Davis from QUT, as well as Lesley McFarlane and John McCollow from the QTU, and the leaders, teachers and students and their families and communities who engaged with us at the research school.

purpose of the project was to demonstrate how a socially just education which provided parity of access and improved outcomes for students could be achieved in the current education context. As such, social justice education was a theoretical foundation of the project. Drawing on the work of Fraser (1997, 2003, 2009), we configure social justice education as multidimensional with a key focus on providing quality education to all students regardless of who they are, where they live or what communities they represent.

According to Fraser (2003), when working for social justice, consideration must be given to recognitive, redistributive and representational justice if parity of access and outcomes is to be achieved for all students in schools. In education terms, recognitive justice has a focus on ensuring that the curriculum and pedagogy within classrooms and schools engage with the histories, identities, languages and representations of all children and young people involved. While being able to see oneself and those like you in the school curriculum might be a way to promote a sense of belonging to the education space, in order to redress the cumulative effects of decades of disadvantage, there is also always a redistributive element to socially just education. By this we mean more than just the redistribution of financial resourcing. Redistributive justice requires the provision of parity of access to the skills, knowledges and resources valued by dominant society. In recent work, Fraser (2009) has made the point that additional to recognitive and redistributive measures, consideration needs also to be given to how to work towards providing spaces for a diverse range of voices in the *what* and *how* of education – some level of community governance and accountability that goes beyond token representation. Achieving a socially just education in communities where poverty has daily implications for the children and young people attending school requires attention to elements across all of these dimensions, and this framed our interactions within the school and community at all levels.

The mid-sized public school was located in a community where poverty and disadvantage did impact on the lives of many of the children who attended. The reform project was focussed on investigating what could be achieved in schools where reform was built on teacher professionalism and community engagement rather than top-down accountability and an overly defined curriculum. The student population at the school was approximately 600, with most living in the surrounding housing estates. The cohort was culturally diverse, including 10–15% Aboriginal and/or Torres Strait Islander students, a further 15% of Pacifica heritage, and children who had been born or whose parents had been born in a diverse range of countries. Approximately 6% of students received formal English as an additional language instruction – but as is the case in most schools, there was likely a much larger percentage who could have benefitted from such specialised programmes if resources had allowed.

One component of our approach in this reform project was to work with teacher-researcher colleagues as they considered reform of their pedagogy and curriculum, investigating ways to increase access to digital technologies and media arts, and to consider appropriate pedagogies for the students in their classrooms. The focus was on increasing rigour and enabling differentiation in a high-quality, high-equity

curriculum coupled with positive framing of children's experiences, capacities and skills. In the preparatory classroom featured in this chapter, the teacher and students worked alongside a researcher with media art expertise (hereafter called the media specialist) and other researchers to consider ways to diversify the use of particular tools, materials, resources and technologies in the everyday activities of learning literacy.

The preparatory class was taught by an experienced early years' teacher who had taught at the school for several years. She was an expert literacy teacher and led literacy curriculum reform with her colleagues. She had less experience in using new technologies with young children but was open to trialling new approaches to digitise some components of her curriculum. The children in the class were used to working as a whole class, as well as in groups and individually. There was access to a significant amount of adult expertise for student individuals and groups throughout the day as part of the normal school-based allocations of staff. Recent education system's curriculum mandates in Australia have led to much more basic skills and much less critical or problem-based learning or play-based pedagogy in the early years of schooling. Despite these mandates, in this preparatory class, time remained available for group work, hands-on activities, children's talk and a good measure of critical literacy work at the same time as learning about basic skills (see Exley et al. 2014).

As was the case with all of the in-class work conducted in this research project, the decisions about what reform focus to take in this preparatory class were based on the collective knowledge of the teacher and researchers. The URLearning project did not involve researchers bringing a prepared literacy or media arts programme to the teacher. Instead the class teacher and researchers, including the media specialist, collaborated to bring a dual perspective to the curriculum planning as a way to best meet the needs of the class as a whole and to ensure that individual children were all provided with access to the benefits of this expanded curriculum. The class teacher was also responsible for ensuring the digital literacy components introduced as part of this reform process integrated with the class curriculum as a whole. Furthermore, her knowledge of the individual students ensured that media arts learning complemented the disposition, prior knowledge in print and digital literacies and the social needs of each child. The media specialist mentored the class teacher on the best ways to implement media arts and digital literacies into the classroom curriculum. Together, the media specialist and the class teacher developed a literacy learning programme which foregrounded pedagogical practices to benefit the students' literacy learning broadly configured and to capitalise and develop print and digital literacy skills, practices and understandings.

In focussing on researching literacy learning in classrooms, we understood that the current context of classrooms and education more generally has implications for how children learn literacy. Furthermore, we were interested in what learning literacy could look like when teachers and children understand literacy learning to involve print and digital tools and texts, as well as being a collective or collaborative practice rather than just an individual pursuit. So within this classroom, the emphasis of literacy learning was not only on the production of accurate print texts but

rather on the negotiation of digital and print tools, texts, technologies and resources. The young children were also expected to be engaged in text production across multiple modes – print and digital. Therefore, literacy learning took place for children as they used and produced digital media as well as print texts, and used a variety of technologies. The objectives of the classroom curriculum were to utilise the learning in digital media and literacies to produce outcomes in conjunction with, and for, print literacy learning. There were often direct links between the content covered for English and the print and digital skills and understandings being developed. As an example, when the class curriculum in print literacy learning focussed on picture books, students produced their own picture books, and tools such as iPads or laptops were utilised to support these production practices.

In collaboratively planning the class curriculum, technology was viewed as an integral part of the curriculum by the teacher and the researchers. Traditional literacies and becoming proficient in print literacy remained an integral part of the curriculum. But, by building students' capacity in both print and digital ways of communicating, students developed a wider choice of communication tools, and the links between what they were able to do with print texts and what they were able to do with digital texts were consistently made transparent in the curriculum. This transparency was key to demonstrating how digital text practices affected print text practices and how print and digital texts were linked to enable broader choices for children's representation of ideas and greater scope for literacy learning.

Planning for a new integrated, digitised curriculum meant that there were necessary changes to teaching practices to allow for the introduction of the new digital tools. This in turn led to the young students' negotiation of digital texts. At the same time, these students were learning to negotiate traditional print texts: oral, written and visual. The challenges for planning were the facilitation of learning across the range of traditional and digital texts and how to best ensure that learning in both traditional and digital texts complemented each other. As a result, the type of pedagogical practice needed to be considered carefully. Students' engagement with the range of texts necessitated explicit, guided practices as well as active participation with the variety of technologies that was to be used in the classroom programme.

14.3 Reshaping Pedagogy: Digitising the Curriculum

Reshaping the pedagogy in this classroom meant diversifying the methods of teaching and learning in terms of the tools, texts, resources and technologies employed for developing print and digital literacy skills with the young children. However, prior to and throughout the pedagogical process, the media specialist and the class teacher shared mentoring sessions on ways to establish the best digital media teaching practices which would enable the young students to be involved in digital culture productively and also complement the traditional print literacy curriculum. The focus was on respecting the class teacher's professionalism and recognising her prior experiences and strengths through collaborative learning. Planning sessions

were collegial in nature with teachers and researchers working together to share knowledge and ideas. However, the media specialist had specific expertise in digital technologies and media arts that was invaluable especially in the early stages of the reform. Finding a way to provide similar support for teachers beginning to work in this field in other contexts does need to be considered by anyone considering following a similar path. Pedagogically, the reshaping of classroom methods entailed the class teacher embracing the digital materials and technology, as well as coming to terms with the framework of digital media literacy and the links between digital literacies to print literacies. The key was to think deeply about pedagogical praxis that might be enabling for students' learning, teacher monitoring and assessment as well as successful, productive classroom management.

Reshaping the pedagogy drew on Dezuanni's digital media literacy building blocks (Dezuanni 2015; Dezuanni and Woods 2014). According to Dezuanni, the digital media building blocks consist of four dimensions. By this way of thinking, in order to communicate creatively and also to develop new conceptual understandings and the capacity to critique, we need to learn about digital materials, be engaged in digital production, develop conceptual knowledge and learn about how to analyse digital texts (Dezuanni 2015). This model formed the basis of the mentoring sessions with teaching staff and also worked at the foundation of how the year-long literacy programme came together in this class for while the approach does not presuppose a hierarchical development, it does make the point that the materiality of working in digital ways needs attention. For this reason, early in the year, working with young children who had minimal experiences with digital tools for creating meaning required a focus on the skills with explicit teaching about, with and of digital materials and production. These were further developed and taken to automaticity later in the year as the young children were also expected to build conceptual understandings and begin the analysis of texts. Table 14.1 provides examples of what working from a focus of each building block might look like in a practical sense.

In practice within this classroom, reshaping the pedagogy through digitising the curriculum meant that there were explicit lessons on using digital materials and producing digital texts to communicate. Early in the year, these were taught by the

Table 14.1 Explanation of digital media literacy building blocks via specific examples (Adapted from thinking presented in Dezuanni, 2015)

Building block	Practical examples
Digital materials	Learning about digital text, still and/or moving images, sound effects, voice, music and generated media
Media production	The creative process from written and drawn formats, story boarding, laying out, animation to digital materials and media products such as broadcasts, videos, games, books and so on
Media analysis	Viewing, reading and listening to media products – specific contexts for specific purposes and to consider how things work
Conceptual understandings	Knowledge development of digital materials for media production and media analysis – context and purpose of specific media productions

media specialist; however, a model of gradual release saw the teacher taking over much more of this content by mid-year. The focus was often on the technological resources and digital aspects of the programme – the digital materials and production processes. Early on, these lessons provided a model from which the class teacher could take ideas as she continued to plan and teach the curriculum content for the class. As the year progressed, the lessons became much more shared and collaborative, and eventually the control and responsibility for teaching were shifted completely to the teacher. A similar shift from explicit, modelled, highly directed instruction through a gradual release process to more implicit learning opportunities where students used their skills and capacities to communicate and design could be seen in the structure of the planned learning sequences taught to the young children. We have theorised this by calling on Bernstein's (1975) ideas of visible and invisible pedagogies.

Early in the year, children were provided with specialised time to learn about digital materials and media production, individually and in small groups. In the first two terms of the school year (February through to June), children worked on laptops individually. Routines and basic skills were taught explicitly. Routines such as how to collect and return their laptops to the trolley were established. Basic skills required to use the laptops, for example, basic operating skills, how to locate programmes such as Word and Photo Booth and how to shut down the computer, were the explicit focus for lessons in these early weeks. Table 14.2 provides a more substantive summary of the routines and basic skills foci during these introductory months.

The pedagogical process in these early days of basic skill development with the children was laborious. However, the explicit and visible pedagogy supported success. Students responded well. Each child was also individually assessed on these basic skills with positive results. Of course issues related to the young children's fine motor skills or literacy skills such as letter recognition made some of this work difficult for some children. However, there were simple workarounds that meant all

Table 14.2 Routines and basic skills

Routines		Basic skills
• Laptop allocations	Following directions	• Turning on the laptop
• Laptop collection and return	⟷	• Logging on
• Care of laptops	Procedures	• Saving
• Plugging in the charger	⟷	• Shut down
		• Letter identification
		• Letter/sound relationships
		• Specified vocabulary
		• Location of symbols, icons, save
		• Symbolic language and meanings
		• Typing own name plus a short sentence: "Hi. My name is..."

children continued to have access to learning about digital literacies and media arts, while also continuing to develop their print literacy skills. For example, some print texts were translated to words in capital letters, so that the child could match the letters of the print text to the letters on the keyboard (Cottrell and Levido 2012). The focus was on the digital materials and digital production, and a basic assumption was that these should not wait until after a certain plateau of print-based literacy skills was achieved.

Implicit teaching practices were also engaged during this initial teaching period whereby the children were given time to explore and 'play' with the laptops and other digital materials in order to practise the new skills. Figure 14.1 (adapted from Doyle 2011, p.131) demonstrates a continuum between highly visible (explicit) pedagogy and highly invisible (implicit) pedagogy. If the continuum is applied to this classroom, then teaching practices at these early stages of digitising the curriculum shifted from visible pedagogy to less visible pedagogy where children engaged in guided play and practised skills. Thus, students were given times where they had more choice with elements such as talk, pace or space as they participated in practising skills. Later in the year, there were continued shifts along the continuum to more implicit, invisible ways of working. These shifts were enabled as the children's skill levels increased and there was less need to build capacity in basic skills.

This shifting from explicit to implicit pedagogical practices and back again which occurred in order to familiarise the young students with the digital materials required for the digital production tasks was often two-way. Shifting pedagogies (Doyle 2011) capitalised on opportunities for students to 'play' with the digital

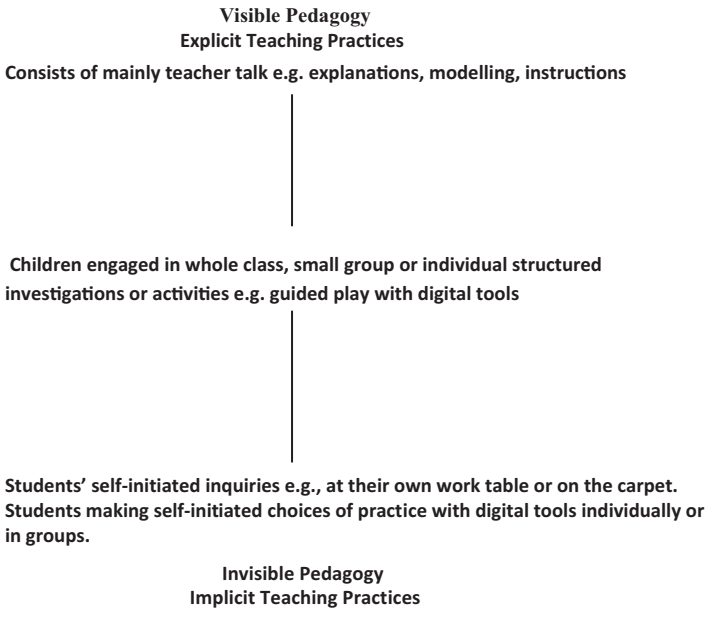


Fig. 14.1 Visible to invisible pedagogy continuum

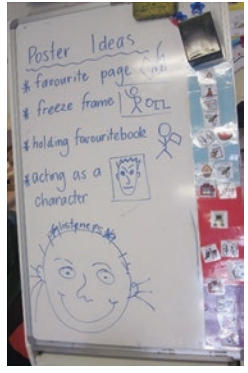
tools, use associated language and vocabulary and demonstrate their grasp of skills. For those working in the classroom, the shifting from visible to invisible pedagogies provided time to offer individualised instruction to particular children as required and time to assess each child's conceptual and skills' development. This also provided continual feedback for ongoing curriculum planning.

Students became more adept with the technology and had mastered the routines, word processing, photographing, moving text and images on a page and basic computer skills as the year progressed. So in the third school term – when students had been in school for approximately 6 months – the students were introduced to iPads along with a variety of apps, including *Little Story Maker* and *Comic Life*. The classroom curriculum included activities based around oral language and innovations on texts, creating a book review poster, critical literacy activities such as interpretations of texts through freeze frames, and also increasing fluency with a range of texts. Skill development was centred on narrative using the iPad, photography, typing and audio recording and by extending previous skills to create a poster in Comic Life. By the end of the school year, the students had produced a movie of themselves reading their own book creation as well as a news broadcast using iMovie and digital cameras. Table 14.3 details the schedule of teaching and learning provided to the young children as they developed their print and digital literacy capabilities in text production. Here the focus was on a poster of a favourite component of a loved story or book. The table attempts to provide some detail on what was included and achieved as well as what was left unfinished in the cycles of digital production.

In this sequence and others like it, the iPad lessons, as they came to be called by the students, were conducted once a week. However, during the week, students would work on print literacy preparations, preparing and editing drafts of their posters and other related activities that were the foundation of the lessons where engagement with the digital tools was the explicit aim. Over the year, this shifted again with iPads and other digital technologies becoming more embedded in the curriculum generally.

The children were expected to develop their skills and independence as they learnt about digital materials and eventually were involved in digital production of the poster. This graduated development was also evident in the sequence of learning experiences over time whereby the complexity of the digital and print literacy products produced by the children increased. As an example, making a movie in the form of a television news programme was the final project of the year. As demonstrated above in the poster production, a similar sequence of explicit and implicit learning activities guided these young students from learning about, and with, digital and print products through to production and eventually to analysis of their texts. The conceptual understandings being developed through these graduated sequences of learning continued to build throughout the year also. Initially, the teacher and media specialist explained to the students that they would be making a movie in the form of a news story. Their task was to look out for people performing kind acts. Captain Caring (a teddy bear) was used as a resource to spot children acting in a kind manner. As incidents were collected and collated, they were used as the subject matter

Table 14.3 The teaching-learning process – creating a poster using *Comic Life*

Description	Considerations of pedagogy	
Beginning of the process. Making a poster of a favourite book	Explicit visible pedagogy	 **Fig. 14.2** Explicit models provided for children
Teacher explicitly laid out the format and worked with children to consider what was included	Teacher modelling and explanations	
Children then drew a picture of one a part of a favourite story or book. Additional activities around children's literature and drama were also featured as part of responding to the different texts, books and stories	Small groups drew together, while talking and discussing and giving opinions	 **Fig. 14.3** Children working in groups to draw their favourite part of a storybook

(continued)

Table 14.3 (continued)

Description	Considerations of pedagogy	
Teacher demonstrated the use of the apps on the electronic whiteboard. For example, one lesson focussed on how to insert a title using the *Comic Life* app. Children then worked independently or with adults to master these techniques	Explicit pedagogy	 **Fig. 14.4** Explicit, visible instruction on skills
	Teacher modelling using the interactive whiteboard	
The children then created their draft posters using paper and pencils. This was presented as a plan for the posters to be produced through digital means	Implicit pedagogy	 **Fig. 14.5** Print and digital technologies used together by children as they designed their posters
The teacher then worked with individual students to write, or where necessary scribe, the written text	Individual activity	
Children worked to translate their plans to a digitised text. This began with teacher modelling and moved to directed student practice	Explicit pedagogy	
	Teacher directed writing process	
	Explicit pedagogy	
	Teacher modelled the process	
	Step by step. Children took increasing control of the text as the process continued, and the pedagogy became more implicit. The children worked in small groups and discussed their texts as they developed the digital texts using the iPads and Comic Life application	

Children created the posters with a combination of photographic and drawn images	Implicit pedagogy. The children were in control. They asked for help when required but controlled the process of creation, made decisions about representation and drew on a variety of print and digital tools and resources to produce their text. The products were displayed after they were produced	 **Fig. 14.6** One child photographs images for use in a digital production

to put together the ‘movie’. The following points summarise the steps of the lesson series:

- Explanation of terms and roles: camera person, news reporter and reader roles
- Explanation, demonstration and practice activity: taking ‘still’ photos with digital cameras:
  - For example, on/off button, photo button, focus and wrist band

(The organisation of students in these activities was paramount in terms of grouping students, and routines were explicitly taught such as turn-taking, following directions and responding to signals for changeover of tools between partners.)

- Demonstration of the process for viewing photos students had taken
  - Individual assistance given where required
- Further practice with the cameras in the playground with turn-taking for photographers
- Return to classroom for recapping of experience
  - Photo tips explained and demonstrated, e.g. camera angles and the causes of blurred photos

After a week of this preparation, the children continued to practise taking photos and then moved on to recording videos. The control of the lessons shifted from the media specialist to the teacher who was by now highly proficient in utilising the affordances of digital technologies and tools within the literacy curriculum. As well, the children had worked on gathering and collating information for their news reports. They had been allocated to groups, and roles had been determined. The digital pedagogy and the use of digital tools, resources and texts were becoming more integrated into the curriculum – no longer a separate component digital texts and technologies were embedded in the literacy learning of the classroom.

The students practised the skill of video recording and then moved to consider what recording the news reports would entail. For this, groups were provided with adult facilitation. The lessons were moved to the library where the students had access to a blue screen wall and they worked with the media specialist in the library space. To conclude this session, completed film footage was shared with the whole class. Some children then joined the specialist to edit using iMovie. These new skills were demonstrated on the interactive whiteboard (IWB) before different children took control of the editing process for different parts of the news report.

Discussion and sharing of other video examples made at home, on phones or with video cameras were also shared before re-viewing classroom footage available. Next, children were involved in further discussion leading to decisions about which were the best clips to use and why. During this time, further skills such as how to highlight a clip and drag it to the ‘project’ box on the screen were demonstrated.

After a further 4 weeks in this series of lessons, the end products were completed. By then, student groups had filmed a whole news programme which consisted of a main news reader, interchange between the reader in the studio and

the filmed event, an interview where an interviewer questioned an interviewee and then the switch back to the main news reader. The students had filmed and produced these programmes, and the products were of an extremely high standard. This culminating episode for the year demonstrated the children's growth and confidence in digital literacies and the integration of these skills with print literacy learning.

The pedagogical approach described here involved reaching out beyond the immediate classroom to the school and wider communities. As a result, the class published their posters, stories and news broadcasts for audiences including peers, other teachers and university representatives as well as their own families. The assessment processes were ongoing and involved assessment of collective and individual literacy practices and skills. The children were assessed in terms of the digital and print literacy skills, practices and understandings along with an assessment of how these were utilised in digital production. There was an understanding that literacy is a collective as well as an individual practice and that if this is to be valued, that assessment must also be of collective practice and not just an individual activity. In the following section, we provide some insight into how one child progressed. Harriet (pseudonym) was as typical as she was atypical within this classroom. As such we do not suggest that she is representative of the literate development of all children in the class. We instead provide some detail here as a way to further explore how young children might develop print and digital literacies in the earliest years of their schooling.

14.4 Journeying Through New Experiences in Digital Literacy: One Child

This section describes the achievements of one child whose outcomes reflected those of several of her class members. After briefly recapping the early classroom experiences with digital materials and production, we focus on outcomes evidenced in the later periods of the school year.

Harriet began the school year with little prior experience in digital literacies and minimal access to digital tools and resources in her outside school life. With the rest of the class, she was introduced to using laptop computers and participated in teaching/learning experiences as described above. She attained the basic skills along with other class members, and her confidence grew in terms of using the new technologies and tools to represent meaning to a variety of audiences.

The early focus on digital materials and explicit skills practice enabled this young child to build a confidence with utilising digital tools, texts and resources. By mid-year, Harriet participated actively in class lessons that involved media art learning or digital literacies. Her ability to follow directions, engage in processes, focus on activities and produce written and digital products was evident. Because the teaching process nurtured both digital literacy learning and traditional print literacy learning, achievement in the latter led to enhancement of the former. In turn, the digital literacy learning supported traditional print literacy learning. Figure 14.7

Fig. 14.7 Digital and print literacies in synchronisation

Fig. 14.8 The production process for Harriet's story

demonstrates print and digital devices being used together where Harriet is captured transferring her prepared written draft to digital texts. Both print and digital texts are being used as the children were also engaged in small group discussion about the text.

In term three, the children produced a book using the iPad app, *Little Story Maker*. Harriet reproduced her version of Bill Martin Junior's *Brown Bear, Brown Bear, What do you see?* Again, the process involved preparing a written draft and transferring the story to the iPad. This time, all the drawn pictures that Harriet had drawn to accompany the written text had to be photographed with the iPad and then used in the book production as indicated in Fig. 14.8.

The culmination activity for term three was a *reading party.* Students' families were invited along with school administration members. Harriet confidently read her book to her mother and younger brother and demonstrated how to use the iPad. She could explain how she produced the story. She also read traditional story books, demonstrated the use of the computer by demonstrating how to play a language game and showed her mother the digital *Well Wisher* board where she could enter a comment about her *Reading Party* experience. She provided explicit instruction to her mother and guided her through the process of adding a sticky note to the electronic board. She had appropriated the pedagogical processes of the classroom.

By the end of term four, Harriet had continued to develop as a literacy learner, user and producer. Her digital literacy skills included working with digital cameras; basic computer skills; word processing, filming and editing; using apps such as *iMovie*, *Comic Life*, *Little Story Maker* and *Photo Booth*; adding background music and transitions; and reducing noise in video productions. She used digital and print tools, texts, resources and technologies as she engaged in literate practice. She took on different roles in discussion groups, read and wrote confidently, acted in small dramas and spoke in front of audiences and recording equipment with confidence. Her achievements were exhibited in her ability to present as news reader in the year's culminating news report activity.

14.5 The Material Effects of Digital Texts and Tools on How Young Children Are Learning to Read and Write

While there is a burgeoning field of research on young children using and producing digital texts and tools, what is sometimes forgotten is that print literacy still matters. Conversely, in current debates about improving student outcomes and cries to return to a narrowly defined, back-to-basic curriculum, what becomes invisible is the social justice issue of providing all children with access to a diverse range of digital materials and production techniques that they will need for successful futures. Redistribution of what matters for text production and comprehension is an equity issue. The teaching sequence described here is more than a sequence of solid teaching and learning opportunities in either digital or print literacies. The example demonstrates what is still able to be achieved by teachers in classrooms when they work explicitly to open new opportunities for teaching and learning with increasingly diverse cohorts of children. We believe that an important message is that this locally crafted pedagogy and curriculum work that foregrounds recognition of a diverse range of values, languages, social and cultural practices and that provides some space for children's perspectives to be considered can still occur in our current education contexts of high-definition curriculum, accountability as testing and standardisation.

The teachers and researchers involved here began with a real respect for what the children did bring to the learning opportunities. Understanding that many of the children had not had a great deal of experience with digital materials and digital production, they set about providing an explicit focus on the basic skills, routines and procedures required to engage with digital materials, tools, texts and technologies. The visible pedagogies enabled all of the children access to the means to key into literacies, so to speak. However at the same time, the students were involved in teaching and learning opportunities to engage in digital and print production and analysis, as well as to build conceptual understandings that had currency in other content area learning as well. The regular simple assessment of these skills meant that the curriculum planning was always fluid and paced to suit the children in this preparatory classroom, in the here and now.

Two other key points need to be made here. Firstly, note that the collective nature of literacy learning and using was reflected in the pedagogy within this class. Children had support from adults, especially when being instructed explicitly and when first asked to 'play' or practise the new skills to which they were being introduced. Secondly, the children were also learning in a space where talk was valued. Of course there were times when children worked individually. However, what is evident from the learning planned is that the teachers and researchers involved worked explicitly to arrange times for children to work with children, to be experts, knowers and *becoming knowers* as well as to come up with collective responses to queries or collaborative solutions to problems. This classroom was not hamstrung by a constant reaching for one correct, individualised and standardised response. In all that was planned and taught, there was an underlying understanding that children learn about literacy by communicating and putting into words what they are seeing, hearing and experiencing, and wondering and solving. The final production of the news report is an example in point. The children worked in groups to plan and record the different components. Children acted, others produced, and still others provided technical support in these small groups. Other combinations of children brought the parts together and edited the news report to ensure the messages were portrayed as the producers had originally intended.

Finally, this example demonstrates the materiality of literacy learning and insists that we consider digital and print literacies as intertwined. As the children in this class learnt literacy, the materials of print and digital literacy, that is, pens and paper, along with iPads and cameras were laid out together on tables and on the floor, available for children to access as required. Learning about print occurred at the same time as children learnt about how to use digital tools, texts, resources and technologies. In all of this, a clear focus on literacy as multimodal was evident. Our observations link to the findings of Flewitt et al. (2014a) and Neumann (2016) who have noted the positive influence of young children's use of tablets on their early literacy skills development (see also Dezuanni et al. 2015). Furthermore, Flewitt et al. (2014b) demonstrated how the use of iPads in a special education setting also enhanced literacy learning. Here they emphasised the positive implications of the iPad on print literacy learning due to the tactile relationship students had with the iPads. In the early years' classroom described by Flewitt and colleagues, the *digital*

touch afforded entertaining ways of learning phonics and word recognition which was inclusive to all children and "contribute(d) positively to their engagement in the learning activity" (p. 112). Similarly, Cubelic and Larwin (2014) noted the positive impact of the use of iPad applications in early literacy remediation and reinforcement of higher-level thinking skills. They noted the relevance too of the tactile rapport students had with the iPads which afforded deeper understandings in literacy learning. However, it remains that despite the growing emergence of research in digital technologies and literacy in early childhood, there are still few studies that actually measure the impact of digital technology use on young children's print literacy development. Here we have attempted something else – our aim has been to flesh out the experience of the children and adults who worked in one classroom to provide a socially just curriculum through the use of digital technologies to enhance literacy outcomes for all of the students in the preparatory class.

We began this chapter by making the point that in current times of standardised curriculum and accountability, it is crucial to investigate what can be done by professional teachers who understand the particular needs, strengths and lives of their students. When there is a focus on learning literacy as a multimodal and collective practice, we believe that it is still possible to craft a pedagogical practice that provides children with access to quality and relevant literacy learning in the earliest years of schooling. In such contexts, there remain possibilities for teachers and students to learn together across print and digital modes for improved outcomes, and we believe that this can occur in schools in communities of high poverty as a way to ensure children have access to a rigorous substantive curriculum, well suited to encourage literacy learning for positive future outcomes.

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Chapter 15
Digital Tools to Support Children's Speech and Language Skill

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15.1 Introduction

Learning to talk is one of the most important skills children master in their early years. Yet some children have difficulty acquiring speech and language skills at the same rate as their peers. Although prevalence rates vary, data from the Longitudinal Study of Australian Children found that a quarter of parents (25.2%) of children aged 4–5 had concerns about how their child talked and made speech sounds (McLeod and Harrison 2009). Children may have difficulty communicating for a number of reasons, but the most common reason for referral to speech-language pathology services is due to difficulty saying the sounds in words correctly, known as speech sound disorders (SSD) (Broomfield and Dodd 2004; Mullen and Schooling 2010). SSD can persist well into the school years with one population-based study in the UK suggesting that up to 3.6% of 8-year-old children may have ongoing SSD

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(Wren et al. 2016). Moreover, this particular difficulty can impact upon the development of literacy skills (Stackhouse and Wells 1997) and can have a negative effect on academic progress and the development of social interactions (McCormack et al. 2009, 2011).

This chapter explores how digital tools can be used to support children's speech and language skills in three different ways. First, an overview of the types of tools which are available to help is presented, and the potential benefits of these tools are discussed. Then, the chapter describes one specific tool, the *Phoneme Factory Sound Sorter*® software (PFSS, Wren and Roulstone 2013), and the implementation of PFSS in early childhood centres in New South Wales, Australia. Finally, an investigation into how parents and early childhood educators of children with SSD view technology (including digital software) is reported.

15.2 Digital Tools to Support Speech and Language Skills[1]

Digital tools to promote speech and language have typically been used by speech-language pathologists (SLPs) to assist with the development of skills or to provide an augmentative and alternative communication aid for children with physical disabilities (Lidström and Hemmingsson 2014). In the case of the former, digital tools may be used within the context of a structured intervention to enhance the efficiency of implementation (McAllister et al. 2008). Typically, SLPs would facilitate the session, but if the child is able to use the software independently, the SLP role might be to determine the level at which the child should be working and the timing of progress to subsequent levels.

A discussion of the theoretical basis for intervention for speech and language is provided below together with an overview of how some digital resources can be used to support this intervention. While it would be possible for parents and educators to independently discover the digital tools described (e.g. through Internet searches), it is more likely that they would be informed about these tools by SLPs.

15.2.1 Theoretical Basis for Speech Intervention

For children to develop speech, they need to learn the system within which speech sounds occur in the language that they are learning (Cohn 2008; Davenport and Hannahs 2010) and how to make the movements required for speech. To this end, speech development requires the interaction of auditory, cognitive and motor processes. Stackhouse and Wells (1997) provide a useful framework to consider the processes through which speech is perceived, processed and produced. Within the psycholinguistic framework described by Stackhouse and Wells (1997), input processing (e.g. knowledge of the sounds in words), storage of information about

[1] Mention of a particular product in this chapter does not constitute a recommendation.

words (e.g. storing details of the meaning of words and the sounds within words) and output processing (e.g. programming the mouth, lips and tongue to produce the sounds in words) all interact to support speech processing and production. The development of accurate speech production is contingent upon, and influenced by, each level of processing though intervention approaches, whether digital or otherwise, might only focus on one area.

For example, digital tools to assist with speech might target the development of motor or output processing skills through providing increased opportunities for practice (e.g. 'Articulate it', 'Articulation scenes' and 'R-intensive' from http://smartyearsapps.com; 'Speech sounds on cue' from www.bungalowsoftware.com). Other tools are available to develop children's auditory or input processing skills. One such programme—'Speech Assessment and Interactive Learning System' (SAILS) (Rvachew 2009)—targets children's ability to perceive speech sounds in words and make judgements about the accuracy of those speech sounds. Tools targeting speech may also help develop the underlying cognitive skills involved in speech processing such as rhyming skills (e.g. 'Rhyming bus' from www.therapy-box.co.uk) and auditory memory (e.g. 'Auditory memory club' from http://smartyearsapps.com).

15.2.2 Theoretical Basis for Language Intervention

Children develop both understanding and expression of language in three core domains: form (e.g. grammar, sentence structure and word forms to mark different meanings), content (e.g. vocabulary and the meanings of words) and use (the conventions of social communication or social use of language) (Berko Gleason 2005). Apps and software tools have been developed to address one or more of these domains.

Where children have problems understanding and using intact grammar, sentence structure and word forms, digital technology can provide visual support to supplement auditory teaching of new grammatical constructs. This visual support provides children with additional contextual information about new language concepts and reduces the reliance on fleeting auditory messages which require good auditory memory skills. Ebbels (2007) highlighted the need for visual approaches to intervention for children with language difficulties and recommended the use of either colour or shape to assist with this. Digital technology can provide this multimodal experience, and several tools have been developed to target grammar and sentence structure (e.g. 'Yes-no barn', 'Language trainer' and 'Syntax city' from http://.smartyearsapps.com, 'Splingo' from www.speechandlanguagestore.com; and 'Fun and functional' from http://smartyearsapps.com).

Intervention to support children's knowledge of language content includes targeting vocabulary development through frequent repetition (Rice et al. 1994) and/or through linking the meaning of a word with the sound features of a word (Parsons et al. 2005). Apps have been designed for children who are showing a delay in their

vocabulary development but also for children who show difficulties with word-finding, that is, when they know a word but have difficulties in retrieving the word from their memory when they want to use it. Some examples of apps which target these skills are 'Sort this out' and 'Odd one out' apps from www.therapy-box.co.uk, 'Go words' from http://smartyearsapps.com and 'Name that category' from www.superduperinc.com.

Children's development of social communication skills refers to children's knowledge of the context in which speech and language is used and the social functions of communication. Intervention in this area builds on a number of underlying theoretical rationales including executive functions, theory of mind, central coherence theory and social emotional processing (Winner and Crooke 2009). Digital tools for supporting communication include those which target children's social skills using animation and hypothetical situations (e.g. www.socialskillbuilder.com, http://thesocialexpress.com/, http://smartyearsapps.com/service/social-quest/). Others target children's understanding of emotion in others (e.g. 'Odd face out' app from http://www.iosnoops.com), while some tools help children create social stories to help them in retelling events and developing 'scripts' to help with a variety of social situations (e.g. 'Special stories' app from www.specialiapps.org).

15.2.3 Evidence of Effectiveness of Digital Technology Use in Children with Speech and Language Impairment

A systematic review of software programmes designed to act as a virtual SLP for children and adults with speech disorders concluded that software was an effective means of non-SLPs delivering intervention planned by SLPs (Chen et al. 2016). However, most apps and software for children with speech, language and communication needs have been developed in response to market demand, and few have been tested empirically. There are a few exceptions to this however. Tallal et al. (1996) tested a software programme, Fast ForWord©, which used acoustically modified speech to target receptive language abilities in language-impaired children. Despite their initial positive results, a subsequent systematic review and meta-analyses of studies using Fast ForWord found no significant effects on outcome of the intervention (Strong et al. 2010).

In 2005, Moore et al. used a similar strategy to target auditory perceptual skills using a specific software programme, Phonomena©, in a group study and found that children who received the experimental intervention made more progress on measures of phonological awareness, i.e. awareness of the sound structure of words, than did the control group. However, these were typically developing children rather than children with language impairments, and the study has not been replicated. Similarly, Segers and Verhoeven (2004) measured change in phonological aware-

ness following an intervention with children with language impairment. Although they noticed that the children benefited from this intervention compared with a control group who played computer games targeting vocabulary, neither study measured change in children's speech output.

One investigation that did measure change in speech output was that of Rvachew et al. (2004). They found that using a computerised intervention which targeted children's speech perception (specifically, the SAILS software described above), in addition to standard speech and language therapy provision, resulted in significantly greater improvements in children's speech output compared to children who received a computerised book intervention.

Wren and Roulstone (2008) also measured speech output in their small group trial of a computerised intervention targeting children's auditory/input processing skills for speech. This included several activities which would be familiar to teachers as phonological awareness tasks but with the options to select targets which reflected the child's speech errors. Eligibility criteria for inclusion in the study were that children demonstrated SSD and were aged between 4 and 7 years. Participants in the study were randomised to either computer intervention, tabletop intervention or a no therapy control group. Computer intervention was provided to 11 children under the guidance of a SLP working in schools with a teaching assistant over 8 weeks. A second group of 11 children received the same amount of input but using traditional tabletop methods of intervention rather than the software, while the remaining 11 children received no intervention.

At the end of the trial, there was a trend for those children receiving the computer intervention to have made more progress than the other two groups, though this difference did not reach statistical significance. An analysis of the assessment data from individual children revealed that children who were stimulable for the sounds targeted in intervention (i.e. they could imitate the sound when asked to but did not use the sound spontaneously in speech) made markedly more progress than those who were not stimulable. Also, children who made developmental errors (i.e. substitutions and omissions in their speech that are commonly seen in younger children) and showed a more cognitive-/phonological-based disorder responded better to the software intervention compared to those children who made non-developmental (unusual or disordered errors) and showed a more articulation-/motor-based disorder.

Given that digital tools provide us with new ways of working and that children are so familiar with these tools, it is worth considering whether such tools can be effective when facilitated by non-SLPs who have received support and guidance from an SLP (i.e. a consultative model of service delivery). While the results from Rvachew et al. and Wren and Roulstone are encouraging, the tools were facilitated by SLPs. Yet it is recognised that there is a problem with availability of SLP services for preschools in Australia with SSD (McAllister et al. 2011), and if digital tools could be used to assist with this, clear benefits might be observed.

15.2.4 Phoneme Factory Sound Sorter®

The software used in the Wren and Roulstone (2008) intervention study was developed further and marketed as a commercial tool called Phoneme Factory Sound Sorter® (PFSS, Wren and Roulstone 2013). Using the Stackhouse and Wells (1997) psycholinguistic model as the theoretical framework for the content of the programme, seven interactive games were developed into a software tool. Each game could be customised to a child's specific needs based on the sounds which were in error in a child's speech and the substitutions they typically used. Each game targeted a different aspect of speech input processing and storage skills such as rhyme awareness (i.e. identifying whether words rhymed), phoneme detection (i.e. identifying the sounds within a word), phoneme blending (i.e. identifying a word from given sounds) and minimal pair discrimination (i.e. distinguishing between two words which differ in one sound only such as *bed* and *bell*). To allow the games to have maximum applicability in targeting speech processing skills at a range of levels, options to use non-words rather than real words were available as well as options to turn the sound off for a particular stimulus, in order to target specific aspects of speech input processing.

Following the small group trial, pre-set settings were added to the software to enable teachers and support staff to use the tool independently to target common speech sound error patterns in early child development when access to SLPs was limited. This aspect of the tool had not been trialled in Wren and Roulstone (2008) but could be of use in places where availability of SLP services is limited as has been identified in parts of Australia (McAllister et al. 2011).

A follow-on study was designed to investigate the effectiveness of the pre-set settings in the PFSS software within a stronger research design and building on the findings from Wren and Roulstone (2008). This follow-on study is referred to as the Sound Start Study and was undertaken from 2013–2015 with children with SSDs attending early childhood centres in New South Wales (McLeod et al. 2017). In contrast to Rvachew et al. (2004), the intervention would be delivered using the computer software and facilitated by early childhood educators with minimal additional input from SLPs. The main aim of the investigation was to find out whether PFSS delivered by early childhood educators would improve the speech, emergent literacy skills and well-being of preschoolers with SSD.

15.3 The Sound Start Study

15.3.1 Research Design

Designed as a blinded cluster randomised controlled trial, the Sound Start Study explored the effectiveness of the Australian adaptation of PFSS, in addition to typical classroom practices. Early childhood education centres ($n = 45$) were identified

Table 15.1 Number of participants at each stage of the study

Stage of the sound start study	Total
Stage 1: Screened for eligibility	1205
After stage 1: excluded (total)	930
Stage 2: screened for eligibility	275
After stage 2: excluded (total)	143
Stage 3: further assessed for eligibility	132
After stage 3: excluded (total)	9
Stage 4: Number of sites randomised	39
Number of participants	123
Received intervention	63
Received standard care	57
Did not complete stage 4	3
Stage 5: Immediate post-intervention assessment	113
Lost to follow-up	7
Stage 6: Delayed follow-up	114
Lost to follow-up	6

by geographical location (postcode) in order to obtain a sample of children living in range of socio-economic advantage and disadvantage.

The Sound Start Study was completed over 3 years and included 6 stages for each year: (1) whole-class screenings where parents and teachers indicated concerns about children's speech production; (2) direct screening assessments of children whose parents were concerned about communication development; (3) further direct comprehensive assessment of children's speech, receptive vocabulary and emergent literacy skills; (4) intervention, where children received (a) PFSS or (b) typical classroom practice (depending on the randomisation of their centre); (5) immediate post-intervention follow-up (1–2 weeks post-intervention completion); and (6) delayed post-intervention follow-up (5-8 weeks post-intervention) (McLeod et al. 2017). In the post-intervention assessments, children were assessed by one of four experienced SLPs who were blinded to participants' pre-intervention assessment data and intervention condition. The number of participants who were included at each stage is outlined in Table 15.1.

Inclusion criteria for participation in the stage 4 (intervention/control phase) were that children needed to be identified as having SSDs which included at least one speech error pattern that could be targeted by the pre-set settings within the PFSS software (see Table 15.2). In addition, children needed to have no reported history of developmental delay, hearing loss or cleft lip/palate and no observed delays in language, oromotor structure or cognition during stage 2 and stage 3 assessments by the SLPs. All participating children passed a hearing screening at stage 2 or stage 3. Children with English as another language were included as long as their English language proficiency was equal to (or better than) their proficiency in their other language(s). Participants were 123 children (males: $n = 79$, 64.2%), ranging in age from 4;0 to 5;4 ($M = 54.89$ months; $SD = 4.2$). The participants lived

Table 15.2 Description of speech error patterns which can be targeted using PFSS (Australian adaptation)

Speech error pattern	Description
Stopping	Long consonants (e.g. 's') are produced as short consonants (e.g. 't' is produced instead of 's')
Fronting	Consonants produced at the front of the mouth (e.g. 't') are produced at the back of the mouth (e.g. 'k' is produced instead of 't')
Final consonant deletion	Consonants which should be produced at the end of words are omitted (e.g. the 'l' sound in *ball* is omitted so *ball* is produced as 'ba')
Gliding	The consonants 'l' and 'r' are produced as 'w' and 'j'. For example, *leg* is produced as 'weg'
Context-sensitive voicing	Consonants produced without vocal cord vibration such as 'k' are produced as with vocal cord vibration and therefore sound like 'g'
Deaffrication	Affricate consonants (e.g. 'ch') are produced as fricative consonants (e.g. 'sh'). For example, *chips* is produced as 'ships'
Cluster reduction[a]	One or more consonants within a cluster (two to three consonants together) are omitted. For example, *stop* is produced as 'top'

Note. There is also a setting which targets general phonological awareness which is not designed to target one specific phonological process

in a range of suburbs from the least advantaged (1st decile) to least disadvantaged (10th decile) according to the Australian Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD). The mean IRSAD decile of participants was 5.97 (SD = 3.2) and mode of 8 (25th percentile = 3, 50th percentile = 7, 75th percentile = 8). The majority of participants (n = 114) were reported to use English at home (107 spoke English only at home and 7 spoke English and an additional language at home). Nine children spoke a language other than English at home.

All children completed the assessment tasks to measure speech accuracy, language, phonological processing, print awareness, letter name and letter sound knowledge. Information was also collected about children's home literacy environment and access to digital media, children's well-being and participation (based on parent report) and children's own attitudes to participation. Table 15.3 summarises the participant characteristics at the beginning of the intervention phase.

15.3.2 Results

The results from the primary analysis suggested that the impact on speech production, phonological awareness and emergent literacy skills following delivery of the intervention by early childhood educators using the PFSS pre-set settings varied across children with some children making marked improvement while others made very little or none. However, as some of the control group also made improvements during the time period, a significant difference in progress was not observed between the two groups. This resulted in a number of new research directions, some of which will further our understanding of digital tools and SLP. Specifically, supplementary investigations were completed to explore factors relating to the implementation of

Table 15.3 Characteristics of participants in Sound Start Study at the beginning of the intervention phase

	Measure	Intervention group (n = 65) [a]M (SD) [b]n (%)	Control group (n = 58) [a]M (SD) [b]n (%)	Significant difference
Age[a]	In months	55.3 (4.1)	56.9 (4.3)	.044
Sex[b]	Male	43 (66.2%)	36 (62.1%)	.637
	Female	22 (33.8%)	22 (37.9%)	
Multilingual status[b]	English only	52 (80.0%)	48 (82.8%)	.695
	Multilingual	13 (20.0%)	10 (17.2%)	
Socio-economic status[a]	IRSAD	6.2 (2.9)	5.8 (3.5)	.495
Speech severity[a]	DEAP percentage of consonants correct	68.15 (9.90)	63.19 (13.76)	.022
Consonant stimulability		22.3 (1.8)	22.0 (1.9)	.338
Phonological awareness composite score[a]	CTOPP-2	89.0 (11.5)	87.4 (10.4)	.432
Nonverbal IQ[a]	PTONI	22.4 (8.8)	22.0 (8.9)	.788
Receptive vocabulary[a]	PPVT	68.1 (18.3)	71.5 (19.2)	.309

Note. [a]M (SD), [b]n (%); IRSAD, Index of Relative Socio-Economic Disadvantage; DEAP, Diagnostic Evaluation of Articulation and Phonology Dodd et al. 2002); CTOPP-2, Comprehensive Test of Phonological Processing – 2 (Wagner et al. 2013) PPVT, Peabody Picture Vocabulary Test (PPVT; Dunn and Dunn 1997)

the intervention; parents' and educators' attitudes to the use of technology to support speech, language and literacy and children's use of technology both at home and at school.

15.3.3 Intervention Implementation

The Sound Start Study used the Australian adaptation of PFSS (Wren and Roulstone 2013) which includes four Australian speakers, an increase in the number of real- and non-word stimuli and a number of cluster-reduction pre-set settings which were not in the original software (Wren and Roulstone 2005). Children were allocated a pre-set setting for intervention based on speech error patterns observed during assessments. Educators (i.e. teachers and teaching assistants) were provided with all the hardware required to complete the intervention (i.e. computers, wireless mouse and headphones) as well as one-on-one training with one of the researchers about how to navigate the software and facilitate children's participation in the intervention. Computers were preloaded with children's settings, and educators were asked to complete intervention sessions (of four to seven games) with the participating children at least four times a week for 9 weeks. At the end of every week, the

educators changed the settings for each child so they moved to the next level of difficulty.

It was important to consider the frequency of dosage and fidelity to the intervention protocol in the Sound Start Study. Educators were provided with a paper-based recording system to track the days, games and plays that were completed by all children. All data from the sessions were concurrently recorded by the PFSS software. At the end of the implementation phase (stage 4), the data from both sources were matched. There was a moderate match for the total number of days that children completed the PFSS task (76%), and much poorer matches reporting the total number of games (54%) and plays (35%), owing to differences in how the two methods recorded the completion of games. Mismatches between the prescribed dosage and the dosage received are unfortunate but not surprising, given research suggesting that relatively few studies achieve implementation rates (particularly prescribed dosage rates) greater than 80% (Durlak and DuPre 2008). The ability of the educators to undertake the intervention was affected by multiple factors, which is explored in depth in other venues (e.g. Crowe et al. 2017). However, further detail about the perceptions of the use of digital tools to support speech development from all stakeholders may provide some useful insights, including the perspectives of caregivers, educators and children themselves.

15.3.4 Parent and Educator Perspectives Regarding the Use of Technology to Support Speech, Language and Literacy

The use of digital tools within early childhood environments could be influenced by multiple factors including accessibility and requirements of the child/carer and also the beliefs of the carer regarding the value of the tools in supporting learning/development. Besides investigating the value of the PFSS tool, the Sound Start Study also examined attitudes to the use of computers and apps with young children more generally. Parents (n = 222) of children with SSDs and early childhood educators (ECEs, n = 44) of participating children were asked about their use of digital tools to support children's learning in early childhood centres and at home and their attitude towards them.

15.3.4.1 Children's Access to, and Frequency of Using, Technology at Home and at Preschool

In the Sound Start Study, parents and ECEs were asked to indicate the number of computers (including iPads) available in the home and centre, respectively, and the frequency with which computers were used. They were also asked to identify the frequency with which other technologies (i.e. television, videos and DVDs) were used.

Parents' Reported Use in the Home Parents reported an average of 2.84 computers in the home (range 0–16). Some computers were for adult-use only; parents reported an average of 1.94 (range 0–12) of computers in the home for use by children. Most parents reported that children used the computers a few times a week (29%) or daily for less than an hour (22%), although some indicated much more frequent use (i.e. daily for more than 2 hours) (10.1%), and others indicated computers were never used by the children at home (6.5%). In contrast, the majority of parents indicated that other forms of technology were used daily for 1–2 hours (45.4%) or for more than 2 hours (34.5%), and only one parent indicated that these were never used. The differences in frequency of technology use reported by parents may reflect the accessibility of the technology (i.e. not all parents reported having computers at home). It may also reflect the manner in which the technology is used (i.e. computer time may need to be shared between family members).

Reports of Use in Early Childhood Centres ECEs reported an average of 2.84 computers/tablets that were used by children (range 0–8), 2.32 computers/tablets that were used by staff (range 0–12) and 2.68 computers/tablets that were used by children and staff (range 0–13). These data demonstrate the wide range of computers/tablets available for both children and staff at the participating centres which highlights the considerable difference in access to technology resources across the sites. Similar to the data from parents, most ECEs reported that children used the computers daily (for less than an hour) (36.4%) or a few times a week (22.7%). No staff reported use for more than 2 hours per day, and only one reported that computers were never used by children at the centre. In contrast to the parental data, ECEs reported little use of other technologies (i.e. television, videos and DVDs) with the majority (34.1%) indicating these were never used or used monthly (or less) (38.6%). This may reflect the difference in purpose between the use of technology in the home for play and recreational use and the use in early childhood centres for learning and education.

Most staff reported that activities in which children worked individually or with peers or an adult at the computer occurred at least once per week and often on multiple (or every) days. Teacher-led and child-led demonstrations using the computer occurred less than once per week. The frequency and variety of the use of the computers are again likely to be influenced by the number of computers available and number of children in the centre. Another factor of importance is the beliefs of ECEs regarding technology in the classroom. For example, one ECE did not use computers or tablets, believing that children's development would be better served through other sensory and motor experiences (see Crowe et al. 2017).

15.3.4.2 Educators' Beliefs About the Role of Technology at Preschool

In the Sound Start Study, ECEs completed a questionnaire that required them to indicate their level of agreement (strongly agree to strongly disagree) with a series of 17 statements about the role of digital technologies in the classroom. The

questionnaire had been developed and used previously in Australian research with ECEs in the Australian state of Queensland (Thorpe et al. 2015) to explore their digital access.

The ECEs in the Sound Start Study recognised the value of technology within the early childhood environment. The *Internet* was regarded as a learning resource like other resources by the vast majority of ECEs (93.2%), and having *computers* available in the classroom was considered an essential part of learning for many (77.3%). Furthermore, ECEs recognised the value of computers in enabling children to learn literacy skills (77.3%) and to learn through interactions with others (68.2%). Thus, there was a sense that computers may benefit the development of language, communication and literacy skills. According to Blackwell et al. (2014), the attitude of ECEs towards the value of technology as an aid to children's learning is the strongest factor influencing technology use, followed by confidence and support to use the technology. Given the positive attitudes expressed by the ECEs in this study, it would be expected that many are incorporating technology within their early childhood settings and curriculum. In the following section, we outline the ways in which technology was reportedly used.

ECEs saw benefits beyond learning new skills via the computer, recognising that learning digital literacy skills was itself important. The majority (86.4%) believed it was good for children to have computer experiences at home and considered it important that they built on the child's interests (93.2%) and experiences at preschool (84.1%). A very small proportion considered the Internet to be an unnecessary learning resource (4.5%), but only a third of the sample indicated that giving children access to the Internet was a priority. Thus, the use of technology (computers and the Internet) may be seen as one resource among many utilised within early childhood environments to facilitate children's learning. Very few ECEs reported safety or access issues prevented them from using technology in the classroom, but 46.5% had concerns about children spending too much time with technology.

The results from the ECEs in the Sound Start Study were similar to those reported in the study by Thorpe et al. (2015), indicating similarities across different states of Australia. In particular, there was a high level of agreement related to the importance of building on children's existing experiences with technology (see Table 15.4) and the benefit of children having experiences with the computer at home. The high level of agreement with these items reflects a widespread perception of technology as being a tool that transcends setting (centre and home) and the perception of digital competence as being an ongoing process.

There were some differences across the studies, particularly related to concern about the amount of time children spend with technology (stronger agreement from ECEs in Queensland than in the Sound Start Study in NSW) and encouragement of children bringing Web search activities from home (again, stronger in Queensland). This second item might reflect the different ways in which ECEs across the two states utilise digital tools and the Internet in their classroom practices. However, it might also reflect issues of accessibility. As indicated in Table 15.4, ECEs in Queensland were much more likely to indicate that computer login and password access stopped them from using the Internet in the classroom. Inability to use the

Table 15.4 Early childhood educators' beliefs about the value of digital technology (agree/strongly agree)

Item	Sound start study ($n = 44$) (%)	Digital access study (Thorpe et al. 2015) ($n = 131$) (%)
Having one or more computers in the classroom is an essential part of learning	77.3	72
Young children learn literacy skills through the use of the computer	77.3	85
A computer enables learning opportunities for children to interact with each other	68.2	69
It is important to build on children's existing experiences with technology	84.1	87
It is good to use technology to build on the interests children bring to the classroom	93.2	92
Using technology in the classroom is an everyday part of learning	68.2	64
It is good for young children to have experiences with the computer at home	86.4	83
I am concerned that children spend too much time with technology	46.5	57
Internet use in the classroom is a learning resource like other learning resources	93.2	82
Internet use in the classroom is an unnecessary learning resource	4.5	8
I find my main technology role is to actively initiate ideas and engage children with the Internet	58.1	50
I like to encourage children to bring their Web search activities from home	29.3	41
Giving children access to the Internet is a priority for me	32.6	36
I like to model how to do searches on the Internet	61.9	59
The practicalities of computer login and password access stop me using the Internet in the classroom	14.3	47
Safety concerns stop me using the Internet in the classroom	7.0	16
Young children do not have the literacy skills necessary for Web searching ($n = 44$)	13.6	18

Internet in class may lead to children being encouraged to do Internet-based activities at home instead. These findings present insights into potential perceptions of ECEs regarding the implementation of technology-based learning activities (including language and literacy activities) that are important for professionals (including SLPs) to consider for productive and respectful collaborations in the future.

15.3.4.3 Children's Use of Technology at Home and at Preschool

Questions regarding how technology is being used specifically with children with SSDs were explored through a thematic analysis of the free-text responses by parents of children with SSDs and ECEs to the question 'How do children typically use computer (including iPads) in your home/centre?' The responses were analysed and then categorised.

Of the 222 parents who completed the questionnaire, 139 parents provided free-text responses describing how their child used technology at home. Across their responses, 14 parent categories were identified. Of the 44 ECEs who completed the questionnaire, 27 provided free-text responses about how computers (including iPads) were being used in their centre. Across their responses, 14 ECE categories were identified. Of the 14 ECE categories, 11 categories were common with the parents' categories. The three categories unique to the ECEs responses were (1) learning how to use a computer mouse, (2) using technology to create and display a visual routine/timetable and (3) creating and maintaining a blog. It was unclear if and/or how the children were involved in the latter two uses of technology.

In total, 17 different categories were identified across parent and ECE responses. The categories for parents and early childhood educators, in addition to the number of comments aligning with each category, are shown in Table 15.5. For parents, the most commonly reported category was using technology to play games (64.7%).

Table 15.5 Reflections by parent and early childhood educators on how children with speech sound disorders use technology at home and at preschool

Technology use category	Number and percent of parents (n = 139)	Number and percent of early childhood educators (n = 27)
Playing general games	90 (64.7%)	4 (14.8%)
Watching movies, YouTube, TV shows	54 (38.8%)	5 (18.5%)
Playing educational games	47 (33.8%)	8 (29.6%)
Literacy-based activities	14 (10.1%)	5 (18.5%)
Drawing/painting/colouring-in	10 (7.2%)	1 (3.7%)
Reading e-books	9 (6.5%)	3 (11.1%)
Listening to music	7 (5.0%)	3 (11.1%)
Numeracy-based activities	6 (4.3%)	3 (11.1%)
Doing puzzles	6 (4.3%)	–
Taking or looking at photos	6 (4.3%)	2 (7.4%)
Written communication (e.g. word processing and typing letters)	6 (4.3%)	1 (3.7%)
Spoken communicating (e.g. Skype, FaceTime)	3 (2.2%)	–
Searching for information	2 (1.4%)	8 (29.6%)
Learning to play the piano	1 (0.7%)	–
Activities for specifically learning how to use a mouse	–	2 (7.4%)
Social media: creating and updating a class blog	–	1 (3.7%)
Displaying a visual routine	–	1 (3.7%)

Other categories frequently noted by parents included using technology to watch movies (38.8%) and playing educational games (33.8%). The most common categories reported by the ECEs were using technology to search for information relevant to a topic of interest in the curriculum and/or of interest to the children at their centre (29.6%) and playing educational games (29.6%). Technology was specifically reported as being used to support the children's literacy acquisition (parents, 10.1%; ECS 18.5%). It was surprising that more ECEs did not comment on the use of technology in their centre to support literacy, given that 77.3% of the ECEs agreed or strongly agreed that young children can learn literacy through the use of a computer. It was also noteworthy that no parent commented that technology was used to support their child's speech, despite the fact that they had reported that they were concerned about their child's speech. Similarly, the ECEs did not explicitly comment that technology was used to support the speech abilities of the children identified with SSDs at their centre.

15.4 Conclusion

The development and use of digital tools to support children's speech and language skills is a rapidly growing area. The Sound Start Study implementation of PFSS software with preschool-aged children with SSDs highlights a number of key issues to consider when implementing digital tools in an educational setting. Firstly, comprehensive assessments should be completed to gather key information about children's skills at baseline, before any additional digital technology has been utilised. Secondly, any collaborating educational staff (i.e. teaching assistants or early childhood educators) require one-to-one training about how to use the new technology or software with children with speech and language difficulties. And thirdly, although digital tools frequently collect comprehensive data about the specific use of the software (i.e. how many times a game was played or a picture was clicked), additional comprehensive information may be gathered from implementation agents who are assisting children with their use of the technology.

The additional information provided from parents' and ECEs' responses to questionnaire items suggest that there is overwhelming support for the benefits of digital tools in the home and early childcare centre. Moreover, with the exception of a few comments regarding log in and password difficulties, there is generally good access to the devices in both environments. However, limited use of digital media for the benefit of children's speech is being made in either setting. The overview of tools outlined in this chapter shows that there are number of software programmes and apps available so lack of resources appears not to be an issue. Rather, it could be that both parents and ECEs are unaware of the tools available or, if they are aware, that they lack the knowledge required to determine which tool to use.

Parents and early childhood education centres clearly consider that digital tools have an important part to play in children's development but are currently not using

these tools on a regular basis or not maximising the potential of the tools. The need for ongoing development to be supplemented by rigorous evaluations is paramount to ensure that parents, educators, SLPs and other professionals working with young children are aware not just of what tools are available but how they should be used and with whom.

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Chapter 16
Digital Games in the Early Childhood Classroom: Theoretical and Practical Considerations

Zoi Nikiforidou

16.1 Digital Games and Young Children

Information communication technology (ICT) comprises today an integral part of education. The main question set almost 20 years ago by Papert (1993) regarding at what age should children start using technology has now been replaced by the question of which is the effective use of technological practices and applications and, more specifically, how can we meet "a balanced approach to technology in learning, with thoughtful planning to provide for the important needs of childhood" (Van Scoter et al. 2001, p.5). Even though in the 1990s there was a huge debate on whether the computers should be integrated in the educational practice, at what educational levels, through what ways and under what cost (Armstrong and Casement 2000; Cordes and Miller 2000), today planning activities that make use of ICT are incorporated in the majority of early childhood curricula and policy agendas.

ICT has nowadays many different forms and applications. Amongst them, digital games combine education with entertainment, within the broader context of edutainment and gaming. Digital games involve playful learning within the broader context of learning through playful exploration and inquiry. According to Kinzie and Joseph (2008, p. 664), a digital game is "an immersive, voluntary and enjoyable activity in which a challenging goal is pursued according to agreed-upon rules". A digital game is structured by rules, with a defined outcome (winning, losing) or other quantifiable feedback (e.g. points) that facilitates reliable comparisons of in-player performances, across media, time, social spaces and networks of meaning (Klopfer et al. 2009). In particular, a digital game can be played in a classroom through a computer, a tablet, a digital device or a game console, individually or collaboratively, with or without the teacher's support and scaffolding.

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Digital games have specific characteristics that make them distinct from other technologically based activities. They have a purpose and objective; they have predetermined rules, steps, actors, learning outcomes, a tuned balance between challenges and rewards, feedback and environments within a meaningful, gradual and structured approach. In other words, digital games are rule-based systems that involve the challenge to reach a goal while providing feedback on the player's progress (Lieberman et al. 2009b). Like with other early childhood ICT programmes, digital games can promote learning when they are characterised by child-centred interactions, set within environments that have a meaning and interest for the children and are designed to match their abilities and desire to play and explore (e.g. Plowman et al. 2012; Siraj-Blatchford and Siraj-Blatchford 2006; Yelland 2010). Through this way, children have the opportunity to develop representations, to identify links through their actions, to develop their critical thinking and creativity, to solve problems, to develop cognitive and collaborative skills and consequently to construct knowledge (Lieberman et al. 2009b; Moyer et al. 2002).

The aim of this chapter is to further explore the role and importance of digital games in children's learning experiences addressing issues of pedagogical implications in the early childhood classroom. An overview of factors that determine the educational value and quality of digital games as well as how digital games can be considered as a novice or different type of play is discussed. As Howard-Jones (2011, p.7) states: "rather than label any type of technology as being good or bad for our brain, it is how specific applications are created and used (by who, when and what for) that determine their impact". The principles of digital game-based learning and the factors influencing the pedagogical potential of digital games are argued.

16.2 Digital Games and Digital Game-Based Learning

Digital game-based learning (DGBL) provides users with opportunities to develop skills, knowledge and attitudes through the principles and features of gaming or gameplay. DGBL is multisensory and learner centred, connecting prior knowledge, feedback, self-assessment and social communities of players (Oblinger 2004). According to Pivec (2007), through DGBL, learners may apply factual knowledge, learn on demand and gain experience in the virtual world. All these, in turn, can shape their behaviours and influence their emotions, reflections and understanding. DGBL is the consequence of a balance between learning and gaming elements (Nussbaum and Beserra 2014).

In their review, McClarty et al. (2012) identify that the most exceptional aspect of digital games, compared to other learning innovations, is the fact that they provide opportunities for combining motivation, adaptivity, simulation, collaboration and data collection. The learning principles that underpin digital games are learning through mistakes, having space for repetitions, using play through simulations and imaginative contexts and providing direct feedback. Also, digital games encourage personalised learning opportunities through meeting students' needs, scaffolding,

agency and autonomy, interactivity and decision-making. While playing, the users are in control and develop strategies and fantasy with a goal for achievement in a fail-safe environment. A good example of this practice is illustrated in the study of Ferrari and Addessi (2014), where children aged 3–5 years played with an interactive reflexive music system, the Continuator, and developed discovery, invention and creativity skills, their self-regulation and autonomy, collaborative play, high levels of intrinsic motivation, control of the situation and excitement. Through this digital device that encouraged gaming and interaction, children were provided the opportunity to enhance their musical creativity and exploration.

DGBL targets the acquisition of knowledge as its own end and fosters habits of mind and understanding, according to Klopfer et al. (2009). They go on to propose four types of learning through digital games, content-based learning (like maths), training on specific skills (like storytelling), systems thinking (like how changing one element affects relationships as a whole) and the creation of artefacts (like the production of videos). In addition, digital games provide more engagement for learning, through rich graphics and multitasking interfaces (Prensky 2001) and through a taste of flow (Csikszentmihalyi 1990) and motivation. Abdul Jabbar and Felicia (2015) outlined that the fun elements reported from children, aged 8–12 years old, in DGBL, are the virtual characters and environment, the narratives/storyline, the challenges, the role play, the opportunities to control and make choices and the conflicts. These gameplay aspects create deep levels of engagement and influence learning and motivational outcomes. They provide space for the development of a number of twenty-first-century skills and competences (McClarty et al. 2012) like attention, creativity, reasoning, problem-solving, collaboration and procedural and relational thinking from early ages.

However, according to Pierce (2013), there are challenges while implementing digital game-based learning in early childhood, clustered in three categories. One category relates to technical aspects like accessibility and child-based devices. For example, Marco et al. (2009) mention that touchscreens are not sensitive to small fingers and support the use of tabletops. There are also some pragmatic challenges, like the gap in standardised curricula or the limited capacity of children to interact with feedback. For instance, it has been noted that many times gaming cannot align with the structure and learning plan of the day (Groff et al. 2010). Finally, there are ethical issues, especially regarding the role of digital games in substituting traditional physical play (Linn et al. 2012) and in considering children's voices and evaluations of these games; do they enjoy them? Are they meaningful to them?

16.3 Why Use Digital Games in Early Childhood?

Digital games provide young children a unique mixture of media experiences in conjunction with learning and play (Lieberman et al. 2009b). The specific attributes of goal orientation, interactivity, control over the action, feedback, external rewards or penalties (through winning/losing points, advancing to higher levels, repeating/

starting from the beginning), active participation in the story scenario, identification with the character(s) or avatars and social interaction with other characters or with peers/adults while playing can support children to learn and develop interpersonally and intrapersonally. Digital games give children opportunities and the sociocultural contextual perspective (Edwards 2013) to experience virtual representations and creative environments. Games have immersive properties, such that the player experiences herself as being 'inside' the game.

Games recreate virtual environments with rich backgrounds where players participate actively and creatively. For instance, Ott and Pozzi (2012) in a longitudinal 3-year study, with 8–10-year-olds, advocated that digital mind games can be considered powerful educational tools potentially able to foster creative thinking. Mainly through observations and with the use of eight creativity indicators, the researchers found that the cognitive processes of problem solution strategies and strategic decision-making were enhanced and recognised that the type of game at hand may influence the ability to evidence, trigger and foster students' creative skills and attitudes.

Like any other type of play, digital games support social and cultural meaning-making (Edwards 2013), as well as holistic development. Under this perspective, digital games should not be compared to or be differentiated from traditional forms of play but should be considered as a pedagogical activity that allows children to interact and experience their worlds through a digital environment. Digital games are not discrete artefacts or tools that produce a type of play comparable to the traditional play. Instead, they are educational tools that serve a pedagogical purpose and the underpinning principles of 'learning through play' and 'playing through learning' by merging play and technology in a unified approach. "The important issue is how to maximize the positive consequences of these new media so that they enrich rather than hinder children's play experiences" (Johnson and Christie 2009, p.285). Digital games allow young children to extend playful experiences through active engagement in scenarios with rules, desirable goals and in some cases learning communities. According to Bers (2012), technological resources should be viewed as potential playgrounds – places to explore, to play autonomously and to take safe risks – instead of playpens which are restricted spaces with limited space for autonomous exploration.

Through diversity and mixture of stimuli, like images, symbols, sounds, motion, microworlds, avatars and virtual environments, digital games can enable a strong motive of engagement (Abdul Jabbar and Felicia 2015; Yelland 2006) and support young children to construct advanced concepts and cognitive processes (Lieberman et al. 2009a). Through 'embodied' experiences, digital games enable users to connect action with perception (Borghi and Cimatti 2010). While interacting with digital games, children make movements, either with their fingers or palms, for instance, on a screen or through a mouse, or interact with other tools such as helmets, masks and sensors in order to achieve a goal and reach an outcome. This multisensory and active learning allows correspondence between sensory-motor

experience and conceptual knowledge (Wellsby and Pexman 2014). For instance, Lu et al. (2010) found that fifth graders who participated in an embodiment intervention group with LEGO robotics and the physical experience of abstract science notions had a better understanding of and a more positive attitude towards science than those without the embodiment intervention.

Recently, there has been a growing interest in researching the connection between digital games, learning and young children; however, more research is needed in this direction. For example, Homer et al. (2014) found that digital gesture-based Kinect reading games supported children's language acquisition. The digital games with embedded activities were found to be superior to games without activities for participants aged 5–7 years, indicating that reading books on a gesture-based digital system can be an interesting and engaging activity for children, and with the addition of well-designed activities, they can support children's literacy and reading vocabulary. Another study by Núñez Castellar et al. (2015) presents that children, aged 6–8 years, who played digital mathematical games reported more enjoyment than children who used traditional methods. This study also presented a significant correlation between the gains in children's working memory scores when interacting with digital games compared to traditional paper exercises. Also, digital games can support children from diverse cultural or language backgrounds (Brooker and Siraj-Blatchford 2002) as well as children with a diverse range of special needs or characteristics (Bray et al. 2004). Educational games can also enable dialogue, inclusive values and the breakage of social and cultural boundaries (Pivec 2007).

16.4 How and When to Use Digital Games in Early Childhood Settings?

Digital games like any ICT should be implemented and aligned in the daily classroom activities; they should be integrated into children's routines in ways that support existing classroom activities and at the same time extend playful experiences. They do not have to replace other instructional formats or teaching/learning. They are educational affordances that embrace the principles of play, gaming and learning as any other playful preschool activity. As such, Edwards (2013) proposes that in order to bridge the existing gap between play and technologies in early childhood curricula, in the sense that it is commonly either the one or the other, the discourse on 'new' digital play should emerge. If selected, used, integrated and evaluated appropriately, digital games can enhance young children's learning and exploration.

In order to do so, this chapter proposes three key aspects to be taken into account while applying digital games in the preschool classroom, children's health and participation, issues of educational effectiveness and the role of the teacher (Fig. 16.1).

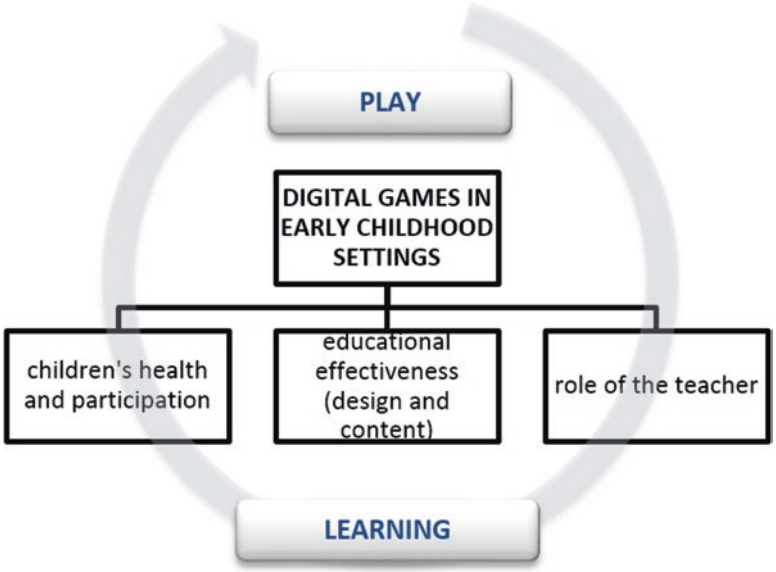

Fig. 16.1 Factors influencing the pedagogical potential of digital games under DGBL

16.4.1 Health and Participation

To start with, there are health and well-being issues to be taken into account, as is the case with children's exposure to any sort of technology at the expense of other activities. The ergonomic safety and the posture, the eye level and the time spent in front of the screen are of great importance. There are many studies examining the negative influences of extensive screen time, converging on the fact that screen time increases as children grow. Linn et al. (2012) go on to list studies that show how extensive screen time is connected to numerous dangers and risks, including childhood obesity, sleep disturbance, attention and learning, socialisation issues, exposure to commercialism and stereotypes. In a longitudinal study in the UK, Parkes et al. (2013) found that early patterns of TV and computer use and time are associated with some later adjustment problems in young children. Data from the use of TV and computer in 11,014 children, aged 3 and 5 years, were associated with behavioural and emotional problems when the same children became 7 years old. The researchers concluded that there is a need to restrict hours of exposure at this young age.

The content and the prevention from exposure to inappropriate and undesirable messages is another significant criterion determining the educational effectiveness of digital games. Digital games should be carefully selected ensuring children's emotional, social and personal well-being. Like with other activities, overuse or misuse can have drastic consequences on children's health and growth, and screen

time should not replace children's engagement with other beneficial and creative activities, such as play, face-to-face interactions, time with nature and hands-on experiences (Linn et al. 2012). Media content and games can provide children with negative gender, ethnic and racial stereotypes, aggression or fear, depression, nightmares and sleep problems or alienation and loneliness (i.e. Hourcade 2007).

Children's voices and perspectives in the usage of digital games are other important key factors. In order to address this, Lieberman et al. (2009b) emphasise the importance of including children in the game design process itself. They argue that the involvement of young children as game design partners is an excellent approach to game development. Children can come up with innovative and fun ideas for making games especially challenging, motivating and appealing to their interests and needs. In the same direction, Druin (2002) noted that children can participate in the design process through diverse roles, as users, testers, informants or design partners. Furthermore, she states that each role succeeds the next, with all testers also being users, all informants being testers and all design partners being informants, and proposes this framework for actively engaging and considering children's perspectives in regard to designing technologies that support learning.

On another note, the fact that through interaction with digital games children have control and agency over the context is really crucial. Digital games offer opportunities for users to take control over their own learning processes. Games can empower children and reinforce their skill mastery at their own pace, through mistakes, through various levels of difficulty, through movement, through active involvement and through motivation (Abdul Jabbar and Felicia 2015; McClarty et al. 2012). Digital games can meet children's learning styles and enable differentiated learning (Kebritchi and Hirumi 2008).

16.4.2 Educational Effectiveness of Digital Games

According to Howard-Jones (2011), the design of materials is of central importance especially because the developing mind compared to that of an adult is more "susceptible to environmental influence" (p.64). Briefly, the main questions and challenges relate to aspects of who designs the games; what are the theoretical pedagogical frameworks included; have practitioners, manufacturers and even children contributed in the setting up of these games; are the technical features suitable for this age group; what about the developmental design considerations including cognitive, socioemotional and psychomotor characteristics at each age-stage (Peirce 2013); and are these games really child-friendly?

Plowman and Stephen (2005) argue for the need for better evaluation of technologies at young ages. Siraj-Blatchford and Whitebread (2003) have proposed and recommended that ICT applications used in the early years are developmentally appropriate when they ensure an educational purpose and distinct learning aims, encourage collaboration, are integrated with other aspects of the curriculum and educational practices, ensure the child is in control, are transparent, avoid violence

Table 16.1 Criteria of selecting and implementing digital games in the preschool classroom

DATEC (Siraj-Blatchford and Whitebread 2003)	Developmental Software Scale (Haugland 1999)
Educational purpose	Process orientation, age appropriate, transformations
The child should be in control	Child in control
Avoid violence or stereotyping	Nonviolence
Transparent and intuitive applications	Clear instructions, expanding complexity, real-world models
Encourage collaboration	Independence (with the support of adults/peers)

or stereotypes and provide awareness of health and safety issues. They underline that all these principles serve as criteria for discussion and reflection on how ICT applications and hence digital games can be used within a play-centred and responsive environment.

For the last 15 years, there has been a wide research interest in identifying the features of the 'developmentally appropriate use' of ICT and interactive media, including digital games, in early childhood education worldwide (i.e. NAEYC & Fred Rogers Centre 2012; Siraj-Blatchford and Siraj-Blatchford 2006; Siraj-Blatchford and Whitebread 2003; Yelland 2010). However, there is lack of a specified evaluation scale for early childhood digital games to be considered for educational purposes. The reason might be because digital games are structured and designed based on educational software; thus, scaling criteria for early childhood software would apply to digital games, respectively. Oguz (2012) proposes the quality of games for children to be measured under three constructs: enjoyment (fun), usability and learning.

Well-designed games can be considered as the ones that provide powerful interactive experiences that foster young children's learning, skill building and healthy development (Lieberman et al. 2009b). Regarding the evaluation of developmentally appropriate software for preschoolers, Haugland devised in 1999 the Haugland Developmental Software Scale consisting of ten criteria. These are age appropriateness; the ability of the child to remain in control and set the pace and the flow of the events; the clarity of the instructions; the increasing difficulty of levels; the ability for the child to work independently by allowing adult facilitation and peer support; the nonviolent content; the process orientation of the programme which should be intrinsic motivation and the desire to explore; the connection of the programme with the real world; the technical features such as graphics, music and interface; the transformations in terms of cognitive accomplishments and manipulation of objects; and finally the antibias deduction in the sense that the content reflects and includes the diversity of the global society. By taking into account and combining the two scales (see Table 16.1), it is proposed in this chapter that digital games can be used effectively within the preschool classroom if they have an educational scope, if they have a child-friendly content, if they are transparent and concise and if they enable collaboration and child-led interactions. These principles are also supported by

Lieberman et al. (2009b) who adds that digital games can provide their full educational potential of interactivity and experiential learning if they enable stories, appealing role models, adaptive learning, interactive questioning, meaningful children contexts, challenges, repetition, personalisation, fun, entertainment and space for choice.

16.4.3 Role of the Teacher

Furthermore, the role of practitioners is also really vital in promoting and applying educational digital games in the preschool classroom. Particularly, when adults have been providing responsive scaffolding strategies, children tend to gain a lot in terms of their learning (Matthews and Seow 2007; Schmid et al. 2008). Practitioners should encourage, facilitate and support children while they interact with games. Additionally, they should have professional judgement in determining the age and cultural, linguistic and pedagogical appropriateness of games while selecting, integrating and evaluating them (NAEYC & Fred Rogers Centre 2012). ICT, and precisely digital games, offers teachers additional resources and modes of teaching to use while they plan to meet a range of levels, learning styles and individual needs (Van Scoter and Boss 2002).

The teachers' attitudes, professional development and digital literacy in the area of ICT competencies determine at a certain level the successful integration of ICT and in turn digital games into the classroom (UNESCO ICT-CST 2011). It has been found that teachers' views and confidence or anxiety about using technology are correlated with the actual use of technology in classrooms (e.g. Ertmer et al. 2012; Lindahl and Folkesson 2012). In order to meet this target, training and ongoing professional development for all practitioners, the consideration of early learning in national ICT strategies for education, the optimisation of ICT policies by supporting parental involvement through knowledge building and cooperation at all levels for practitioners, policy-makers and parents are proposed as factors that need to take place (Siraj-Blatchford and Siraj-Blatchford 2006). Groff et al. (2010) agree that teachers are key to effective game-based pedagogy by directing the learning approach, encouraging discussion and debriefing and supporting in the construction of the social learning culture that surrounds the gameplay.

Nevertheless, teachers often meet many challenges and barriers in inserting gaming in their teaching. Groff et al. (2010) note that teachers find difficulties in identifying how certain games would connect to the curriculum, in deciding about the accuracy and appropriateness of the content of the game, in persuading other school stakeholders and parents to the value of the game in the classroom, in finding time and in gaining specific training and support on the effective use of games in the classroom.

16.5 Final Thoughts and Future Steps

Digital games are part of children's contemporary lives, in formal contexts, informal contexts, at home, at school and everywhere, as close as at the tip of their finger. Their particularity compared to other interactive media and technological tools is the fact that they provide opportunities and possibilities to link play, learning and technology (Edwards 2013; Lieberman et al. 2009b). They count as a 'new' type of play that is not comparable with other traditional types of play. According to Plowman et al. (2012), digital media has been found to support children's acquisition of operational skills, extension of knowledge and understanding of the world and development of their disposition to learn. Indeed, they can provide diverse spaces for learning, exploring and experimenting under the principles of digital game-based learning in a risk-safe environment.

However, only accessing them or only pressing on the 'play' button is not enough. Digital games can be operative only if selected, used and assessed effectively (NAEYC & Fred Rogers Centre 2012). They need to be embedded in a pedagogical context that scaffolds meaning-making, communication, conceptualisation, making mistakes, moving forward, achieving goals, being strategic and taking decisions. The pedagogical affordances of digital games can be maximised based on three key factors: safeguarding children's health and taking their contribution into account, using mindful criteria while selecting digital games and considering the role of the practitioner in the classroom. These dimensions need to be addressed carefully prioritising children's physical, emotional, social, cognitive and personal well-being.

Digital games can serve DGBL principles when there is clarity and intentionality, educational value, safety, age appropriateness, interactivity, empowerment, adult scaffolding, personalised learning, participation in learning communities and prevention of misuse or overuse (Oblinger 2004; McClarty et al. 2012). Children's control and ownership (Ferrari and Addessi 2014; Lieberman et al. 2009b) is a key criterion while interacting with game environments in early childhood. Kebritchi and Hirumi (2008) emphasised DGBL as an effective tool for learning as it (1) uses action instead of explanation, (2) creates personal motivation and satisfaction, (3) accommodates multiple learning styles and skills, (4) reinforces mastery of skills and (5) provides an interactive and decision-making context.

Digital games should be connected with other child-centred activities in the daily classroom practices instead of being seen as fragmented or additional. In this respect, children need a balance between screenplay and actual play (Johnson and Christie 2009); it is not a matter of either the one or the other. This faulty attitude leads to misunderstandings about the educational potential of games. Moreover, the curricula need to reflect the technologically rapid advances and encapsulate "contemporary notions about creativity, imagination and design that provide opportunities for children to explore and investigate in ways that were not possible without the new technologies" (Yelland 2006, p. 122). Similarly, teachers' attitudes shaped by their teaching experience and confidence as well as the support systems

and policies in place contribute in the way technology applies in daily practice (Blackwell et al. 2014; Schmid et al. 2008).

Overall, digital games are an evolving reality that develops constantly and in multiple ways. Digital games, as a new type of play, can provide opportunities for young children's growth, shaping their personal, social and cultural experiences. Like any other technological tool, they can give learning a new dimension if implemented in a child-centred way to meet children's interests and needs. The importance of children's health and safety, the criteria and ways of embedding them in daily practice and the crucial role of the teachers are factors that need consideration. Future research is needed to explore the nature and the consequences of this child – digital gaming relationship and more global ways of establishing this new type of play. In conclusion, digital games can offer possibilities for playful learning and engagement by offering 'digital natives' space for bridging virtual and real experiences, if used safely, appropriately and constructively.

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Chapter 17
A Young Child's Use of Multiple Technologies in the Social Organisation of a Pretend Telephone Conversation

Brooke Scriven, Christine Edwards-Groves, and Christina Davidson

17.1 Introduction

There is an increasing body of research revealing the complexity of children's play during technology use. Recent studies describing children's interactional and technological competencies have shown they draw on a range of digital and physical materials simultaneously (Kervin 2016; Kervin et al. 2015; Verenikina and Kervin 2011). In doing so, children pursue activities together across physical and digital spaces at the same time (Kervin 2016; Kervin et al. 2015). Additionally, research has addressed sociocultural notions of technologies as tools for communication in children's play (Gillen 2000a, b, 2002; Marsh 2002b, 2004). As multiple technologies are increasingly used for a variety of purposes, children are presented with, and create, new ways of engaging in the world as social actors.

In the past decade, qualitative research has revealed young children engage in various digital activities using a variety of devices at home. Studies have described children's computer and video gameplay (Aarsand 2007; Davidson 2010; Kervin et al. 2015), use of applications ('apps') on tablets and smartphones (Danby et al. 2013; Kervin 2016; Scriven 2017), engagement in virtual words (Marsh 2011, 2013) and web searching (Davidson 2011). Worldwide, young children's access to and use of digital technologies continues to grow (ABS 2012; Childwise 2014; Common Sense Media 2013; Ofcom 2016). Recent survey data reveals tablets, smartphones, laptops and game consoles are the most used devices by children under 8 years (Chaudron 2015; Ofcom 2016). More and more, children are using these devices for viewing videos and television and playing games (Common Sense Media 2013; Ofcom 2016). The portability of these relatively new technologies

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opens up opportunities for playful experiences where multiple technologies and objects can be brought together.

Children's playful engagement with technologies is becoming known as *digital play*. This contemporary perspective on play identifies technologies as resources that provide children opportunities "to play in multiple modes so they are able to acquire deeper understandings about how things work, connect, and are relevant to their lives" (Yelland 2010, p. 6). Children's digital play is diverse and differs between families (Marsh 2002a) as technology use is mediated by personal preferences, interactions with siblings and parents and exigencies on time (Stephen et al. 2013). Commercial companies have recognised the "emerging phenomenon" (Kervin 2016, p. 65) of digital play, with the consequence that material toys and books are given "digital add-ons and online connectivity" (Nixon and Hateley 2013, p. 34). For instance, Barbie™ by toy company Mattel® can be engaged with at a website, on apps and in films and music videos, enabling play with characters or narratives to occur across media (Alper and Herr-Stephenson 2013). As children construct digital play "in multiple modes" (Yelland 2010, p. 6) and with a variety of media and technologies, there is an enhanced need to examine their technology use.

Where digital play involves interacting with others who are not physically present, young children's communication practices are mediated by technology use. A case in point is children's telephone conversations, such as with toy or non-functioning telephones. Toy phones are a common item in homes with a considerable number of children owning a toy phone from an average age of 12 months (Marsh 2002b, 2004). Research (Gillen 2000a, b, 2002; Marsh 2002b) suggests that children's use of toy phones inducts them into "sociocultural practices and values of society" (Marsh 2002b, para. 20). Gillen's (2000b) transcript analysis of children's recorded telephone conversations demonstrated how they engaged in social and cultural practices. Specifically, children employed turn-taking practices to take turns at talking. They also recontextualised language to account for the restraint of not being visible to one another. Drawing on perspectives of language acquisition and use (Vygotsky 1987), Gillen (2000b, p. 251) showed children became "members of a telephone using society". This research highlights children's telephone conversations as social and cultural accomplishments, though further research is needed to show how they are produced in situ.

Collectively, research on young children's technology use comprises a growing number of analytic accounts of how they use technologies to engage in playful experiences and interact with others. However, there remains limited knowledge of how young children use more than one technological device at a time to accomplish their activities. This chapter presents an analysis of a young child's pretend telephone conversation as she used multiple technologies simultaneously during play. The child constructed an interplay between the technologies as she drew on one (a YouTube video) to inform her activity with the other (her telephone call). Specifically, the child's telephone conversation was touched off from what she could see and hear in the YouTube video. This chapter highlights how the child uses multiple technologies and displays interactional competencies and knowledge of how people interact over the phone, to accomplish her social world.

17.2 Technology, Play and Interaction: An Ethnomethodological and Conversation Analytic Perspective

The perspectives of ethnomethodology (Garfinkel 1967) and conversation analysis (Sacks 1995) are used to produce rich descriptions of how the child orients to two technologies to produce a pretend telephone call. These perspectives uncover the organisation of everyday life, produced through the practical reasoning and methods of people in what they say and do (Garfinkel 1996). Early examinations of telephone calls by founding conversation analysts Harvey Sacks (1995) and Emanuel Schegloff (1968) identified the structures and patterns of ordinary language. In particular, turn-taking was identified as the method by which speakers take turns to initiate and respond to prior turns. The 'turn relevance place' signifies a point in conversation where a new turn is made relevant (Sacks et al. 1974). Analyses also established there to be a specific order to conversation produced over the phone. Though the structure of telephone conversation is considered as a social and cultural practice in sociocultural research, ethnomethodology and conversation analysis instead show how practices are actively constructed by people in local and situated ways. A brief overview of this structure is provided to support the analysis presented in this chapter.

Telephone conversations typically comprise a pre-beginning, an opening sequence, the body of the call and a closing sequence. A telephone call pre-beginning encompasses a series of actions by which a caller and recipient prepare for the telephone exchange, such as the caller dialling a number to cause the recipient's phone to ring (Haddington and Rauniomaa 2011). The ringing is a summons used to ascertain the recipient's availability to engage in talk (Schegloff 1968). In the summons-answer sequence, the recipient speaks first. The recipient provides an answer to the summons by responding through self-identification, using their name, also referred to as an 'address term' (Schegloff 1968). Following this, the caller may return a self-identifying greeting or expect the recipient to recognise them by their voice (Schegloff 2002). Next, the caller introduces a topic of talk (Schegloff 1968) as the reason for their call (Button and Casey 1985). The speakers organise talk on the topic(s) in the body of conversation and then sequentially exit talk through a closing sequence (Schegloff and Sacks 1973). This constitutes closing adjacency pairs (e.g. 'goodbye/goodbye') which lead to the termination of the conversation. This structure of telephone calls is so well established that telephone conversations have been described as "a sociointeractional form or genre" (Schegloff 1993, p. 4547).

The telephone conversation examined in this chapter is drawn from a large Australian-funded project that investigated young children's web searching practices at preschool and in their homes. Informed consent was gained from participants, and pseudonyms were used to protect their privacy. This chapter examines an extended sequence from a 10-min video recording of Tina (3 years, 11 months), made by her mother in their home. In the recording, Tina views YouTube videos on a laptop. The mother helps Tina locate the music video *Queen of the Waves* (based

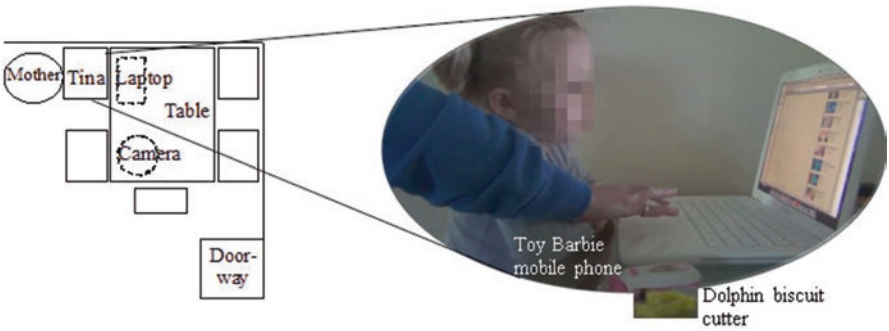

Fig. 17.1 Setting and participants

on the film *Barbie in a Mermaid Tale*) and remains behind the camera for the remainder of the recording (Fig. 17.1). Tina engages with the video by singing lyrics and moving a dolphin-shaped biscuit cutter to recreate onscreen action. A toy Barbie™ mobile phone is beside her. The phone features an image of Barbie on the cover and inside. In the sequence analysed here, Tina uses the phone to construct a telephone conversation with Barbie as she continues to view the video. Analysis demonstrates how Tina's actions produce an interplay between the telephone and computer technologies.

The recording was transcribed according to the Jefferson notation system (Atkinson and Heritage 1984). This notation system records minute details in talk, such as pauses (0.2), elongation of sounds (ea::::) and emphasis (ea). It employs brackets [ ] to identify where utterances and/or embodied actions overlap. Additional notation symbols were developed to pictorially represent Tina's embodied actions towards the multiple technologies and other objects. These additional symbols depict lyrics of the music video (♫) and Tina's gaze direction, e.g. to the screen (👁→□). As the insertion of these symbols renders the transcript especially complex, Tina's talk is bolded to identify it from embodied actions and music. As well, Table 17.1 presents Tina's telephone conversation without surrounding actions. A reading of the notation symbols in the appendix is also recommended prior to reading the transcript extracts.

17.3 Analysis

Extract 17.1 begins with Tina picking up a toy mobile phone (line 1) and lowering the dolphin biscuit cutter to the table (line 2). In her selection of materials, Tina works towards the launching of a new play activity (Whalen 1995). Her actions display a transition in her engagement with the video and project further use of the phone.

Extract 17.1: Tina Announces a New Activity

```
1            (0.3) ((T picks up toy mobile phone,
2            then puts down dolphin))
3            ♫ te[aring up the curr=
4      T:        [I'm [gonna ca:ll=
5                    [((T 👁→phone))
6            ♫ =[ent=
7      T:      =[Barbie=
8                [((T 👁→□))
9      T:    =[mU:::=
10             [((T 👁→phone))
11             [((T opens phone))
12           ♫ =[like a girl's  ] (.) got
13     T:      =[M,              ]
14               [((T 👁→□))     ]
15           ♫ (.) gill::s
```

Tina announces the transition in her activity, 'I'm gonna call Barbie mU:::M' (lines 4, 7, 9 and 13). Her announcement accounts for her actions using the mobile (lines 1 and 11). It also resumes talk with her mother, which had lapsed following the video selection. By addressing the news of her activity to her mother (lines 9 and 13), Tina identifies it as being relevant (Wootton 1981) to her. Tina's elongation and raised volume of the address term 'mU:::M' (lines 9 and 13) work to ensure her announcement is hearable by the mother.

During her announcement, Tina's gaze alternates between the screen and phone as she references them in her talk. For example, her gaze shifts to the phone as she announces she is 'gonna call' (lines 4–5) and then returns to the screen, where Barbie is portrayed, as she names Barbie as the call recipient (lines 7–8), and finally shifts again between the phone and screen as she opens up the phone and addresses her mother (lines 9–11 and 13–14; Fig. 17.2). Tina's gaze correlates with her refer-

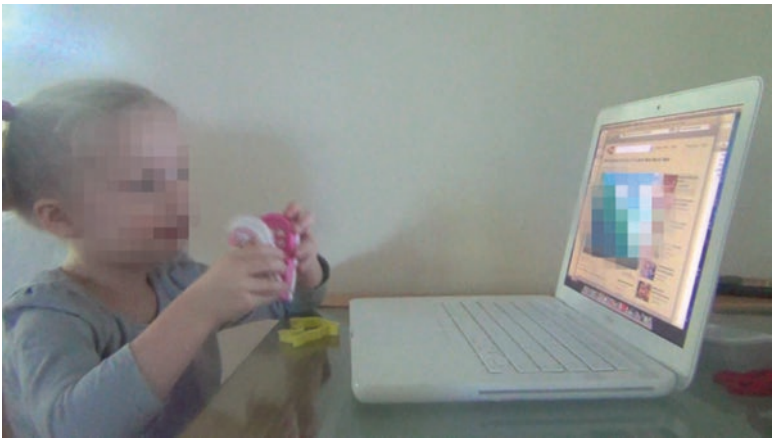

Fig. 17.2 Line 14

ences to the phone and Barbie and works to monitor both the action onscreen and the developing activity of her telephone call. These actions demonstrate the complexity of Tina's engagement with the video, where she manages her viewing with the introduction of a new activity. Tina's next actions in Extract 17.2 produce the pre-beginning (Haddington and Rauniomaa 2011) of her telephone call.

Extract 17.2: Tina Dials Barbie's Telephone Number

```
16          (0.3) ((T puts phone to ear))
17          (0.2) ((T takes phone off ear))
18          ♫ [po=
19            [((T 👁→phone))
20          ♫ =[p up
21    T:       [↑do↑
22             [((T taps phone on 'do'))
23          (0.1)
24          ♫ l[ea:nin  ] [si   ]de [to   ] [si   ]:=
25    T:       [↑do do↑] [↑do↑]   [↑do↑] [↑do↑]
26             [((T taps phone on 'do'))
27          ♫ =[de
28             [((T 👁→□))
29          (0.2)
30          ♫ l[ai:d ] back
31    T:       [↑do do↑]
32             [((T taps phone on 'do'))
33          (0.5)
34    L:    ♫ hang te[n
35                    [((T lifts phone))
```

Tina puts the phone to her ear and then quickly removes it (lines 16–17). Her actions indicate trouble in making the call, and she 'repairs' her act of calling by dialling a number. Tina taps the dial pad eight times (lines 19, 22, 26, 28 and 32; Fig. 17.3). As she taps, she makes the high-pitched sound 'do' to represent the sound of a telephone registering the selection of numbers (lines 21, 25 and 31). Tina's 'sound effects' show her familiarity with the activity of making a call, which contributes to the authenticity of her actions. By recognisably producing the distinct routine of a telephone call pre-beginning, Tina accomplishes 'doing' being a caller. Tina begins the telephone conversation in Extract 17.3.

Table 17.1 presents a simplified transcript of Tina's pretend conversation.

Fig. 17.3 Lines 31–32

Table 17.1 Tina's utterances in the pretend telephone conversation

Transcript lines	Tina's telephone turns
36, 38	hello Bar:bie:¿
	(3.0)
44	↑o:::w::h↑?
	(1.2)
46, 48	Barbie. (0.3) I just
	(2.2)
50, 52, 54	wan:ted to::
	(1.2)
58	to see
	(1.1)
58	do you want to come have a Bar:bie in a mermaid tale and,
	(0.5)
64	and bring your dolphin
	(0.4)
67	and take a sur::fboar:d,
	(0.7)
67	s-
	(1.6)
68	.hhh
	(1.1)
71	an::d,
	(2.5)

(continued)

Table 17.1 (continued)

Transcript lines	Tina's telephone turns
76	°and°
	(0.5)
77	I (wonder?)
	(1.0)
80	see: ya
	(0.7)
83	see: ya:::
	(1.5)
85, 88	to be (.) a mermai:d as well?
	(1.4)
93	I:'ll see t-
	(0.4)
97, 101	to::? (.) to be::
	(0.5)
102	a (0.2) mermaid.

Extract 17.3: Tina Talks with Barbie on the Phone

```
36    T:    [hel=
37          [((T puts phone to ear))
38    T:     =[lo Bar:bie:¿]
39          ♫ [go for a ri:]de
40          (0.5)
41          ♫ catch that cur:l
42          (.)
43          ♫ get into the tu[:be  ]
44    T:                    [↑o:::]w::h↑?
45          ♫ do the mahi mahi
```

Tina lifts the phone to her ear and utters the first part of a greeting sequence 'hello Barbie?' (lines 36 and 38; Fig. 17.4). Typically, a caller will only speak first if reinitiating a summons when a recipient does not respond (Schegloff 1968). However, Tina's caller-initiated greeting (Fitzgerald 1999) is not heard as a response to an absence of recipiency. Rather, Tina's greeting follows directly after her dialling of the telephone number, so that when she initiates the greeting, she is still lifting the phone to her ear. The quick succession of these actions shows a lack of trouble in the opening of the telephone conversation. Instead, Tina's actions suggest that she is orienting to the availability of Barbie pictured on the cover and inside the phone. In this way, Tina produces a telephone conversation opening that is not reliant on the summons-answer sequence to establish Barbie's availability (Schegloff 1968). Therefore, Tina pretends the presence of Barbie and begins a conversation with her.

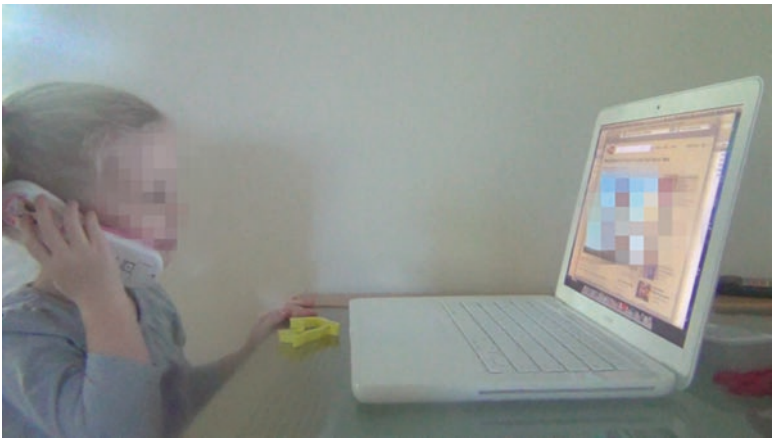

Fig. 17.4 Line 38

Tina's construction of the greeting sequence establishes that Barbie is someone with whom she is familiar. Her greeting 'hello Barbie?' provides the opportunity for Barbie to recognise her as the caller (Schegloff 2002). The absence of Tina's self-identification produces a "voice recognition test" (Sacks 1995, Vol. 2, p. 161) requiring Barbie to recognise her by her voice. Tina makes apparent that Barbie passes the voice recognition test; she organises the conversation so that Barbie does not require confirmation that she is the caller. Accordingly, Tina establishes that Barbie knows her well enough to recognise her by her voice (Schegloff 1968).

In the following utterances, Tina responds to imagined turns by Barbie. After her greeting, Tina pauses to allow time for Barbie to 'respond' (lines 40–42). According to the rule of two-party talk (Sacks 1995), the conversational floor returns to the caller following the recipient's response. So, it would be this position in the conversation that Tina would introduce the first topic of talk. However, Tina produces an acknowledgement token (Heritage 1984) 'o:::w::h' (line 44) to receipt some new information. The token indicates Barbie took an extended turn following her responding greeting and has introduced a topic of talk informing Tina of something. The raised intonation of Tina's token indicates that what Barbie has said is pleasing to her. In so doing, Barbie 'displays' recipient design by showing "an orientation to who-in-particular the other [Tina] is and what is going on in the life of that other" (Schegloff 2002, p. 260). Therefore, Tina's imagined turns by Barbie establish them as having a friendly relationship. Tina's construction of responding turns establishes the opening of the telephone call. In Extract 17.4, Tina continues the conversation by providing the reason for her call.

Extract 17.4: Tina Makes an Invitation to Barbie

```
46    T:    Ba[rbie.]
47          ♫ [make ] your ta[il fi:n] mo:::ve
48    T:                        [I just]
49          (0.6)
50    T:    [wan:=
51          [((T 👁→table))
52    T:      =[ted=
53          ♫ [she's the=
54    T:     =[to::,
55            [((T 👁→□))
56          ♫ =queen of the
57           wa::[::    ]:::[v::es          ]
58    T:         [to see]   [do you want to]
59           come [have a Bar:bie] in a=
60          ♫    [check it ou:t   ]
61    T:     =[mermaid tale and,]
62          ♫ [she's spinnin tha:t b]oar:d
63           a[r:ou::nd       ]
64    T:      [and bring your] dol[phin   ]
65          ♫                    [queen of the]
66           wa[::::::             ]::[v:]:es
67    T:       [and take a surfboard,]  [s-]
68          ♫ no one's gonna take [away] her
69    T:                          [.hhh]
70          ♫ crow[:n]
71    T:          [an]::d,
72           (0.1)
73          ♫ her majesty (0.1) is dropping in
74            (.)
75          ♫ w:[oa:: ]:H
76    T:        [°and°]
77    T:      I [(wonder?)]
78          ♫   [surf's up] (.) bow down
79            (.)
80    T:     s[ee: ya  ]
81          ♫ [she's the qu]een of the
82           w[a:::ves]
83    T:      [see: ya]:::
```

A pause (line 135) following the extended greeting suggests a turn relevance place where the conversational 'floor' returns to Tina. Tina breaks the pause by beginning a new turn that addresses Barbie by name (line 46). Her address term not only projects further talk of relevance to Barbie (Wootton 1981), but the emphasised vowel and fall in intonation suggest it is a "topic-initial elicitor" (Button and Casey 1985, p. 47). This is used to command Barbie's attention and attribute the projected talk as noteworthy and the reason for calling (Button and Casey 1985; Schegloff 1986). Following this, Tina extends an invitation to Barbie (lines 48–77).

The beginning of Tina's invitation, 'I just wanted to:: to see' (lines 48, 50, 52, 54 and 58), produces a possible incomplete pre-invitation (Schegloff 2007). The shape

Table 17.2 Tina's talk touched off by lyrics

Tina's vocal orientation to lyrics		
Video lyrics and Tina's telephone talk		
62		♫ [she's spinnin tha:t b]oar:d
63		a[r:ou::nd]
64	T:	[**and bring your**] **dol**[**phin**]
65		♫ [queen of the]
66		wa[::::::]::[v:]:es
67	T:	[**and take a surfboard,**] [**s-**]

of Tina's pre-invitation indicates trouble in producing it. Tina begins by indexing herself as the one extending the invitation with 'I just' (line 48). Her elongated words (lines 50 and 54) and pauses (while the song lyrics continue, lines 49 and 56) form a series of word searches that enable her to produce the pre-invitation 'wanted to:: to see' (Sacks 1995) before launching into the invitation.

Tina's orientation to the video is "interactionally relevant" (Sacks 1995, Vol. 2, p. 7) to her construction of the invitation. Her invitation indexes shared understanding with Barbie touched off by the video. Tina asks Barbie, 'do you want to come have a Barbie in a mermaid tale and' (lines 58–59 and 61). Tina's event 'Barbie in a Mermaid Tale' is touched off from the video (and which originates from the film *Barbie in a Mermaid Tale*). Her description of the event indexes where Barbie swims as a mermaid and surfs in the video. Tina invites what she sees onscreen to happen again. As such, her invitation refers to a place which is identifiable "by virtue of what goes on there" (Schegloff 1972, p. 101). Tina's description of the event draws upon shared understanding of what 'Barbie in a Mermaid Tale' constitutes.

Tina's talk continues to be touched off by the video. Her request for Barbie to 'bring your dolphin' (line 64) and 'take a surfboard' (line 67) draws on the temporal unfolding (Schutz 1976) of the lyrics and onscreen video. Tina's request for Barbie to bring a dolphin is touched off by scenes of Barbie and a dolphin swimming in the ocean. In addition, Tina's request for Barbie to take a surfboard follows after song lyrics referencing Barbie's use of the surfboard (Table 17.2) and after Tina observably oriented to images of the surfboard in the video. Therein, Tina uses her viewing and listening to the video as a resource to socially organise (Sacks 1995) her invitation.

Tina's next actions indicate trouble constructing the telephone conversation and she brings about its closure. A possible place for Barbie to respond ensues (partly filled by Tina's discontinued restarts, lines 67–68). It is 'hearable' that Barbie has not taken a turn when Tina says 'and' (line 71). This continuing device (Sacks 1995) holds onto her turn and suggests that she has more to say related to her invitation. After a significant pause, during which Tina appears to listen to the lyrics (lines 72–74), she recycles (Schegloff 1987) 'and' to produce an incomplete request 'I (wonder)' (lines 76–77). Tina's talk and continued gaze to the screen suggest she is trying to coordinate her extended utterance to the actions onscreen. However, no further talk is forthcoming beyond Tina's restarts. Tina then engages in a closing

sequence to end the conversation. She produces the farewell ‘see ya’ and leaves a short pause for Barbie to respond (line 80). Tina elongates a repeated farewell (line 83) which indicates the imminence of the closing. Her consecutive farewells suggest she has exchanged two closings to end the conversation. Tina’s closing and gesture to the dolphin biscuit cutter (line 84) project a transition in her activity. However, Tina’s next utterance in Extract 17.5 shows the call has not ended as she has been listening to Barbie speaking.

Extract 17.5: Tina Ends Her Conversation with Barbie

```
84              (1.6) ((T picks up dolphin))
85      T:      to be a m[ermai:d  ]    as
86              ♫         [she’s floating]
87              ♫ Sh[e’s fly ]ing
88      T:          [we::ll?]
89              (0.1)
90              ♫ she’s so out of
91              rea[ch
92                 [((T 👁→dolphin))
93      T:      I:’l[l see t-
94              ♫  [Zooma to La[goo:=
95                             [((T 👁→□))
96              ♫ =[ma
97      T:         [to::?
98                 [((T 👁→dolphin))
99              (.)
100             ♫ she’s [the best] on the beach
101     T:              [to be::,]
102     T:      a (.) merma[id.         ]
103                        [((T 👁→□))  ]
104             ♫          [high        ] ti:de
105             (.)
106             ♫ low ti:de
107             (.)
108             ♫ and rip ti[:de=
109     T:                  [i:de=
110             ♫ =[too
111     T:         =[doo,
112                  [((T takes phone off ear))
```

Tina’s question ‘to be a mermaid as well?’ (lines 85 and 88) shows her to be responding to an invitation from Barbie to be a mermaid. Her question indexes Barbie’s identity as a mermaid and suggests she is being invited to be a mermaid like Barbie. Tina’s turn suggests Barbie produced an extended turn in which she accepted Tina’s invitation to a ‘Barbie in a Mermaid Tale’ and then extended an invitation of her own. Tina’s construction of this part of the conversation is touched off by her orientation to a video scene showing Barbie as a mermaid. Thus, Tina uses her orientation to the video to construct the continuation of her telephone call.

Fig. 17.5 Lines 111–112

The mother's continued presence in the room suggests that Tina's actions are always potentially visible to her. Although the mother does not speak, her copresence means that she may resume interaction with Tina at any point. Therefore, Tina's question 'to be a mermaid as well?' (lines 85 and 88) makes Barbie's invitation interactionally accountable. By it, Tina produces an identity of herself as someone who receives invitations from Barbie. In this way, Tina's relationship with Barbie is potentially witnessable to her mother.

Tina's question produces an insertion question-answer pair (Schegloff 1972) within the standing invitation-response sequence. Her inserted question makes an answer from Barbie relevant (Schegloff 1972). Tina's next turn shows that Barbie responded affirmatively to her question. Barbie's response makes Tina's answer to the invitation relevant. Tina's response, 'I:'ll see t- (0.4) to::? (.) to be:: (0.5) a (0.2) mermaid' (lines 93, 97 and 101–102), avoids giving a dispreferred response (Pomerantz 1984) by indicating she will need to think about her answer. Her pauses (lines 99–100) and restarts (lines 97 and 101) suggest her to be pausing for time to design her turn.

Through a combination of actions, Tina accomplishes the end of her telephone conversation and produces a transition in her activity with the video. In the previous part of the conversation, Tina moved her gaze between the dolphin and the screen (lines 92, 95, 98 and 103). This gaze movement, combined with the pauses and restarts of her response (lines 93–102), projects the end of her conversation. A significant pause follows and is broken by Tina when she begins singing with the video lyrics (lines 109 and 111; Fig. 17.5). This demonstrates the complexity of Tina's viewing of, and interaction with, the video, that she engages and disengages (Szymanski 1999) from different activities that are informed by her orientation to it.

17.4 Discussion

The analysis examined how Tina designs her conversation with Barbie to resemble a real-world telephone call. While to spectators Tina is simply engaged in pretend play with a fictional character, detailed examination reveals she accomplishes her call by employing societal interactional practices specific to communicating over the phone. Her social organisation of the telephone conversation highlights her interactional competence to initiate and produce interaction with others. Tina draws on understandings of the structure of telephone calls to produce a pre-beginning and opening sequence, provide the reason for her call, produce a closing sequence and reopen the channel of talk in her organisation of the conversation. Her 'repair' of the pre-beginning to dial Barbie's number illustrates her attention to the practices by which communication is accomplished over the telephone. Showing the sequential development of Tina's telephone conversation demonstrates how she drew on societal interactional practices in situ and revealed the content of her call for her mother. This extends the existing body of knowledge (e.g. Gillen 2000a, b, 2002) on how children construct telephone conversations to reveal how they are produced moment by moment.

As well as drawing on her emerging understanding of the structure of telephone calls to produce her conversation, Tina utilises what she can see and hear in the music video to inform her talk. The content of Tina's conversation with Barbie is touched off from the images and song lyrics of the music video. This is clearly observed in the temporality in which objects are observed in the video and referenced by Tina in her talk. Tina used the video as a resource for constructing her relations with Barbie. Her orientation to the video and the telephone, in her talk, gaze and gesture, produces an interplay between the technologies present. Therefore, this interplay arose from and was embodied in Tina's telephone conversation.

This analysis provides insight into how children construct their social worlds using technologies. Tina arranged her use of multiple technologies to inform her talk and therefore enable her construction of her social world. By her conversation, she demonstrated understanding of the purpose of telephone calls for commenting on shared understandings, extending invitations and organising future events. In addition, analysis suggests the complex nature of children's social worlds, which are informed by digital media. Though Barbie is a fictional character, Tina treats her as an important member of her social world, with shared knowledge and experiences informed by Tina's engagement in digital media. These findings contribute to a growing body of evidence showing children to be active members of society who interactionally construct their social worlds (e.g. Danby et al. 2013; Hutchby and Moran-Ellis 1998; Scriven 2017). In particular, the findings suggest the importance of digital media for children's social worlds.

Tina's pretend telephone conversation shows how children engage in complex interactional practices with communication technologies, demonstrating their understanding of social and cultural applications of these technologies. In fact,

findings direct us to the idea that the utility of technologies in play (or other real-life activities) is more than a unilateral singular notion; rather, it is a dynamic interplay between an ever-expanding presence of multiplatform technologies in our day-to-day life. It could be postulated that children's increasing access to technologies (ABS 2012; Childwise 2014; Common Sense Media 2013; Ofcom 2016) enables new ways for them to use technologies, namely, using multiple technologies simultaneously. It is suggested that Tina's technology use on this occasion was informed by previous experiences using the devices. It could be argued that familiarity with the technologies afforded Tina knowledge about them and how they could be used together in such a way to accomplish her play. In this sense, technology use, such as for communication purposes in play, is an *inter*play whereby past experiences inform future use and the possibilities which exist to accomplish activities.

17.5 Conclusion

This chapter established how Tina produced an interplay between multiple technologies in her simultaneous activity with them. In her play, she constructed a telephone conversation touched off from her listening to and viewing of the video and informed by her emerging understandings of the structure of telephone calls. The temporality in which Tina referenced objects or lyrics showed the video was intricately tied to her organisation of the telephone conversation. Tina's telephone conversation revealed her understanding of how social worlds are organised using multiple technologies in everyday life. Drawing on interactional resources known to her, Tina produced a socially recognisable telephone call in her pretend play. But, as the empirical data illustrated, Tina's accomplishment of her pretend telephone conversation was contingent on an *inter*play between a number of digital technologies that, at the same time, contributed to her play. In fact, the play event itself relied on the interplay between the multiple technologies and objects in the site at the time. These insights demonstrate that young children engage with technologies in complex ways, drawing upon their knowledge of societal practices with technologies, which manage and organise their social life. Continued consideration of children's everyday technology use, using approaches such as conversation analysis, can further identify the methods by which they accomplish their social worlds.

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Appendix: Transcription Symbols

[to]	Indicates where participants' speech and/or embodied action overlaps
=	Indicates where participants' speech follows on from each other without a break
(.)	Indicates a micro-interval during participants' speech
(0.4)	Indicates the length of a participant's pause (in approximate seconds)
::	Indicates a prolonged sound in a word (i.e. to::)
-	Indicates where a word is cut off (i.e. t-)
?	Indicates rising inflection
¿	Indicates rising inflection weaker than?
,	Indicates continuing intonation
.	Indicates falling inflection
↑	Indicates where the intonation in a participant's speech rises
↓	Indicates where the intonation in a participant's speech falls
TO	Uppercase words indicate that a participant's speech is loud
to	Underlining indicates emphasis on a syllable or word
.hhh	Indicates a participant's audible inhalation
(( ))	Provides a description of the verbal and embodied actions of participants
( )	Indicates where participants' speech could not be heard

Additional Transcription Symbols (Developed by First Author)

□	Screen
👁	Gaze
((T 👁→□))	Focus of gaze to screen
♫	Music/lyrics generated from technology
Hello Barbie	Talk by participants bolded
Queen of the	Singing of song lyrics italicised

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