Early years practitioner beliefs about digital media:
from pedagogical incompatibility to new pedagogy

Charlotte Vidal-Hall

Thesis for the degree of Doctor of Philosophy
UCL Institute of Education
2019
Statement of originality

I, Charlotte Vidal-Hall, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Word count (exclusive of appendices and bibliography): 98,000 words
Abstract

This dissertation reports research that investigated the integration of technology into early years pedagogy. The work contributes to knowledge about teaching and learning in the early years in the context of the pedagogical challenges practitioners face when integrating technology.

The theoretical framework for the study combined theories of activity theory and learning ecologies. The methodology was framed by educational design research. Collaborative design was adopted by the researcher and a primary-school nursery teacher to develop and implement an intervention in her classroom, focussing on the integration of digital media in teacher-to-children, and peer-to-peer interactions. Ongoing reflective dialogue facilitated the collaborative nature of this study and supported the adoption of new practices. Research data included video observations of the children, the teacher and other practitioners. The data sets also included interviews and reflective discussions with the teacher, and scrutiny of classroom planning documents. Qualitative data analysis involved thematic analysis to identify key factors that were related to changes in teacher beliefs and pedagogy across the phases of the design research.

Iterative cycles of the intervention were designed and implemented in collaboration with the teacher. This resulted in the development of teaching and learning strategies to integrate digital media into free-flow play and into directed teaching. The developments required the reconstruction of some practitioner beliefs about the value of digital technologies in early education. The study findings suggest professional development should address practitioner beliefs about digital media and early years pedagogy, and provide time and space for reflection.

The research makes an original contribution to knowledge about the integration of digital media into early years classroom pedagogy, including in-depth understanding of the potential barriers and gateways between practitioner beliefs about new technologies and their uptake in the classroom, and the processes of bringing about change through appropriate intervention and reflection.
Impact statement

The impact of educational research can be seen through the changes it brings about in classroom practice, and in children’s experiences of learning. The research undertaken for this study had an impact on the practice of one early years practitioner and her use of digital media to support learning. The use of educational design research enabled a twofold contribution to knowledge: theoretical understanding of the problem under investigation and a workable solution tested in the classroom. This study developed a naturalistic, classroom-based intervention to address a problem identified in academic literature and observed in the classroom where this research was conducted. Namely, teachers lack of conviction in the use of digital media to support early years play-based learning and a lack of effective pedagogy to support digital media integration. This study therefore has potential impact on the academic field of early years technology use; for example on better understanding of barriers to digital media uptake, and pedagogy to support effective integration. The findings also have impact for the early years practitioner community by reporting research-informed examples developed and tested in situ that practitioners can use to inform their pedagogy.

Much has been written about the need to integrate digital technologies into early years classrooms and develop young children’s digital literacy. However, there is still ambivalence about how digital media can support learning in ways that do not create tension with individual practitioners’ beliefs about young children’s learning. This research addressed two key areas shown to be hindering the uptake of digital media in early education; practitioner beliefs and lack of effective early years pedagogy to support learning with digital technologies.

The impact of the research beyond one classroom is through the development of a classroom-based intervention that can be implemented in similar settings. This intervention resulted in a set of design principles that can be used in similar settings. The research findings provide a model for researchers and practitioners to implement and develop for use across early years settings. Activities found most effective in developing an effective and workable intervention are implemented in similar classrooms to refine and develop a workable model that can be disseminated and implemented in classrooms.

This model and key features of the intervention will continue to be disseminated through practitioner conferences and events as well as academic conferences. To date, the findings have been presented at the British Educational Research Association (BERA) Conference and TACTYC: Association for Professional Development Early Years conference. The knowledge dissemination strategy includes future publication of the research findings in academic journals, practitioner publications and on-line platforms. Early findings have also been published on the BERA blog.
## Contents

**Chapter 1**
Introduction: the case for the research ................................................................. 11
  - The pros and cons of educational technology ................................................. 12
  - The context for early years education in England .......................................... 15
  - Barriers to digital media integration ............................................................... 17
  - Moving beyond the current debate ................................................................... 18
  - Aims of this study ............................................................................................... 20

**Chapter 2**
Theoretical framework for the research ................................................................. 23
  - A socio-cultural view of learning ...................................................................... 23
  - Tool and sign in mediated learning ................................................................. 24
  - Explicit and implicit mediation .......................................................................... 26
  - Social institutions mediating learning ............................................................... 28
  - Dynamic social learning systems ...................................................................... 30
  - Conceptualising contexts as learning ecologies ................................................ 33
  - Visible and invisible elements of a classroom learning ecology ...................... 36
  - Summary ........................................................................................................... 38

**Chapter 3**
A review of literature .......................................................................................... 39
  - Search strategy .................................................................................................. 39
  - Published literature on digital media integration ............................................. 41
    - Lack of planned practitioner interaction ......................................................... 43
    - Pedagogical challenges in supporting digital play .......................................... 48
    - Practitioner research ...................................................................................... 51
    - Digital media in practitioner-directed teaching ............................................ 53
    - Ecological perspectives on digital media integration .................................... 55
  - Summary ........................................................................................................... 57
  - Barriers to digital media uptake ........................................................................ 58
    - Beliefs shaping practice ............................................................................... 59
    - Tension between beliefs and practice ........................................................... 61
    - Beliefs about learning and digital media ....................................................... 62
    - Developing new beliefs ................................................................................. 64
  - Summary ........................................................................................................... 66

**Chapter 4**
Methodology and research methods .................................................................... 68
  - Addressing the research questions ................................................................... 68
    - Philosophical framework .............................................................................. 68
      - Paradigmatic choices .................................................................................... 69
      - Philosophy underpinning this research ....................................................... 71
    - A Design-based approach to research ........................................................... 72
    - Research design and methods of inquiry ....................................................... 77
  - Site and sampling strategy ................................................................................ 78
    - The school ..................................................................................................... 79
    - The nursery .................................................................................................... 80
    - The practitioners ............................................................................................ 84
    - The children .................................................................................................. 85
Chapter 5................................................................................................................................. 132
Implementing an effective intervention................................................................................ 132
Pre-intervention constraints to integration ............................................................................ 132
Having to teach ‘mouse skills’ ................................................................................................. 133
Vicky’s dislike of practitioner-directed learning ..................................................................... 134
A ‘passive and solitary’ way of learning ................................................................................. 136
Tension between digital media and language development .................................................. 137
Classroom learning environment for digital media ............................................................... 140
Summary and intervention development .............................................................................. 142
Intervention Cycle 1 – 13 weeks ............................................................................................ 143
Planning for digital media ...................................................................................................... 143
Planning direct teaching ........................................................................................................ 146
Practitioner interaction .......................................................................................................... 148
Using the IWB during free-flow play ..................................................................................... 148
Developing operational skills ................................................................................................ 151
Supporting language development ....................................................................................... 152
Intentional interventions in digital play ................................................................................ 155
Reflecting on change .............................................................................................................. 156
Summary and intervention development .............................................................................. 159
Intervention Cycle 2 – six weeks .......................................................................................... 160
Planning for digital media ...................................................................................................... 160
Planning for other practitioners ............................................................................................ 163
Practitioner interaction .......................................................................................................... 164
Integrating tablet technologies into free-flow play ............................................................... 164
Introducing LearnPads in the classroom .............................................................................. 169
LearnPads supporting language ............................................................................................ 170
Reflecting on change .............................................................................................................. 172
Summary and intervention development .............................................................................. 174
Intervention Cycle 3 – eight weeks ....................................................................................... 175
Planning for digital media ...................................................................................................... 175
Practitioner interaction .......................................................................................................... 178
All practitioners using digital media ..................................................................................... 178
<table>
<thead>
<tr>
<th>Chapter 6</th>
<th>191</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors enabling change and the impact on practice</td>
<td>191</td>
</tr>
<tr>
<td>Factors enabling change</td>
<td></td>
</tr>
<tr>
<td>Turning beliefs on their head</td>
<td>192</td>
</tr>
<tr>
<td>Digital media supporting language and communication</td>
<td>195</td>
</tr>
<tr>
<td>Making it fit: the relationship between beliefs and pedagogy</td>
<td>197</td>
</tr>
<tr>
<td>Using evidence to support reflection</td>
<td>199</td>
</tr>
<tr>
<td>Effective practices supporting integration</td>
<td>201</td>
</tr>
<tr>
<td>Establishing a presence during free play</td>
<td>201</td>
</tr>
<tr>
<td>Congruence with classroom practice</td>
<td>203</td>
</tr>
<tr>
<td>Integration into practitioner-directed learning</td>
<td>204</td>
</tr>
<tr>
<td>A ‘supportive’ pedagogy</td>
<td>205</td>
</tr>
<tr>
<td>Extending pedagogy to operational skills</td>
<td>208</td>
</tr>
<tr>
<td>Distal interactions supporting integration</td>
<td>209</td>
</tr>
<tr>
<td>New classroom environment for digital media</td>
<td>212</td>
</tr>
<tr>
<td>Summary</td>
<td>214</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 7</th>
<th>217</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion and conclusions</td>
<td></td>
</tr>
<tr>
<td>Returning to the problem</td>
<td>218</td>
</tr>
<tr>
<td>Factors influencing digital media uptake</td>
<td>220</td>
</tr>
<tr>
<td>Beliefs about digital media shaping teaching and learning</td>
<td>222</td>
</tr>
<tr>
<td>Focus on direct teaching</td>
<td>225</td>
</tr>
<tr>
<td>Lack of understanding of children’s digital practices</td>
<td>226</td>
</tr>
<tr>
<td>Constraining digital literacy development</td>
<td>228</td>
</tr>
<tr>
<td>Classroom learning ecology for digital media</td>
<td></td>
</tr>
<tr>
<td>Elements of a learning ecology</td>
<td>229</td>
</tr>
<tr>
<td>Norms of participation hindering integration</td>
<td>230</td>
</tr>
<tr>
<td>Reconstructing the classroom learning ecology</td>
<td>232</td>
</tr>
<tr>
<td>Renegotiated norms</td>
<td>233</td>
</tr>
<tr>
<td>Pedagogical congruence supporting effective integration</td>
<td>237</td>
</tr>
<tr>
<td>Critical reflection supporting change</td>
<td></td>
</tr>
<tr>
<td>A ‘supportive’ pedagogy for digital media</td>
<td>239</td>
</tr>
<tr>
<td>Supporting digital literacy</td>
<td></td>
</tr>
<tr>
<td>Explicit and implicit mediation enabling change</td>
<td>240</td>
</tr>
<tr>
<td>Implicit discourses shaping practice</td>
<td>241</td>
</tr>
<tr>
<td>A remediated position</td>
<td>243</td>
</tr>
<tr>
<td>Conclusions</td>
<td>245</td>
</tr>
<tr>
<td>Implications for classroom practice</td>
<td>246</td>
</tr>
<tr>
<td>Implications for future research</td>
<td>247</td>
</tr>
<tr>
<td>Methodological reflections</td>
<td></td>
</tr>
<tr>
<td>Limitations of the research</td>
<td>249</td>
</tr>
<tr>
<td>References</td>
<td>250</td>
</tr>
<tr>
<td>Appendices</td>
<td></td>
</tr>
</tbody>
</table>

References ........................................................................... 261
Appendices ......................................................................... 290
List of tables

Table 3.1: Search strategy used to identify studies for review ........................................ 41
Table 3.2: Practitioner/child interactions described in research and their common features ..................................................................................................................... 45
Table 4.1: Common features of different orientations to design research ...................... 76
Table 4.2: Ferny Croft primary school morning nursery .............................................. 87
Table 4.3: Pedagogical approaches observed in class and the degrees of structure governing them .............................................................................................................. 90
Table 4.4: Summary of design principles used to drive the intervention ....................... 96
Table 4.5: Date and length of intervention phases and cycles ...................................... 97
Table 4.6: Data collected at different phases of the intervention .................................. 110
Table 4.7: Date and type of interview data collected from participants ....................... 111
Table 4.8: Final categories used for analysis and their definitions ............................... 126
Table 5.1: Type and frequency of digital media use referred to in 20 nursery .............. 145
Table 5.2: Type and frequency of digital media use referred to in 26 nursery weekly planning documents ................................................................. 161
Table 5.3: Type and frequency of digital media use referred to in 34 nursery weekly planning documents ................................................................. 176
Table 6.1: Summary of design principles showing developments and modifications during the intervention ................................................................. 192

List of extracts

Extract 5.1: Supporting learning at the IWB ................................................................. 149
Extract 5.2: Children collaborating at the PC .............................................................. 153
Extract 5.3: Practitioner-initiated activity using Our Story on an iPad ...................... 166
Extract 5.4: Supporting child-initiated digital play .................................................... 180
List of figures

Figure 2.1: Model of an activity system (Engeström, 1987, p. 78) ........................................... 33
Figure 2.2: Engeström’s (1987, p. 78) model of an activity triangle showing elements of a classroom learning ecology in red ................................................................. 36
Figure 4.1: Nursery book area with displays of children’s work ................................................. 81
Figure 4.2: Post office role-play area set up by practitioners ....................................................... 81
Figure 4.3: Location of the IWB and desktop computer .............................................................. 82
Figure 4.4: The nursery outdoor area ...................................................................................... 83
Figure 4.5: Example of nursery planning showing practitioner-directed whole class teaching and focus activities ................................................................................................. 92
Figure 5.1: Jack and the Beanstalk class display showing children’s words scribed by Vicky ........................................................................................................................................... 139
Figure 5.2: Planning document showing the addition of a section for ICT .................................. 144
Figure 5.3: Busy Things home page of interactive games for early years .................................. 146
Figure 5.4: Vicky and Maryam using the TES iboard activity .................................................... 149
Figure 5.5: Sam and Danny using Simple City together on the computer .................................. 153
Figure 5.6: Vicky’s handwritten additions to nursery planning directing early years educators to use Busy Things on the IWB (planning 25.2.15) ........................................... 161
Figure 5.7: Vicky on pirate day using Our Story with Alessandro and Matt .................................. 166
Figure 5.8: Handwritten addition to weekly planning (planning 26.6.15) .................................... 177
Figure 5.9: Weekly planning directing Huma to use LearnPads during free-flow play (planning 11.5.15) ........................................... 178
Figure 5.10: Danny interacting with Vicky at the PC ................................................................... 180
Figure 5.11: LearnPads put out by practitioners in the writing area ........................................ 182
Figure 7.1: Pre-intervention activity with digital media showing the relationship between elements of a learning ecology in red ........................................................................ 232
Figure 7.2: Pre-intervention activity without digital media showing the relationship between elements of a learning ecology in red .................................................................... 233
Figure 7.3: Post-intervention activity with digital media use showing the relationship between elements of a learning ecology in red ................................................................. 236
List of appendices

Appendix 1: bibliography of all papers considered for review ........................................ 290
Appendix 2: Summary of empirical research included in the review of literature ............ 299
Appendix 3: Nursery medium-term planning .................................................................. 303
Appendix 4: Summary of intervention phases and modifications .................................. 305
Appendix 5: Staff and parent consent forms ................................................................. 309
Appendix 6: Information letter sent to parents ............................................................... 311
Appendix 7: Pre-intervention questions for nursery staff ............................................... 312
Appendix 8: Example of video log .................................................................................. 313
Appendix 9: Table of video clips transcribed for analysis ............................................... 314
Appendix 10: Formatted weekly planning document ....................................................... 316
Appendix 11: Final code book used for analysis ............................................................. 318
Appendix 12: Development of codes and sub codes for different stages of analysis .... 323
Appendix 13: Intervention diary extracts referring to reasons for intervention developments ................................................................. 326
Appendix 14: Date and type of digital media use referred to in weekly planning documents for 2014/2015 ................................................................. 329
Chapter 1

Introduction: the case for the research

Young children are now born into social and cultural contexts in which digital technologies, and the consumption of digital media\(^1\) and popular culture through these technologies, is increasingly common (Plowman, Stevenson, Stephen, & McPake, 2012). However, the integration of digital technologies into early years classrooms remains problematic. One in four practitioners feel digital media do not have a place in the early years (Billington, 2016) and ‘we are not seeing significant advances in the utilization and implementation of technology in early childhood settings’ (Parette, Quesenbery, & Blum, 2010, p. 337). Despite evidence of children’s interactions in highly mediated digital environments digital media is often not seen as a priority or of pedagogical value for early learning (Johnston, Highfield, & Hadley, 2018). Successful integration of technology has been related to its prominence in classrooms rather than whether practitioners are using digital media for ‘better’ or more ‘relevant’ learning outcomes (Prestridge, 2017).

We also know that digital media can play an important role in supporting early communication, language and literacy when used as tools for teaching rather than to replace adult intervention (Billington, 2016). However, research consistently shows a lack of effective practitioner engagement with young children’s learning with digital media. Most notable is the absence of effective teaching and learning strategies to support children’s digital play. This is particularly pronounced in settings where pedagogy is underpinned by a strong belief in the valuable learning opportunities offered by children’s participation in free play (Ingleby, 2016; Palaiologou, 2016). Many practitioners frequently struggle to adopt effective approaches to integrating digital media that are congruent with their beliefs about young children’s learning and development.

---

\(^1\) Digital media is used to refer to a range of devices that can transmit digitized content over computer networks. This includes desktop personal computers (PC), interactive whiteboards and touch screen tablets. This differentiates digital media from the term technology which refers to a wide range of devices including cameras, remote controlled cars, TV and digital media devices.
The case made for the research reported in this dissertation was supported by my own professional experience, something which also influenced my choice of research focus. I have a long-standing interest in the use of digital media in early years classrooms. The small action research project I completed as part of an Early Years PGCE more than 20 years ago investigated more creative ways to use computers to develop writing in a nursery class. When I began my teaching career personal desktop computers (PCs) were beginning to be common in early years classrooms, although they were often not connected to the internet and frequently did not work. I was an early years and primary teacher for 15 years working in local authority maintained Early Years Centres and primary schools, and independent early years classrooms. During this time, I experienced first-hand how teachers used, or did not use, interactive whiteboards² (IWBs), iPads and PCs in their classrooms. Although no longer a teacher, I am still closely involved with schools as a school governor and chair of governors at a local primary school. I also regularly visit schools and speak to teachers as part of my job as a researcher for Ofsted.

**The pros and cons of educational technology**

The role of educational technology is a contested one. The potential of technology in education has been linked to reducing teacher workload, student motivation and raising pupil achievement (Department for Education, 2019). Educators and policymakers have valued the potential of digital technology to ‘revolutionize’ education, and governments and schools have invested heavily in software and internet connectivity (Blackwell, Lauricella, & Wartella, 2014). Behind the introduction of technology into schools lies a belief in the transformative nature of education technology and its ability to enhance learning environments (Hermans, Tondeur, van Braak, & Valcke, 2008). In addition to highlighting its potential impact on learning, debates in favour of educational technology focus on the lack of digital skills amongst school leavers and argue current use of computer-based technology is leaving children unprepared for the world of work (McFarlane, 2019). Not all children have access to high-speed internet and schools provide important access for children (Wohlwend, 2010). However, while some believe digital technologies in classrooms have the potential to transform learning (Hermans et al., 2008), others call for greater scrutiny of their ability to improve pupil outcomes among much hyperbole (Selwyn, 2016, 2017).

---

² An IWB allows images from a computer to be displayed onto a board using a digital projector. Pupils can manipulate elements directly on the board using a pen tool or finger as a mouse.
Both sides of the debate for and against the presence of educational technology in classrooms are guilty of ‘emotive language’ (Selwyn, 2016). Despite exaggerated claims surrounding the ability of digital technology to transform learning (op. cit) we still do not know enough about how technology is used in classrooms and its impact on learning (McFarlane, 2019). Empirical research has yet to demonstrate unequivocally the link between the use of technology and pupil’s learning (Selwyn, 2016). These polarized debates make it hard to objectively and accurately determine how educational technology may, or may not, affect pupil outcomes. Access to technology is no guarantee of effective use. How technology is used, rather than because it is used, needs greater scrutiny. There needs to be greater criticality in the debates about educational technology and its potential to change teaching and learning. We need to understand when educational technology can enhance teaching and when it might not (McFarlane, 2019).

The debate around the use of digital technology with young children tends to be more polarised than with children in primary and secondary education. Although much has been written about the power of technology to transform teaching, and the possibilities it offers for learning and developing 21st century skills (Burnett, 2016), there is still ambivalence towards the presence of digital media in early years settings (Flewitt, Messer, & Kucirkova, 2014). The view that early education should be closely linked to natural materials and ‘hands-on’ experiential learning has tended to intensify practitioner misgivings about integrating digital media in early years play resources (Wohlwend, 2010).

Arguments for and against the presence of digital technology in early years classrooms are heightened by debates about its suitability for young children and its contribution to early learning. Empirical research has demonstrated that digital technology has much to offer early years classrooms (Flewitt et al., 2014; Gillen et al., 2018; Lynch & Redpath, 2014; Marsh, 2010). This view is contested by those arguing that digital technologies are damaging for young children's development (Cordes & Miller, 2000) and that computer play is at odds with imaginative, child-initiated play (Miller, 2005). Multiple concerns exist around the widespread use of digital media, and the effects on young children (Dubicka, Martin, & Firth, 2019). Digital technology is seen as leading to lack of exercise, poor concentration, impaired language development and isolation (Cordes & Miller, 2000; Miller, 2005).
Growing evidence points to the potential harmful effects of Internet usage on children’s brain health (Dubicka et al., 2019) given that young children are developing cognitively and socially. Very young children’s development may be adversely affected by screen use (op. cit.) However, children’s experiences with digital technologies vary (Plowman & McPake, 2013) and not all forms of screen time have equal effects and some, for example video gaming, are not associated with adverse outcomes (Dubicka et al., 2019). Technology can also provide new opportunities for learning, participation, creativity and communication (Plowman et al, 2011). When used judiciously digital technology can promote cognitive and social development of young children (Couse & Chen, 2010; NAEYC, 2012). However, not all use of educational technology is appropriate and involves practitioners making decisions based on the needs, interests and capabilities of young children. Technology can be used inappropriately in early years settings when integrated without consideration as to its use as a pedagogic tool (NAEYC, 2014).

There are risks associated with digital technology, and children’s interactions via the screen may not always be positive ones (Gillen et al., 2018). Children may be exposed to potentially problematic experiences with digital media, such as inappropriate content, accidental purchases, health and social impacts and misuse of data (Marsh, 2010). It is important to consider the way digital technology is used and the type of activities children are engaged in rather than condemning screen use in schools (Holloway, Green, & Livingstone, 2013). Research is needed to explore how to better harness the positive effects of digital media (Dubicka et al., 2019). Children need to be protected from the potential harms of digital media but also taught to use the advantages digital media can offer (Dubicka et al., 2019). While pointing to the harmful effects of digital technology on young children, Miller (2005) argues a need for greater understanding of the ways educational technology can be used to support and develop children’s social and cognitive development through activities that enhance current early years practice rather than replace it. Putting technology in schools is no guarantee of its positive impact on learning outcomes and ‘how digital technologies are used is as important as whether they are used’ (McFarlane, 2019, p. 3).

Early years practitioners have a strong pedagogy to support learning in other areas of the curriculum (Plowman & McPake, 2013), but they need help to reflect on how they might apply their pedagogic skills and expertise to supporting learning with technology.
Digital media alone does not make a difference to children’s learning but needs careful planning for practitioners to support activities that meet intentional learning goals or outcomes (Flewitt et al., 2014). For many early years practitioners, there is a conflict between a constructivist, play-based approach to learning and using digital media in early years classrooms (Stephen, 2010; Stephen & Plowman, 2008). This uncertainty is compounded by the existence of forceful debates about what constitutes appropriate approaches to early learning as seen most recently in the strong reaction of the early years sector (Early Education, 2017; Gifford, 2017; TACTYC, 2017; Ward, 2018; Williams, 2017) to the publication of the *Bold Beginnings* report (Ofsted, 2017).

**The context for early years education in England**

The field of early years education internationally has different understandings of the ages at which this phase of education ends, the type of pedagogy deemed to be both effective and appropriate for young children, and the different qualifications early years practitioners hold. It is important, therefore, to set out how these terms are understood and used in this dissertation. The context for this research is early years education and practice in England where this phase of learning applies to children from birth to five years. This age and phase of learning is defined in the English Early Years Foundation Stage (EYFS) curriculum and statutory framework which sets out the standards and early learning goals (ELGs) for children’s learning and development (DfE, 2017). The EYFS framework covers both non-statutory preschool provision as well as the first year of statutory education. Throughout this dissertation the term ‘practitioner’ refers to all those engaged in young children’s learning in formal education settings whatever their qualifications. The term ‘early years educator’ is used to refer to practitioners who are not qualified teachers to distinguish them from qualified teachers who are working in the same setting or classroom.

The past 20 years have seen a string of policy developments and strategic initiatives that have addressed the early years curriculum and pedagogy. Not all these initiatives are still in place but they have left their mark on the early years sector (Faulkner & Coates, 2013). Government interest in the early years education sector can be traced back to the 1990s and the introduction by the Conservative government of the Desirable Outcomes for Children’s Learning on Entering Compulsory Education (SCAA/DfEE, 1996). This document outlined the ‘learning goals’ 4-year-olds were expected to reach before entering compulsory education. Since then, a series of documents culminating the publication of a statutory framework for the Early Years
Foundation Stage (EYFS) for children 0-5 years old (DCSF, 2008) has established the foundation stage of education as a distinct phase characterised by its teaching methods and curriculum (McGuinness 2005; Roberts-Holmes, 2012). Government funding initiatives have also shaped the types of early years provision on offer in England. In 1996, the government introduced a Nursery Voucher scheme for 4-year-olds in four local authorities in England and by 2010, all 3- and 4-year-olds were entitled to part-time nursery provision for 38 weeks a year. After the increase in government funding for provision for 3- and 4-year-olds there was a growth in the number of children in state maintained nursery schools and nursery classes in primary schools (Lewis, 2003).

A consequence of the focus on the early years sector has been increasing accountability through the establishment of statutory assessment practices beginning with the publication of a statutory end of foundation stage assessment in 2008 (QCA, 2008). Although increasingly regulated, the early years sector now has its own curriculum for children from birth to 5 years old and a distinct pedagogical approach founded on principles of play and through a mix of adult-led and child-initiated activity (DfE 2017). Early years practitioners perceive their role as distinctly different from that of their primary colleagues in terms of the pedagogical approaches and intended outcomes for this phase of education (Aubrey, 2004).

Approaches to early years pedagogy and the role of practitioners are hotly debated topics, but the central role of play is more widely accepted. It is not the intention here to enter into this debate, but to acknowledge that play underpins effective approaches to young children’s learning and development. The English EYFS framework calls for ‘planned, purposeful play and through a mix of adult-led and child-initiated activity’ (Department for Education, 2017, p 9) to underpin learning and development for young children up to the age of five years old. Play-based approaches promote purposeful learning through child-initiated play and the roles practitioners adopt to help children achieve their chosen goals. A key aspect of play-based learning is the time and space practitioners provide for open-ended exploration free from externally imposed goals or rules. Learning takes place in relevant and meaningful situations and is guided by children’s developing interests and capabilities. Although play is always structured to varying degrees through the spaces and resources made available to children (Bennett, Wood, & Rogers, 1997; Wood, 2010), freely chosen play activities are closest
to ‘free play’ (Wood, 2013). During free play children also make choices about the amount of interaction with others (Anning, 2010).

Practitioner involvement is critical to play-based learning and practitioners have an important role in extending and facilitating the learning children engage in as part of their play. Interventions in play are responsive to children’s interests and chosen activities rather than directing them as in practitioner-directed teaching. Interventions in children’s play are part of practitioners’ pedagogical decision-making and in this dissertation pedagogy is defined as: ‘All those processes and provisions that could be considered to initiate or maintain learning processes, and achieve educational goals’ (Siraj-Blatchford, 2009, p. 2). Pedagogy informs teaching strategies and approaches, the actions of practitioners and their decisions, and takes into account theories of learning and understandings of children and their needs. Pedagogy refers to decisions practitioners make about the roles they adopt in the classroom and how they interact with children as well as the learning environment practitioners seek to establish and the resources available in that environment. In other words, pedagogy is reflected in everything a practitioner does that results in children acquiring new knowledge or extending existing knowledge.

**Barriers to digital media integration**

Although the conditions for digital media use in schools appear to be in place, including ready access to technology, high-speed internet connections, and increased training for practitioners (Ertmer, 2005), there is a lack of progress with regard to their use in early childhood education (Thorpe et al., 2015). The reasons for this are complex and there are a number of barriers hindering the uptake of digital media in early years settings. Prominent among these barriers are practitioner beliefs and attitudes (Plumb & Kautz, 2015). Research has indicated that successful professional development is related to practitioners’ beliefs and practices (Desimone, 2009) and matches practitioners’ varying levels of skill, confidence and practice (Chen & Chang, 2012). To date, professional development to support the uptake of digital media has tended to focus on overcoming external barriers such as lack of skills and technical support rather than the personal and professional barriers to integration. Practitioners frequently lack specific understanding of how to integrate digital media into their pedagogy in ways that are appropriate to early learning. Early years pedagogy is often seen as distinct from digital media use and what practitioners value as part of young children’s learning (Marsh, Kontovourki, Tafa, & Salomaa, 2017). Practitioners have yet
to develop their pedagogic skills and expertise to support children's learning with digital media (Plowman, Stephen, & McPake, 2010). Without an understanding of appropriate pedagogy, practitioners may abandon their professional knowledge and adopt didactic practices rather than the interactive and co-constructed approaches to learning based around the primacy of play (Brooker, 2003).

The rhetoric around the use of digital technologies in schools has often focused on its transformative potential with less attention paid to how this might be achieved and the profound changes in classroom practice that may facilitate this transformation. One factor hindering new practices is the lack of research-informed practical examples that practitioners can use to inform their pedagogy. Relatively few studies have focused on direct observations of practitioners using digital media and although this is an emerging field there is a limited number of intervention studies aimed at changing practice (Aubrey & Dahl, 2013) and developing practitioners' knowledge (Evens, Elen, & Depaepe, 2015). If practitioners are to meet the educational challenges presented by digital media they may need to base their judgements of its potential on real experiences and informed personal understanding (Lankshear & Snyder, 2000). Currently, many practitioners do not recognise the potential of digital media in children’s learning and the key role adults play in supporting this learning (Billington, 2016; Flewitt et al., 2014).

Moving beyond the current debate

Outside school, young children are immersed in practices using digital technologies, which have a ubiquitous presence in their lives (Marsh, 2005). As Edwards (2013) argues, the time has come to move beyond the debates for and against young children’s use of technology and accept that there is a generation of children for whom there is no distinction between a camera and a digital camera. Most children entering school have never known a world without mobile digital technology and they spend an increasing amount of time engaging with digital media (Lorraine, 2017). At least 98% of children in the UK live in a household with internet access and 71% of children have access to tablet technology at home (Office for National Statistics, 2017). More than half (52%) of 3-4-year-olds are online and 19% have their own tablet (Ofcom, 2018). Children now arrive at school with varying degrees of understanding of how to use digital media (Lorraine, 2017). However, at times it might seem that at school children are being asked to ‘leave their technology at the door’ (Parette et al., 2010, p. 336) as digital media are less frequently used in early years settings than in out-of-school
settings (op. cit.). The House of Commons Science and Technology Committee (2019) has said there is a ‘pressing need’ for schools to ‘catch up’ and ensure children are equipped with the skills they need to navigate and critically assess what they see and do on screen. To this end, the Committee has called for digital literacy to be an integral part of the curriculum in schools.

The integration of digital media into early years settings remains problematic and we are still no closer to understanding how best to use the diverse devices available to young children (Yelland, 2011). Key skills for life are developed in the early years of education and in a rapidly developing technological world these skills include proficiency in digital media. Practitioners may be ‘missing the boat’ (Parette et al., 2010, p. 335) by not embracing digital technologies as part of early years practice. Early years practitioners have a role to play in supporting and extending children’s digital literacy through providing relevant and meaningful experiences with digital media. Rather than being distracted by concerns over the damage these technologies may, or may not, be doing to children and their impact on children’s education, there is a need to understand how to integrate digital media into early years settings. There is a lack of research that explores how practitioners can support children’s use of diverse devices in early years classrooms in ways that are in tune with their established pedagogies, rather than adopting a primarily skills-based approach as offering little more than specific on-screen activities.

This dissertation reports research that addressed practitioner beliefs about technology and pedagogy in relation to the integration of digital media in the early years classroom. The research draws on a definition of integration taken from the National Association for the Education of Young Children (NAEYC) which describes effective learning with digital media:

Technology and interactive media are tools that can promote effective learning and development when they are used intentionally by early childhood educators, within the framework of developmentally appropriate practice, to support learning goals established for individual children (NAEYC, 2012, p. 5).

Integration requires active mediation by practitioners to support children’s learning with and about digital media. This may be through face-to-face interactions or indirectly through the way practitioners support and plan for children’s use of digital media. What is key in this definition of integration is that practitioners’ actions are intentional and aimed at children’s learning goals rather than unplanned and reactive, and the use of digital media in classrooms should be founded on practitioners’ knowledge and
understanding of appropriate strategies to support young children’s learning and
development. Effective integration of digital media is characterised by practices that
enhance teaching and learning opportunities across all areas of the curriculum
throughout the day rather than technology seen as a separate activity. Effective use of
digital media involves their incorporation into daily classroom routines, including child-
led digital play, practitioner interventions in play that enhance learning, and
practitioner-directed activities.

**Aims of this study**

The aim of this study was twofold. It aimed to contribute to existing literature on digital
media in the early years through a focus on beliefs and their role in shaping pedagogy.
Previous research had established the importance of the link between teachers’ beliefs
and classroom practice (Nespor, 1987; Pajares, 1992) and their choice of teaching
strategies (Ertmer, Ottenbreit-Leftwich, & Tondeur, 2015). However, there is a lack of
research that looks in detail at the relationship between teachers’ pedagogical beliefs
and their uses of digital technologies (Ertmer et al., 2015). This gap in knowledge is
more pronounced in the early years where practitioners’ strong pedagogical beliefs
may act as a barrier to technology use (Plowman, Stephen, & McPake, 2010a). The
research also aimed to add to knowledge of pedagogical strategies to support young
children learning with digital technologies across the curriculum. Existing literature
shows practitioners frequently do not support and extend learning with digital media
and that practitioners struggle to use their pedagogical skills to play an active role in
young children’s learning with and about digital media (Arnott, 2016; Vangsnes &
Ołkland, 2015).

The study reported in this dissertation has two research questions:

- What factors influence the integration of digital media into early years pedagogy?
- What pedagogical approaches reflect effective integration of digital media into early
  years settings?

The methodology of design research was fundamental to the present study, which
sought to address the research questions in collaboration with practitioners. Design
research is therefore an appropriate approach as it involves the design and
implementation of an intervention developed with practitioners in order to enact
change. Through the use of design research, this study aims to make a contribution to
both theory and practice, and provide a robust link between these two critical elements
of effective pedagogy. The significance of this study lies in its combining of theoretical knowledge with understanding about practitioner beliefs and pedagogy through a classroom-based intervention that addressed both beliefs and pedagogy to integrate digital media into an early years classroom.

This dissertation consists of six chapters. The first, introductory chapter describes the background and context of the research and its aims.

Chapter 2 consists of two sections. The first section outlines the socio-cultural view of learning which underpins the theoretical framework of this thesis. Vygotskian and post-Vygotskian scholarship on socio-cultural theory, including activity theory is drawn on, and combined with an ecological model of learning as a way of conceptualizing contexts. The section introduces and discusses the concepts that inform the theoretical framework including tools and signs, mediation, activity systems and the notion of a classroom learning ecology. It also explores the implications of these concepts for teaching and learning with digital media.

Chapter 3 consists of two sections that review published research investigating technology use in early years classrooms. The first section of this chapter introduces empirical literature relating to how digital media is integrated into teaching and learning, and the strategies and approaches adopted by practitioners. The second section discusses factors constraining the uptake of digital media and includes research into early years practitioners' beliefs about pedagogical uses of diverse technologies. The review of published research on pedagogy and beliefs establishes the gap in the field of early years practice with digital media into which this research fits.

Chapter 4 sets out the design of this study and its philosophical underpinnings. The chapter describes the epistemological and ontological assumptions of the research and its axiomatic values. This chapter has sections describing the use of educational design research and the development of the intervention used to investigate effective teaching and learning with digital media. The chapter also describes the research setting and methods of data collection and transcription. It addresses questions of rigour, the role of the researcher and the ethical considerations that arise as part of research with young children. The final section of this chapter details the approach taken to data analysis and describes how activity theory informed the analytical framework that was constructed to ‘make sense of’ the data and develop the themes for the two findings chapters.
Chapters 5 and 6 present the findings of the research divided across two distinct chapters. The first findings chapter contains two sections that describe the process of conducting an intervention to enable digital media integration; its design, implementation and modification over three iterative cycles. Included in this chapter are findings for each phase of the intervention including the pre-intervention baseline assessment of the setting. The second findings chapter is organised in discrete sections that address the intervention effectiveness in addressing constraints found to hinder integration and the characteristics of effective early years practice supporting digital media use.

Chapter 7 relates the findings to the theoretical framework and research literature. The features of effective practice supporting digital media integration are discussed in relation to theory as well as the contexts that influenced children’s learning with digital media. This chapter considers the implications of the findings for classroom practice and theory and includes reflections on the use of design research in this study, its effectiveness in bringing about change and its use as a collaborative endeavour. Finally, this chapter considers the limitations of this study and offers recommendations for future research.
Chapter 2

Theoretical framework for the research

This chapter sets the research within socio-cultural theory, and conceptualises learning as individual cognition mediated by socially and culturally constructed tools and signs (Vygotsky, 1978). Within this framework mediation is both implicit and explicit (Wertsch, 2007). The theoretical framework also draws on activity theory (Leont’ev, 1977) and the notion of a classroom learning ecology (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Gravemeijer & Cobb, 2006) to conceptualise the factors that constitute socio-cultural contexts for learning. The chapter ends with a description of the elements shaping learning in a classroom learning ecology.

A socio-cultural view of learning

Socio-cultural approaches to learning and development are inspired by the work of Russian psychologist Lev Vygotsky. Vygotsky's (1978) theory of human cognition centred on his belief that cognitive development is the result of human interaction in society. This interaction is mediated by the use of socially and culturally created tools and signs; typically language. The belief that the individual constructs the social and at the same time is constructed by the social distinguishes a socio-cultural approach from other ways of viewing cognitive development (John-Steiner & Mahn, 1996). Socio-cultural approaches to learning are based on the ontological belief that there is a relationship between human development and its social, cultural and historical context (Wertsch, 1991). Learning is socio-culturally informed activity that occurs through children’s participation in social practices (Nilsen, Lundin, Wallerstedt, & Pramling, 2016) as the result of which they internalise new ways of thinking and acting. Vygotsky (1978) proposed children could only construct and internalise new knowledge once they had encountered it in a social context. These two key concepts - the social and individual origins of human consciousness and the process of mediation - are central to socio-cultural approaches to human development (Cole, 1995; Wertsch, 1991).

Vygotsky's distinctive approach to human development and his theory of the social formation of mind relied on the concept of mediation. ‘Mediation is the central fact of his [Vygotsky’s] psychology’ (Wertsch, 2000, p. 19) and his view of ontogenesis (Daniels, 2015b). The focus of Vygotsky’s research and writing lay in exploring the relationship between social language used for communication (words) and individual
thought (Bakhurst, 2007). Mediation was the means by which Vygotsky argued that a child's individual cognitive development is related to the social and cultural contexts in which learning takes place. The concept of mediation explains the process by which humans internalise new ways of thinking. Humans do not passively receive culture, but they exercise individual agency when they use a concept or technique (Bakhurst, 2007). Tools, and signs such as language, do not mediate activity until they are internalised as psychological tools (Vygotsky, 1978) and actively employed by individuals to shape their actions. Human behaviour and activity is shaped by what we know (Edwards, 2011) and humans actively and individually construct and internalise new ways of thinking and behaving by interacting with them in social environments. Through the process of externalization new ways of thinking can be used to identify and solve new problems (John-Steiner & Mahn, 1996). It is not just participation in social activity that is key to cognition, but individual construction of meaning that results from that participation and allows humans to master their physical environment. It is through the process of mediation that the social and the individual mutually shape each other (Edwards, 2011).

Since the time Vygotsky's work was first published in the West his writing has often been read as foregrounding the social nature of cognitive development through human engagement in social practices mediated through the use of cultural tools (Bakhurst, 2005) rather than 'events in individual minds' (Bakhurst, 2007, p. 55). Bakhurst (2005) argues that this reading of Vygotsky overemphasizes the importance of enculturation at the expense of material interaction with the environment. Vygotsky's stated desire to produce a Marxist psychology, the need to remain within the political boundaries of the rise of Stalinism and the fact that much of Vygotsky's work was preserved by his former colleagues, who themselves worked in an environment where his work was banned, have influenced the way Vygotsky's work is read and understood. As a result, Vygotsky's emphasis on individual construction of consciousness through interaction with the physical environment has often been overshadowed (Bakhurst, 2005).

**Tool and sign in mediated learning**

Vygotsky's research and writing sought to investigate the process of learning and the mediators humans use (van der Veer & Valsiner, 1994). His experiments frequently studied children using external tools and signs to solve problems and understand how they actively constructed new conceptual understanding through the use of mediation. Vygotsky's (1978) proposal that all human activity, both psychological and physical, is
mediated, relied on the use of cultural artefacts in the form of tools and signs that evolve over time in different cultures and societies. Tools and signs are imbued with meaning and value through their use in human activity (Daniels, 2015b) and by being used for a particular reason in a certain way (Cole, 2005). The concept of a ‘cultural tool-kit’ (Wertsch, 1991) created by society changes the way humans think and use thinking to solve problems. Tools and signs can be both material and conceptual (Cole & Scribner, 1978) and mediation applies equally to objects and people (Cole, 2005). Humans create mediators to assist the way they interact with their social worlds (Edwards, 2007) and mediators can be adapted and developed as problem-solving tools (Engeström, 1999). The use of tools and signs to mediate behaviour changes the nature of the processes of development in a fundamental way; it enables humans to go beyond what they might be capable of individually (Wertsch, 1981). Vygotsky’s proposal of ‘word meaning’ as the unit of analysis points to his prime interest in the developmental relationship between inner speech (thought) and external or social speech (words) in cognition (Vygotsky, 2012). Children construct new meanings through their experience of speech in social contexts and these meanings take on the form of internal speech that can be used for individual problem-solving. The meanings of mediators and how they are used will vary according to different socio-cultural contexts in which they are encountered and the same mediator may have different meanings. For example, the meanings attached to a saw will vary depending on whether it is being used by a surgeon or a carpenter.

The use of tools and signs combines in human activity so that external social activity results in internal mental activity: ‘We can use the term higher psychological function, or higher behaviour as referring to the combination of tool and sign in psychological activity’ (Vygotsky, 1978, p. 55). Although Vygotsky (1997) linked the notion of tools and signs through their combined function in mediating human behaviour there is a ‘profound difference between the one and the other’ (Vygotsky, 1931, p. 60). In spite of Vygotsky’s ‘shifting’ view of tools and signs (Daniels, 2015a), crucially they act differently to change behaviour and have different functions.

the tool … is directed outward, it must result in one change or another in the object, it is the means for man’s external activity directed towards subjugation of nature. The sign …is a means of psychological action on behaviour, one’s own or another’s, a means of internal activity directed towards mastering man himself; the sign is directed inward. These activities are so different that even the nature of the devices used cannot be one and the same in both cases. (Vygotsky, 1997, p. 62)
Humans create tools to manipulate the world while signs manipulate behaviour (Bakhurst, 2005). Whereas tools act outwardly to change the way humans act, signs or psychological tools act inwardly to change the way they think. There is, therefore, a fundamental difference between Vygotsky’s concept of tool and sign and the way they function in human cognition. Through the use of tools and signs humans actively change their environment (ie nature) so as to create new mediators. The relation between the environment and humans is never unidirectional but constantly mediated by tools and signs (Bakhurst, 2005). A tendency to focus on the external mediation of adult/child interactions and collaborative problem-solving (van der Veer & Valsiner, 1994) is partly related to the need to consider how any reading of Vygotsky’s work has to be undertaken with an understanding of the potential problems caused by reading anything in translation (Daniels, 2001). Vygotsky uses the Russian word *obuchenie* to refer to the relationship between adults and children in learning and the way in which adults orchestrate that learning (Cole, 2009). *Obuchenie* has no equivalent word in English, and Cole (2009) argues that translations are frequently ambiguous in its being differently translated as teaching or instruction. Implicit in these translations are transmission models of pedagogy. A more appropriate translation would be the two-way process of teaching and learning (Cole, 2009) or ‘all the actions of a practitioner in engendering cognitive development and growth’ (Daniels, 2001, Chapter 1, Translation and transformation). In this way Daniels links Vygotsky’s view of development to pedagogy and all the actions practitioners take that have an impact on children’s learning. Translations of *Obuchenie* as a two-way process also point to Vygotsky’s concern with the process of learning and the role of external mediation, rather than explicit teaching.

**Explicit and implicit mediation**

Vygotsky’s concept of mediation underwent significant development, from his early focus on tools as mediators of external activity, towards the use of semiotic sign systems to organise internal thought (Bakhurst, 2005). Wertsch (2007) proposes two types of mediation - explicit and implicit - as a way to understand the different ways Vygotsky used the concept of mediation throughout his lifetime. The different types of mediation described by Wertsch (2007) also explain the developmental relationship between thought and word. Explicit mediation occurs when a tool or sign is artificially and purposefully introduced into an activity to mediate development. Examples of explicit mediation include practitioners introducing a new concept during a lesson or the provision of a tool that enables a child to complete an activity or task. Explicit
mediation is needed as a way of introducing new ways of thinking and acting, leading to their use as implicit mediation in the process of learning. Wertsch (2007) describes implicit mediation as the use of spoken language that is typically ‘transitory and ephemeral’ (op. cit. p. 184). Implicit mediation is predicated on a shared understanding of words and their meanings related to particular contexts of use. The combined use of thought and word is evidence of implicit mediation as it is not the word/s alone that mediate, but what is understood by their use in a particular context. Implicit mediation also refers to the ‘unconscious, unreflective, or transparent use of tools’ (Hilppö, Lipponen, Kristiina, & Rajala, 2016, p. 3). Examples of implicit tool mediation can include the use of a knife to cut food or changing gears when driving. Implicit mediation can also refer to the social institutions in which humans act (Daniels, 2015b) that are ‘transformed through the actions of those whose transactions are transformed by them’ (Daniels, 2010, p. 107). The use of implicit mediation may not be visible, and may be sub-conscious, but it influences human action, as does explicit mediation. Daniels’ view of implicit mediation extends its use to refer to the social contexts in which learning takes place. This points to the need to consider the socio-cultural contexts in which humans act and the impact on learning and development as forms of mediation.

Vygotsky’s (1978) central thesis demonstrated the link between the social and the individual in human cognition, but he did not address the way in which different socio-cultural contexts and the way people act in them may construct the individual differently. He had not begun to explore how and why the process of learning may vary across different settings and the nature of the relationship between mental processes and the socio-cultural setting (Wertsch, 1995). Although there are indications Vygotsky was moving towards the idea that contextually situated practices may be related to cognitive development there is no evidence of this in his writing (Wertsch & Tulviste, 1996). Daniels (2015a, 2015b) argues Vygotsky’s development of socio-cultural theory does not adequately explain how learning emerges in relation to the social institutions in which it takes place. Human cognition is a dual process of shaping and being shaped through culture. Different social and cultural environments develop different ways of thinking and these ways of thinking impact the construction of social institutions as means of mediation.

There are explicit and implicit elements mediating teaching and learning which shape practitioners’ and children’s actions in different learning situations. Learning is therefore inextricably linked to the contexts in which it takes place and how humans behave in
those different contexts. It is not possible to isolate individual human action from the social contexts in which it takes place. The corollary to this is that human cognitive development is best studied in the contexts in which it takes place in order to understand how learning and development occur within particular socio-cultural contexts and how mind and world shape each other (van der Veer, 2007). In other words, it is crucial to understand how and why humans act in different environments, and how individuals actively construct these environments as socio-cultural contexts through their actions. However, Vygotsky did not provide a way to conceptualise the contexts in which humans act and understand how they are constructed. Daniels (2015b) goes so far as to argue that Vygotsky ‘failed’ to consider the social systems in which human consciousness develops, and that he does not provide a way to constitute those contexts and visualise the elements that are factors in the way humans act in particular social worlds. Nor does Vygotsky appear to give individuals a role in the active creation of their social worlds through their interaction with the factors constituting different socio-cultural contexts. As a result, there has been a tendency to focus less on the impact of social institutions and how the factors constituting them may mediate teaching and learning in the classroom.

**Social institutions mediating learning**

Leont’ev’s (1977) formulation of activity theory provides a way to extend Vygotsky’s socio-cultural formation of mind to consider the ways social institutions mediate learning and how those who work in institutions actively construct and are transformed by them (Daniels & Edwards, 2010). Leont’ev viewed human activity as the basic unit of analysis to understand individual actions within their social environment. By focusing on the difference between individual actions and collective activity, Leont’ev (1977) demonstrated how the same actions can have different meanings depending on the activity and socio-cultural contexts of activity. Using activity as the unit of analysis avoids the individual-society antinomy and the related paradox between mind (cognition) and world (socio-cultural context) by focusing on human action as a whole rather than the individual or the context in isolation of one another (Wertsch, 1995). The aim of activity theory is to understand how learning takes place within complex systems of interacting relationships between individuals and their social environment.

Different approaches to activity theory, for example, cultural historical activity theory (CHAT), and Engeström’s (1987) concept of activity, reflect different emphases on Vygotsky’s work (Edwards, 2001). CHAT emphasizes the contexts of learning and
recognises that teaching and learning is intertwined with the contexts in which it takes place and the institutional constraints and affordances shaping how children and practitioners act. Engeström’s (1987) model of activity theory places a greater emphasis on an interventionist approach with a view to enacting change (Sannina, 2015). Activity theory is an ‘accommodating framework’ rather than a neat set of propositions (Roth & Lee, 2007) and different approaches are unified by a focus on human activity. Given the socio-cultural framework of this research and the use of an intervention to enact change (and because the distinction between the two approaches to activity theory is becoming blurred (Daniels, 2001; Kaptelinin & Nardi, 2006)), this dissertation does not distinguish between the different approaches. The intention is to use activity theory to analyse the relationship between key elements that influence different pedagogical approaches, and understand the impact of this relationship on children’s learning. Activity theory is a way to study the use of mediation in action as mediators may be defined and used differently in different contexts resulting in different kinds of activity.

Activity is a pre-condition for human thinking and often leads to the creation and use of cultural artefacts that mediate activity. Whereas Vygotsky (1978) focused on the process of mediation and humans’ use of artefacts, activity theory considers the person or people undertaking activity, the contexts in which they act and the direction of actions in addition to the use of mediation. Activity theory also demonstrates how ‘the activity of the human individual is a system that obeys the system of relations of society’ (Leont’ev, 1977, p. 3). Human activity can shape society, but individual actions remain within the boundaries constructed by society and history. Leont’ev’s conceptualisation of activity shifts the focus of mediated action to the contexts in which that action takes place. Individual actions are conceptualised as part of a larger pattern of activity in order to understand the role they play in the overall activity. Mediated action is a key ontological entity in socio-cultural theory (Bakhurst, 2005) and all activity is made up of actions (Leont’ev, 1977). Leont’ev distinguishes between activity and actions and argues that ‘one and the same action may realise various activities’ (Leont’ev, 1977, p. 7). A series of actions such as selecting a book, taking it off a shelf and giving it to another person can have different meanings depending on the object of the activity and its motive, which can be mental or ideal. The crucial difference between action and activity is that activity has a motive. This distinction means that a ‘chain of actions’ can have different meanings until they become part of socio-cultural activity and are directed towards the same motive. The distinction drawn by Leont’ev (1977)
between action and activity can be used to understand the different social and cultural contexts in which learning takes place and how these contexts mediate learning.

Humans control their individual actions based on the social use of tools and signs developed historically over time to mediate activity. Within this view of activity, learning is ‘a relatively permanent change in the way action is achieved as the result of prior experience’ (Chaiklin, 2015, p. 96). Learning is therefore the result of the activity, context and culture in which it occurs. It is not possible to separate what children learn from how they learn (Brown, Collins, & Duguid, 1989) or to separate what and how children learn from the contexts in which learning takes place as ‘man is not only a product of his environment, he is an active agent in creating that environment’ (Luria, 1979, p. 43). Hence the need to conceptualise classrooms as the socio-cultural contexts in which teaching and learning takes place. The view that how and what children learn is inextricably linked to where that learning takes place means considering how the contexts for teaching and learning are constructed by those acting in them (Luria, 1979).

**Dynamic social learning systems**

Leont’ev (1977) conceptualised contexts for learning as dynamic systems in which human activity is underpinned by the relationship between the person undertaking a series of actions (the subject), the means of mediation and what the subject does and why (the object motive). All human activity is unique as it meets the need of an individual acting in a particular context, and is directed towards solving a problem which is defined by the object-oriented goal of activity (Leont’ev, 1977). Although tools and signs are imbued with certain social and cultural meanings, these meanings do not come to the fore until mediators are used as part of human activity. The use of particular mediators then shapes activity and the actions taken in pursuit of that activity (Wertsch, 1991, 1994). Hence the need to consider how the choice of mediators shapes human activity and the interrelationship between socio-cultural contexts and individual action. Subjects define the object of activity and the mediational means by which it is achieved and are motivated by a particular concern or problem (Roth & Lee, 2007). In defining the object of activity the subjects draw on their cultural references and understandings of the nature and purpose of the ‘chain of actions’ that comprise human activity.
A key concept in activity theory is the relationship between object and motive as the object of activity brings together motives, goals and social contexts (Edwards, 2011). Leont’ev described this relationship:

The main thing that distinguishes one activity from another, however, is the difference in their objects. It is exactly the object of activity, that gives it a determined direction. According to the terminology I have proposed, the object of activity is its true motive. (Leont’ev, 1979, p. 17)

Motives are the reason subjects are part of the activity: why they have chosen a particular means by which to achieve their object. Although the object of activity may be the same between subjects, their motives can differ as they have different reasons for wanting to take part in an activity. Motives are socially constructed (Jacob, 1995) according to what matters to subjects. Leont’ev (1977) refers to the object of activity as its motive hence the use of the term ‘object motive’ (Edwards, 2011) to describe the object of activity as this encompasses the idea of object oriented motives. If human activity is distinguished by the establishment of motive then it becomes important to understand how those motives are constructed by the subject’s relationship to different social and cultural factors and the impact of these factors on how activity is achieved.

Analysis of cognition needs to extend beyond the individual to view individuals as one of the dynamic elements in learning and development. Consideration of the motive can also take into account the constraints on an activity and how those constraints may affect its outcome (Kaptelinin, 2005). Socially constructed motives may hinder as well as encourage activity depending how those motives are constructed through the use of mediation.

The dynamic relationship between socio-cultural contexts and those participating in them can be viewed through Engeström’s (1987) heuristic of an activity triangle (see Figure 2.1). An activity triangle is a way to analyse the relation between different elements of social environments and how they are constituted by human activity. The nodes on an activity triangle represent the subject/s undertaking the activity, their object motive and the means of mediation. Subjects taking part in an activity realise the overall object or motive in different ways through their choice of mediation. The nodes on the bottom of an activity triangle place the subjects in the wider socio-cultural context or community in which they act and the actions taken as part of that community. Rules determine how and why people act and reflect historical role expectations. The division of labour is the distribution of actions and operations between participants in activity. Subjects may give individuals more or less opportunity
for participation and therefore shape activity according to their object motive. The arrows in an activity triangle indicate dynamic relationships between its elements.

There are limitations to the activity system model particularly as the rules and division of labour are not defined (Bakhurst, 2009). Bakhurst’s (2009) critique of activity theory also suggests that although the points of the triangle are joined by lines, there is no indication what these lines represent. One of the strengths, and possible weaknesses, of using activity theory is that it can be used with a number of other methods of enquiry. However, the activity triangle can be seen and used pragmatically as a tool to understand and bring into view the complexities of the interactions being studied. An activity triangle is particularly relevant when a phenomenon is not easy to capture using more traditional social science methods. This could be because a phenomenon is part of a complex system and in part because it involves a ‘rich human texture’ (Bakhurst, 2009, p. 206).
Activity theory shifts the focus of human development from either the individual or the social and views socio-cultural contexts as a dynamic interaction between subject, object and means of mediation. However, defining the factors that may constitute those contexts is problematic as, ‘there is no consensus about what to focus on for a sufficient study of context’ (Griffin, Belyaeva, Soldatova, & The Velikhov-Hamburg Collective, 1993, p. 123). From a socio-cultural perspective contexts are self-constituting and in a constant state of flux. They are resourced and constituted through interaction, artefacts and physical settings. Contexts emerge through humans actively changing their environment so as to create new tools that mediate shared understanding (Bakhurst, 2005). They are not static but bound up with activity and the processes that are part of activity (Pettigrew, 1990). Contexts are ‘a production of action and vice versa’ (op. cit., pg. 270), as human action actively forms and is formed by socio-cultural contexts. Although activity theory is a lens through which to view the
dynamic relationship between interacting elements of human activity it does not provide a satisfactory way to conceptualise the slippery notion of contexts and what constitutes them. In this dissertation, therefore, the flexible approach of activity theory (Daniels & Edwards, 2010) is combined with the idea of a classroom learning ecology (Cobb et al., 2003; Gravemeijer & Cobb, 2006). Cobb et al (2003) use the term ‘learning ecology’ to indicate the way in which there are several ‘systems’ that interact in the ‘messy’ classroom environment. The contexts in which learning takes place are never straightforward but a complex web of factors all of which impact on children’s learning. Combined with activity theory the idea of a classroom learning ecology is a way to visualise and define the contexts in which learning takes place. Understanding and analysing the classroom learning ecology as contexts for learning is relevant here given the complexities of the different and interacting elements that function together to support learning in an early years setting. The concept of a classroom learning ecology makes it possible to account for those factors.

The term ecology derives from Bronfenbrenner’s ecological model (Plowman, 2016) and from its origins in the Greek word oikos meaning house or household, ecology has come to refer to the branch of biology that deals with relationships between living organisms and their environment (Oxford English Dictionary, 2018). The concept of a learning ecology can, therefore, be used to describe the relationship between classroom environments and the children and adults that operate in them. Plowman (2016) argues frequent use of the term ecology mistakenly suggests the pre-existence of common factors to take into account. Hence the need to define the concept of ecology and the factors pertaining to it as a way to conceptualise the socio-cultural contexts for learning described in this dissertation. While Bronfenbrenner (1979) describes a set of ‘nested structures’ that influence child development at different levels including home, family, the local community, school and wider influences, the concept of a classroom learning ecology used in this study focuses on the local factors underpinning approaches to teaching and learning (Gravemeijer & Cobb, 2006). Local factors are shaped by wider national and international influences on how education is structured and organised. ‘The learning ecology accounts for the learning process of students’ (Gravemeijer & Cobb, 2013, p. 95) and its use in this dissertation provides a frame of reference that can be used when describing the learning process and what shaped it at different stages of the research. Elements of a learning ecology typically include:

- the tasks or problems that students are asked to solve,
- the kinds of discourse that are encouraged,
- the norms of participation that are established,
- the tools
and related material means provided, and the practical means by which classroom practitioners can orchestrate relations among these elements (Cobb et al., 2003, p. 11).

Cobb et al’s, (2003) description of a learning ecology accounts for the key elements in this research; the process of teaching and learning with digital media and the factors mediating the integration, or lack thereof, of digital media into an early years classroom. The classroom learning environment takes into account practitioner beliefs and practitioners’ pedagogical skills in making the whole system work (Gravemeijer & Cobb, 2006).

The factors constituting a learning ecology are the variables in an intervention designed to influence practice: a change in one or more of the variables will have an impact on learning. Unlike research with a quantitative design these variables cannot be controlled but have to be accounted for when coming to an understanding of a classroom learning environment and the elements that interact within it to create the social worlds in which learning takes place. The idea of an ecology emphasizes that designed contexts are conceptualised as several interacting and shifting factors rather than a list of separate elements (Edwards, 2016). The description of a learning ecology emphasizes that we are dealing with a complex, interacting system involving multiple elements of different types and levels (Gravemeijer & Cobb, 2006, p. 47–48). This complex matrix of factors shapes children’s classroom experiences (Arnott, 2016). The notion of a classroom learning ecology enables an examination of how individual elements may change with the introduction of new practices and resources and what might make the integration of these practices and resources possible in other contexts. Conceptualising socio-cultural contexts through the lens of a classroom learning ecology is a way of interpreting what is happening in the classroom and what might be changing. Analysing the factors that constitute a classroom learning environment also helps to account for elements which might hinder or support change and the way they interact as part of any process of change. In this dissertation the heuristic of an activity triangle (Engeström, 1987) is used to map the relationship between digital media activity and elements of a learning ecology. Figure 2.2 shows the relationship between beliefs, pedagogy, and practice and how these three elements mediate and construct the contexts in which learning takes place through their relationship to subjects and the object motive.
Figure 2.2: Engeström’s (1987, p. 78) model of an activity triangle showing elements of a classroom learning ecology in red

**Visible and invisible elements of a classroom learning ecology**

The conceptualisation of a classroom learning ecology used in this dissertation suggests there are visible and invisible factors that explicitly and implicitly mediate (Wertsch, 2007) the use of digital media in a contemporary early years classroom. Explicit elements of a learning ecology are the visible ways in which practitioners organise learning. This organisation of learning includes: the physical layout of the classroom; the position of resources and the ease with which they can be accessed by children; classroom activities and experiences organised by practitioners, and the extent to which learning may be supported or hindered by different kinds of interactions. Practitioners also explicitly influence learning through their planning and management of classroom routines and different approaches to organising teaching and learning. Elements of a learning ecology also contribute to establishing the social
norms that implicitly influence behaviour in the classroom. Social norms are patterns of behaviour within the classroom that ‘become instantiated through a process of mutual negotiation between practitioner and pupil’ (Gravemeijer & Cobb, 2013, p. 88). Distal and face-to-face interactions with children and the way digital media are constructed as tools to support learning (Hicks, 2003) establish patterns of behaviour. Norms will differ according to the ways practitioners approach teaching and learning in different curriculum areas, and the extent to which practitioners support or constrain children’s activities and use of different resources. Classroom norms also relate to practitioners’ and children’s beliefs about their own and others’ roles in the classroom. Children act according to the way they understand and experience the actions of others (Hicks, 2003). Social norms affect learning as it occurs in the social world of the classroom and are an important factor when developing a socio-cultural understanding of learning.

Norms related to child and adult perceptions and beliefs about what counts as learning establish the classroom discourses that are part of the learning ecology (Arvaja, 2011; Gravemeijer & Cobb, 2013; Hicks, 2003). This discourse defines what counts as learning with digital media, the types of learning they support, and the extent to which digital media learning is valued within the wider discourses mediating practice. Beliefs about young children’s learning and development place practitioners within a discourse of early years pedagogy and practice that reflects their ideologies and systems of values. Practitioners act in accordance with the particular practices, customs and presumptions that surround early years practice. Being part of a particular discourse means accepting these assumptions and acting in accordance with them (Ljung-Djärf, Åberg-Bengtsson, & Ottosson, 2005). There may be different practices in different settings depending on the local discourse created by practitioner beliefs (op. cit.).

In this dissertation, the early years discourses shaping practice are viewed as cultural artefacts that mediate human thought and action (Daniels, 2011). Even though they may do so unintentionally, practitioners’ ways of thinking and the beliefs associated with them implicitly shape the actions that support or hinder children’s learning. Practitioners actively create contexts for learning by their beliefs and the way beliefs are externalised in the form of different approaches to organizing teaching and learning. The integration of new resources such as digital media is linked to the prevailing discourses that mediate practitioners’ actions. The use of digital media also creates a classroom discourse which reflects the way contexts are constructed by those acting in them: people construct and are constructed by the contexts in which
they act. The way people act defines the contexts in which learning takes place, therefore, it is necessary to consider not only how people act, but how their actions may influence others visibly and invisibly. Conceptualising contexts as a classroom learning ecology is a way to bring into view practitioner beliefs, pedagogy and practice, and the norms and discourses they establish, as key elements in children’s learning. A consideration of practitioner beliefs as part of a classroom learning ecology is crucial when there are strong beliefs surrounding early years pedagogy and the use of digital media with young children (Ingleby, 2016).

**Summary**

The socio-cultural view of learning framing this research suggests that children’s learning is an individual construction within a social world. The concept of mediation is central to a socio-cultural view of learning, and to explaining how individual learning is dependent on the use of tools and signs developed over time in different cultures and societies. The idea of explicit and implicit mediation is used to understand how different forms of mediation shape human action in different learning contexts. Activity theory addresses how learning emerges in relation to the socio-cultural contexts in which individuals act and how contexts for learning are constructed by human actions. The important concept of ‘activity’ is used to conceptualise the way contexts for learning consist of several dynamic and interacting factors. Activity theory is therefore adopted as a way to view the complex relationship between practitioners, children and the classroom factors that mediate learning. The heuristic of an activity triangle is used to visualise the complex relationship between socio-cultural contexts, the individuals acting in them and their use of mediation. Finally, activity theory is combined with the idea of a classroom learning ecology to conceptualise the elements of an early years classroom constituting contexts for learning in this research, and to introduce the norms and discourses that influence human behaviour in different contexts. Mapping elements of a classroom learning environment to an activity triangle enables the visualisation of the dynamic relationships between the multiple factors that shape learning with digital media. These factors constituted the socio-cultural contexts for learning which mediated how the children and practitioners in this study behaved.
Chapter 3

A review of literature

This chapter consists of two sections: 1. a review of published literature on the integration of digital media, and 2. the barriers to digital media uptake. The first section adopted a systematic approach to: identify what empirical evidence exists about the integration of digital media into early years classrooms and the approaches practitioners adopt; identify gaps in published research investigating practitioners’ pedagogical interactions using digital media with children aged under 4 years. In the second section, barriers to the uptake of digital media in early years classrooms are discussed, focusing on practitioner beliefs.

Search strategy

The review of empirical research into digital media integration conducted for this dissertation was underpinned by a systematic approach that limited the search to literature published between January 2000 and December 2017. Although this time frame overlaps with earlier reviews (Burnett, 2010; Kontovourki, et al., 2017; Lankshear & Knobel, 2003) this was considered necessary in view of the need to focus on practitioner interactions and the strategies and approaches adopted to integrate digital media into teaching and learning. Previous reviews (Burnett, 2010; Kontovourki, et al., 2017; Lankshear & Knobel, 2003) do not focus on practitioner interactions and have drawn out different themes from the reviewed literature. In common with these earlier reviews, the systematic approach adopted for this dissertation was used to identify literature and consider as many relevant studies as possible. Systematic review is a rigorous tool allowing published evidence to be collected and summarised while identifying gaps in existing research. Such reviews are selective, but selection is set within carefully defined criteria (Davies, 2000). Systematic review makes it possible to generalise the knowledge produced by several studies (Davies, 2000). Although not a formal systematic review, the review described here uses some of the methods familiar to this type of research synthesis, including defining the search aims and strategy, quality assessment, and synthesis (Davies, 2000; EPPI-Centre, 2010; Gough, Oliver, & Thomas, 2012).

The search strategy aimed to identify papers related to the use of all forms of technology by children aged 0-6 years in formal learning settings. Although 0-5 years is
the age at which children in England are considered to be part of the early years foundation stage, in many of the reviewed studies the early years of education extended to 6 years old. Hence the view of early years settings adopted for the purposes of this review was one which referred to educational settings in which children aged 0-6 years engage in planned activities and free play. The review focused on play-based pedagogies as opposed to the broader concept of child-centred pedagogy which does not rely on learning through free play. Following models for conducting systematic reviews suggested by the EPPI-Centre (2010) and Gough et al. (2012), the search strategy used several stages of screening.

The first stage defined the aims and scope of the review and identified the search terms as well as inclusion and exclusion criteria. Quality of research was addressed by searching for papers in peer reviewed journals. At this stage of the review process the following search terms were identified: young child, early childhood (abbreviated to child), education, kindergarten, digital, computer and technology in abstracts. The search terms were selected based on the research questions guiding this research and a knowledge of the field. The selection of terms aimed to strike a balance between sensitivity (finding all articles on a topic) and specificity (finding only the relevant ones).

In the second stage of review the selected online databases were searched using combinations of search terms shown in Error! Reference source not found. applied to titles and abstracts. At this stage, the exclusion criteria shown in Table 3.1 were applied to more than 800 abstracts to further narrow the selection to ensure the identification of papers directly relevant to the review. This process identified a total of 102 papers which were retrieved for further reading of the whole article to identify their relevance. The references of these papers were also reviewed to determine further articles suitable for inclusion. This produced an additional 23 papers (see Appendix 1 for full list of papers retrieved). The final review process generated a total of 28 papers reporting data for 26 separate studies related to practitioners’ use of digital media with children aged 0-6 years. Only two studies (Plowman & Stephen, 2005, 2007; Roberts-Holmes, 2013) focused on findings related to practitioner interactions with 3-4-year-old children using digital media. While not proclaiming to be a definitive list the articles reviewed are representative of the body of literature detailing the ways in which early years practitioners integrate digital media into teaching and learning.
Table 3.1: Search strategy used to identify studies for review

<table>
<thead>
<tr>
<th>Search terms used</th>
<th>Exclusion criteria applied</th>
<th>Databases searched/source of papers</th>
<th>No of full papers retrieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>technology+education+young child</td>
<td>• investigating practitioner beliefs</td>
<td>British Educational Index</td>
<td>75</td>
</tr>
<tr>
<td>computer+education+young child</td>
<td>• children older than 6 years</td>
<td>Proquest</td>
<td>18</td>
</tr>
<tr>
<td>digital+education+young child</td>
<td>• did not include digital media</td>
<td>Australian Educational Index</td>
<td>4</td>
</tr>
<tr>
<td>technology+education+early child</td>
<td>• quantitative study of the impact of specific apps or games</td>
<td>Education Resources Information Center (ERIC)</td>
<td>3</td>
</tr>
<tr>
<td>computer+education+early child</td>
<td>• no findings reported for practitioners’ interactions</td>
<td>Wiley Online Library</td>
<td>0</td>
</tr>
<tr>
<td>digital+education+early child</td>
<td>• studies of children with additional needs</td>
<td>Sage Journals</td>
<td>2</td>
</tr>
<tr>
<td>technology+education+kindergarten</td>
<td></td>
<td>References</td>
<td>23</td>
</tr>
<tr>
<td>computer+education+kindergarten</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>digital+education+kindergarten</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>125</td>
</tr>
</tbody>
</table>

Published literature on digital media integration

The review conducted for this dissertation adopted a similar search strategy to earlier reviews of research in the field by Lankshear & Knobel (2003), Burnett (2010) and Kontovourki et al. (2017). Using these reviews as a starting point helped to provide continuity and identify gaps into which the current research could fit. The authors of each of these reports conducted rigorous reviews of technology use in early years settings with clear statements of their search methodology. All three reviews used a systematic approach to conducting a search using electronic databases and a combination of search terms. The reviews considered research with children aged 0-8 years and focused on the use of all forms of digital technology to support literacy and digital literacy development. The term digital literacy can be an ambiguous one and describes the technical or operational skills needed to access and use digital technologies as well as the social, creative and critical skills children engage with through their use of digital technologies. The broader view of digital literacy as a social practice (Sefton-Green, Marsh, Erstad, & Flewitt, 2016) acknowledges the range of digital practices children engage with through their use of digital media.

Despite their focus on literacy these three reviews are included here because the findings relate to digital media use in early years settings. Although conducted several
years apart, reviews by Lankshear and Knobel (2003) and Burnett (2010) drew remarkably similar conclusions. Both comment on the paucity of research with children under 5 years old and the prevalence of studies in which digital media supported traditional literacy learning with pre-packaged games and programs. The papers reviewed by Lankshear and Knobel (2003) and Burnett (2010) frequently viewed digital media use as a way for children to develop and practice cognitive skills and concepts associated with print reading rather than adopting a wider view of digital literacy described by Sefton-Green et al. (2016). Of the 36 papers reviewed by Burnett (2010), only 11 conducted research with children under 5 years old and 23 investigated computer programs to support the development of print literacy. The majority of the studies in both reviews had a quasi-experimental design and few explored children's interactions around digital texts and the role of practitioners.

The conclusions and recommendations of Lankshear and Knobel (2003) and Burnett (2010) form the background to a review of literature by Kontovourki et al. (2017) who reviewed papers published between 2000-2015. The review conducted as part of the EU-funded COST Action ‘DigiLitEY’ project focused on young children's practices in early years settings, schools and informal learning spaces for children aged 0-8 years. Kontovourki et al. (2017) reviewed 126 papers grouped into three categories. One of these categories was related to practitioners' pedagogical practices, and, therefore, this review had a greater focus on practices related to teaching and learning with digital media in early years settings than previous reviews by Lankshear and Knobel (2003) and Burnett (2010). A comparatively large number of the papers reviewed by Kontovourki et al. (2017) focused on children's engagement with digital media rather than the ways in which practitioners interact to facilitate children's development of digital skills and knowledge. The review confirmed the conclusions drawn by Lankshear and Knobel (2003) and Burnett (2010) in asserting that there was a comparatively large number of studies in which digital media was portrayed as facilitating literacy rather than other areas of the curriculum including children's wider social and communication development.

The above-mentioned reviews cover a broad age range from 0-8 years old and do not separate out different age groups. The reviews identify a lack of published research

---

3 The spelling program is used to refer to computer programs.
4 DigiLitEY is an interdisciplinary network established to advance understanding and create a research agenda focusing on children aged 0-8 years and their digital literacy and multimodal practices in formal and informal education settings.
with children under 5 years old and research showing the ways practitioners in early years settings support and facilitate children's use of digital media and their digital literacy development. To date, research has tended to focus on outcomes for children and 'says little about practitioners and learners as practitioners per say - that is their pedagogical roles and performances' (Lankshear & Knobel, 2003, p. 78). This need for research into effective pedagogical approaches persists and Kontovourki et al. (2017) conclude that 'pedagogical and content knowledge emerge as most important types of knowledge that are influential for digitally rich learning environments' (op. cit. p. 31). Practitioner knowledge of digital media is important, but this has to be combined with effective pedagogy to integrate diverse digital technologies into different aspects of young children's learning and the EYFS curriculum.

The review of literature conducted for this dissertation produced studies primarily of a qualitative nature, and many investigated the use of a broad range of technologies rather than specific digital media (see Appendix 2 for a summary of papers included). Although most collected interview and observational data, few studies focused on practitioners using digital media with children. Only a handful of studies used interventionist approaches to research, including action research. Studies were mainly generated in the UK with a small number of studies conducted in the USA, Sweden, Norway, Australia and Greece. This was largely due to a need to limit the search to literature published in English. However, it is interesting to note the proportionately high number of studies conducted in Sweden and Norway which have traditionally had a strong early years sector founded on principles of learning through play. The review conducted for this dissertation identified four themes: 1. lack of planned practitioner interactions in children's digital media use, 2. pedagogical challenges in supporting digital play, 3. practitioner directed teaching with digital media, and 4. ecological factors influencing digital media integration.

**Lack of planned practitioner interaction**

A small number of studies included observations of practitioners’ interactions with children using digital media as part of their play. Table 3.2 summarises data from seven studies detailing the roles practitioners typically adopted. These roles range from practitioner ‘absence’ from children’s digital media use to interactions that actively support and encourage learning beyond the objectives embedded in educational games and software. These seven studies show early years practitioners frequently do
not play an active role in children’s use of technology during play and their infrequent interactions are rarely planned.

Investigating how a wide range of technologies was incorporated into free play and adult-led activities, Plowman & Stephen (2005) included observations of practitioner interactions with children using a desktop computer (PC). This study was conducted in seven nursery settings (3-4 years old) adopting a child-centred approach and children’s free choice of play. Practitioner interactions were most often to manage access or teach operational skills. The most commonly observed interaction was ‘reactive supervision’ whereby practitioners managed children’s access to the PC. This included turning the PC on, checking on children’s turn taking and intervening to solve problems with the technology rather than problems with children’s use of the games. Plowman and Stephen (2005) argue that reactive supervision cannot be described as a pedagogical strategy given its unplanned nature. Practitioners were not observed contributing to play or learning with the PC, and they found it difficult to articulate any learning that took place during reactive supervision. The authors found that although practitioners felt children would benefit from a structured introduction to the PC, they did not know how to do this in a free play environment. Not only was practitioner support to scaffold learning notable by its absence, but practitioners did not feel they had the skills to record learning with computers partly because technology activities did not feature prominently in the curriculum. The authors concluded that free-flow play activities were not possible with computers due to children’s limited experience of computers and difficulty in reading the screen. This suggests children aged 3-4 years may often lack the skills needed to enable them to use digital media effectively as part of free play.
Table 3.2: practitioner/child interactions described in research and their common features

<table>
<thead>
<tr>
<th>Authors</th>
<th>Date</th>
<th>Types of interactions observed</th>
<th>Common features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plowman &amp; Stephen</td>
<td>2005</td>
<td><strong>Reactive supervision:</strong> monitors and manages access, troubleshooting technical problems</td>
<td>Managing access</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Guided interaction:</strong> teaches operational skills, demonstrates use of software, giving encouragement, pedagogical, rare</td>
<td>Operational skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Hybrid approach:</strong> combination of these, identifies what children need and supports accordingly</td>
<td></td>
</tr>
<tr>
<td>Ljung-Djärf, Åberg-Bengtsson, &amp; Ottoson</td>
<td>2005</td>
<td><strong>Protective:</strong> practitioners regulate and supervise</td>
<td>Managing access</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Supporting:</strong> active engagement, offering ongoing support and help, encourages computer use</td>
<td>Following children’s interests</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Guiding:</strong> guides and challenges, starts from children’s interests, pedagogical interactions, rare</td>
<td></td>
</tr>
<tr>
<td>Plowman &amp; Stephen</td>
<td>2007</td>
<td><strong>Distal guided interaction:</strong> curriculum planning, identifies next steps, creates an environment to facilitate learning with technology</td>
<td>Teaching cognitive skills</td>
</tr>
<tr>
<td>Stephen and Plowman</td>
<td>2008</td>
<td><strong>Proximal guided interaction:</strong> face-to-face interactions</td>
<td>Following children’s interests</td>
</tr>
<tr>
<td>Howard, Miles, &amp; Rees-Davies</td>
<td>2012</td>
<td><strong>Continuous:</strong> minimal practitioner presence, at request of children, reactive</td>
<td>Operational skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Focused:</strong> direct teaching of skills, frequently whole class teaching</td>
<td>Teaching cognitive skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Enhanced:</strong> between these two, practitioners direct children towards an activity to apply a previously learned skill</td>
<td></td>
</tr>
<tr>
<td>Roberts-Holmes</td>
<td>2013</td>
<td><strong>Pedagogical framing:</strong> practitioners extending home-based interests and knowledge of digital media, technologies used to support and extend children’s interests and knowledge, extending children’s talk around the computer</td>
<td>Following children’s interests</td>
</tr>
<tr>
<td>Vangsnes &amp; Økland</td>
<td>2015</td>
<td><strong>Intervening:</strong> enhances game play through meta dialogue, disrupts children’s game play</td>
<td>Teaching cognitive skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Distal:</strong> indirect interaction with game play, managing and monitoring access</td>
<td>Managing access</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Supportive:</strong> adult involvement is invited, does not ‘invade’ game play, helps children complete the game, rare</td>
<td>Following children’s interests</td>
</tr>
<tr>
<td>Carlsen, Erfjord, Hundeland, &amp; Monaghan</td>
<td>2016</td>
<td><strong>Assistant:</strong> aids loading, starting and running software, ensure turn taking, gives instruction on buttons to press</td>
<td>Managing access</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Mediator:</strong> proactive, helps children interpret the screen and become aware of crucial elements and parts of the screen</td>
<td>Teaching cognitive skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Practitioner:</strong> focusing children on concepts and skills embedded in the game</td>
<td>Operational skills</td>
</tr>
</tbody>
</table>

A further study by the same authors conducted in eight different nursery settings (Plowman & Stephen, 2007; Stephen & Plowman, 2008) judged that although there
was evidence of practitioners’ pedagogical intent in their interactions these were primarily distal and did not offer direct support to children’s learning through proximal, face-to-face interactions. This type of ‘guided interaction’ (Plowman & Stephen, 2005) was observed on occasions when practitioners’ focus was on assisting children’s use of the technology itself rather than engaging with children’s digital game play. Although guided interaction was in evidence in practitioners’ practice and thinking about technology, and the way they deployed staff and prioritised objectives which made interaction more likely to occur, practitioners were still reluctant to engage in face-to-face interactions with children (Stephen & Plowman, 2008). Evidence of guided interaction as a pedagogical strategy was rare and focused on children’s technological capabilities. There were few observed examples of extended oral communication at the PC and practitioners focused on developing children’s ability to operate the technology, providing feedback and encouragement, and demonstrating how to use a program.

The lack of practitioner engagement in children’s computer use was noted by Ljung-Djärf, Åberg-Bengtsson, & Ottosson (2005). Although the practitioners in this study acknowledged the possibilities of computers, the classroom PC was frequently not regarded as a main activity and seldom described as useful in its own right. Ljung-Djärf et al. (2005) describe three learning environments - protective, supporting and guiding - characterised by ways the practitioners in settings with children aged 3-6 years related to children’s computer use. Practitioners’ pedagogical interactions characterised as guiding were rare and most interactions adopted protective and supporting roles practitioners. In these environments practitioners managed access to digital media and perceived their role to be one of an instructor in the background; intervening when children encountered problems and guiding children’s choices, but primarily leaving children to use the PC without practitioners being present. In each of these studies there was little evidence of practitioners directly supporting children’s use of digital media and using them to mediate learning beyond the technological skills needed to operate the technologies.

Research conducted more recently between 2012-2017 shows the continued prevalence of the pedagogical practices described in earlier studies particularly practitioners’ absence from children’s digital media use and a focus on managing access or teaching operational skills. Observing 3-7-year-old children in Wales, Howard, Miles, & Rees-Davies (2012) reported practitioners were rarely involved in free play with computers and that their presence was frequently at the request of
children rather than part of planned pedagogical action. When practitioners were part of children’s computer use it was generally related to practitioner-led focused tasks. Research conducted by Arnott (2016) in nursery and reception classes (3-5 years old) using a diverse range of digital technologies also found that the majority of observations did not directly involve practitioners. However, practitioners’ distal influences were evident through the way the rules and routines around technology use directed children’s behaviours. Recent research shows that the most frequently observed face-to-face interaction is practitioners’ supervision of children using digital media and managing access to them. This can be by directly monitoring and supervising the amount of time children spend using digital media (Carlsen, Erfjord, Hundeland, & Monaghan, 2016; Vangsnes & Økland, 2015), loading software, (Carlsen et al., 2016) or troubleshooting technical problems (Carlsen et al., 2016). These roles are primarily reactive rather than planned and focus on children learning to use technology rather than learning from technology. The eleven-year span of these seven studies indicates little has changed and practitioners are still frequently not engaging directly in young children’s digital play in ways that are responsive to their interests. The most frequently observed interactions support children’s technological skills and their ability to play digital games.

Surveys of early years practitioners confirm findings of observation and interview studies demonstrating that practitioners’ use of digital media does not support play and frequently focuses on basic skills. A survey of 232 pre-school practitioners in grades 1-3 (3-6 years old) in Belgium identified two types of digital media use: supporting basic technological skills and delivery of curriculum content (Kerckaert, Vanderlinde, & Braak, 2015). The authors also reported that the use of digital media was greater with children in grades 2-6 (4-8 years old) as it was not considered appropriate for use with younger children. Nikolopoulou & Gialamas (2015) questioned 190 practitioners in Greek kindergartens (3-6 years old) and found that 58.9% of practitioners considered digital media use peripheral to ‘real learning’ in the classroom. This research referred primarily to all forms of technology, but selective questions about computer use provide valuable insight into how practitioners might integrate digital media more specifically. The practitioners’ focus of learning with computers was as a cognitive tool (95.8%), a class teaching method (71.1%) or as part of planned activities (63%). Only 35.7% of practitioners surveyed associated computers with children’s free play. Thorpe et al’s. (2015) survey of 131 early years practitioners in Australia working with children aged 3-4 years old found the majority of practitioners (87%) agreed it was important to build on
children’s existing experiences with internet connected technology and that computers were an essential part of learning. However, practitioner responses to a series of questions about how they believed computers could be used in the classroom suggested that they saw digital media as a resource children used to interact with each other rather than with practitioners. Only 50% of practitioners perceived their role to be one of actively engaging with children’s internet use and initiating ideas for using computers. Although practitioners were only able to respond to the questions on the survey with no opportunity to comment, beyond agreeing or disagreeing with a series of statements, the results give some indication of how practitioners used digital media. There was a disconnect between classroom practice and aims specified in curriculum documents which emphasized the importance of digital literacies. Practitioners were uncertain of their pedagogical role and the approach to integrating technology tended to be individual, and based on a personal understanding of play and its relationship to young children learning with technology.

**Pedagogical challenges in supporting digital play**

Few studies have set out with the intention of documenting practitioner interactions and the pedagogical challenges and tensions practitioners face when digital media is part of teaching and learning. In one of a few studies to include practitioner/child interactions Vangsnes & Økland (2015) and Vangsnes, Økland, & Krumsvik (2012) report different degrees of interaction and describe practitioners’ pedagogical actions as supportive, intervening or distal. The authors observed four Norwegian kindergarten (4-5 years old) practitioners using educational games on a desktop computer and investigated the impact on learning of practitioners’ approaches to supporting children. Practitioners in this study adopted different roles when interacting with children playing educational games ranging from active participation to spectator (Vangsnes & Økland, 2015). The approach most closely aligned to children’s interaction with the game involved practitioners joining in games and playing them with the children as a participant player, rather than focusing children’s attention on the educational aspects of the game. When participating in games, practitioners occasionally adopted a ‘supportive’ role that focused on children’s game play. They helped children to complete a game rather than using the game as the starting point for a meta dialogue which ‘disrupted’ children’s play (Vangsnes & Økland, 2015). However, this role was observed infrequently among a minority of practitioners in the four classrooms and was associated with planned activities when the practitioners’ role was to praise, encourage and suggest solutions and occasionally take part as a participant in the game.
Practitioners were far more likely to be present in the classroom when children used the computer, but absent from the gaming activity (distal) or they intervened in the game with a different agenda from that of the child. This research highlights the challenges the practitioners face in knowing how to develop a pedagogical response to children’s use of educational games, and the potential dissonance between educational games and the social constructivist approach to learning practised in these classrooms. Vangsnes and Økland (2015) found practitioners struggled to use their pedagogical skills to play an active role in children’s use of educational games in ways that were not in conflict with their professional beliefs. Practitioners’ response to this conflict was to adopt a primarily distal approach to supporting teaching and learning with digital media.

A few studies have shown how practitioner interventions in children’s digital play can support learning beyond the games being used and provide opportunities for children to lead learning. Although primarily focused on outcomes for children, these studies include some findings related to practitioners’ pedagogical actions to support children’s learning with digital media. The studies demonstrate the need for planned use and sensitive support by practitioners to embed digital media in broader contexts for learning. Roberts-Holmes’ (2013) study of 3-4-year-olds observed how practitioners developed strategies to support children’s use of computers in ways that recognised their developing digital and non-digital interests. With the support of a digital consultant, practitioners began to extend children’s home-based interests and knowledge of digital media and practitioner interactions with children using the classroom desktop computer showed evidence of sustained shared thinking (Siraj-Blatchford, 2009) that supported and extended children's learning. In this setting, the presence of a digital consultant was crucial to practitioners’ development of a ‘playful’ pedagogy that supported children’s digital media use. The consultant was instrumental in nurturing practitioner confidence to develop strategies to support learning in ways that extended beyond technological competence so that digital media were embedded in wider learning. In the absence of such expert support, practitioners may struggle to find effective ways to interact with children using digital media. The kind of playful framing reported by Roberts-Holmes (2013) is noted by Lagerlöf, Wallerstedt & Pramling (2013) whose observations of two six-year-old children using a computer program found that practitioner participation enabled the children to frame the activity as play. When she did so the children changed their participation and explored the computer program. In doing so the children became more skilled and able to initiate
and take the lead in using the program. In both of these studies (Lagerlöf et al., 2013; Roberts-Holmes, 2013) there is evidence of practitioners’ pedagogical actions supporting children's self-directed learning and using this as an opportunity to extend learning beyond the confines of the activity on the screen. However, this type of interaction was infrequent and practitioners most often focused on academic and technological skills rather than children’s interests.

A study by Flewitt et al. (2014) investigating the impact of an iPad introduced into a nursery and reception class produced findings confirming the importance of practitioners’ active engagement with technology. However, reported data in this study referred primarily to children’s use of the iPad rather than describing the nature of practitioner interactions considered effective in supporting children’s learning. O’Hara (2008) found that practitioners recognised how their pedagogic interventions offered opportunities for children to demonstrate learning in areas other than competence with a wide range of technologies including floor robots, computers and walkie-talkies. In common with other studies, Yelland (2016) found it proved difficult for children to incorporate the use of tablet technology without specific and directed adult involvement. Yelland (2016) explored ways in which practitioners’ pedagogical actions in a kindergarten (4-5 years old) influenced learning and how the children responded to iPads as catalysts for exploration and learning. Children very quickly became fluent with the technology, but practitioner support was still needed to ensure there could be focused learning. A key finding of this research was that as practitioners learned how to use apps with children there were ‘teachable moments’ (Yelland, 2016).

The supportive pedagogical interactions observed by Ljung-Djärf et al. (2005) were used by practitioners to guide and challenge children starting from the children’s interests in using desktop computers. Although supportive of the way children chose to use and learn with computers this type of interaction was rare and practitioners more often ‘protected’ children by controlling their access to computers or actively encouraged children to use computers independently. Observing a Swedish practitioner in a class of 3-5-year-olds Bourbour & Masoumi (2017) also showed how practitioners’ pedagogical actions supported learning in response to children’s interests and as part of child-led learning. In one reported interaction with a child using a maths game on an interactive whiteboard (IWB) a practitioner is guided by what the child wants to draw rather than game completion, and the practitioner integrates technological skills and maths concepts into an activity led by the child. However, in all
other reported observations the practitioners’ focus was on helping the child to complete the activity.

Fleer (2018) offers insights into the way 16 practitioners engaged with children aged 3-5 years creating digital animations on an iPad with the MyCreate app. Practitioners helped children create their chosen animated story and showed them how to use the app to achieve their own aims. The study presents pedagogical practices that supported children’s digital play with the MyCreate app as part of one activity to create animated stories. Gillen & Kucirkova (2018) investigated early years teachers (3-5 years) using technology in ways that did not compromise good pedagogy as part of a study investigating ways to connect practice with children’s home experiences with digital technologies. Practitioners’ use of technology supported children’s progress as part of free play and adult lead activities. Gillen and Kucirkova (2018) found practitioners’ curriculum knowledge and children’s interest led their uses of a range of technology including and the metal detectors. The study did not set out to explore pedagogy to support technology use, but it does show how technology might be integrated into play. These two studies show there are classrooms where practitioners have developed pedagogical approaches that support children’s innovative and creative uses of digital media, but this is not yet widespread. Technology may be physically embedded in early years settings but it has yet to be widely embedded in practitioners’ pedagogical thinking. Technology is not conceptualised as an integral part of early years curricula and pedagogy particularly in play-based classrooms. This suggests the need to understand what may be wider barriers to integrating digital media into early years settings particularly those founded on play-based approaches to learning.

**Practitioner research**

A small number of studies has addressed the integration of digital media through action research designed specifically to develop practitioner strategies to implement the use of digital technologies in early years classrooms. A common feature of these studies is the use of an interventionist methodology to address factors constraining the use of digital media. These few studies provide practical examples of effective practice. Tsumura and Robertson (2017) implemented an action research project in two Canadian kindergarten classrooms (4-5 years old) to investigate best practices to integrate iPads. Significantly, the practitioners discovered that early use of the iPads did not follow their play-based pedagogy. Both practitioners initially chose apps
focused only on language and maths and used them for practitioner-led groups in which the practitioners suggested which apps children used and for how long. The practitioners in this study were initially concerned about children spending too much time on the iPads and were sceptical about play as the primary vehicle for learning with technology. Through reflection on their use of digital media and its implementation as part of play the practitioners adapted their pedagogy and practice and gave the children more freedom and choice with the iPads. A key finding of this research was that when practitioners did interact with children their pedagogical interventions supported learning that was related to children’s interests and capabilities. In one instance a practitioner playing Minecraft with a child found opportunities to discuss light and shadows, and properties of some of the rocks used in the game. It was the practitioner’s skilful interventions that developed the learning opportunities in this game. Tsumura and Robertson (2017) demonstrated how practitioners’ reflection on their use of iPads within the context of play had an impact on their pedagogy and the practitioners adapted their approach to using the iPad as part of children’s learning. The findings of this study support the view that practitioners lacking the experience and confidence to apply their pedagogy to technology may rely on more didactic, practitioner-directed uses of educational games to support maths and literacy learning.

An action research project by Hesterman (2011) investigated how four practitioners integrated ‘ICT’ to support 4-5-year-olds literacy learning. This study concluded there is no one model for the integration of technology into early years education. Effective pedagogy for integration needs to be negotiated amid the multiple realities and constraints of early years classrooms. The practitioners in this study found that effective technology integration required them to reflect on what they defined as high quality early years literacy learning and how this was enacted within their individual school contexts and beliefs. Reflection allowed these practitioners to adopt practices that connected the interests of the children to their use of a wide range of technologies including digital and video cameras, overhead projectors, mobile phones and photo copiers. As with Tsumura & Robertson (2017) the opportunity for reflection was a vital part of practitioners’ changing practice, and helped make the connection between technology and pedagogy. However, although Hesterman (2011) reports findings related to practitioners’ pedagogical uses of technology, practitioner interactions involved a high degree of modelling and there is little data related specifically to practitioner interventions in children’s play using digital media.
Johnston, Highfield, & Hadley (2018) used design-based research as part of an investigation into Australian practitioner beliefs and practices in relation to technology integration. The study was conducted in play-based early years settings (3-5 years) and included reflection and discussion as part of practitioner inquiry projects to integrate technology into their practice. Researchers were involved as a critical friend to encourage practitioners’ engagement with research readings, the application of ideas to practice and critical reflection on the outcomes of research. Findings showed a complex set of factors influenced the integration of technologies that included digital toys, keyboards, PCs and tablets. As this study considered a wide range of technologies in addition to tablets and PCs it is not possible to know how practitioners’ beliefs related more specifically to digital media as part of learning. What the study does contribute to the discussion of the relationship between beliefs and practice is greater understanding of the complex factors shaping technology use. Johnston et al (2018) concluded that the shift in thinking resulting from practitioners’ critical reflection could potentially challenge long-held beliefs that act as barriers to integration. The study highlights the importance of practitioner reflection on how technology can feature in play and to challenge assumptions about the pedagogical value of technology to play-based approaches to learning. The practitioners in this study needed critical reflection on their beliefs and practices to consider how to deconstruct broader beliefs and conceptualisations of how technologies influence practice and approaches to supporting young children. There remains a need to understand the relationship between beliefs about digital media and how this may support young children’s learning. While shifts in beliefs may support integration the nature of those beliefs in relation to digital media still needs to be understood.

This small group of studies reporting on practitioner interactions with children’s digital media use have demonstrated how planned pedagogical actions to support children’s choices have an impact on their learning. However, this type of face-to-face interaction is not embedded in practice and practitioners frequently use distal interactions to influence learning. These studies also suggest that practitioner reflection on practice with digital technology is a key component in changing practice and developing a pedagogical approach to supporting young children’s digital media play.

**Digital media in practitioner-directed teaching**

Despite the presence of diverse digital technologies in settings guided by principles of play and child-led learning, they are frequently used as part of practitioner-directed
learning, particularly whole class teaching. A common feature of studies investigating digital media in early years settings is the use of maths and literacy programs to support and extend children’s cognitive skills and conceptual understanding. A large-scale study of 30 foundation phase classrooms (3-7 years old) in Wales investigated pedagogical approaches to IWB use and how they were used as part of planned and spontaneous play activities (Morgan, 2010). The aim of this research was to identify practitioners’ use of the IWB as part of the recently introduced foundation phase framework for children’s learning in Wales (Qualifications, Curriculum and Assessment Authority for Wales, 2004). Although Morgan (2010) reported data for children up to 7-years-old the study is included here because the foundation phase curriculum in Wales is underpinned by socio-cultural theories of learning highlighting the importance of play, the key role of peers and practitioners as mediators of learning, and practitioners and children as co-constructors of knowledge. Morgan (2010) observed how when practitioners interacted with children using the IWB there was a risk the activity became too practitioner-led and instructional. The IWB was most frequently used for whole class teaching directed by the practitioner using pre-prepared resources during which there was little sustained dialogue between practitioner and children. Also common was the use of the IWB for practitioner-set group tasks during which the practitioner was usually absent. The remainder of the time the IWB was rarely available for children to use independently. The significance of this study is that although the IWB was part of a curriculum underpinned by social constructivist pedagogy and founded on the principles of play, practitioner uses of the IWB more closely aligned with a formal, didactic pedagogy. The practitioners in the study all identified the value of play as a vehicle for learning but struggled to integrate technology in a way that was congruent with their approach to practice. The practitioners in this study did not appear to apply their early years pedagogy to their use of digital media.

Other studies have identified how early years practitioners meet the challenges to integrating digital media devices by adopting practitioner-led approaches to learning rather than engineering their introduction into children's play in ways that are congruent with early years pedagogy. Clarke & Abbott (2016) found that teaching strategies and approaches to embedding iPads in a class of 4-5-year-olds did not substantially change from the ways in which practitioners used the IWB. Both devices were used to reinforce maths and literacy using a range of apps. Practitioners found it difficult to apply their pedagogical skills to these games in ways that extended beyond the learning embedded in the games, particularly when children became familiar with the
games. These findings are similar to those reported by Fenty & Anderson (2014) who found that although each of the three pre-school settings (3-5 years old) they investigated had an IWB it was either not used or used infrequently. When the IWB was part of teaching and learning it supported whole class or group teaching and was often used as a form of static display. This study identified a lack of pedagogical knowledge about how to integrate technology into their practice. Bourbour & Masoumi (2017) confirm the prevalence of practitioner-led uses of digital media and the lack of practitioner interventions in children’s play. They describe how practitioners used educational games on the IWB to supplement teaching and as a motivational tool to support the teaching of maths concepts. In many instances the activities on the IWB could have been completed with material objects. The use of digital media as part of subject-specific practitioner-led learning, particularly maths and literacy, is frequently mentioned in the literature. In many examples, digital media is used to supplement the practitioner and/or for children to practise new and developing skills. In each of these studies there is little reported evidence to show how practitioners intervened in children’s digital play and used their interactions to support learning, and how this may, or may not, differ from their actions in support of practitioner-directed teaching.

**Ecological perspectives on digital media integration**

A small body of research has viewed classrooms from an ecological perspective as a way of accounting for the complex contexts and norms inherent in early years education, and the ways in which the local discourse around early years practice influence digital media uptake. Research conducted from this perspective describes classroom contexts and the ways contexts may shape digital media use. This is an important consideration in early years classrooms where there is a strong link between practitioner beliefs about young children’s learning, and their pedagogy and practice (Palaiologou, 2016; Plumb & Kautz, 2015). Importantly, research adopting a socio-cultural approach to the ecology of early years settings has identified a trend where the early years sector acts as a barrier to technology uptake (Parette, Quesenbery, & Blum, 2010; Plowman & Stephen, 2005; Plowman & McPake, 2013; Wood, Specht, Willoughby, & Mueller, 2008).

Ljung-Djärf (2008) observed how practitioners used desktop computers in accordance with their attitudes towards them and the local discourse of early years practice. The author argued that practitioner attitudes and practices created the environment and discourses around computer use. Practitioner approaches to integrating computers
were framed by their socio-cultural understanding of the contexts in which they were used. In this instance, an early years classroom and an understanding of the particular practices of early years practitioners. However, Ljung-Djärf (2008) does not describe the classroom contexts in which the research was conducted. This makes it difficult to compare the use of computers with other resources and tools and to ascertain to what extent computer use was different from, or the same as, other non-digital resources. In addition, this study does not record the pedagogical approach of each setting and how this related to practice. Therefore, while it is possible to gain insight into how practitioners used computers, there is no indication as to how this might differ from the pedagogical strategies used to support learning elsewhere in the classroom.

The impact of ecological factors on children’s digital play was investigated by Arnott (2016) who developed a techno-ecological model to consider the social and contextual factors shaping children’s use of a broad range of technologies. This research explored aspects of context as well as the relationships and connections between these, and was based on the assumption that contextual factors do not exist in isolation of one another but are part of a complex pattern of interaction. Although Arnott (2016) does not report directly on practitioner interactions with children, the inclusion of factors such as the physical layout of the classroom and the rules and routines established by practitioners does relate to the types of distal interactions described by other studies (Plowman & Stephen, 2007; Vangsnes & Økland, 2015). Arnott (2015) showed how children’s use of a diverse range of technologies as part of play was influenced by the decisions practitioners made around the rules and routines that directed children’s behaviours with technology. Findings described how the pre-school system (3-5 years old) and culture – the rules, structures and regulations that impact experiences of digital play – and the digital play system – the behaviours, interactions and negotiation processes observed in children’s digital play – interlinked in the classroom ecology.

Arnott (2016) does not propose effective pedagogical models, but suggests practitioners reflect on the different elements of the classroom ecology that shape children’s use of technology. This reflection offers practitioners a route to consider the influence of the ecological elements of the early years classroom settings in order to inform their own pedagogy with technology.

In common with Arnott (2016), Edwards, Henderson, Gronn, Scott, & Mirkhil (2016) demonstrated the importance of analysing how different socio-ecological settings may mediate the use of digital media in these settings. As part of research into the
disconnect between home and school uses of diverse technologies among 2-5-year-olds, Edwards et al. (2016) described how different socio-ecological settings mediated the use of technology. In educational settings technology use was heavily influenced by practitioner beliefs. Children’s use of technology was guided by the interactions, experiences and social expectations of the setting constructed around practitioner concepts of play and what constituted appropriate play to foster young children’s learning and development. Practitioners did not perceive technology as part of this carefully constructed context and their concepts of play. Consequently, practitioners limited children’s access to technology or avoided its use. Although not focused on classroom uses of digital media alone, this research shows how the contexts in which technology is used may influence the ways practitioners use it. Edwards et al. (2016) relied heavily on interviews with practitioners stimulated by photographs and record sheets of children’s use of different technologies over the course of one week. There are no observations of practitioners using different technologies; rather, practitioners discuss their role in regard to the presence of technology in the classroom. This study indicated how tension between beliefs about technology and early learning influenced practitioners’ descriptions of their technology use but not the reality of this tension in practice.

Summary

At the time this literature review was conducted, a total of 26 empirical studies was identified reporting findings related to the roles and interactions of practitioners when digital media were part of teaching and learning. These studies had a common focus on children in early years settings with a pedagogical approach based around play. Despite a search for papers from 2000 onwards no relevant papers were identified before 2005. This is indicative of a growing focus on practitioner interactions with digital media as a part of studies investigating the use of a diverse range of technologies in early years classrooms. Furthermore, 50% of the studies included in this review were published between 2014-20175. The review highlights a paucity of research with children aged 3-4 years old investigating the use of digital media in settings described as underpinned by a pedagogy foregrounding the importance of learning through play. There are no qualitative studies of digital media use that focus on practitioners addressing their beliefs as one of the primary barriers to technology integration. Although studies have included practitioners’ pedagogical uses of digital media, few

---

5 Papers published after 2014 were not available during the development of the intervention used in this research and could not be used to develop the design principles.
focus specifically on practitioner interactions rather than children’s outcomes. The studies reviewed reveal practitioners working with children under 4 years old rarely moving beyond learning outcomes embedded in games. There are few detailed descriptions of the ways practitioners use their interventions to support children’s development of communication.

The evidence suggests practitioner interactions provide limited opportunities for extending learning in response to children’s developing interests and capabilities in order to develop the wider digital literacy skills, as described by Sefton-Green et al. (2016). Furthermore, there is little evidence of digital technologies being used as tools to mediate wider learning and development, or of them being embedded in the curriculum in ways that support the development of new practices around technology. When digital media are introduced to early years settings, their use is most often linked to practitioner-led focus tasks and whole class teaching, with practitioners frequently using their co-presence to focus on children’s academic skills, particularly maths and traditional print literacy, and their technological capabilities. This review of literature has identified a lack of effective practitioner interactions to support digital media integration, the following section, therefore, explores some of the barriers to uptake in early years classrooms.

**Barriers to digital media uptake**

Research has shown that digital media has the potential to extend and enhance provision for children in early years settings (O’Hara, 2008) and has demonstrated the pedagogical potential of digital technologies for early learning (Kontovourki, et al., 2017). However, empirical research reviewed in this dissertation shows there is still very little evidence of practitioners integrating digital media effectively into the early years curriculum, particularly in settings founded on learning through play. Studies have identified factors that hinder the use of digital media in early years classrooms, including the first- and second-order barriers to technology use posited by Ertmer (1999). Ertmer’s description of different barriers to technology uptake distinguishes between intrinsic and extrinsic factors that hinder integration. First-order barriers are external to teaching and include lack of access and software, insufficient time to plan teaching, inadequate technical and administrative support, and lack of training. As first-order barriers are comparatively easy to identify and eliminate (Ertmer, 1999), early integration initiatives by schools, local authorities and central government have frequently focused on eliminating them based on the assumption that once eliminated,
technology uptake would follow (op. cit.). This has not proved to be the case, hence the need to look to the internal second-order barriers that are intrinsic to teaching. Second-order barriers include practitioner beliefs about technology, established classroom practices and (un)willingness to change. As Ertmer (1999) observes, second-order barriers may be harder to overcome and involve challenging belief systems and the classroom learning ecology.

Beliefs shaping practice

Beliefs are core components in teaching practice: ‘To understand teaching from the teachers' perspective we have to understand the beliefs with which they define their work’ (Nespor, 1987, p. 323). The decisions practitioners make about how and what to teach are shaped by beliefs (Nespor, 1987). Beliefs about teaching and learning are vital in the ways practitioners conceive of their practice and in the ways they organise knowledge and information (Nespor, 1987). Although visible interventions and interactions with children explicitly mediate learning, practitioners’ ‘ways of thinking and understanding are vital components of their practice’ (Nespor, 1987, p. 317) and influence the conceptualisation of tools such as digital media and how they are used with children. Practitioners construct their own approach to creating purposeful learning environments drawing on a combination of factors that shape tacit ‘theories-in-action’ (Pajares, 1992, p. 19). This conceptualisation of beliefs as playing a central role in classroom practice makes it vital to understand in more detail the beliefs that mediate the practice of teaching and the relationship between beliefs and other factors shaping teaching and learning with technology.

Beliefs are held within the individual (Buehl & Beck, 2014) and serve different functions in relation to teachers’ knowledge and actions. They may be used to filter and interpret information and frame a specific task or guide immediate action (Buehl & Beck, 2014). The beliefs practitioners hold about their pupils and their roles as practitioners are the implicit ‘theories’ (Clark, 1988) that define practice and shape approaches to organising learning. These implicit theories relate to how children learn as well as the ways to achieve that learning, and ultimately affect teachers’ behaviour as well as children’s learning (Fang, 1996). There are different approaches, activities, tools, resources and strategies teachers can use to achieve their goals. How teachers choose to achieve these goals are shaped by beliefs. Beliefs define the problem space and the tasks that teachers create based on their beliefs (Nespor, 1987) and act as a filter through which pedagogical decisions are made. Teacher beliefs are built up over time and as the
result of teachers’ understanding of different contexts for teaching. Beliefs are, therefore, the best indicators of the decisions individuals make about teaching (Pajares, 1992).

Beliefs are closely related to knowledge and it may be difficult to pinpoint where beliefs end and knowledge begins and clearly distinguish between the two (Pajares, 1992). The close relationship between beliefs and knowledge is addressed by Kagan who says:

> most of a teacher’s professional knowledge can be regarded more accurately as belief…whereas knowledge is generally regarded as belief that has been affirmed as true on the basis of objective proof or consensus of opinion. (Kagan, 1992, p. 73)

The inclusion of consensus of opinion here is important as it suggests that knowledge can be distinguished from beliefs by the fact that it is a view shared by the majority of people in a group. From this perspective, aspects of early years pedagogy and practice widely shared by practitioners such as learning through play and the role of child-initiated learning could be considered as knowledge. Knowledge about some aspects of early years pedagogy may be universal while others remain as beliefs until they are accepted by a consensus of opinion or verified to be true. Knowledge of a domain also differs from feelings or beliefs about it (Nespor, 1987). Teachers may feel that children do not need to know how to do something but they know that they need to know it. This may be particularly true in the early years where conflicts exist between curriculum outcomes and beliefs about child-centred practice.

Teachers’ beliefs are complex and multidimensional and they may hold multiple beliefs according to the aspect of teaching being investigated and the weight given to different beliefs (Buehl & Fives, 2009). In the early years, beliefs about child development may have greater impact than beliefs teachers hold about curriculum or assessment. Similarly, different early years practitioner beliefs about an appropriate balance between child-led and practitioner-initiated learning may be stronger for some tasks than for others. Different beliefs will come to the fore and shape practice depending on the strength of beliefs relative to the aspect of teaching being considered. This suggests the need to investigate the nature of different beliefs and their relationship to other beliefs teachers may hold in order to understand how different beliefs may interact to shape learning. Beliefs may play different roles depending on their relationship to specific practices (Buehl & Beck, 2014).
Tension between beliefs and practice

Teachers do not always act in accordance with their beliefs and there may be inconsistency between beliefs and practice (Fang, 1996). They may express a belief about a particular way of teaching but not act in accordance with this in the classroom. The extent of this mismatch will depend on the nature of the beliefs practitioners hold, how they were formed and the contexts in which those beliefs are employed. The organization of teaching and learning in early years settings may be inextricably bound up with practitioners’ beliefs about the nature of young children’s learning and development and how to support them. One impact of these personal beliefs is that while play-based approaches to early learning are generally accepted, how this pedagogical approach is enacted in the classroom may vary.

Inconsistency between beliefs and practice may be the result of practitioners’ inability to act in accordance with their beliefs given the influence of external cultural factors such as the way national policies influence curriculum and assessment (Ashton, 2014). A belief in the importance of building the curriculum around children's interests may conflict with the need to meet nationally determined outcomes. These conflicts represent pedagogical dilemmas that may, or may not, be resolved depending on the beliefs systems practitioners hold and how they choose to enact them in response to such dilemmas and tensions. There is a need to pay attention to the goals teachers pursue and how these may be multiple and conflicting in addition to understanding the contexts in which beliefs are enacted (Nespor, 1987). Research needs to focus on teachers context specific beliefs and their interconnections to other beliefs and practices (Ashton, 2014) rather than seeing beliefs in isolation.

Beliefs may persist and shape practice even when they no longer represent reality (Pajares, 1992) but in order to change beliefs requires teachers’ existing beliefs to be shown to be unsatisfactory or no longer valid. Beliefs can shift through personal experiences and reflection on the tensions that may exist between beliefs and practice (Buehl & Beck, 2014). Beliefs are unlikely to change unless they are challenged ‘and one is unable to assimilate them into existing conceptions’ (Pajares, 1992, p. 320). For example, outdated beliefs about certain teaching strategies may continue to shape practice unless and until they become incompatible with other beliefs teachers hold. At this point teachers need to either adjust the beliefs they hold so that they can accommodate new ones or reject certain beliefs entirely. A change in beliefs may only
be possible if alternative beliefs or new beliefs can replace the old ones through teachers becoming more reflexive and aware of their beliefs and the validity of them in new contexts (Nespor, 1987). The extent to which teachers engage in self-reflection and self-awareness is also related to the alignment of beliefs and practices (Buehl & Beck, 2014). When teachers discuss the tensions between beliefs and practice inconsistencies are brought to the fore and beliefs and/or practices can be modified.

**Beliefs about learning and digital media**

Research has established the importance of the link between teachers beliefs and classroom practice (Nespor, 1987; Pajares, 1992) and their choice of teaching strategies (Ertmer, Ottenbreit-Leftwich, & Tondeur, 2015). However, there is a lack of research that looks in detail at the relationship between teachers pedagogical beliefs and their uses of digit tech (Ertmer et al. 2015). This gap in knowledge is more pronounced in the early years where practitioners strong pedagogical beliefs may act as a barrier to tech use (Stephen & Plowman, 2008). There is a growing body of evidence indicating a close relationship between early years practitioners’ attitudes towards digital media and how it is conceptualised and used in early years settings as part of children’s play (Edwards, 2016; Yelland, 2011). Decisions to integrate digital media are affected by multiple factors related to the technologies themselves, the users and the contexts in which they are used. The nature of early years education and its emphasis on first-hand experiential learning is frequently a barrier to the integration of digital media (Mertala, 2017). Anxieties exist about children’s physical inactivity, passivity and lack of verbal and social development when using digital media (Flewitt et al., 2014). These anxieties are compounded by beliefs about the developmental appropriateness of technology-based virtual learning experiences versus traditional hands-on, non-digital activities (Lindahl & Folkesson, 2012). This view is supported by the findings of a survey of 190 Greek kindergarten (3-6 years old) practitioners which demonstrated that computers were not perceived as supporting and enhancing play or as a free play activity (Nikolopoulou & Gialamas, 2015). Given the centrality of learning through play to the way practitioners construct the early years curriculum, what they deem to be relevant to play will influence the way practitioners choose to use, or not use, digital media to support the educational goals of the classroom (Nuttall, Edwards, Lee, Mantilla, & Wood, 2013).

Surveys of early years practitioners continue to highlight how beliefs shape the use of digital media. Hatzigianni & Kalaizidis (2018) asked Australian practitioners working
with children under three years old about their beliefs related to the use of touchscreen technology and factors that influence practice. Although teachers were open to change they remained unconvinced about the use of technology in play. The practitioners in this survey did not believe technology could enhance free play as a core value of early years education. The authors suggest more research is needed to elaborate teacher views about technology and how children learn best in terms of different approaches to early years pedagogy. There is a need to understand the complex relationship between pedagogical beliefs and those shaping how practitioners conceptualise technology.

Zabatiero, Straker, Mantilla, Edwards, & Danby (2018) looked at attitudes towards technology and young children among 515 early childhood educators; early childhood service administrators, managers and/or directors; and parents/guardians. The results present a complex picture of attitudes and beliefs and the role of early years settings in relation to the potential of digital technology. Respondents believed digital technologies have great potential benefits for young children’s learning but they did not think early years settings are appropriate places for children to acquire digital skills. Furthermore, although 57% believed early years practitioners have the skills and resources they need to support young children’s learning about digital technology this question does not address learning with technology. The response could be interpreted to suggest practitioners are concerned with the use of technology to teach operational skills.

Jack and Higgins (2018, 2019) challenge the view that technology is used in limited ways with a focus on operational skills in early years settings. The authors interviewed practitioners working with children aged 3-5 years who all identified the need to provide time for exploratory, child-led, play-based activities and a balance of child-initiated and adult-led, directed learning opportunities. All the practitioners in the study were using technology across the curriculum to support their teaching and learning philosophies. The authors suggest this finding contrasts with Plowman’s (2016) findings that practitioners focus on operational skills rather than open-ended activities. Jack and Higgins (2018) conclude that technology is more embedded in practice than earlier literature suggests. However, while the findings of this research relate to digital media specifically and demonstrate their use across the curriculum to support literacy, numeracy, operational skills and learning dispositions there is no indication of how teachers did this and the strategies they adopted to support children’s use of iPads and computers during free play. Most practitioners gave examples of technology used to support pedagogy as modelling the use of devices to children rather than using them alongside children as part of play. Furthermore, as the authors themselves note the
findings are based on self-reported uses of technology rather than observations of actual use.

A later survey by Jack and Higgins (2019) of practitioners and childminders in a range of maintained, voluntary and private settings showed that adults regularly worked alongside children and provided support when using technology. However, findings do not support the view that technology was embedded in practitioners’ pedagogical thinking. Although 52% of the 335 respondents said it was important to use technology, fewer (27%) said technology had pedagogical value to support the curriculum. Both these studies (Jack & Higgins, 2018, 2019) report how practitioners say they use technology rather than observations of their practice. The authors’ suggestion that technology is used by children across the curriculum in more open and exploratory ways supporting early years pedagogical approaches is not wholly convincing and needs further exploration.

**Developing new beliefs**

Early years practitioners may need new beliefs about the relationship between digital media and play in order to develop a concept of digital play that can inform their provision of play-based learning (Edwards, 2016). Practitioners need a clearer understanding of how children learn to use a diverse range of digital media through play in order to harness their potential within play-based approaches to pedagogy (Bird & Edwards, 2014). They may then be able to identify a range of roles and strategies that are most effective for realising play behaviours with digital technologies. Edwards (2016) proposes changing practitioner beliefs by changing their concept of play rather than practitioners’ concepts of digital media. The suggestion is that practitioners can observe and assess children’s interactions with technology as play through the use of a digital play framework (Bird & Edwards, 2014; Edwards & Bird, 2017). Although this framework provides a way to view children’s use of digital media as part of their play it does not address the ways practitioners might directly support children using digital technologies. The focus of the digital play framework is on conceptualising children’s technology use as play rather than exploring ways to extend and develop its use through practitioners actively supporting children’s digital play. The view that existing concepts of play-based pedagogy leave little room for digital media is one way to argue the need to change practitioners view of play. However, an alternative approach is to challenge the concept of digital media that shapes its integration into play. This would allow practitioners to integrate digital media into their existing concepts of play.
A key point for this research is to understand the factors influencing the enactment of practitioner beliefs within the context of digital media integration in an early years classroom. Few studies have looked specifically at the link between practitioner beliefs about digital media to support play-based approaches to learning and their pedagogical beliefs. In a review of literature on early years practitioners’ beliefs, Plumb and Kautz (2015) considered 19 papers out of 625 published in peer reviewed journals. In the papers reviewed the most frequently cited barriers to digital media use in early years settings were practitioner beliefs and attitudes. However, Plumb and Kautz (2015) did not consider the nature of the practitioners’ beliefs in relation to their practice with digital media. For this it is necessary to look at research conducted with older children as this provides insights into the relationship between pedagogy and digital media integration that are relevant to this research. Research with older children has examined the intrinsic second-order barriers which strongly influence practitioners’ uptake of digital media (Ertmer, 2005), including beliefs, established classroom practices and an unwillingness to change. Ertmer, Ottenbreit-Leftwich, & Tondeur (2015) suggested practitioners’ use of digital media was related to effective teaching and learning strategies rather than deeper personal theories of learning, teaching styles, perceived value of technology or confidence, skills and knowledge. Consequently, digital media replaced or supplemented existing classroom teaching and learning methods rather than being used to support the adoption of more effective and innovative approaches to using technology in meaningful and authentic learning (Tondeur, Braak, Ertmer, & Ottenbreit-Leftwich, 2017).

In the studies described above the most frequently cited barrier to technology uptake was practitioners’ pedagogy. Practitioners use technology in different ways according to their beliefs. Those with constructivist pedagogies were found to be most likely to demonstrate effective use of digital media (Ertmer et al., 2015; Tondeur et al., 2017). Practitioners with more child-centred pedagogical beliefs used technology more frequently and more effectively than those with a transmission approach (Ertmer & Ottenbreit-Leftwich, 2013; Ertmer et al., 2015). While practitioners’ pedagogical beliefs were consistently shown to influence their use of technology, the conclusions drawn relating to constructivist pedagogies are at odds with research showing that in early years settings a constructivist pedagogy may constrain technology use (Stephen & Plowman, 2008). Despite variation in findings to date, it is evident that technology integration is related to practitioners’ pedagogical orientations and their beliefs about
teaching and learning, but this needs to be explored within the specific context of early years play pedagogy. When digital technologies were first introduced into classrooms it was believed that the presence of technology alone would lead to changes in practice and subsequently changes in beliefs (Ertmer et al., 2014). Educators and policy makers believed new technologies would act as a catalyst for change and that teachers would use them in innovative ways (op. cit). This belief was based on the presupposition that the relationship between beliefs and practice was for the most part one directional and that new technologies would lead to a change in beliefs. Although Buehl & Beck (2014) suggest that this complex relationship may be a reciprocal one, this has yet to be explored in relation to early years practitioner beliefs about digital media and how this relationship mediates classroom practice.

**Summary**

The review of literature for this dissertation adopted a systematic approach to identifying research into digital media integration in early years classrooms between January 2000 and December 2017. The search strategy identified generated 28 papers reporting empirical research into the use of digital media with children aged 0-6 years. The review drew on three previous reviews as a starting point to identify gaps in research and key themes relating to early years practitioner uses of digital media to support learning. Earlier reviews of literature identified a lack of effective pedagogical approaches to support technology integration and a focus on children’s engagement with digital technologies rather than practitioner interactions in support of learning with technology. The review conducted for this dissertation highlighted a paucity of research with children younger than 4 years old and a lack of planned practitioner interactions with young children’s digital play. Practitioners are typically absent from children’s digital media use and their infrequent interactions focus on managing access and developing children’s technological capabilities. Planned pedagogical interactions were not a strong feature of practitioner engagement with children’s digital media use and there is little evidence of practitioners supporting digital play.

The limited number of studies documenting practitioner interactions has highlighted the pedagogical challenges practitioners face in developing effective approaches to integrate digital media. A few studies have shown that practitioner interventions in free play can support wider learning but the lessons from these have yet to be built on. Most practitioners working with 3-4-year-olds have yet to develop ways to use digital media that are congruent with play-based pedagogies. Digital media are
frequently used as part of practitioner-directed activities with a focus on children’s
cognitive skills and technological capabilities. A small number of action research
studies has shown that reflection is a key element in changing practice particularly
where there are strong beliefs about the appropriateness of digital media in early
years classrooms. Research viewing classrooms as learning ecologies has indicated
a strong link between practitioner integration of digital media and the discourses
around early years practice. The integration of digital media may be hindered or
supported by the way elements of a classroom ecology shape technology use by
children and practitioners. Practitioner beliefs about teaching and learning are a key
component in their pedagogical decision-making and classroom practice. Early years
pedagogy is inextricably linked to practitioner beliefs about appropriate practices for
young children’s learning. Core beliefs about learning through play and young
children’s use of digital media may conflict and hinder their effective integration into
early years classrooms.

This study addresses the paucity of research with children aged under 4 years and
uses an intervention to address the gap in literature around pedagogical uses of digital
media. In particular, it investigates approaches to teaching and learning in the context
of tensions between play-based learning and practitioner beliefs about digital
technologies. Little research to date has explored the relationship between practitioner
pedagogical beliefs and practice and their decision, or not, to integrate digital media
into teaching and learning. Technology hardware alone does not have the power to
change practice and the way children learn; it is how digital media are used by
practitioners and children and the contexts in which they are used that should also be
considered (Merchant, 2010), along with the ‘development of positive attitudes towards
digital literacies and technologies [as] necessary for the integration of digital literacy
into the current models of pedagogical practice’ (Kontovourki, et al., 2017, p. 36). This
research addresses practitioner beliefs as a barrier to the development of effective
pedagogy to support effective integration of digital media into early years settings.
Chapter 4

Methodology and research methods

This chapter details the interpretivist perspective and methodology that underpinned the research and addresses the appropriateness of this approach for the research questions. The chapter is divided into two sections; 1. methodology and 2. research methods. The first section outlines the philosophical framework that guided the research including its epistemological, ontological and axiomatic perspectives. This is followed by a description of the educational design research (EDR) approach used. The second section presents and reflects critically on the methods of data collection and analysis.

Addressing the research questions

The aim of the research was to explore teaching and learning strategies in the context of digital media use in early years settings. The study was framed by socio-cultural theory and conceptualised the classroom as a complex learning ecology consisting of multiple interacting factors. A naturalistic, classroom-based intervention was used to address the integration of digital media into young children's learning. Having reviewed the literature on digital media use with children aged 0-6 years in educational settings the research questions were:

- What factors influence the integration of digital media into early years pedagogy?
- What pedagogical approaches reflect effective integration of digital media into early years settings?

Philosophical framework

The philosophy underpinning research connects the research design to the researcher’s understanding of the social worlds in which research is conducted. The methods chosen for collecting, analysing and understanding data ‘cannot be separated from the epistemologies, social theories and ethical stances that shape our understanding of the issues we seek to address’ (Brydon-Miller, Kral, Maguire, Noffke, & Sabhlok, 2011, p. 398). These worldviews affect how researchers choose to construct knowledge about the phenomena being explored as well as the specific techniques chosen to gather and analyse that knowledge. It is therefore incumbent on researchers to set out their beliefs and to identify how these beliefs might relate to the
research approach and the methods adopted for data collection and analysis. The resulting philosophical framework serves as a constant thread that connects theory with research practice and can guide any unanticipated questions or issues that may arise during the course of research (Maykut & Morehouse, 2002). The system of methods, principles and rules that are contained within the methodology link the theoretical framework to methods of collect data and details the methods and principles appropriate to the particular field of study (Savin-Baden & Howell Major, 2013). The methodology also helps to define the nature of the problem to be investigated as well as to justify the particular methods chosen. Individual research methods may differ, but different methodologies share a general orientation within the model that frames the research (Maykut & Morehouse, 2002). One way to view the relationship between the different elements that shape and inform research is as a process of narrowing the research design from grand philosophical theories and paradigmatic choices to practical matters of data collection and analysis (Silverman, 2013).

**Paradigmatic choices**

The choice of a paradigm is critical as paradigms contain the 'concepts, results and procedures' (Simon, 1994, p. 276) that a researcher accepts as reflecting their worldview. A paradigm is the basis on which the research is built (Maykut & Morehouse, 2002) and at the heart of each paradigm are fundamental differences in ontology and epistemology and axiomatic beliefs about the purposes of research (Lincoln, Lynham, & Guba, 2011). Although ontology and epistemology are distinct, beliefs about ontology are deeply enmeshed with epistemological beliefs. How researchers go about investigating knowledge is governed by epistemological beliefs as to how that knowledge exists. Knowledge needs to be studied within the ontological frame of reference that researchers construct. A researcher’s paradigmatic choice is not entirely free but based on their assumptions about the world, the topics they choose to investigate and how they can understand these topics (Maxwell, 2013). The aim is to find a paradigm and method that will frame the research questions through the most appropriate approach to collecting and interpreting data.

Alignment to a particular paradigm can be made difficult by the existence of the ‘baffling array of approaches advertised and practised’ (Hammersley, 2012, p. 1). Hammersley (2012) lists four ‘orientations’ – positivist/post-positivist, interpretivist/hermeneutic, critical and constructionist – but acknowledges that this does not suggest only four basic kinds of research. Some authors include mixed methods.
research as a paradigm of its own (op. cit.) while more recent approaches such as
design research are described as pre-paradigmatic (Dede, 2004) as they do not as yet
have a single set of agreed concepts. Different research orientations present
alternative ontological and epistemological worldviews with which researchers align
themselves by adopting the values and assumptions that underpin them. Positivist
worldviews accept that a phenomenon can be studied, and what is seen interpreted,
without acknowledging the way in which society, and the researcher’s own subjectivity,
may determine what is uncovered and how it can be interpreted. Knowledge can be
measured and quantified objectively as it is not affected by how that knowledge is
formed. However, the borders between paradigms are becoming blurred (Denzin &
Lincoln, 2011) and there is increasing recognition that experiments conducted within a
positivist tradition may yield knowledge that is ‘often dependent on context and imbued
with many unstated theoretical assumptions’ (Shadish, Cook, & Campbell, 2002, p.
29). Shadish et. al. (2002) argue all experiments are a ‘profoundly human endeavour,
affected by the same human foibles as any other human endeavour’ (op. cit. p. 30).

The crucial difference between positivism and interpretivism lies in the degree to which
these foibles and theoretical assumptions are controlled and accounted for by
researchers in their attempt to present research as an objective account of the world.
Research adopting a positivist worldview aims to minimise the impact of context rather
than considering it a valid part of research. Interpretive research is based on the
ontological assumption that knowledge is constructed through interaction with others
and does not exist to be discovered without reference to the contexts in which
knowledge occurs. Researcher participation in the subject’s world aims to ensure that
the knowledge produced reflects something of the subject’s reality (Lincoln et al.,
2011). Alongside this interpretivist view sits the epistemological assumption that the
data produced and the way it is interpreted will reflect the social and cultural contexts in
which data is constructed as well as the researcher’s own socio-cultural background
(Lincoln et al., 2011). Subjectivity is not seen as a failing of interpretive approaches,
but can be an element of understanding (Stake, 1995).

Axiology, from the Greek meaning value or worth, is the philosophical study of values
and is related to ethics and aesthetics (Simon, 1994). Axiological assumptions address
the values that feed into the research process; the choice of problem; choice of
paradigm; choice of theoretical framework; and the choice of data collected and
analysis (Lincoln et al., 2011). Axioms can be grouped with the basic values and
beliefs that are contained within a particular paradigm and are among the features that distinguish and define different paradigms (Denzin & Lincoln, 2011). Axiology addresses what knowledge a researcher considers to be valuable (Lincoln et al., 2011) and its consideration as part of research points to the need to outline the axiomatic assumptions guiding research as part of a researcher's philosophical position (Heron & Reason, 1997; Lincoln et al., 2011). Reference to axiology as part of the basic philosophical underpinnings of research helps to view ethics embedded within paradigms and not as an additional facet of research methods (Lincoln et al., 2011). A researcher's axiomatic values provide a way to reflect on how philosophical assumptions refer to the ‘proper purpose and product of research’ (Hammersley, 2012); the value of the knowledge produced (Lincoln et al., 2011) as well as what is worthwhile knowing (Simon, 1994)

**Philosophy underpinning this research**

This research adopted an interpretivist perspective to understand how pedagogic approaches with digital media might support young children’s learning. The socio-cultural view of learning framing the study seeks to understand the process of learning within particular social and cultural contexts. The intention is not to measure and quantify the outcomes of learning but to explore and understand the process of learning and the contexts in which practitioners and children act. This reflects the belief that knowledge is socially constructed and that qualitative research is a means for exploring and understanding the meanings individuals or groups give to human or social action (Creswell, 2009).

One of the issues that can divide researchers is whether research should be aimed primarily at producing knowledge about practice and institutions, or be designed to directly improve those practices and institutions (Hammersley, 2012). The decision about the aims of research can be considered through recourse to axiology and a researcher’s beliefs about the value of research and the knowledge it produces. The axioms that are part of the philosophical framework underpinning this research include the belief that the value of research lies in its ability to enact change and involve practitioners in a process of change to address real life problems. Hence the decision to work with practitioners to develop effective, theoretically informed pedagogy to support digital media integration that might be useful for different classroom contexts. Classroom interventions offer a way to change practice and address problems from inside the classroom and are one response to research findings not being used
The philosophical assumptions underpinning this research are aligned to the socio-cultural theoretical framework outlined in Chapter 2 that views knowledge as individually constructed and socially mediated through the use of cultural artefacts. This social constructivist model of cognitive development draws on Vygotskian and post-Vygotskian theory that argues the way individuals use and construct meaning from artefacts is dependent on the contexts in which those artefacts are used and that the meanings people give artefacts are shaped by their own socio-cultural backgrounds. This epistemology also underpins and guides the approach to learning theorised as an individual cognitive act in which meaning making is contingent on the contexts in which it takes. As such the philosophy that underpins the methodological approach provides a way to connect theory and practice. The philosophical framing for this study is also reflected in the choice of design research as a methodological approach to designing and conducting research that uses a collaborative classroom-based intervention.

**A Design-based approach to research**

The choice of design research reflects a desire to ensure that research is meaningful and relevant by integrating theory and practice to produce usable knowledge. Design research has been described as ‘a series of approaches, with the intent of producing new theories, artefacts and practices that account for, and potentially impact, teaching and learning in naturalistic settings’ (Barab & Squire, 2004, p. 2). Design research focuses on what happens when learning environments are changed and this approach recognises the significance of context in the development of theories about learning (McPake & Stephen, 2015). McPake and Stephen (2015) argue that successful innovations in education require knowledge of learning environments in order to understand how, where and why innovations work (or fail to work) in practice. Many design research characteristics are shared by other approaches to research aimed at addressing real world classroom problems. Action Research (AR) for example also aims to bridge the gap between research and practice (Somekh, 1995). However, Bielaczyc and Collins (2007) argue that design research differs from AR in its goal to refine theory and not solely design an intervention to improve practice. Design research contributes to understanding a phenomenon as it occurs in a particular context through study of one or more instances of the problem (McKenney and Reeves, 2019). The 'intertwining' of research and practice and explicitly stated intention to develop theory, combined with naturalistic interventions, defines design research and sets it apart from other approaches to educational research (Bell, 2004).
The contribution of design research to knowledge is twofold; usable knowledge in the form of a solution to a problem, and theoretical understanding of a problem that can be applied to the practice of others.

The iterative process of developing, testing and analysing an intervention that is a feature of design research provides a 'testing ground' for theoretically informed ideas developed to address real problems faced by practitioners. A prototype solution is developed and the design, and assumptions on which it is based, are tested and revised in situ (Mckenney and Reeves, 2012). Design researchers test the effectiveness of an intervention and focus on what happens when learning environments are changed. Design research is intended to be a long-term endeavour taking years to design and refine long-term solutions and the assumptions on which they are based to produce findings and solutions that can be applied to the practice of others (op. cit.). Scalability involves extending the methods shown to be effective in a certain context to larger and more diverse contexts (McKenney & Reeves, 2012).

The goals of the research are drawn from the local context as well as the researcher's interests and agenda. An essential element in examining what works and what does not work in a particular classroom is the process of working closely with practitioners who are a key factor that may influence the success of an intervention (Gutierrez & Penuel, 2014). Design research requires collaboration between researcher and practitioner to identify the initial problem/s to be addressed through an intervention and then develop and 'test' a solution to determine what is effective and why. Design research does not determine the form of the intervention, and projects are designed to address a particular problem and the context in which solutions are to be implemented. An intervention can be anything that aims to bring about change to the classroom learning environment. Interventions can take the form of tools, approaches to teaching and learning, theories and products tested in the field (Reeves and McKenney, 2012). The intervention may also include the presence of the researcher as an agent of change. In this instance the researcher is viewed as a 'reflective, observant participant who helps to make visible the practices, meanings and contradictions that often become invisible to those closest to the action' (Gutierrez & Penuel, 2014, p. 20).

One of the problems facing researchers choosing to use design research is the existence of several descriptions and approaches which can make it difficult for researchers seeking consensus about how to use design research in the field.
Reviewing studies that have used design research indicates its use primarily by learning scientists who work to further scientific understanding of learning and improve teaching by investigating cognition (Barab, 2018). This has resulted in different orientations to design research among a ‘family’ of related research approaches (Bell, 2004; Engeström, 2011) each with a different terminology. Different conceptualisations of design research reflect diverse theories of human cognition (Bell, 2004) and make it difficult to see design research as a coherent theory or methodology for intervention (Penuel, 2014).

Penuel (2014) argues that design research was not intended to be seen as a singular methodology. Design researchers are ‘bricoleurs’ in the way they ‘assemble, adapt, and repurpose existing concepts, tools and instructional models for a given design experiment’ (Penuel, 2014, p. 99). They use different methods during different phases of research including informal analysis of on-going activity during an intervention and systematic retrospective analysis of interviews and observations. Some design researchers also use experimental designs to test an innovation in a large number of classrooms. Design researchers are purposefully ‘eclectic’ in the concepts and methods they use and develop. It is this flexibility which affords design researchers a pragmatic approach to data collection and analysis and makes it possible to use design research to investigate classroom problems in-situ. This methodological flexibility makes design research an attractive approach to investigating real world problems in the ‘messy’ contexts of classrooms. Furthermore, despite different orientations design research is unified by a common goal of designing an intervention which is tested in the classroom to develop theory related to how children learn (Penuel, 2014). Design research allows the researcher to identify as far as possible which particular features of an intervention are more effective and why (Reeves, 2011) and develops existing practices or leads to new practice. Design research also helps researchers and practitioners to confront their beliefs through close collaboration (Bradley, 2013) and is suited for research where practitioner beliefs are a feature of teaching and learning.

In response to the existence of different descriptions of design research this dissertation uses the term educational design research (EDR). This description firmly locates the approach in the field of education and provides a way to recognise the value of interventions in developing practice and theory. The use of EDR also distinguishes its use in this dissertation from intervention studies that have tended to rely on an experimental design and quantitative methods. In this research,
implementing an intervention with an experimental design would not take into account the socio-cultural contexts for learning or the interaction between practitioner and child that has been shown to be an important element of effective teaching pedagogy (Wyse, 2010). It is the process of teaching and learning that is investigated in EDR rather than its outcomes as is the case in classroom interventions adopting an experimental design (Brown, 1992). The inclusion of contexts for learning as part of the analysis in EDR results in a greater understanding of how a learning ecology and environmental factors may affect learning outcomes (Cobb et al., 2003; Reinking & Bradley, 2008).

Despite different orientations a review of key literature describing design research indicates a common set of characteristics (see Table 4.1) that can be used to counter the suggestion that it is difficult to define design research in a ‘realistic’ way (Dede, 2004, p. 106). This table shows there are at least five core elements common across different approaches to, and descriptions of, design research. Namely, that design research uses a classroom-based intervention tested over iterative cycles to develop practice and theory. These characteristics and goals show design research to be a distinctive methodological approach to research and one that is consistent with the philosophy that underpins this study. Design research is distinguished by its twin focus on theory construction and explanation when solving real world problems (McPake and Stephen, 2015). The goals and defining features of design research, rather than its methods, distinguish it from other approaches to education research. The outcomes of design research are the interaction of resources, learners and practitioners to produce meaningful change in learning environments (op. cit.).
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>object of study is always an instructional intervention</td>
<td>develops and tests solutions to problems</td>
<td>research aims at designing an intervention</td>
<td>designs interventions</td>
<td>interventionist methodology</td>
<td>Includes an intervention</td>
</tr>
<tr>
<td>theory used to create, implement and refine an intervention</td>
<td>theory frames the enquiry and shapes the design of the intervention</td>
<td>design based on theoretical propositions, field testing of design contributes to theory building</td>
<td>develops theories about the process of learning and means to support it</td>
<td>process of learning and developing theory</td>
<td>Explicit drive to develop theory</td>
</tr>
<tr>
<td>aims to make a positive impact on practice</td>
<td>aimed at improving practice and generating pedagogy</td>
<td>utility oriented - practicality for users in real contexts</td>
<td>theories help to communicate relevant implications to practitioners</td>
<td>Practical contributions to practice</td>
<td></td>
</tr>
<tr>
<td>responsively grounded in authentic, real world contexts</td>
<td>research is conducted in authentic settings</td>
<td>real world contexts for intervention</td>
<td>research accounts for how designs function in authentic settings</td>
<td>Research carried out in authentic contexts</td>
<td></td>
</tr>
<tr>
<td>intervention is continuously tested and tweaked</td>
<td>multiple iterations of an investigation</td>
<td>cyclical approach of design evaluation and revision</td>
<td>continuous cycles of design, enactment, analysis and redesign</td>
<td>Iterative</td>
<td></td>
</tr>
<tr>
<td>collaborative</td>
<td>requires collaboration among those connected to the problem</td>
<td>researchers and practitioners work together to change practice</td>
<td>flexible methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methodologically inclusive and flexible</td>
<td>flexible and pragmatic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The knowledge produced by EDR is grounded in existing theory and empirical findings to develop theory that relates to effective practice and the implementation of interventions in real classrooms. EDR contributes to theoretical understanding through development of a 'local theory' (Gravemeijer & Cobb, 2006; McKenney & Reeves, 2012) of classroom practice to address the problem space into which an intervention is designed to fit. Development of a local theory of teaching and learning can take into account literature, theory and previously used interventions (Bannan-Ritland, 2003). It is the problem that is the starting point. Local instructional theory consists of ‘conjectures about a possible learning process, together with conjectures about possible means of supporting that learning process’ (Gravemeijer & Cobb, 2006, p. 21) that are ‘tested’ through the intervention. Interventions are theoretically driven and theory is tested and generated in real world classrooms. This theoretical understanding of teaching and learning is instrumental in developing the ‘design principles’ (Plomp & Nieveen, 2013; Reeves, 2006) that drive the intervention implementation and development. Design principles derived from an abstraction of empirical findings contain the rationale behind the design of individual features of the intervention (McKenney & Reeves, 2012). The design principles are refined during the course of the intervention cycles as the result of on-going empirical findings.

**Research design and methods of inquiry**

Within EDR, diverse methods and instruments of data collection may be used to suit the purposes of individual studies. The methods of data collection and analysis used in this research reflect the interpretive paradigm and socio-cultural view of learning, and were selected to provide the data required to address the research questions. The research was naturalistic in that it focused on teaching and learning as it occurred in a natural classroom setting and the intervention was designed to fit into classroom approaches to teaching and learning. The research methods were therefore chosen to remain naturalistic as far was possible given the use of an intervention while at the same time allowing the research questions to be answered.

The study used a design-based research approach to develop and implement a year-long naturalistic intervention in a primary school nursery class. The five design principles that drove the intervention were introduced to address practitioner beliefs and develop strategies to support the integration of digital media across the curriculum and into all aspects of practice. These design principles included practitioners interacting with children using digital media, and reflective conversations with the
researcher. Data was collected over a baseline phase and three iterative cycles of the intervention. Data collection included observational field notes, video recorded observations, practitioner interviews and documents. Data was analysed using a thematic approach with the activity of teaching and learning as the unit of analysis. Ongoing analysis at the end the baseline phase and after each intervention cycle informed the intervention development. Post-intervention analysis developed understanding of practitioner beliefs and their relationship to the practitioner’s developing pedagogy for digital media.

Site and sampling strategy
The site and participants for this research were selected based on the researcher’s judgement as to their interest, and were chosen to meet the needs of the research (Robson, 2011) and to illustrate a particular feature or process (Silverman, 2013). The sampling did not seek to be representative of a wider population but aimed to provide an in-depth exploration and understanding of a particular phenomenon. The selection of the setting was also opportunistic given the researcher’s connection to the classroom practitioner Vicky (all names used in this dissertation are pseudonyms) and some experience of her views on children’s use of digital media. The sample therefore provided access to a site and participants that would provide a context relevant to the issue being investigated.

The sample could also accommodate the particular needs of EDR as an interventionist and collaborative approach to conducting research. When the intention is to introduce change into a classroom learning environment where practitioners may hold strong pedagogical beliefs, a degree of personal trust is needed between researcher and participants that will allow the researcher to challenge and question core beliefs and practices that may have been established over several years. Vicky was an experienced nursery practitioner and a former colleague, who had expressed an interest in this research in view of her own wish to develop practice around using the interactive whiteboard (IWB) and desktop computer in the classroom. I first got to know Vicky and her beliefs about digital media when we worked together as teachers in the same nursery setting prior to Vicky working at Ferny Croft (pseudonym). While mindful of the need to maintain objectivity, this relationship allowed for a degree of access and openness that was evident from the start of data collection, and was invaluable given the need to gain an in-depth understanding of the setting and participants as part of the interpretive nature of this research.
The school

Ferny Croft Primary School is a larger than average, two-form entry, mixed, community school in an inner London borough. The school caters for nearly 500 children aged 3-11 years old and has a nursery class. At the time of data collection, the school’s nursery provision consisted of two part-time sessions for up to 25 children in each morning and afternoon session. For the purposes of this research the morning session was chosen purposively to meet the needs of both the researcher and classroom teacher.

Ferny Croft Primary School has a higher than average (67.9%) number of pupils from ethnic minority groups and 41% of pupils speak a first language other than English. The school also has a higher than average (38.1%) number of pupils eligible for free school meals (FSM). The school had been graded as outstanding at its most recent Ofsted (Office for Standards in Education) inspection in 2009. However, as this grading was obtained six years before the start of fieldwork, and the Ofsted inspection framework has subsequently changed substantially, I used more recent documents to judge the quality of the nursery provision. These documents included a 2016 review of the early years provision at Ferny Croft by the local authority early years advisor which highlighted the ‘quality of interactions between children and nursery practitioners which support and extend children’s learning’ (Early years advisor note of visit 2.10.16). This review also noted the high levels of engagement children showed in a range of practitioner-led and independent learning experiences outdoors and indoors and learning intentions which were made clear by practitioners and supported by the learning experiences on offer for children. The nursery provision was therefore considered to be an example of exemplary practice.

The school’s most recent Ofsted inspection in 2009 highlighted technology use across the curriculum as an area for development. The school responded to the Ofsted report by buying a set of Apple iPod touch devices for classroom use throughout the school. These were used in a variety of ways that included children practising mental maths skills using an app and making films as an alternative to written work in English and history lessons. In 2014, the school bought different forms of tablet technology to replace the iPod touches and in response to the need for children to develop digital literacy. The deputy head teacher had interpreted aspects of digital literacy as

---

6 School data for 2014/2015 taken from RAISEonline.
children’s ability to operate a range of different digital technologies. This understanding of digital literacy was reflected in the decision to buy three different types of touch screen tablets for children to use across the school and in different age phases - Hudls, iPads and LearnPads. Sets of 15 tablets were shared between classes and at the time of this research few class teachers had begun to use them. Where the devices were used, teachers frequently relied on apps to practise mathematical or literacy skills. All the classrooms in the school had an IWB and a PC used primarily to produce finished examples of work, create presentations or search for information. The school also had an ICT suite with 20 PCs that every class except the nursery had access to at least once a week.

In 2014, changes to England’s Primary National Curriculum (PNC) introduced the new subject of Computing to replace the subject Information and Communications Technology (ICT). Computing is concerned with how computers and computer systems work in addition to the previous ICT curriculum focus on using technology to exchange and share information, find things out, and reviewing, modifying and evaluating work (Berry, 2013). The head teacher had redesigned the school curriculum to incorporate the changes in the PNC to teach computing including coding in addition to technology used to support other curriculum subjects.

**The nursery**

The nursery was located in a building separate from the main school on the other side of the school playground and had its own outdoor area for the nursery children separate from the main school playground. The main nursery classroom was large and well-resourced with clearly-defined spaces for different curriculum areas. There was also a smaller area leading from the main classroom which had been set up with musical instruments and a CD player for children to use independently. The learning areas in the classroom, such as the book area (see Figure 4.1), were clearly defined by the nearby resources and/or activities set out by practitioners (see Figure 4.2) before the children entered nursery for the morning and afternoon sessions. There were displays of children’s work on the walls at different heights around the room as well as displays on surfaces at child level.
Figure 4.1: Nursery book area with displays of children’s work

Figure 4.2: Post office role-play area set up by practitioners
There were opportunities throughout the setting for children to be physically and mentally active and the classroom environment offered opportunities for children to be independent. They could freely select and use resources, materials and equipment that were stored in accessible containers, with pictures as content labels. The containers were placed so children could easily reach and open the containers and retrieve the resources they wanted to use and replace them afterwards. Digital media in the classroom for the children (see Figure 4.3) consisted of an internet-connected desktop computer (PC) and an interactive whiteboard (IWB) connected to a second PC for practitioners' use. During the 2015 spring term the school also bought a set of 15 LearnPad tablets for the early years classes. The IWB and the two desktop computers were located in the same area of the classroom near the carpet area where children gathered for group learning activities. These devices were pre-loaded with a range of interactive games and drawing programs children could select and use independently. There were remote-controlled cars and an audio cassette player for children to use, and practitioners had digital cameras the children occasionally used as part of practitioner-led focus activities.

Figure 4.3: Location of the IWB and desktop computer

The outdoor area (see Figure 4.4) was attractive and organised with similar curriculum principles to those guiding the provision indoors. The ‘garden’ was originally a
tarmacked playground which Vicky had transformed by constructing planting areas and painting murals on the walls, and adding resources such as books, and drawing and painting materials children could use outdoors. The strategies of curriculum planning and organisation applied equally to the outdoors and indoors. The outdoor area was an additional classroom where children could take risks and explore the natural world and experience a wide range of activities not afforded indoors. Children could select and move large construction equipment such as planks and tyres, and use the large sand tray, scooters, planting areas, balls and climbing equipment that were permanently available outside. Around the outdoor area were small areas to sit and raised planting beds and pots made from old tyres stacked and filled with soil. These were planted throughout the year by Vicky and the children with a selection of flowers and vegetables. There was also a mud garden constructed by the children in response to their interest in digging in the planted areas of the garden.

Figure 4.4: The nursery outdoor area

The indoor and outdoor areas were organised to provide key learning experiences in curriculum areas and encourage flexibility and independence. In addition to the continuous provision of resources available for children to choose, practitioners set up activities outdoors and indoors on tables and the floor around the room before each nursery session. On a typical day, for example, this included:
• a puppet theatre and selection of story-related puppets and props in the reading area
• a train track built for children to add to, or change
• a selection of puzzles
• magnifying glasses with a selection of objects to look at
• books about mini-beasts and different plastic mini-beasts with paper and drawing tools
• magnetic letters and a large magnetic easel/whiteboard with whiteboard pens
• large mirrored numbers and a selection of natural objects
• play dough with modelling tools
• boats and plastic fish with glitter in the water tray
• large playground chalks outside
• a chalked, numbered scooter racetrack outside
• large dice and a 100-square number mat outside

**The practitioners**

The nursery staff consisted of a classroom teacher - Vicky - and two early years educators (EYEs). Vicky was a qualified teacher with more than 25 years’ experience in a range of mainstream and special settings. She had been a nursery teacher for eight years and had worked in the nursery at Ferny Croft for two years. At Ferny Croft, Vicky led a team of two EYEs - Huma and Karen - both of whom had an NVQ level 3 early years qualification. Huma had worked at Ferny Croft for seven years and Karen had been at the school for two years. Both EYEs expressed an interest in the research. Huma wanted to develop her practice and teaching strategies to use digital media more effectively in the classroom and was aware that she was not doing enough to facilitate children’s use of the IWB and classroom PC. Karen also wanted to extend her knowledge of ways to use digital media to support children’s learning other than ‘showing them [the children] how to turn it on, how to log on, how to control the mouse, how to use the pen to navigate’ (interview 29.1.15). For the first six weeks of the Spring term there were two first year BEd students from a local university working in the nursery as part of their first block school experience. One day a week the school English as an additional language (EAL) support teacher for the early years and key stage one classes (3-7 years old) worked with groups of nursery children directed by Vicky and also interacted with children during free-flow play.
As the classroom teacher Vicky’s role was one of leadership. She was responsible for planning and leading children’s learning and guiding other practitioners. Although the EYEs had input into planning daily free-flow activities and their own practitioner-initiated activities this was always closely monitored by Vicky to ensure these activities were appropriate and related to children’s interests and developing capabilities and needs. In this sense Vicky had a strong presence in the classroom and in shaping the learning environment. Although the initial intention had been to focus equally on Vicky, Huma and Karen early on it became evident that the strong leadership role played by Vicky necessitated focusing on her and her responses to the research and the intervention. This focus provided a contextualised understanding of the barriers to digital media uptake in early years classrooms in order to develop a solution tested in situ that could be used in similar classrooms.

Vicky and I developed a collaborative relationship during the research based on our previous experience of working together as colleagues in another nursery setting. Vicky allowed me to implement suggested changes to classroom practices and these were discussed before suggesting further changes. However, although we worked closely to develop an effective intervention she was not a co-researcher in terms of the overall intervention design or data analysis. Co-researcher suggests an equal role in all aspects of the research. This was not the case here. We had a close working relationship based on mutual trust and professional knowledge of early years practice. Vicky was involved in the research through discussions of emerging findings and proposed intervention development but these developments were proposed by the researcher in response to ongoing discussions. Huma was also part of some discussions about what worked and why, but it was Vicky to took the lead in implementing change, and directing and encouraging other practitioners in developing their practice around digital media. In this sense the focus on Vicky was in many ways determined by her and the EYEs response to the research and the intervention. This is also in keeping with the aims of design research to develop contextualised understanding of a problem as it occurs in real world classrooms and design solutions accordingly. In this classroom the strong role played by the teacher was a factor in how the intervention was developed and implemented, as well as what worked any why.

**The children**

Most of the children in Vicky’s class had started nursery in September 2014, but six children had been in the class for at least one term prior to my first visit at the start of
the Autumn term. There were eight children in the class for whom English was not their first or only language and who were at different stages of learning English; some were already fluent speakers of English while others started nursery with little knowledge of English. Table 4.2 is a pseudonymised list of all the children in the class showing their gender and home language status. The children were all aged between 3 and 4 years old. Two of the children who started in September had identified speech and language needs and over the course of their first term three additional children were referred for an assessment for speech and language therapy.
Table 4.2: Ferny Croft primary school morning nursery pseudonymised class list

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Gender</th>
<th>Home language</th>
<th>English speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zarina*</td>
<td>F</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Mounir*</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Maryam*</td>
<td>F</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Harry*</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Matt</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Aaron*</td>
<td>M</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Cameron</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Michelle*</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Felicity</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Ellie</td>
<td>F</td>
<td>both</td>
<td></td>
</tr>
<tr>
<td>Iraj</td>
<td>M</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Emily</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Fifi</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Niamh</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Flora</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Zita</td>
<td>F</td>
<td>both</td>
<td></td>
</tr>
<tr>
<td>Danny</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Michael</td>
<td>M</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Chris</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Mack</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Sam</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Olivia</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Alessandro</td>
<td>M</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Suzy</td>
<td>F</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Farhad</td>
<td>M</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

* Children present in class for at least one term before September 2014
Classroom organisation of teaching and learning

Vicky’s organisation of teaching and learning throughout the day reflected her pedagogical beliefs about young children’s learning and development; statutory and school assessment practices; the Early Years Foundation Stage (EYFS) curriculum outcomes for learning and development, and her knowledge and understanding of children’s needs and interests. Each three-hour morning and afternoon nursery session followed the same routine and was split into two practitioner-directed teaching times and a free-flow play session. In the morning, children came into the classroom from 9am onwards and self-registered by placing their names on a board on the wall. They were then free to play until ‘group time’ at 9.15. This practitioner-directed whole class session lasted for no longer than 15 mins and children were sometimes split into smaller groups led by Vicky and the EYEIs according to the activity or children’s individual needs (SEN, EAL). After this, children were free to play indoors or outdoors until ‘tidy-up time’ at 11.30 after which there was a second ‘group time’ until the children went home at 12pm. Through the use of practitioner-directed group time and free-flow play Vicky sought to achieve a balance between practitioner and child-initiated learning and incorporated practitioner observations of children’s developing interests and needs into all aspects of teaching and learning. In this integrated approach (Wood, 2010, 2013) to curriculum and pedagogy Vicky’s planning and pedagogical decisions were informed by children’s choices, capabilities and developing knowledge as well as being guided by the EYFS curriculum outcomes.

A strong feature of the learning environment was the different roles adopted by practitioners and children throughout the day and the different pedagogical approaches these represented. Table 4.3 shows the mix of practitioner-directed and child-initiated activities ranging from pre-planned, structured practitioner-directed teaching sessions to children’s self-initiated free play. Between these two pedagogical zones (Wood, 2010; 2013) were activities with differing degrees of structure depending on the roles practitioners adopted and the decisions they made about how and where to spend their time and with what purpose. The degree of structure related to the extent to which activities were pre-planned with defined learning intentions or unstructured free play, and the roles practitioners played. During practitioner-directed, whole class and small group teaching, Vicky’s perception of her role was to introduce and explain new skills and knowledge during activities which frequently used the EYFS curriculum as a guide for what counted as legitimate knowledge. The children had limited influence over
these activities, their role was to individually receive and make sense of this knowledge and, when called upon, to demonstrate their understanding of it. Children asked questions during practitioner-directed sessions, but only when invited to do so. Vicky planned the twice-daily practitioner-directed activities, and her learning intentions determined the direction of learning.
Table 4.3: Pedagogical approaches observed in class and the degrees of structure governing them

<table>
<thead>
<tr>
<th>Organisation of learning</th>
<th>Pedagogical approach</th>
<th>Learning outcomes</th>
<th>Degree of structure and practitioner role</th>
<th>Rules of participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practitioner-directed whole class</td>
<td>Planned, structured whole class teaching, carpet session</td>
<td>Pre-defined learning intentions (LI)</td>
<td>Tightly controlled, practitioners deliver skills and knowledge, children follow instructions and receive knowledge determined by practitioners, little choice</td>
<td>Governed primarily by curriculum elements, compulsory participation, strong behavioural rules</td>
</tr>
<tr>
<td>Practitioner-directed small group</td>
<td>Planned, structured small group teaching, carpet session</td>
<td>Pre-defined LI, according to children’s needs and knowledge</td>
<td>Tightly controlled, practitioners deliver skills and knowledge, children follow instructions and receive knowledge determined by practitioners, little choice</td>
<td>Governed primarily by curriculum elements, compulsory participation, behavioural rules</td>
</tr>
<tr>
<td>Practitioner-directed, 1-1</td>
<td>Planned, practitioner-directed structured 1-1 teaching during free-flow play</td>
<td>Pre-defined LI, according to individual children’s needs</td>
<td>Practitioners deliver skills and knowledge, children follow instructions and receive knowledge determined by practitioners</td>
<td>Governed by curriculum and developmental needs, compulsory/voluntary participation</td>
</tr>
<tr>
<td>Practitioner-led focus group</td>
<td>Planned focus groups during free-flow play</td>
<td>Some defined LI, planned according to children’s interests, knowledge and needs</td>
<td>Practitioners lead activities but take account of children’s interests and needs, limited choice and flexibility</td>
<td>linked to curriculum elements, voluntary participation, behavioural rules</td>
</tr>
<tr>
<td>Structured free play</td>
<td>Child-initiated play with resources set-up by practitioners</td>
<td>Loosely defined LI</td>
<td>Little intervention or direction, children as active explorers, some choice</td>
<td>Voluntary participation, free access to resources, governed by children’s interests</td>
</tr>
<tr>
<td>Unstructured free play</td>
<td>Child-initiated and led play</td>
<td>No defined LI</td>
<td>Little intervention or direction, children lead activities, choice and flexibility for children</td>
<td>Voluntary participation, free access to resources, governed by children’s interests</td>
</tr>
</tbody>
</table>
Outside practitioner-directed teaching sessions, children took part in free-flow play when they selected activities and resources and made choices about what they wanted to do and the direction they wished to take their play. Children also chose where and with whom they wanted to play and could move ‘seamlessly’ through the different indoor and outdoor learning spaces. Free-flow play provided moments when practitioners might choose to intervene in child-initiated play to support and extend learning. When practitioners interacted with children during free-flow play they were frequently guided by children’s interests and choices rather than pre-planned learning intentions. Practitioners acted to move play forward in the direction indicated by the children and by helping to resolve the problems they encountered. Interventions in free-flow play were more often a collaborative endeavour with a shared motive as practitioners took account of what the children wanted to achieve and how their interventions could support children’s needs and interests.

**Planning for learning**

The most visible forms of planning were the weekly planning documents that described the practitioner-directed ‘carpet sessions’. Vicky’s weekly plans outlined the daily activities and the intended learning for these teaching times at the beginning and end of each half day session. Each whole class teaching session was planned around children’s developing needs and capabilities with a written learning intention (LI) linked to a curriculum area of learning and development, and a related skill. In the example of weekly planning (see Figure 4.5) the learning intention is related to the EYFS curriculum Early Learning Goal\(^7\) (ELG) for Communication and Language - Listening and Attention:

> Children listen attentively in a range of situations. They listen to stories accurately anticipating key events and respond to what they hear with relevant comments, questions or actions. They give their attention to what others say and respond appropriately while engaged in another activity. (Department for Education, 2017, p. 10)

and Mathematical Development - Shape, Space and Measure:

> Children use everyday language to talk about size, weight, capacity, position, distance, time and money to compare quantities and objects and to solve problems. They recognise, create and describe patterns. They explore characteristics of everyday objects and shapes and use mathematical language to describe them. (Department for Education, 2017, p. 11)

\(^7\) The EYFS early learning goals are the skills and knowledge children are expected to develop by the end of the foundation stage at five years old.
Class: Nursery  Teacher: Vicky Lake  Term: Autumn 2014  Week: 4  22.9.14

Theme(s): Settling, adapting to changes, getting to know each other, building trust.
Special events: Starting school
Key vocabulary: apple class, orange class, staff names, new, different, same, happy, worried, frightened, sad, angry, vocabulary for nursery equipment, mum, dad, brother, sister, dark, night time, nocturnal
Counting rhyme: 10 little owls - Education city/Espresso 10 little ducks
Maths focus: size vocab - tiny, small, smaller, big, bigger, huge, enormous
Book / text: Owl babies  Song(s): There’s a wide-eyed owl banana song

<table>
<thead>
<tr>
<th>Beginning of the morning</th>
<th>Morning adult roles</th>
<th>End of the morning</th>
<th>Beginning of the afternoon</th>
<th>Afternoon adult roles</th>
<th>End of the afternoon</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monday</strong></td>
<td>Good sitting</td>
<td>All-Getting to know the children. Observing the children, identifying interests. Encourage children to explore their new environment. Relationship building with parents and carers.</td>
<td>'What’s in the box?' game Have a box with a variety of animals in it Sing the 'What’s in the box?' song, give the children a descriptive or sound clue, can they guess? Invite a child to come and pull it out of the box, did they guess correctly? Recap the clue with the animal we found and extend the description as we look at it.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>All-Getting to know the children. Observing the children, identifying interests. Encourage children to explore their new environment. Relationship building with parents and carers. Support Lucy in sitting/attending/understanding.</td>
</tr>
<tr>
<td></td>
<td>Sing ‘hello’</td>
<td></td>
<td>‘What’s in the box?’ game Have a box with a variety of animals in it Sing the 'What’s in the box?' song, give the children a descriptive or sound clue, can they guess? Invite a child to come and pull it out of the box, did they guess correctly? Recap the clue with the animal we found and extend the description as we look at it.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>All-Getting to know the children. Observing the children, identifying interests. Encourage children to explore their new environment. Relationship building with parents and carers. Support Lucy in sitting/attending/understanding.</td>
</tr>
<tr>
<td></td>
<td>Introduce apple class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Introduce apple class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
<tr>
<td></td>
<td>Good sitting</td>
<td></td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
<td>Good sitting Sing ‘hello’ Introduce orange class name Story - A new house for a mouse Encourage children to guess what might live in the holes, point out the relative size of each hole to encourage children to name a bigger animal.</td>
</tr>
</tbody>
</table>

Figure 4.5: Example of nursery planning showing practitioner-directed whole class teaching and focus activities

---

8 Highlighting of individual practitioner activities in original documents
Weekly planning documents included a description of the practitioner-initiated focus activities that each of the three practitioners organised one day a week. These focus group activities were planned by the practitioners leading them and were often in response to children’s developing interests and needs as observed by practitioners. Although the learning intentions for these were not written, Vicky had clear learning intentions for these activities ‘in my head’ (interview 27.5.15) and she guided the EYE to ensure the focus activities they planned had a definable learning intention. There was also space on the planning document for the practitioner-directed activities undertaken by other practitioners in the classroom such as the EAL teacher and the student teachers when they were in school. The only other form of written planning in evidence was the medium-term plans Vicky completed for each half term (see Appendix 3). These outlined the main focus of the children’s learning and development in each of the curriculum areas across the half term as part of the nursery’s on-going continuous provision

In addition to the visible planning sheets displayed on the nursery wall, there was evidence of Vicky’s invisible pedagogical planning (Bernstein, 2000). Pedagogical interactions were not only face-to-face with children but included the indirect interactions that were part of practitioners’ planning for interaction rather than their reactive unplanned actions (Siraj-Blatchford, Sylva, Muttock, Gilden, & Bell, 2002). Invisible planning encompassed everything Vicky and other practitioners did as part of their pedagogical decision-making that had an impact on children’s learning. This invisible planning included decisions about classroom routines, resources made available to children, and the way in which practitioners set up the classroom each day. Practitioner decisions about whether or not to intervene in children’s play and their decisions about where to be in the classroom to be available to children were also forms of invisible planning. The ways Vicky guided the early years educators during discussions about their observations of children and the next steps the EYE planned for children’s learning was evidence of the way invisible planning shaped children’s learning. Children learned through practitioners’ direct interactions as well as the indirect interactions that were part of practitioners invisible planning and decision-making.
**Intervention design**

In most instances EDR sets out to test existing theoretically derived design principles. However, this may be difficult in cases where there do not appear to be existing design principles to test. This can mean using design principles that are a ‘best fit’ solution to the particular problem based on literature and previous research in a related field. These may then be proved, disproved or altered through the intervention (Reeves et al, 2011). Given the emerging status of pedagogy related to digital media use in early years settings (identified in Chapter 2) the design principles developed and tested by this intervention used a ‘best fit’ approach, and drew on socio-cultural theories of learning and empirical research related to practitioners’ use of digital media with young children. The intervention design also took into account the classroom learning environment as well as Vicky’s stated desire to find better ways of using the IWB as part of her teaching.

The intervention was designed to address beliefs, a lack of practitioner use of technology, and to provide contextualised episodes to develop pedagogy. The research literature shows that changing beliefs is a long-term process and can be addressed using evidence-based research designs (Ashton, 2014). Practitioners may need to trial new practices and reflect on pupil reactions before they are able to challenge existing beliefs and construct new ones (Nespor, 1987; Pajares, 1992). A key part of this reflective process is practitioners’ awareness of pre-existing beliefs and their ability to challenge them through practice and be open to an evaluation of their beliefs (Kagan, 1992). The inclusion of reflection as one of the design principles was to address beliefs within the context of changing practice around technology. The teacher’s lesson planning also provided ways to enact change by directing practice towards creating an intervention that was in keeping with the practitioner’s beliefs about pedagogy. The intention was not to attempt to change Vicky’s pedagogical beliefs about early years practice but to reorient her pedagogy to include technology.

The intervention addressed beliefs about pedagogy in relation to the use of practitioner-directed activity by encouraging practitioner interaction with children’s digital game play rather than focusing on teaching skills. The aim was to extend these interactions beyond operational aspects of technology as these interactions were disliked by the practitioner and did not support children’s use of games and their social interaction. Planning was introduced to encourage Vicky to use digital media in
different ways and in different curriculum contexts. There is a strong relationship between beliefs and pedagogy (Nespor, 1987, Pajares, 1992) and beliefs are strong predictors of the way teachers behave in the classroom and the decisions they make about teaching and learning (Buehl & Beck, 2014). Reshaping beliefs requires reflection on existing beliefs and practices to see whether they hold true (Nespor, 1987). This suggested the need to address practitioner beliefs by developing new practices with digital media and reflecting on changing practice so that Vicky could become aware of her pre-existing beliefs and practice and how these might change through the intervention.

The collaborative nature of EDR and its focus on context meant it was important the proposed intervention could fit into the existing classroom learning environment so that sustainable change in practice might be possible. For this reason, the design principles were also designed to be sympathetic to the approach to young children’s learning in evidence in the classroom and as part of Vicky’s pedagogical beliefs. The intervention strategy was not constructed directly with Vicky or the EYE but it was shared with them before implementation to gain their understanding and acceptance of it. At this stage practitioners did not ask for any changes. Developments to the intervention were discussed with Vicky at the end of each cycle and during these conversations Vicky did suggest changes and additions for the following cycle. These changes and Vicky’s suggestions are described in Chapter 5. The summary of the individual design principles and their rationale is presented in Table 4.4, which shows how five design principles related to three key areas of intended change: practitioner/child interactions using digital media; planning for digital media use; and practitioner reflection. These design principles were developed from the local theory of instruction, literature relating to digital media integration and teacher beliefs, and socio-cultural theories of learning.
Table 4.4: Summary of design principles used to drive the intervention

<table>
<thead>
<tr>
<th>Design principle</th>
<th>Related theory or literature</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Vicky to plan to use digital media with children</td>
<td>Extension of existing classroom practice, literature around pedagogy and ICT in primary classrooms (Somekh, 2007)</td>
<td>Planning</td>
</tr>
<tr>
<td>4. Planning should take into account what digital media can add to learning</td>
<td>Literature showing a lack of pedagogy around use of technology to support learning (Aubrey &amp; Dahl, 2013; Flewitt, 2011; Plowman &amp; McPake, 2013; Plowman, Stephen, &amp; McPake, 2010b; Drew, 2014)</td>
<td>Planning</td>
</tr>
<tr>
<td>5. Provide time and space for reflection on the intervention and changing practice</td>
<td>Literature around teacher beliefs (Nesper, 1987; Pajares, 1992)</td>
<td>Reflection</td>
</tr>
</tbody>
</table>

The first design principle was for practitioners to interact with children using digital media as part of free-flow play. The second design principle supported this first principle by encouraging practitioners to use digital media in meaningful ways that followed children’s interests. This drew on socio-cultural theory relating to the importance of socio-cultural contexts for teaching and learning in which learning occurs by children participating in socially meaningful activities and culturally relevant situations in which they have some control over learning. In this learning situation practitioner interactions are also used to extend children’s learning by responding to their interests with a clear understanding of the knowledge to be developed (Wyse, 2010). The third design principle was for practitioners to extend classroom planning to include the use of digital media as part of teaching and learning. Given the emerging status of pedagogy for digital media use in early years settings this design principle drew on a planning framework for ICT integration in primary schools (Somekh, 2007). Somekh’s generic pedagogic framework provides a starting point for thinking about ways to integrate digital media into the classroom by starting from the planning stage and relating planning to curriculum outcomes. The fourth design principle was designed to encourage practitioners to actively consider how digital media could
support learning in ways that took account of the unique features of the technologies rather than being included as an ‘add-on’ to planned activities. The fifth and final design principle was related to the need for practitioners to have time and space to critically reflect on practice as part of their goal to enact change.

The intervention was implemented during one academic year (2014/2015) and included a pre-intervention baseline phase and three cycles of implementation and development (see Table 4.4). At the end of each phase and cycle the intervention was evaluated to determine what was effective and what hindered its effectiveness. Evaluation included an interview with Vicky and Huma and an initial analysis of all data collected. This allowed evaluation to be in collaboration with participants and informed by the data. These activities informed modifications to the original design principles for the following phase or cycle of the intervention. The findings of each phase and intervention cycle were carefully documented together with the resulting modifications to the intervention (see Appendix 4).

**Table 4.5: Date and length of intervention phases and cycles**

<table>
<thead>
<tr>
<th>Phase of research</th>
<th>School term and date of data collection</th>
<th>Length of phase/cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase one: Pre-intervention baseline</td>
<td>Autumn 1: September 8,-October 17, 2014</td>
<td>Seven weeks</td>
</tr>
<tr>
<td>Phase two: Cycle 1</td>
<td>Autumn 2/Spring 1: October 27, 2014-February 13, 2015</td>
<td>13 weeks</td>
</tr>
<tr>
<td>Phase two: Cycle 2</td>
<td>Spring 2: February 23-April 1</td>
<td>Six weeks</td>
</tr>
<tr>
<td>Phase two: Cycle 3</td>
<td>Summer 1 and 2: April 27-May 22, June 1-July 3, 2015</td>
<td>Nine weeks (excluding half term)</td>
</tr>
<tr>
<td>Phase three: Post-intervention evaluation</td>
<td>Summer 2: July 6-10, 2015</td>
<td>One week</td>
</tr>
</tbody>
</table>

The length of the phases and cycles was largely determined by the nature of the school year which consists of three terms of approximately 12 weeks each divided into two half terms. The holidays at the end of each term provided natural breaks during which it was possible to reflect on and evaluate the intervention with Vicky before discussing possible modifications for the beginning of the following term or half term.
Ethical considerations and procedures

Research ethics are founded on educational researchers’ responsibilities towards research conduct, with an ‘ethic of respect’ for participants, knowledge, the field of education and the quality of research (British Educational Research Association [BERA], 2018). BERA (2018) ethical guidelines also refer to the essential element of trust between researcher and researched that should be part of ethical research. Ethical considerations and decisions are defined and guided by what a researcher believes to be ‘right and good’ (Mortari & Harcourt, 2012) as well as what has been established as ethical research within a particular field. Ethical considerations begin before data collection starts and continue long after the research has been completed and written up, particularly when research includes young children. This research followed BERA ethical guidelines and was mindful of particular ethical issues that arose during the course of the research. The research was also passed by the UCL, Institute of Education student research ethics committee. Although BERA guidelines provide a framework within which to think through the ethical dilemmas and challenges researchers encounter in research they do not provide answers as to how to manage specific situations that might arise in the course of research (Wiles et al., 2008). As discussed below, researchers applying an ethic of respect may find themselves facing tensions or challenges (BERA, 2018) particularly when participants include young children.

Gaining consent

Working with young children presents ethical challenges for researchers when explaining the research to children and gaining their voluntary informed consent. Morrow and Richards (1996) argue there are two main issues to address: ‘informed consent’ and the protection of those taking part. There are three parts to informed consent; ‘informing’ and ‘consenting’ the fact that consent should be given voluntarily. Only when participants understand their role and the purpose of the research and signify voluntary consent is ‘informed consent’ said to be given (Mayne, Howitt, & Rennie, 2016). Gaining informed consent can be particularly challenging with young children in order to adequately ensure children understand the reason for the research and their role in it, and that they are free not only to make that choice but also change their minds at any time.
Young children may not have the capabilities to understand all aspects of the research to the same extent as adults, but it is important that they understand the information that is given to them (Mayne et al., 2016). This raises the question of what information children should receive in order to make an informed choice about participation and how best this information can be delivered. Researchers need to consider a balance between providing too much and too little information, and information that may be too simplistic or too complicated (Dockett, Einarsdóttir, & Perry, 2012). Giving too much information at the start of a project may confuse and overwhelm children (Gray & Winter, 2011) while not giving enough information runs the risk of children not having the information needed to make an informed choice. Information about research and their involvement should be given in a way that young children can understand (Mayne et al., 2016). This may mean finding ways of informing children that they are familiar with and that are appropriate to children’s developing language and communication. Consent is not meaningful if children do not understand the purposes of the research and what is required of them (Mayne et al., 2016).

The terms consent and assent are frequently used interchangeably when referring to children’s decisions to participate in research (Mayne et al., 2016). Consent is used for both adults and children to indicate they are capable of making an informed decision about research participation (Faden, Beauchamp, & King, 1986). Assent is frequently used to indicate agreement by children who may not understand fully the research and their role in it, or minors who have no legal right to consent (Alderson & Morrow, 2004). Use of the term assent has been criticised by those who suggest it refers to a lower level of understanding (Balen et al., 2006) or that the use of different terms suggests an imbalance of power between children and adults (Gray & Winter, 2011). However, assent is based on the same principles as consent (Mayne et al., 2016) and may be used in situations where a child signifies their willingness to participate by the fact that they are taking part in an activity undertaken as part of research (Bourke & Loveridge, 2014). Assent also implies an on-going mutual process between child and researcher rather than a one-off giving of permission (Mayne et al., 2016).

In this dissertation, the terms consent and assent are used to describe children’s permission at different stages of the research as consent is fluid and on-going (Flewitt, 2005; Gray & Winter, 2011). Children’s feelings towards research may change hence consent is provisional and may need to be renegotiated (Dockett et al., 2012).
particularly when a project occurs over time and involves different forms of participation (Flewitt, 2005). Consent is used to refer to children’s initial agreement to be part of the research and the consent received from parents. As used in this dissertation assent describes children’s on-going agreement, or not, to take part in specific events and activities. Dockett et al, (2012) use the term ‘dissent’ to describe children’s ‘non-agreement to take part in specific experiences (op. cit. p. 245). Their reference to ‘specific’ activities suggests children may consent to research as a whole but choose not to take part in some activities connected to the project. Dockett et al (2012) found that children as young as two years old were able to signify their unwillingness to participate in research through words or actions such as showing disinterest or discomfort. Flewitt (2005) also showed that children 3-4 years old were competent and confident enough to grant and withdraw consent. In this research I did not assume that children’s consent given at the start of the research was fixed. I was mindful of the fact that children may change their mind at any stage of the research and that their dissent could be signified verbally or through body language, facial expression or changing engagement.

Consent was received from all those involved in the research including school gatekeepers – the head teacher and school governors – and two BEd students who joined the class during the data collection period. Parents and practitioners were informed of the research and given the opportunity to ask questions before signing a formal consent form (see Appendix 5). The parent consent form included a letter describing the purpose of the research and both their and their children’s role in it (see Appendix 6). A letter and consent form were given to parents and practitioners to take home and they had the opportunity to individually ask questions before signing. In most cases the consent form was signed in my presence and I had the opportunity to confirm parents and practitioners understood the research and their involvement. Parents and practitioners were made aware orally and as part of the consent form that they could withdraw from the research at any time and that their names would be anonymized. Practitioners and parents were informed that anything said during interviews and any video or audio recorded data would be kept strictly confidential, stored in a secure location and only used for the purposes of the research. As data included observations of teaching I was clear as to who would, and would not, have access to the recorded data. Practitioners were informed that anything they said or did would be kept strictly confidential to minimise the risk of any adverse effect on their
self-esteem or position within the school. As the proposed design research approach necessitated a close working relationship with practitioners it was particularly important they were made fully aware of what was involved in the research process and how it could affect their own practice before deciding whether or not to take part in, or indeed withdraw from, the research at any point.

Negotiating consent with parents took place over several weeks as new parents entered the nursery over the course of one half term at the beginning of the academic year. During this initial ‘negotiation’ period informal observations of classroom routines and teaching took place, but no video or audio data were collected. As an interpretive study the strength of the relationships developed between researcher and participants early on in the research process can have an impact on the progress and outcomes of research (Flewitt, 2005). It is critical to establish a research relationship with children (Harcourt & Conroy, 2011) based on mutual trust and participants’ informed understanding of the research and its purpose. This relationship may go some way to address the power dynamics that may present a barrier to collecting data from children (Roberts-Holmes, 2005) and adults. A period of time before asking for consent can give participants time to become comfortable with the research and the researcher (Flewitt, 2005) hence my decision to spend several weeks in the classroom before asking for formal written consent from parents and practitioners. Gaining parents’ trust was greatly helped by my presence in the classroom at the beginning of the academic year when parents were settling new children into the nursery as this provided extended periods to get to know parents and informally discuss the research and their child’s involvement. Parents could get to know me and ask questions about the research and this proved invaluable when asking for parental consent before beginning data collection.

Although permission was gained from parents for children’s participation this was considered ‘proxy consent’ (Mayne et al., 2016) as it did not meet the need to gain the children’s consent to participating in the research. Children were informed about the research through the use of a digital picture book I wrote for this purpose which was shared with them as part of a whole class activity. The children were familiar with the use of picture books to introduce and discuss issues such as friendship and sharing as well as topics such as Easter or mathematical concepts and I had used picture books this way in my own practice. I was therefore comfortable with this way of presenting
and discussing information and felt it appropriate in this context. I informed children they would be able to change their minds about taking part at any time during the research process as children need to feel that they have some control over the process in order to give them an element of power and redress the balance of power between the researcher and participants (Flewitt 2005). As children may not always be free to make a voluntary choice when part of a group (Faden et al., 1986) I asked parents to discuss the research with their child at home.

Consent was never assumed but always negotiated before videoing, audio recording or note-taking sessions with children and adults. As it was important children did not feel compelled to take part in research activities if asked to do so, they were always given the opportunity to take part at a later time. The fact that throughout the research children agreed to take part in some sessions and not in others indicated their competency to assent and dissent to research activities depending on their feelings at the time. I was also mindful of the ways in which children signified their dissent in different ways and stopped data collection at any signs of discomfort or distress even if this meant losing valuable data. The use of video in research with children raises ethical challenges related to consent and the need to preserve the anonymity of children who have not consented to participation. This necessitated disregarding some data or only filming when children who had given consent were present. The use of video data also raises ethical dilemmas given the way video displays the setting and identity of a place and not just the participants (Jewitt, 2008). This makes it difficult to completely anonymize images of children in the classroom (Flewitt, 2005). This was mitigated by ensuring that as far as possible all school identification features were not part of video recorded observations.

Although it is possible to address potential ethical issues during the research design there are occasions when ethical concerns arise while conducting research in the field. One way to address emerging ethical considerations is through a reflexive approach which distinguishes between procedural ethics (those considerations that need to be addressed in the initial design of research) and 'ethics-in-action' which refer to the everyday ethical issues that arise in the course of doing research (Guillemin & Gillam, 2004). In the messy contexts of early years classrooms these ethical dilemmas cannot be pre-empted but need to be addressed as they arise. In this research dilemmas arose in relation to my role as a researcher and my relationship with the school,
children and nursery practitioners. My role as a school governor and former early years practitioner, as well as my personal and professional relationship with Vicky, required negotiation as issues arose during fieldwork. It is not possible to resolve all the dilemmas faced by those engaged in educational research, but reflection on my role made it possible to take a step back from the research and address potential ethical issues.

**Researcher role**

A fundamental decision in interpretive research is the role of the researcher and recognition that both participant and researcher perspectives should be valued (Flewitt, 2011). The role of the researcher can be addressed by openly discussing the stance taken and how this may influence the data being collected as observers can change a situation just by their presence (Silverman, 2011). The use of EDR also raises particular issues related to the researcher’s role in the classroom as design researchers adopt both insider and outsider perspectives (Bell, 2004). Where a researcher focuses on applying theory rather than taking the participants’ words and perspectives as the starting point they may need take an outsider perspective (Robson, 2011). This is frequently the case in design research where interventions draw on relevant theory as well as insider understanding of the classroom learning ecology. As an ‘agent of change’ (Reinking & Bradley, 2008) design researchers are participants in the research and adopt an insider perspective when investigating the impact and effectiveness of an intervention from the perspective of participants (Bell, 2004). Design research is also a collaborative endeavour and researchers work closely with participants to develop an intervention. Hence, the researcher’s role in design research is a complex one and may shift over the course of the research.

Some authors suggest design researchers become observer participants (Gutierrez & Penuel, 2014) while others argue they cannot be dispassionate observers but need to adopt a participant observer role as taking part in activities will help to gain a better understanding of learning (Reinking & Bradley, 2008). Participation helps to build better relationships with teachers, parents and children but runs the risk of influencing the classroom learning environment and skewing the data (Reinking & Bradley, 2008). As an observer participant researchers may take part in some activities but are not members of the group being observed (Bryman, 2004) and their role as researcher is
clear (Cohen, Manion, & Morrison, 2011). The participant observer is a member of the group being investigated and may have ‘insider knowledge’ (Cohen et al., 2011). In EDR the difference between the roles of observer participant and participant observer may lie in the researcher’s decision about which classroom activities to participate in and when not to take an active role. There are decisions about which elements of the researcher’s role are directly related to the intervention development and which are linked to understanding the intervention effectiveness. In finding an identity, researchers frequently move between different roles over the course of their time in the field (Silverman, 2011) and design researchers may need to be both observer and/or participant at different stages of the research. Yin’s (2003) suggestion that the researcher may need to balance the risk of ‘unwittingly’ manipulating events against the research intentions and its philosophical underpinning is helpful in defining the design researcher’s role. Design research intentionally manipulates events and changes the learning environment through the use of an intervention and these ‘manipulations’ are carefully documented. It is this acknowledgement of the intervention impact that allows the design researcher to be a participant without always skewing the data. Nevertheless, the researcher needs to establish a role in the group being observed if they are to remain objective and address the ‘problematic’ features of observation (Silverman, 2011).

In this research I adopted the role of observer participant and took part in some activities. However, this role was not fixed and shifted over the course of the intervention phases and stages as necessitated by the nature of design research and my role as an agent of change. Observation can never be wholly objective (Ely, 1991) and observers always have some impact on those being observed (Torrance, 1993). As a peripheral member of the group being investigated it was difficult on occasions to maintain an objective stance. The complexities of negotiating a balance between observer and participant, and insider/outsider perspectives, were addressed by reflection and careful documentation of this shifting role in an intervention diary. The diary provided a reflective space in which to consider how and why my role changed at different points and the impact of these changes on the research. When discussing findings with practitioners at the end of the baseline phase and following each of the three intervention cycles, I became more outsider adopting the role of researcher to guide the intervention development. During the intervention implementation cycles my role was closer to that of observer in order to mitigate against skewing the data. There
were also occasions my role was closer to that of participant, such as when I supported children using digital media.

My role in the classroom as an observer participant was negotiated by mutual consent through my interactions with practitioners, parents and children and the decisions I made in response to events as they unfolded and particular dilemmas that arose. Early on in the research I decided it was important to distance myself from the stance of practitioner for several reasons. First, I was aware that my relationship with Vicky and my experience as an early years practitioner might influence the way I acted in the classroom particularly when interacting with children. What I did not anticipate was that practitioners might treat me differently from other researchers for the same reasons. I also distanced myself from the role of practitioner so that staff and children would feel comfortable with my presence and not act differently during my observations. I, therefore, chose not to participate in directed teaching nor did I become involved in behaviour management as these were activities I closely associated with teaching and the role of practitioners in the classroom. It was not always possible to maintain this stance as children do not make a distinction between adults in the classroom when they need help or assistance; in these instances the distinction between researcher and practitioner became blurred. It was also not possible to retain the stance of observer when children got involved in disputes or fights in the absence of practitioners. In these circumstances all adults have a duty of care, and not to intervene or offer help could be seen as a lack of commitment or credibility by practitioners working in the classroom.

My intervention diary showed there were occasions when my role as an observer was affected by the practitioners' knowledge of me as an early years practitioner and this raised particular dilemmas. On several occasions I was left alone for extended periods of time with groups of children and although this was a sign practitioners were comfortable with my presence and trusted me, I had to remind them that I should not be left responsible for children on my own. Practitioners’ acceptance of my role as an observer was also challenged when Vicky asked me to contribute 'useful' observations to children’s individual assessment records. This represented a blurring of the boundaries between observer, participant and practitioner. I recognised that my observations would help practitioners develop the next steps for children’s learning but I also felt that making observations of children was too closely associated with the
practitioner role. This dilemma was resolved by making a distinction between the observations I collected as part of my research and making additional observations for practitioners. Observations of children using digital media were shared with Vicky but I did not make observations explicitly for practitioners.

An important aspect of this intervention was the researcher’s role as a critical friend to Vicky and other practitioners. As a researcher my role was to design and implement an intervention and record the impact on beliefs and teaching and learning. However, by introducing change my role could also be described as an ‘agent of change’. In this sense, I was both observer and part of the intervention. This necessitated adopting a shifting role throughout field work, but one where the boundaries between observer and agent of change were clear. As an observer of change I did not aim to become actively involved in digital media use in the classroom. My actions as an agent of change were to facilitate discussion and reflection which took place out of the classroom and away from the use of digital media. I was careful not to confuse these two roles. As an agent of change I created opportunities to discuss how Vicky’s beliefs and practice were affected by the intervention and explored ways to develop the intervention in line with her developing practice with and shifting beliefs. I acted as a critical friend during reflective conversations about Vicky’s changing use of digital media and her shifting beliefs. My role as a critical friend was part of the intervention and one of the design principles outlined in Table 4.4. At other times, I was a researcher and did not take an active role in the classroom but remained an observer. I did not make changes while observing in the classroom or discuss what I observed at the time. These discussions were part of the process of reflection that took place after episodes of digital media use. I did not feel that these two roles were incompatible or contradictory in this project given that providing the time and space for reflection was an important element of the intervention design and clearly outlined as part of EDR approach and design principles.

Negotiating a role as a researcher includes awareness of the power relationship between researcher and participants particularly in EDR where the researcher is part of the intervention. This power relationship was something I reflected on as the following intervention diary extract shows: ‘I need to be able to talk to Vicky about her pedagogy without feeling that I am being critical and Vicky needs to be able to say when she feels uncomfortable with the process’ (Intervention diary 12.10.14). EDR begins with the
assumption that existing practices can be improved (Herrington, McKenney, Reeves, & Oliver, 2007) and so involves an element of evaluating those practices to look for areas of improvement. In such evaluations the question of who holds the greater power – practitioner or researcher – has to be considered. The researcher may hold the balance of power in relation to theory but practitioners are equally powerful in evaluating the success of an intervention and its impact on children's learning and their own practice. In this instance my experience as an early years practitioner and relationship with Vicky helped to maintain a balance of power between researcher and researched. There were opportunities during and after fieldwork for open dialogue between Vicky and myself during which Vicky spoke freely about the impact of the intervention. These ‘professional conversations’ gave Vicky a voice in the research and allowed me to respond to her concerns and observations about the intervention. My openness to the unfolding nature of qualitative research (Cresswell, 2003) rather than viewing EDR as an intervention designed by researchers and adopted and delivered by practitioners (Engeström, 2011) also helped mitigate the degree to which my own personal history and the complex role of design researcher might influence data collection and the classroom learning environment. I did not view the initial intervention design as fixed, but allowed it to evolve and change in response to both emerging findings and Vicky’s reactions to its implementation and impact on her practice.

**Researcher subjectivity and bias**

Robust research includes consideration of the many ways in which a researcher may alter what is being observed and recorded (Ely, 1991). Hence the ever present need to address researcher subjectivity because ‘the way we perceive and interpret events or even our choice of subject is governed by our own biographies and our own position within it’ (Foster, 1989, p. 196). Qualitative research relies on interpretation of what the researcher sees, hears and understands and these interpretations cannot be separated from the researcher’s background (Creswell, 2009). This inevitably leads to accusations of subjectivity and researcher bias (Stake, 1995, Yin, 2003) as observation is prone to bias which may compromise the researcher’s objectivity. However, the rationale behind qualitative design is not to produce data that can be verified as true but to promote further reflection and learning. As long as it is openly acknowledged researcher subjectivity can be a strength of qualitative research in its desire to understand a phenomenon (Stake, 1995).
In this research I addressed subjectivity by reflecting on my background, biases and preconceptions as an early years teacher and the beliefs and assumptions that underpin my pedagogical approach to early years education. It is not possible to ignore my background as an early years practitioner; the answer is to be ‘critically subjective’ in order not to impose assumptions and values on the research without first examining and acknowledging them (Stake, 1985). This reflexive process is all the more important if interpretation occurs within socio-cultural contexts that will have a bearing on how we approach data interpretation (Altheide & Johnson, 2011). I have a long-held interest in young children’s use of digital media and believe they have a valuable presence in early years classrooms. However, it is important that practitioners’ use digital media effectively for them to have a positive impact on learning and if children are to exploit digital technologies as a force for good. The strong belief that digital media has a role in early learning, and is effective when supported by practitioner interventions, made me alert to the need to openly consider the possibility that the intervention might show the opposite to be true. My belief in the importance of learning through play and limited use of planned directed teaching also has a bearing here as I did not want this belief to influence the intervention design and discourage Vicky from adopting other approaches to integrating digital media into teaching and learning. I was also aware that Vicky and I have similar beliefs about young children’s learning and I wanted to give Vicky the space to explore alternatives to her current practice. These potential biases, as well as any personal perspectives on the research topic, were addressed in the intervention diary. This reflective space facilitated reflection on how I positioned myself in relation to the research so that in reporting the findings the reader can judge whether bias has ‘unnecessarily’ influenced the results (Savin-Baden & Howell Major, 2013). Openly acknowledging my knowledge, background and experience mitigates the possibility of any biases unduly influencing the research and its findings. A degree of bias is inevitable, but as long as it is acknowledged bias can allow for a better analysis based on personal experience and understanding of the problem being investigated and how I chose to investigate it.

Data collection
EDR does not specify a preference about the use of qualitative or quantitative data but adopts a pragmatic approach allowing for data collection tools which match the questions being asked (McKenney & Reeves, 2012). Data collection tools used in this research developed an in-depth qualitative investigation and an understanding of the
impact of an intervention on the classroom learning environment of one nursery class. The aim was to understand rather than measure the changes that took place over the course of one year and investigate the characteristics of an effective intervention to develop approaches to teaching and learning to integrate digital media into early years classrooms.

The qualitative nature of this study and design-based research approach as well as the research questions required several stages and instruments of data collection to meet the need for depth and breadth. Table 4.6 shows different types of data collected during the stages of field work, and how the data collection tools corresponded to the different stages of EDR and the research questions. Data consisted primarily of interviews, video observations and field notes supplemented with research diaries and documents. The specific choices of interviews and observational data, particularly video data, as well as the use of field notes, diaries and documents are explored individually in the section below.
Table 4.6: Data collected at different phases of the intervention

<table>
<thead>
<tr>
<th>Phase of intervention</th>
<th>Aims of data collection</th>
<th>Data collection tools</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1: pre-intervention baseline (7 weeks)</strong></td>
<td>Baseline contextual information</td>
<td>Classroom observation field notes - daily routine, class timetable, resources, class layout, digital media use, child/teacher interactions</td>
</tr>
<tr>
<td></td>
<td>Understanding of the problem</td>
<td>Video observations of digital media use, practitioner interviews, discussions with children, planning documents</td>
</tr>
<tr>
<td></td>
<td>Understanding how current practice relates to theory, develop local theory</td>
<td>Video observations of teaching and practitioner/child interactions, semi-structured teacher interview, observational field notes, intervention diary</td>
</tr>
<tr>
<td><strong>Phase 2: intervention cycles (26 weeks)</strong></td>
<td>Intervention development to test and modify local theory</td>
<td>Video observations of teaching, reflective discussions with practitioners, observational field notes, analysis diary, intervention diary</td>
</tr>
<tr>
<td></td>
<td>Understand changing practice and beliefs, intervention effectiveness</td>
<td>Planning documents, audio recorded critical reflection with Vicky, practitioner interviews, video observations</td>
</tr>
<tr>
<td><strong>Phase 3: post-intervention (1 week)</strong></td>
<td>Understand changes to classroom learning environment and theory development</td>
<td>Semi-structured teacher interviews, video observations of practitioners and children using digital media, teacher assessments of children’s digital media use, analysis diary</td>
</tr>
</tbody>
</table>

*Interviews*

The use of interviews in addition to observations marked a desire to extend information gained through observation and allow the practitioners’ voices to be heard. Observations can show what is happening but they do not always provide information as to why. Interviews provide opportunities for participants to comment and reflect on classroom interactions and their meanings and can be described as ‘conversations with a purpose’ (Burgess 1988). An interview may take on the features of a conversation in terms of its spontaneity and apparent lack of structure but, unlike everyday conversations, interviews have a purpose and are prompted by a mutual interest (Cohen et al., 2011) in a topic that would not exist without the presence of the researcher. The choice of interview types and degree of structure will depend on the purpose of the interview and the research approach. Although literature outlines different types and uses of interview structures and styles (Bryman, 2004; Cohen et al.,
it can be difficult to accurately describe the nature of interviews as they occur in the field. Unless highly structured, interviews do not always follow a definable structure and may shift between degrees of structure, or lack thereof, depending on their purpose and the relationship between interviewer and those being interviewed. The shifting structure of interviews as they occur in the field may be needed in order to capture in as much depth as possible the thoughts and opinions of research participants.

Table 4.7 shows the date and type of interview data collected during field work. In order to maintain an accurate record of discussions between researcher and participants audio recorded interviews were transcribed. Semi-structured interviews allowed me to react to and explore particular points of interest in more depth as they arose during the interview (Yin, 2003).

**Table 4.7: Date and type of interview data collected from participants**

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Date</th>
<th>Type of interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vicky</td>
<td>31.10.14</td>
<td>Discussion* recorded in field notes</td>
</tr>
<tr>
<td>Vicky and Huma</td>
<td>10.12.14</td>
<td>Unstructured^ interview recorded in field notes</td>
</tr>
<tr>
<td>Vicky and Huma</td>
<td>5.1.15</td>
<td>Unstructured interview recorded in field notes</td>
</tr>
<tr>
<td>Vicky</td>
<td>15.1.15</td>
<td>Discussion recorded in field notes</td>
</tr>
<tr>
<td>Karen</td>
<td>29.1.15</td>
<td>Semi structured± audio recorded interview</td>
</tr>
<tr>
<td>Huma</td>
<td>29.1.15</td>
<td>Semi structured audio recorded interview</td>
</tr>
<tr>
<td>Huma and Vicky</td>
<td>12.2.15</td>
<td>Unstructured audio recorded interview</td>
</tr>
<tr>
<td>Vicky</td>
<td>12.2.15</td>
<td>Audio recorded discussion</td>
</tr>
<tr>
<td>Vicky</td>
<td>11.3.15</td>
<td>Audio recorded discussion</td>
</tr>
<tr>
<td>Vicky</td>
<td>20.3.15</td>
<td>Discussion recorded in field notes</td>
</tr>
<tr>
<td>Vicky</td>
<td>25.3.15</td>
<td>Audio recorded discussion</td>
</tr>
<tr>
<td>Vicky</td>
<td>29.4.15</td>
<td>Unstructured interview recorded in field notes</td>
</tr>
<tr>
<td>Vicky</td>
<td>27.5.15</td>
<td>Audio recorded semi structured interview</td>
</tr>
<tr>
<td>Charlie</td>
<td>18.6.15</td>
<td>Audio recorded semi structured interview</td>
</tr>
<tr>
<td>Huma</td>
<td>14.7.15</td>
<td>Audio recorded semi structured interview</td>
</tr>
<tr>
<td>Vicky</td>
<td>11.8.15</td>
<td>Audio recorded semi structured interview</td>
</tr>
<tr>
<td>Vicky</td>
<td>20.8.15</td>
<td>Audio recorded semi structured interview</td>
</tr>
<tr>
<td>Vicky</td>
<td>3.10.15</td>
<td>Discussion recorded in field notes</td>
</tr>
<tr>
<td>Vicky</td>
<td>2.12.15</td>
<td>Discussion recorded in field notes</td>
</tr>
</tbody>
</table>

*Discussion: ad hoc, requested by Vicky or the researcher immediately after an observation
±Semi structured: pre-set questions used to guide the interview
^Unstructured: guided by a single topic, area of interest at researcher’s request
Interviews conducted at the end of each phase and cycle of the intervention used an initial set of questions to ensure key areas were covered and that respondents answered questions related to the intervention design principles. This increased the comparability of answers between individual respondents and across time when evaluating the interventions (Cohen et al., 2011) and helped to develop the intervention in line with the initial design principles. A crucial purpose of interviews was to allow practitioners opportunities to give their perspective on classroom observations recorded in the field and reflect on their developing use of digital media. Relying on observations alone would have shown the changes taking place, but without an understanding of what prompted those changes. Interviews allowed both the researcher and the participants to discuss their interpretations of the phenomena being investigated from an individual point of view. These interviews also shed light on Vicky’s practice and the relationship between beliefs and practice at different stages of the intervention. Semi-structured interviews included baseline interviews with all practitioners using a set of prepared questions (see Appendix 7) to guide the interviews as well as on-going reflective discussions with Vicky. As the intervention progressed the interviews often developed into a ‘conversational partnership’ (Flewitt, 2011) that recognised Vicky as a co-participant in designing and implementing the intervention. This development in the way some interviews were conducted was not planned but was an evolving process that responded to the changing needs of the research and Vicky’s emerging practice with digital media.

Although this research primarily used semi-structured and unstructured interviews this description does not accurately capture the nature of some of the conversations between Vicky and myself. Unstructured interviews that took place following classroom observations were often closer to opportunistic discussions, thus blurring the distinction between interview and discussion (Robson, 2011). These ad hoc discussions were frequently requested by Vicky and guided by her desire to discuss an emerging aspect of the research after her use of digital media. Conducting interviews after observations of specific digital media activities allowed emerging findings to act as the impetus for developing interview questions (Ely, 1991). No data is completely natural (Peräkylä & Ruusuvuori, 2011) but allowing participants to comment on data may help to mitigate the impact of the presence of the researcher. Post-observation interviews and discussions provided opportunities for me to understand the different classroom uses of digital media from Vicky’s perspective. On occasions interviews developed as
‘professional conversations’ (Timperley, 2015). Professional conversations are ‘the informal and formal dialogue that occurs between educational professionals, mentors, coaches and school leaders, which is focused on educational matters’ (Timperley, 2015, p. 6). Both the researcher and Vicky had expertise as early years practitioners and individual expertise relating to the intervention; either insider knowledge of the children and classroom environment (Vicky) or knowledge of effective approaches to digital media integration (researcher). These areas of expertise were invoked as part of conversations between researcher and practitioner which were considered distinct from interviews as they were instigated and guided by Vicky rather than the researcher. Vicky used these conversations to discuss aspects of her practice that related to the intervention; how to address particular problems and reflection on activities with digital media she felt had, or had not, gone well. Professional conversations provided an additional layer of depth to the data as they often raised issues not anticipated by the researcher. Hence these conversations became an important factor in the intervention development.

Interviewing young children presents issues related to children’s ability and willingness to engage in meaningful discussions with adults with whom they are not familiar. However, as long as discussions are conducted in an appropriate manner and children have had time to become familiar with the interviewer young children can provide reliable and meaningful data (Morrow & Richards, 1996). The decision to interview children and include their voice represents a view of children as ‘competent’. I did not conduct formal interviews with children but preferred opportunistic discussions during children’s play as part of data collected. This use of unplanned discussions was considered more appropriate than formal question and answer sessions. This approach to data collection with young children makes it easier for children to feel more comfortable in expressing their ideas and opinions where more structured or semi-structured interviews may lead to them being less forthcoming and curtail discussions. For this reason, I talked to children in small groups during their play using open-ended questions that were relevant to their interests and in classroom situations that were familiar and naturalistic. I also gave children the opportunity to express their views in different ways to create a more authentic space for them to record their responses (Mazzoni & Harcourt, 2014). Some children drew their ideas and responses; one child asked to record his answers on my iPad.
**Video observations**

Video cameras are an invaluable tool for qualitative researchers for their ability to capture the interaction between participants in greater detail than written observations and enable repeated and detailed viewing of the data (Jewitt, 2012). Jewitt (2012) notes how video focuses on all aspects of interaction and records the on-going interaction of people in a specific context while recording the aspects of the environment that structure the interactions. Video can show evidence of this change and the interactions that take place (Erickson, 2006). This ability to capture interaction between participants and the contexts in which interactions take place makes video data valuable from a neo-Vygotskian perspective, which defines learning as change over time as the result of interaction (Chaiklin, 2015) with people and the environment. Written observations document change, but the detail provided by video in recording verbal and non-verbal interactions makes it a far more powerful tool in this respect (Jewitt, 2012). Unlike field notes, video cameras record events as they unfold with less distortion than written observations. The video camera captures what happens around the screen and events that might be out of sight of the researcher’s focus on one aspect of an activity.

The use of video data does not mean the researcher’s view of the world is undistorted (Flewitt et al., 2014). Choices about camera positioning, transcription methods, selection of episodes for recording and analysis, and methods of analysis impact the data collected by video and how they are used (Derry et al., 2010; Erickson, 2006). The researcher's choice of where to place cameras will affect the data collected as will the choice of camera and when to turn it off and on (Jewitt, 2012). The position of the camera needs to relate to the aims of the research, and where to place a camera needs to be planned and tested in advance (Jewitt, 2008). The choice of video camera can also shape the data collected and Jewitt (2012) recommends performing a ‘dry run’ to experiment with cameras and their positioning. The choice of cameras for this research was largely determined by the researcher’s access to a GoPro. Although it was not possible to test other cameras due to time and budget constraints I did experiment with an iPad and the GoPro before making a final decision. Trial use of the GoPro showed that the microphone did not pick up audio sufficiently and so an external microphone was added. The GoPro had advantages in terms of its size as it was small enough to be handheld discretely and could be moved quickly and easily around the classroom. Although the lack of a viewing screen on the GoPro meant it
was not possible to see exactly what was being recorded, with experience – and because of the GoPro’s wide-angled lens – the lack of a screen did not prove to be a problem. The ability to move the camera around the classroom and use it unobtrusively outweighed the lack of a viewing screen.

Camera positioning and decisions about when to begin or end recording were determined by the researcher; video recordings focused on children’s use of the different digital media in the classroom. The use of one camera meant making choices about where to position the GoPro and which activities to record. Although there were occasions when potentially valuable data was missed this was unavoidable with only one camera and was mitigated by using field notes to observe activities when the camera was positioned elsewhere. A range of digital media activities with and without practitioners being present were recorded. I also chose to record events that related to the intervention design principles, particularly practitioners’ use of digital media with children and how this related to children’s use of digital media during free-flow play. I was interested in the ways practitioners integrated digital media into their practice in different learning situations. The camera was usually turned off when children and/or practitioners left an activity or when a potentially more interesting activity was observed elsewhere.

**Video data transcription**

Data for analysis has to be defined and searched for in the video recordings (Erickson, 2006) before being transcribed. All transcriptions are ‘reduced versions of observed reality’ (Flewitt et al., 2014, p. 50) and ‘there is no such thing as a ‘complete’ transcript that captures the full complexity of all verbal and nonverbal events’ (Derry et al, 2010, p 21). The researcher makes choices and prioritises certain details while omitting others and so transcriptions are not neutral but involve an element of interpretation (Lapadat, 2000). In this respect video data are little different from written observations and field notes that include elements of interpretation and selection by the researcher. Unlike video data, however, observations and field notes do not offer the same potential for the amount of detail possible with video recordings.

Transcription of video data for analysis is selective, representing the theoretical goals of the research (Ochs, 1979) and focusing on what is needed to answer the research questions (Mavers, 2012). Decisions about transcription are also influenced by the
researcher’s own discipline (Erickson, 2006) and the use of video within the research aims (Mavers, 2012; Plowman & Stephen, 2008). Transcription is selective, but the full video recording is available for others to view and verify the researcher’s interpretation of events. Ochs (1979) points out that selectivity does not mean transcription should be ‘random and implicit’ (p 44) but that the reasons for selection should be made clear by the researcher and reflect her/his particular interests. Decisions about how to transcribe video and which episodes to select for transcription and analysis require the researcher to be explicit about transcription decisions and leave an audit trail of decisions made (Jewitt, 2012; Lapadat, 2000). Transcription should also meet practical considerations as well as theoretical ones (Ochs, 1979). A key purpose of a video transcription is to facilitate a researcher’s ‘seeing’; (Lapadat, 2000) by preserving data in a more permanent, retrievable and examinable way. Transcriptions facilitate analysis by creating a written text that can be used practically. Video transcription needs to strike a balance between an accurate written record of events and a transcription that reflects the purpose of the research and ‘does justice to the type of data collected’ (Flewitt et al., 2014, p 50). Although Ochs (1979) suggests a transcription should not have too much information as it will be hard to follow and assess, a ‘basic transcription’ should express the relationship between verbal and non-verbal behaviour as accurately as possible.

In keeping with the socio-cultural framework of this research and the research questions, I selected video clips as illustrative examples of interactions to ‘create a narrative account of some phenomenon’ rather than using video recordings as a source for data extraction (Derry et al., 2010, p 9). Episodes selected for transcription were therefore were selected for their ‘narrative power’ rather than as a source for detailed analysis of selected clips. They were chosen as the most representative of the unfolding ‘story’ of changing digital media use and to describe what this change looked like. Episodes were illustrative rather than theorizing (Derry et al., 2010) hence transcription did not adopt a multimodal approach to fully capture verbal and non-verbal interactions. In this research video recordings also provided a way to triangulate data and confirm or disconfirm the findings of classroom observations recorded in field notes and interviews. Viewing video data enabled greater understanding of what was happening in the classroom around the changing use of digital media as part of teaching and learning and the strategies used by practitioners.
Transcription began with repeated viewings of the corpus of video texts as a whole to decide which episodes to retain for detailed transcription. At this stage, pivotal moments in the intervention deemed important for further investigation and analysis were selected. These episodes illustrated the range of interactions that took place using different digital media available in the classroom at different stages of the intervention. The aim was to develop an understanding of how different pedagogic approaches might support, or hinder, learning. Episodes selected for transcription included practitioner/child interactions and the roles adopted by practitioners as well as children working without practitioners. These episodes were used to support and illustrate the developing hypotheses and claims made about the changing use of digital media in the classroom. Each episode selected for transcription was summarised and recorded in a video log for each intervention cycle (see Appendix 8) and a table summarising all video data selected was kept (see Appendix 9). This table ensured a wide spread of video data across all intervention cycles and learning situations with different participants. The video logs included the date, participants, background context, and brief description of the clip as well as notes about possible themes for future analysis. Episodes selected for further analysis were transcribed using HyperTRANSCRIBE software. HyperTRANSCRIBE allowed me to view and hear the video in the same window as the transcription, and to stop and rewind the video in short sections of a few seconds using simple keyboard controls. This made it easy to re watch sections of video as many times as needed to ensure I had an accurate transcription. HyperTRANSCRIBE was also compatible with the data analysis software used to code data and meant that transcriptions could be easily imported and coded alongside other qualitative data collected during field work.

The decision to use video data to ‘build understanding’ and aid the emerging narrative influenced the method of transcription which focused on verbal interactions and selected non-verbal interactions where these were felt to have an impact on digital media use. The intention was to understand how diverse digital media were used and integrated into the classroom learning environment rather than to analyse selected conversations and non-verbal behaviours. Although a transcription of spoken words with occasional references to gestures may not give a true picture of how verbal and non-verbal activity are integrated into interactions between children and adults (Plowman & Stephen, 2008), detailed understanding of the nature of interaction between those using digital media was not a focus of this research. The transcription
choice also reflected an early decision not to focus on multimodal analysis and for the video to support rather than lead data analysis. This helped to avoid the risk of video becoming the focus of analysis rather than one element in an overall view of digital media integration and an in-depth understanding of the classroom learning ecology.

**Field notes**

Observational field notes captured episodes not possible with video alone and helped to provide a ‘rich description’ (Cohen et al., 2011) of the setting and what happened in it. Field notes can be more responsive than video to activities as they occur in different places and are particularly valuable in the fluid contexts of early years settings where children move freely around the inside and outside. This research used field notes written at different levels, and which served different purposes (Cohen et al., 2011). Field notes written *in situ* provided a record of activities at the time they took place and as they unfolded. These records of activity included the physical and contextual setting, chronology of events, participants and critical incidents as well as details of some conversations between those being observed. This type of field note was particularly useful to record whole class teaching activity and practitioner-led activities during free play when children’s focus was on the practitioner rather than the presence of the researcher.

Expanded notes written as soon as possible after the event were more detailed and included a degree of reflection not always possible when notes were made in the classroom as activities unfolded. These field notes provided an opportunity to reflect on areas for further investigation, points to discuss in interview, and areas for intervention development. Reflections were recorded separately from the notes of the activity being observed. Although field notes written after the event run the risk of omitting important details they have the advantage of allowing the researcher to engage with children rather than being focused on writing. When the researcher is focused on writing, the recording process can be a barrier to seeing what is happening beyond the focus of a detailed observation and the physical barrier of a notebook. Recording field notes was largely opportunistic and depended on what I wanted to observe and the learning situations in which activities took place. On occasions, writing observations in the classroom was considered too obtrusive and prevented the more naturalistic type of observation this research sought to achieve. There was no hard and fast rule as to the type of written observation used. The most important consideration was that when not
recorded *in situ* field notes were written no more than a few hours of an activity and most often they were recorded before I left the classroom.

**Research diary**

Field notes were supplemented by a written research diary recording my activities, thoughts and feelings. A research diary provides ‘first-hand accounts of social situations’ (Burgess, 1981, p 80) and can be a valuable tool in adding detail to accounts of classroom practice, particularly where research is conducted over extended periods. The research diary was completed at least weekly for three years from the initial research design phase until beginning to write-up the findings. This diary complemented the use of ‘substantive’ data such as field notes, video recordings and interviews (Burgess, 1981) and provided a reflective space in which to address questions such as researcher role, choice of data collection tools and participants’ reactions to conducting fieldwork. This diary also facilitated reflection on the successes and failures of the intervention and how they were addressed in subsequent intervention cycles. I used diary entries to ‘discuss’ ways to develop the research as well as how to address problems when research did not go as planned. The research diary was a valuable space in helping to reflect on methodological questions such as the philosophical and ethical aspects of this research. I also used the research diary to record more general research difficulties and reflections including emerging ethical dilemmas and intervention problems, and my responses to them.

**Documents**

Digital copies of Vicky’s weekly and half termly planning documents were collected throughout the intervention and used to inform on-going and post-intervention data analysis. Planning documents for 34 weeks of the research provided detail about how learning was organised daily in the classroom and the integration of digital media into children’s learning. The way these documents were physically formatted (see Appendix 10) mediated Vicky’s implementation of the curriculum and how she thought about and planned practitioner-directed activities. The individual headings on each document guided Vicky’s choices about how to structure teaching and learning, and her selection of resources. Copies of Vicky’s planning documents were used to analyse the impact of the design principle related to planning for digital media which was implemented as part of the intervention. Weekly planning documents showed changes to the type and frequency of digital media use from the baseline phase to the end of the final
intervention cycle. It would not have been possible to get a complete record of digital media use as part of practitioner-directed activities without the researcher being in the classroom every day. Planning documents made it possible to capture aspects of changing digital media use that would otherwise have been absent from the research. I also collected copies of EYFS curriculum documents and frameworks as part of the baseline understanding of the wider early years context for digital media and its inclusion as part of the curriculum.

**Analytical framework**

Data analysis adopted a thematic coding approach to generate categories based on the theoretical framework outlined in Chapter 2 as well as themes that emerged from the data. Thematic analysis was chosen as a flexible approach that is not tied to a particular epistemological or theoretical position (Braun & Clarke, 2006). It is suited to interpretive research because it identifies patterns in data that are important to the description of a phenomenon and ‘potentially provides a rich and detailed, yet complex, account of data’ (op. cit., p 78). Thematic coding identifies patterns that are linked to the research questions (Miles & Huberman, 1994) hence helping to ensure the questions are answered. Approaches to analysis may fall on a continuum between pure induction and pure deduction (Kawulich, 2017). While inductive analysis takes place without any preconceived knowledge as to what will be found, a deductive approach involves researchers applying pre-determined codes to the data. In reality, it is difficult to adopt a wholly inductive approach as researchers rarely come to the research process with no preconceived notions about what will be found. Identifying codes is in itself derived from researchers’ existing knowledge, background and experiences and researchers often move between deductive and inductive approaches to data analysis (Kawulich, 2017). One way to approach analysis is to view data collection and analysis as complementary, as both reflect particular forms of culture and social interaction (Kawulich, 2017). The aim is not just to understand the data, but to understand it within particular social contexts and how these contexts are constructed (Atkinson & Delamont, 2005). It undesirable to rely on one analytic strategy, as analysis should pay attention to the relations between, as well as within data collected.

The approach to analysis used in this dissertation drew on abductive analysis (Timmermans and Tavory, 2012) and used a combined inductive/deductive procedure
(Mintz, 2012) to code the data and develop themes to guide analysis. While categories derived from the theoretical framework are more likely to produce robust results that add validity to the findings (Robson, 2011) the approach adopted for this study prevented theory from driving the analysis to the extent that the theory obscured other possible conclusions (Davidson, di Gregorio, & Guba, 2011). An abductive orientation allows *a priori* theoretical ideas to be combined with categories emerging from the data. Although codes are developed inductively this takes place within the researcher’s existing professional knowledge, background and reading of relevant literature. Researchers are ‘neither theoretical atheists nor avowed monotheists but informed theoretical agnostics’ (Timmermans & Tavory, 2012, p 169). An abductive approach to analysis depends on working with empirical data in relationship to a broad and diverse set of literature and theory but not dependent on either. Data and theory have a more equal role to play: rather than hanging the data on a theory the theory has to work alongside the data. This view of abductive analysis links it to the pragmatic approach to theory testing and building adopted by EDR (McKenney & Reeves, 2012; Reinking & Bradley, 2008). In design-based research, local theories of instruction (Gravemeijer & Cobb, 2006) are tested through the intervention and then developed as a result of the findings. Abductive analysis is aimed at theory construction (Timmermans & Tavory, 2012) and, as this is also one of the primary aims of design research, it was deemed appropriate to draw on abductive analysis. Findings reported in Chapters 5 and 6 are therefore grounded in the data, but also informed by theory that can help to make sense of the data, rather than relying solely on *a priori* theoretical considerations.

The activity of teaching and learning was the unit of analysis rather than individual practitioners or practitioner/child interactions. The boundaries of the unit were defined through the use of an activity triangle (Engeström, 1987) and the elements conceptualised as part of the classroom learning ecology (Gravemeijer & Cobb, 2006). Early years classrooms are ‘messy’ environments with complex learning ecologies involving interaction between several elements that contribute to the ways teaching and learning take place. These elements are part of the social contexts in which learning happens and need to be accounted for as part of analysis. Classroom design, the curriculum, assessment practices, the availability and location of resources, types of interaction and practitioner beliefs all shape how and what children learn and much of this is guided both knowingly and unknowingly by practitioners. Analysis therefore included the contextual factors that were part of teaching and learning as well as those
taking part in the activity. This approach to analysis is consistent with activity theory (Engeström, 1987; Leont'ev, 1977) and the notion of a classroom learning ecology (Gravemeijer & Cobb, 2006) outlined in Chapter 2. Seeing the use of digital media through a lens of activity theory and a classroom learning ecology widens the picture beyond those using digital media and links teaching and learning to the socio-cultural contexts in which it takes place. Focusing on practitioners as the unit of analysis would have made it difficult to account for the influence of ecological factors while analysing practitioner/child interactions would have obscured the mediational roles played by practitioner beliefs.

**Phases of analysis**

Arriving at the final analytic themes was a process of data ‘exploration, organization, interpretation and integration’ (Davidson, di Gregorio, & Guba, 2011, p. 628). Data analysis was an iterative process of developing codes, looking at the data, going back to emerging themes to see if the data supported them, and then refining or rejecting those themes. Analysis went through at least three stages of organising and reorganising codes and their definitions as well as reapplying codes to the data in order to arrive at a final set of codes and related themes that were applied to the whole data set (see Appendix 11).

In EDR analysis takes place at different stages; post baseline assessment, during the intervention, and after completion of the intervention cycles. There are also different types of analysis - formative and retrospective - serving different purposes. Ongoing formative analysis of emerging data informs the development of the intervention. Formative analysis took place following baseline observations and at the end of each intervention cycle. Retrospective analysis conducted at the end of the intervention is used to develop theory that can be used beyond the immediate context of the intervention (Gravemeijer & Cobb, 2006). Retrospective analysis addresses changes to the classroom environment and unanticipated results of the intervention (Bradley, 2013) and requires scrutinising the conjectures and assumptions formulated at the start of research to see whether they may need to be developed based on the intervention findings. During retrospective analysis the lenses for analysis are refined and used to examine the whole data corpus and draw conclusions. This process may involve synthesizing findings from all phases of the intervention and developing themes across the research that can be used to develop theory and practice.
The first phase of analysis began during data collection and focused on reflective discussions with Vicky after episodes of digital media use and reflections recorded in field notes. This formative analysis informed the development of the intervention based on an understanding of what was constraining and encouraging the use of digital media in the classroom, and how this related to the intervention design principles. Staff interviews and field notes were reviewed before looking at video data. This allowed analysis of the intervention implementation from the practitioners’ point of view and their classroom practice before considering its impact on children’s use of digital media. At this formative stage weekly planning documents were also reviewed to look for evidence of change to the way digital media were integrated as well as the number of incidences of planned use. Document analysis helped to confirm the findings from interview and observation data. During the first phase of analysis possible themes were noted with corresponding memos describing the memos. This made it possible to explore and develop a wide range of possible themes to be tested during the retrospective analysis. A list of up to 20 possible themes was developed that could potentially be used to organise the data during retrospective analysis. Along the way codes and themes were dropped, renamed, given new criteria, expanded or combined into new themes (see Appendix 12).

Post-intervention, a second phase of analysis using an inductive/deductive approach developed codes based on the data (inductive) and the design principles that guided the intervention (deductive). Interviews and field observations were reviewed several times and notes made as to any possible interpretations and ideas related to the main areas of research; beliefs, pedagogy, digital media and classroom approaches to teaching and learning. Analysis of video data began by considering the corpus of video texts as a whole and noting initial overall impressions as they emerged after watching the videos, writing summaries of what was happening in the videos and noting possible themes. This allowed each clip to be viewed as a complete text first before a more detailed analysis with the overall picture of events in mind. At this stage general themes that emerged across the whole video corpus were combined with themes noted from observational and interview data during phase one analysis. This process ensured a level of consistency and comparability across all data sets, and intervention phases and cycles. The macro-level thematic categories identified helped to guide the process of developing codes that could be applied to interview and observation data. Video episodes included in analysis were chosen by reason of the fact that they:
• Involved children and practitioners together
• Used different digital media devices
• Showed different groupings of children
• Showed successful and unsuccessful use of digital media (as stated by practitioners)
• Included children-only interactions by way of comparison and contrast

Interview transcripts and field notes were entered into HyperRESEARCH qualitative data analysis software and open coded. This was not entirely successful as it was difficult to link these codes to the intervention design principles. The data were therefore reviewed with the original design principles in mind to see whether this might be more successful in developing codes that could be used across all data sets and link emerging themes to the design principles. This provided several additional codes which could be described as ‘analytic hunches’ or working hypotheses. In this way, coding and the development of themes was on-going, and refined and guided by both theory and what was felt to be worthy of further investigation based on knowledge of the data, the research questions and an understanding of the contexts in which the research was conducted.

During coding, a record was kept of all themes and codes including those that were discarded along with the reasons for their inclusion or otherwise. This process was repeated on at least one occasion to allow for new codes and recoding as my understanding and interpretation of the data changed and developed through the iterative process of analysis. These decisions were included in coding memos and were part of a detailed coding diary kept during 27 months of data collection, analysis and interpretation. Analysis was therefore a process of constant revision based on on-going scrutiny of the data and as new data were reviewed and transcribed. By the end of the second phase of analysis there was a coherent structure and organisation of all data into level one codes and related sub codes that related to the design principles and to each other. It was then possible to look for patterns across the data sets as well as across the original design principles. At this stage, outlier codes, that occurred in only one or two pieces of data, were reviewed to check they did not raise questions which had not previously been considered.
During a third phase of analysis, analytical themes that cut across all data sets were identified. These themes were felt to reflect the initial design principles and the way they had developed over the course of the intervention cycles, as well as new principles and ideas that emerged from the on-going analysis that drove the intervention development. Deciding on the final themes described in Table 4.8 was an iterative process of reviewing the coding memos written for several different themes as they presented themselves throughout the different phases of analysis. These memos were subjected to scrutiny to ensure that I was not following my biases or preconceptions and to ensure that early ideas were rigorously questioned and held to account in the light of on-going analysis and reflection. For example, an early theme of ‘identity’ became part of the later theme of ‘value’ as the value Vicky accorded to digital media was in part related to her identity as a practitioner and the need to see the learning potential in all resources. As the result of this iterative process, the final themes were rooted in the initial design principles as well as data that emerged through the intervention cycles to test these design principles in practice. In the formative phase of analysis, themes related to the on-going intervention and derived from the design principles that guided the intervention. During the retrospective analysis phase these early themes were often combined into a broader theme when it became clear that they were part of a bigger overall picture.
Table 4.8: Final categories used for analysis and their definitions

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constraints</strong></td>
<td>First order barriers constraining the effective use of digital media pre-intervention. Included were practitioner skills, the curriculum, lack of training, lack of time to plan and technical issues with the various devices in the classroom. This category did not include beliefs about digital media.</td>
</tr>
<tr>
<td><strong>Practice beliefs</strong></td>
<td>Beliefs Vicky held about what constituted good early years practice and how this related to her own classroom practice. Included were beliefs about the role she believed most appropriate for different learning situations particularly free play and structured teaching. Practice beliefs related to the classroom environment Vicky established through planned activities and free play.</td>
</tr>
<tr>
<td><strong>ICT beliefs pre-intervention</strong></td>
<td>Beliefs of Vicky, other practitioners and parents about the use and presence of digital media in the classroom and the way young children used them. This category included Vicky’s beliefs about different aspects of digital media use including mouse skills, the type of teaching approach needed for digital media and how she wanted to use technology.</td>
</tr>
<tr>
<td><strong>Teaching non tech</strong></td>
<td>Different approaches to teaching and learning observed in the classroom and discussed with Vicky. This category included practitioner-led carpet sessions, child-led play, practitioner interventions in child-led activities, focus group activities, practitioners working one-to-one with children.</td>
</tr>
<tr>
<td><strong>Teaching with ICT</strong></td>
<td>The ways practitioners used digital media pre-and post-intervention. Included the teaching and learning approaches observed in the classroom as well as the different types of digital media activity practitioners engaged with, teaching operational skills, playing alongside children and different types of visible and invisible planning for digital media. Also included were practices and routines that restricted children’s use of technology.</td>
</tr>
<tr>
<td><strong>Value of tech</strong></td>
<td>The value Vicky afforded digital media to support young children’s learning and how this changed. Included was their value to support children’s language and social communication, how they could ‘fit’ with early years practice, references to technology as ‘tools for learning’, and the use of the digital media for assessment and record-keeping.</td>
</tr>
<tr>
<td><strong>Children and ICT</strong></td>
<td>The different ways children used digital media in the classroom pre- and post-intervention without practitioners being present. This included how children worked individually and collaboratively and developed operational skills and language. It also referred to children teaching each other and practitioner comments on their observations of children using digital media.</td>
</tr>
<tr>
<td><strong>Home</strong></td>
<td>References to children’s use of digital media outside school. Included how parents and children talked about the use of digital media at home and the use of non-digital toys.</td>
</tr>
<tr>
<td><strong>Reflection</strong></td>
<td>Ongoing reflection by Vicky on what she saw happening in the classroom around the use of digital media, her shifting practice and beliefs and the importance of reflection as part of the intervention. This category included my own reflections on the intervention, its progress and modifications and my role in the classroom.</td>
</tr>
<tr>
<td><strong>Literacy beliefs</strong></td>
<td>Beliefs about young children’s literacy and language learning and how this could be developed and supported by practitioners. Included references to phonics teaching, definitions of reading and the importance of oral language as part of literacy development. This category included parents’ and children’s beliefs about reading and how it is taught at school.</td>
</tr>
<tr>
<td><strong>Huma</strong></td>
<td>References to other classroom practitioners; their uses of digital media at home and school, and beliefs about children’s use of technology in the classroom.</td>
</tr>
<tr>
<td><strong>Individual children</strong></td>
<td>Codes related to individual children by name.</td>
</tr>
</tbody>
</table>

---

These categories related to the initial research intent to develop pedagogy to address the gap between home and school reading with digital media.
Research quality

The quality of research can be addressed in different ways, but is founded on the belief that ‘all research carries the responsibility of convincing oneself and one’s audience that the findings are based on critical investigation (Rudestam & Newton, 2007, p. 112). It is the researcher’s job to convince not only the user of the research but themselves that the research and its findings can stand up to close scrutiny. This can be achieved by addressing the validity and reliability of research and the steps taken by the researcher to address these different factors. Although discussions of reliability and validity apply equally to qualitative and quantitative studies, they are arrived at in different ways (Ely, 1991) and can have different meanings as well as different terms. The aim is to minimise error and biases (Yin, 2003) and ensure a consistent approach to research (Creswell, 2009). For quantitative researchers, reliability is achieved through the ability to replicate data outcomes (Ely, 1991). As Ely (1991) argues, not only is this not possible for qualitative studies which do not set out to produce quantifiable data, but it is not desirable, given that qualitative researchers working within an interpretivist paradigm seek to understand, rather than measure, the way people react in different situations. In qualitative research validity rests on assessing the potential threats to validity rather than trying to rule them out. Validity refers to the inferences drawn from data and how accurately the researcher’s account represents the participants’ realities of the social phenomena being investigated (Creswell & Miller, 2000). Validity can be a strength of qualitative research as it helps to ensure the findings are accurate (Creswell, 2009).

Given a choice of procedures for establishing reliability and validity, Altheide & Johnson (2011) suggest a pragmatic approach which views validity as ‘what is good for our intents and purposes’ (op. cit., p. 584). No procedures are better or more trustworthy than others, but the reader needs to be able to see how research quality is assured in order to avoid accusations of research not being valid (Altheide & Johnson, 2011). It is the researcher’s transparency in the chosen methods rather than the methods themselves that is addressed. Validity is best established through recourse to the researcher's own philosophical position and methodological approach (Savin-Baden & Howell Major, 2013). It is primarily the researcher's paradigm assumptions that will shape their selection of validity procedures (Creswell, 2009). Given the intention to investigate the beliefs and pedagogical practices of practitioners from within the classroom and to understand and represent their social realities, reliability
and validity can be addressed through credibility, trustworthiness and transferability (Ely, 1991; Guba & Lincoln, 1994), and the authenticity of the final account of the research. In other words ‘how accurately the account represents participants’ realities of the social phenomena and is credible to them’ (Creswell & Miller, 2000, p. 124).

**Credibility**

The researcher’s open and transparent account of research establishes its ‘credibility’ (Guba & Lincoln, 1994) as an accurate record of the research process and its findings. This account should include careful and accurate documentation of the approaches and methods used and their rationale so that readers can judge their appropriateness and to what extent the findings of research may be generalised to other settings (Savin-Baden & Howell Major, 2013). This detailed account creates ‘verisimilitude’ (Creswell, 2000) and credibility is established through the lens of the reader who feels they have experienced the events being described. Readers can decide for themselves whether the inferences drawn from the data are convincing and trustworthy and the researcher’s account of events is true. In this study, I spent a prolonged period of time in the field and became familiar with the participants and the setting. This allowed me to acquire an in-depth understanding of the classroom learning environment as the social world in which participants acted. The authenticity of the final account of the research was given credibility through reflective discussions with Vicky (reported in Chapters 4 and 5) which acted as ‘member checking’ (Creswell & Miller, 2000; Guba & Lincoln, 1994). The account of research also took a reflexive stance as a way of eliminating some of the bias inherent in all research. By reflecting on and documenting my own biases in this chapter (part of the discussion on researcher subjectivity) and positioning myself in relation to the research, the reader is able to judge for themselves whether bias has unduly influenced the results. This reflexive process was documented through the use of a research diary and a more detailed intervention diary as well as reflections recorded in field notes.

Making research relevant to practice should be considered a key criterion of rigour and quality (Gutierrez & Penuel, 2014), and Plomp & Nieveen (2013) argue design researchers include measures of practicality and effectiveness. In other words, was the intervention usable in the intended setting (practical) and did it achieve the desired outcomes (effective). The consistency with which an intervention is implemented is also a key consideration in judging the quality of design research (Plomp & Nieveen,
In this study these indicators of quality were addressed through consistency between the philosophy underpinning the research, particularly the reference to its axiomatic values, and through careful documentation of the design, implementation and development of the intervention including recording elements that were not effective. In EDR researchers are also actively involved in the design and implementation of an intervention and the multiple roles this involves may jeopardise that quality of research. The potential threats to credibility and trustworthiness posed by the researcher’s role in the classroom were mitigated through the measures used to address researcher subjectivity and minimise bias and open description of the role I adopted in the classroom.

The credibility of research requires researchers to address generalizability and the extent to which the research findings are transferable to similar settings. An important element in design research is understanding how, when and why an intervention worked, or failed to work (McPake & Stephen, 2015). The extent to which research conducted in one classroom can be generalised to the population at large is addressed by the researcher not actively seeking to generalise. Rather, the reader makes their own judgement about generalisability to other settings by making links between their own experiences and that of the researcher (Torrance, 1993). The researcher needs to provide sufficiently rich data for users and readers to determine whether transferability is possible (Lincoln & Guba, 1985). In EDR transferability of research findings is addressed by the need to accurately document the contextual factors that are part of the classroom learning ecology (Cobb et al., 2003). Interventions take place in a particular environment and environmental factors will affect the outcomes and implementation of the intervention. EDR also aims to develop a detailed understanding of the research setting through its development and description of a local theory that forms the basis of the intervention and its intention to develop theory that can be applied and tested in similar settings. There is therefore an emphasis on ‘thick description’ (Geertz, 1973) of participants, settings and the intervention to give readers an element of a shared experience (Creswell, 2003) and sufficient detail that can be transferred to other settings (Rudestam & Newton, 2007).

**Trustworthiness**

The trustworthiness of research is the standard by which the rigour can be judged and whether findings are based on rigorous and critical investigation (Guba & Lincoln,
Evidence of methodological rigour needs to be documented (Rudestam & Newton, 2007) as part of the research write up in order to judge whether the conclusions are grounded in the evidence presented. This rigour is also evidenced in the methodological coherence of the research design (Guba & Lincoln, 1994) which allows readers to make a judgement as to the construct validity of the research design and its fitness for purpose. The coherence of the overall research design takes into account the theoretical and methodological frameworks and how data collection and analysis is consistent with this. In this research trustworthiness was established through detailed recording of the research process from the rationale for the research to the final write up. As part of the process of EDR, rigorous reporting and documentation of the changing conditions during the investigation provided a rationale and justification for any alterations made in response to both the changing conditions and on-going analysis (Reinking & Bradley, 2008). The ability to change and be open to adapting data collection and analysis is part of addressing the validity of EDR (Reinking & Bradley, 2008). Hence the importance of maintaining a detailed record of changes to the intervention and the rationale and evidence to support them throughout the research process so that any changes to the design or methodology are incorporated in the final write-up of the research. This ‘audit trail’ included an intervention diary which recorded my reflections of the rationale for changes to the intervention (see Appendix 13). Reflections on data analysis at different phases were recorded in an analysis diary kept during and after the intervention which detailed the development of analytic codes and their grounding in data and theory.

Multiple data sources allowed for triangulation to show how different data converged across categories during analysis (Ely, 1991; Neuman, 2003; Reinking & Bradley, 2008). Data gathered from different sources provided a way of looking at the same thing from different angles (Neuman, 2003) to ensure that different data are telling the same story. Triangulation can also be achieved by concurrence between data and theory. Theoretical triangulation is achieved when the data analysis reflects the theoretical perspective that underlies the study and may provide a framework for subsequent data analysis (Neuman, 2003). In this research the use of activity theory and the notion of a classroom learning ecology provided the theoretical framework for data analysis. This was aligned with the socio-cultural view of learning that underpinned the study and its overall interpretive philosophy. The data collection tools and methodological approach were also related to the research questions. Hence there
was a clear line of travel from the initial identification of the problem and rationale to the final conclusions. This was clearly documented and accounted for throughout the research from different but methodologically and theoretically coherent perspectives and frameworks.

**Summary**

The research methods described in this chapter are consistent with the socio-cultural theoretical framework, philosophical underpinnings and methodological approach of this research. The study adopted an interpretivist framework which underpinned the use of EDR to design, implement and develop a classroom-based intervention. The intervention was implemented in one primary school nursery class with three early years practitioners and 25 children. Teaching and learning in the classroom consisted of child-initiated free play and practitioner-directed whole class and small group activities. A naturalistic, classroom-based intervention was designed following a pre-intervention baseline phase. The year-long intervention was implemented and developed over three iterative cycles. The intervention design principles to support digital media integration focused on practitioner interactions with children, planning and reflection. The research followed BERA ethical guidelines and consent was obtained from all participants including children. The researcher adopted an observer participant role and took part in activities not considered to be directly associated with the role of a practitioner. Researcher bias was minimised by adopting a reflexive stance and acknowledging my background and preconceptions as they related to the research. Methods of data collection were naturalistic, and included: field notes, video observations, interviews, documents and a research diary. Video data were selected and transcribed for their ability to contribute to the emerging story of digital media integration. Thematic analysis used the activity of teaching and learning as the unit of analysis to develop codes using an inductive/deductive approach. Formative analysis at the end of the pre-intervention baseline and each cycle was used to inform changes to the intervention. Post-intervention retrospective analysis was used to develop theory and effective practice around digital media. Research quality and rigour were addressed by means of its credibility and trustworthiness.
Chapter 5

Implementing an effective intervention

This chapter describes the process of conducting the intervention: its design, implementation and modification over iterative cycles. The chapter consists of two substantive sections: 1. the pre-intervention baseline assessment of digital media use and the classroom learning environment, and 2. the three cycles used to develop an intervention to encourage digital media uptake. Section one introduces the factors hindering the effective integration of digital media and Vicky’s beliefs about digital technologies. This section also outlines her pedagogical beliefs about young children’s learning and their language and communication development. The first section concludes with a description of the classroom learning environment constructed around Vicky’s conceptualisation of digital media and the ways she used them with children. This description of Vicky’s beliefs and their impact on her practice serves as a baseline from which to understand subsequent changes to the learning environment and her developing practice with digital media. It also establishes the reasons for the intervention design principles.

The second section of the chapter reports the implementation and development of three intervention cycles and the effectiveness of the design activities. This section documents the changes Vicky implemented in response to the design principles that drove the intervention. Each intervention cycle consists of three sections relating to the key areas of change underpinning the intervention design; planning, interaction and reflection. The three cycles are described separately to show a clear rationale for the intervention development and subsequent modifications to each cycle. The chapter concludes with a summary highlighting the intervention activities that were successful in encouraging the effective integration of digital media and those that hindered its use. This chapter also serves as a precursor to Chapter 5 in which the intervention findings are discussed in relation to factors enabling change and characteristics of effective practice.

Pre-intervention constraints to integration

Prior to the intervention implementation there were key aspects of Vicky’s beliefs and practice that hindered the integration of digital media. Although children and
practitioners used the IWB and PC they were not effectively integrated across the curriculum and as part of the different routines and approaches to teaching and learning observed in this classroom.

**Having to teach ‘mouse skills’**

Vicky’s pre-intervention attitude towards digital media was focused on the desktop personal computer (PC) the children had access to, and the operational skills needed to use it. The prime reason Vicky gave for spending time with children using the PC, despite her obvious distaste for doing so, was to teach mouse skills. Vicky’s dislike was apparent in the way she discussed working with children at the PC and showing them how to use the mouse. She observed that, ‘it leaves a bad taste in my mouth when I have to sit and show them how to use the mouse and click and drag’ (interview 10.12.14). Vicky described teaching mouse control as ‘time consuming’, (interview 5.1.15) and voiced her concern that, that ‘it takes one-to-one with a child on several occasions’ (interview 12.2.15). Vicky frequently referred to having to teach ‘mouse control’ and linked this to preparing nursery children for the reception class in the following year. She mentioned how in the reception class the children would be using the school ICT suite and suggested, ‘I know that reception would love it if our children were mouse savvy’ (interview 5.1.15).

Vicky found it difficult to justify time spent with individual children teaching a skill that she did not believe valuable. She had not considered the ways in which the interactive whiteboard (IWB) and PC might support deeper learning or development in areas of the curriculum other than for technology. Although technological competency was essential before children were able to move on to more creative and agentive activities, observations of digital media use and discussion showed Vicky did not recognise this aspect of children’s digital media learning. Her pedagogical approach was directed towards the operational skills themselves rather than what children might achieve once they had mastered these skills. In focusing on operational skills Vicky appeared to be guided most strongly by the EYFS curriculum outcomes for technology as the only early learning goal (ELG) in the curriculum that makes any reference to technology. This states the requirement for children to ‘recognise that a range of technology is used in places such as homes and schools. They select and use technology for particular purposes’ (Department for Education, 2017, p. 12). The statement for technology is one element of the ELG for Understanding the World and the focus of learning is on
children’s ability to use a wide range of technologies and the physical skills required to operate them.

Vicky likened teaching mouse control to showing children how to use scissors and commented that this aspect of digital media was, ‘exactly the same as using scissors. It’s as difficult and complex as using scissors’ (interview 12.2.15). However, Vicky justified the time she spent teaching children to use scissors in a way that she did not when she talked about her interactions with children at the PC. She argued that, ‘at least with scissors you can have children doing other things’ (interview 12.2.15). This comment suggested Vicky believed children’s ability to use scissors gave them a skill that had value beyond the physical ability to manipulate scissors. The ability to use scissors effectively gave children access to a greater range of activities and learning opportunities, but Vicky did not link mouse control to learning with digital media in the same way. Vicky’s concept of digital media as of little value other than to develop operational skills was one of the main reasons she rarely interacted with children using the PC or the interactive whiteboard (IWB). Vicky did not conceive of digital media as tools that could support the wider goals of learning in an early years learning environment. She did not refer to any learning that might take place as the result of children’s ability to use different programs or the skills and knowledge children developed beyond the technological competencies needed to operate the PC and IWB.

Vicky’s dislike of practitioner-directed learning

Discussions with Vicky suggested her dislike of using digital media was linked to the assumption that it necessitated a practitioner-directed approach. Practitioner-directed learning was not a strong feature of Vicky’s pedagogy and the classroom learning environment which placed an emphasis on children’s self-initiated play and enquiry-based learning. Vicky believed teaching operational skills required an approach to children’s learning that she was not comfortable with. In week four of the pre-intervention phase I discussed with Vicky the idea that teachers possess differing degrees of control over children’s learning depending on how they organise teaching and learning. Vicky’s response that ‘greater control may be needed for skills such as developing mouse control and using the keyboard’ (discussion 3.10.14) was indicative of the practitioner-directed approach she believed was warranted during interactions with children using the PC. This emphasized how Vicky viewed her role when she used digital media with children and the extent to which she believed it necessitated
approach to teaching and learning that was not in evidence during her interactions with children during free play. The type of spontaneous play that Vicky engaged with alongside children was embedded in her practice in a way that was not apparent when she used digital media with children during free-flow play.

Vicky’s belief in the learning opportunities provided by children’s engagement in self-initiated play guided her practice more strongly than practitioner-directed activities. Vicky's preference for free play over more structured, practitioner-initiated learning was demonstrated during visits to the classroom when my field notes recorded mornings when Vicky did not have the first whole class teaching session if she saw children deeply engaged in play around the room. She chose to leave children to play rather than interrupt their activity. The following comment highlights the importance Vicky placed on free play over directed teaching:

I cannot get away from the fact that when I see children really engaged and learning through play, the quality of what they’re learning is far better than anything they get in a more structured, imposed situation. It’s quite rare and that's because they’re pitching it at exactly the level they need. (interview 27.5.15)

In this interview Vicky discussed her different approaches to organising teaching and learning and the balance between child-initiated play and planned, practitioner-directed activities. The above comment juxtaposes play and ‘structured’ activities and indicates how Vicky viewed and valued them. Vicky’s use of the word ‘structure’ in this comment, and its connection with an ‘imposed’ activity, was notable as she frequently used ‘structure’ to refer to practitioner-directed teaching sessions. Vicky described introducing new phonic sounds in small groups as a ‘very short structured situation’ (interview 27.5.15) and referred to the way in which practitioner-directed activities were planned around children who ‘I know cannot tolerate particularly high levels of structure’ (interview 27.5.15). Referring to structure as something that was imposed suggested Vicky believed this gave children less choice in how or what they learned. Vicky’s perceived need for a more directed approach to using the PC with children created tension between her early years practice and the presence of digital media.

Despite her dislike of practitioner-directed teaching Vicky had developed an approach to teaching phonics in small structured groups that she felt comfortable with. Vicky referred to the weekly phonics sessions as ‘my lip service to it' [teaching phonics]’ (interview 27.5.15), but she had overcome her dislike of practitioner-directed teaching
in this instance because she had observed the impact of these sessions on children’s learning. In discussions about phonics Vicky referred to her observations of children using their developing phonic knowledge as part of their play when they wrote shopping lists, party invitations, the names of friends and labels for their work. Vicky understood she could extend and support children’s interest in reading and writing through practitioner-directed teaching in small groups. She had found a way to navigate the tensions she felt between directed teaching and the importance of supporting the interests and skills children developed through their play. Vicky had overcome her dislike of practitioner-directed teaching because she observed how children actively used and explored their developing knowledge of phonics outside these directed teaching times. Children’s ability to use the knowledge and skills they gained from direct teaching sessions as part of their play had a stronger influence on Vicky than any tensions she might feel between free play and directed teaching. Although Vicky had developed an approach to phonics teaching that was compatible with her beliefs, she had not been able to do this with children’s digital media learning.

A ‘passive and solitary’ way of learning

Pre-intervention, Vicky did not believe children’s use of the PC and IWB offered opportunities for engagement in the kind of meaningful learning that she valued as part of an enquiry-based approach focused on child-initiated play and the crucial role of practitioner interventions to support and extend child-led learning. Vicky’s reference to children’s use of the PC and IWB as ‘passive and solitary’ (interview 10.12.14) underlined the extent to which digital media was incompatible with the beliefs that shaped Vicky’s practice. Vicky believed children using digital media were not actively engaged in learning and the kind of social interaction, collaboration and problem-solving that underpinned child-initiated learning. During conversations about ways Vicky hoped to use digital media she referred to wanting children to ‘have some input into what they do’, and discussed children being able to ‘go at their own pace’ as well as ‘creating something of their own’ (interview 10.12.14). These comments suggested Vicky believed digital media offered few opportunities for children to act in accordance with their individual interests and preferences and for them to be actively involved in shaping learning.

Vicky did not incorporate digital media into the curriculum in ways that supported children as active agents in leading their learning compared with the way they were
able to take part in and determine the direction of child-initiated activities in other contexts. Pre-intervention, Vicky did not believe digital media offered this possibility and she did not see a role for herself in supporting children’s digital play. This belief was compounded by the direct approach to teaching Vicky had identified in connection with her interactions at the PC and IWB. Vicky focused on what she perceived as the solitary nature of the PC and the amount of time it took to develop individual children’s ability to operate the IWB and PC. She did not appear to have observed the diverse skills and practices children engaged with when they used digital media as part of their play. Vicky had not taken the time to stand back and observe children and reflect on children’s co-operative uses of the PC and IWB and the way they collaborated to explore and problem-solve their use of a variety of screen-based games and activities.

**Tension between digital media and language development**

Vicky believed children’s early oral language development was an important factor in their later literacy development and explained that, ‘I think you need to talk before you can read and write’ (interview 27.5.15). In this same interview Vicky referred to, ‘my mission to constantly think how can we get more speaking opportunities and opportunities for talking throughout the setting’, and explained how, ‘we actually put a huge emphasis on talking’. Language was embedded throughout the classroom and a typical day showed the following range of activities during practitioner-directed teaching and interventions in free-flow play:

- practitioners asking children to explain what they need to do to operate the remote-control cars
- practitioners leading a cooking activity and asking children to explain what they had done to make a fruit salad
- a student teacher exploring different-sized and coloured ice cubes in the water tray
- listening to children tell stories using the puppet theatre
- whole class maths session with a focus on children explaining their thinking and problem-solving strategies
- Vicky asking questions during whole class book reading sessions

Vicky’s use of open-ended questions was a feature of the way she supported language development and used her interactions as opportunities to extend children’s ability to talk about their thinking and problem solving. The following questions are examples of Vicky’s questioning recorded during interactions with children in different contexts.
How can we attach this string to your mask? (practitioner-initiated group)
How could we make the sandcastle higher? (child-led play)
What do we need to do to make a sandcastle? (child-led play)
How could the picture of the ice cream help us know what mum says? (whole class book sharing)

In addition to practitioner interventions in play that supported children’s developing language whole class teaching times were an important opportunity for talk. Vicky regularly planned sessions with learning intentions on weekly planning documents linked to the EYFS curriculum area for Communication, Language and Literacy (CLL). She explained how ‘quite often in my planning one part of my learning intention will be an opportunity for children talking’ (interview 27.5.15). There was also a strong focus on the language needs of children with English as an additional language (EAL) and Vicky regularly planned practitioner-directed, language interventions for small groups of children with EAL as well as one-to-one interventions during free-flow play.

Children’s oral telling of their own stories and events from their lives as well as retelling familiar tales such as Goldilocks and the Three Bears and Jack and the Beanstalk was another way Vicky incorporated language activities into the classroom. Prior to the intervention, Vicky pointed out a class display of Jack and the Beanstalk she had created with a group of children as part of a practitioner-initiated group activity (see Figure 5.1). Vicky invited children to tell their own version of the story using language from the book and scribed children’s words on a large sheet of paper. Children then added their own words and pictures to the paper. Over the following days I observed Vicky extend this activity by asking each child in the class to tell a story or describe something they had done during the week. Vicky scribed each child’s words on a separate piece of paper which was displayed on the walls around the classroom. This activity was an example of the way Vicky used her pedagogical skill to incorporate oral language into free-flow play by following children’s interests but with a planned outcome for her interactions.
This activity was initiated by Vicky in response to children’s interest in writing and storytelling that she had observed during the *Jack and the Beanstalk* activity. Each interaction between Vicky and individual children was led by the child by virtue of the fact that it was the children’s words that Vicky scribed and children had the chance to add their own writing and pictures in whatever way they chose. Vicky’s comment that she was ‘worried that it [digital media] was stopping them [children] from talking’ (interview 11.8.15) indicated the extent to which digital media conflicted with her strong belief in the importance of children’s language development. The PC and the IWB were not resources Vicky believed could support or encourage children’s language and communication development, and hence they did not support her construction of a language-rich learning environment. This assumption contrasted with her observations of children’s rich language when they played together in the home corner, organised a picnic in the garden or built a zoo together using construction blocks. The focus on language and the value Vicky placed on practitioners finding opportunities to enhance and support children’s language development were not extended to digital media.
Vicky did not, therefore, believe her interventions in children’s use of the PC or IWB could have a valuable language focus nor could digital media support language development as part of free play.

**Classroom learning environment for digital media**

The classroom learning environment for digital media was constructed around Vicky’s conceptualisation of the IWB and PC as incompatible with her early years pedagogical beliefs and practice. These beliefs and assumptions shaped her practice, and tensions between pedagogy and digital media were reflected in the ways Vicky behaved around the PC and IWB. Other than infrequent interventions during free play, Vicky occasionally included the IWB in planned, practitioner-directed teaching sessions. Vicky’s pre-intervention planning documents show that the IWB was referred to seven times over the course of seven weeks and used primarily to show pictures and video clips (see Appendix 14). The following examples are typical of how Vicky used the IWB in this way:

- Sing 10 little owls using whiteboard or 5 little ducks with fox puppet (planning 24.9.14).

- Show-Learn about Shapes with Shawn’s Roller Coaster Adventure YouTube cartoon with 3D and 2D shapes (planning 29.9.14)

Of these seven references to the IWB only three were planned for or considered as part of children’s learning as indicated by a learning intention for each planned teaching session linked to the IWB. Weekly planning was an important part of Vicky’s practice as was indicated by her comment that, ‘I need to have my concrete planning there in order to function’ (interview 12.2.15). The presence, or lack of, the PC and the IWB in Vicky’s planning was indicative of their position in the classroom both physically in written planning documents and metaphorically in terms of the way Vicky thought about their use as part of teaching and learning. Later discussions during the intervention revealed how Vicky was using the IWB through a sense of professional obligation and as part of her own professional development. Vicky described how she felt that she needed to use the IWB more because, ‘you’ve got a bloody great expensive whiteboard in your classroom and the only thing you’re using it for is occasionally drawing things’ (interview 27.5.15). This was one of Vicky’s main justifications for using the whiteboard, rather than as a pedagogical tool and with conviction as to its value for children’s learning.
Vicky’s use of the IWB and PC contrasted with her practice during free-flow play. Discussions with Vicky and observations of her in the classroom indicated that her interventions in child-initiated activities in non-technology areas of the classroom were based on a strong belief in the value of these interactions to extend and support learning. Interventions in child-initiated play were skilfully judged according to Vicky’s knowledge of individual children’s interests and developing capabilities, the EYFS curriculum, and her pedagogical skill in seizing opportunistic moments to extend and deepen learning. Vicky described her role in the following way:

Anything I do as a teacher I need to know why I’m doing it. What the point is. Everything I do has a point somewhere. All my interactions have a point … and I need to know they [the children] can get something out of it. (discussion 20.3.15)

This comment suggested Vicky had a strong rationale for her interventions in child-initiated play based on her understanding of the impact her presence could have. Her interactions were not unplanned but carefully considered according to what she believed her presence could add to children’s learning and the importance of her pedagogical role in supporting and extending the learning initiated by children. Vicky’s interactions with children were planned either explicitly as part of planning documents, or implicitly according the choices she made about how and when to intervene in children’s play. Pre-intervention discussions showed Vicky did not have a similar rationale for her interactions with children using the IWB or PC beyond children’s operational skills.

Observations showed how Vicky’s interactions did not support the way children used these technologies as a collaborative endeavour providing rich opportunities for communication and social interaction. There was not the shared motive that appeared to be at the heart of Vicky’s interventions in children’s play in other areas of the classroom. Post-observation reflective discussion revealed that Vicky’s prime motive for interventions in children’s digital media activity was to teach operational skills rather than to support game play. The children’s motive was to successfully access and complete their chosen game or activity. Although Vicky did not constrain children’s choices, she did not make herself part of their activity and the way children used digital media by joining in their digital game play. Vicky’s only other interactions with children using the PC or IWB during free-flow play were largely to log on; turn the volume down; trouble shoot when a program would not work or the screen had frozen, and to load activities when children asked for help. Having done this, Vicky would then leave the
children their own rather than seeing this interaction as an opportunity to support children’s learning with programs of their choice. In this sense she was largely absent during children’s digital play and her interventions were reactive rather than guided by any pedagogical intent. Vicky’s role was primarily to facilitate and manage access to, rather than support, children’s use of digital media by paying attention to what children were doing or wanted to do.

**Summary and intervention development**

Pre-intervention, there were several constraints to Vicky’s effective integration of digital media so that their use was in evidence across all areas of the curriculum rather than as a separate activity. She focused on the physical skills children needed to navigate programs and play games and expressed a dislike of teaching technical skills that she frequently referred to as ‘mouse control’. Vicky indicated that a key reason she used the PC with children was to develop skills needed for the reception class. Although Vicky was skilled in using her interventions in play to support learning across the curriculum she did not link the development of knowledge about digital media to potentially valuable learning beyond this. Vicky believed the role she adopted around the PC and IWB did not allow children to exercise agency over what they learned nor the direction of that learning. The direct teaching approach she believed was needed created tension with her early years pedagogy. Vicky had found a way to navigate the tensions around the direct teaching of phonics because she valued the ways children incorporated this knowledge into free play, but had not been able to do this with the PC or IWB. Pre-intervention Vicky did not believe digital technologies offered opportunities for children’s active engagement in their learning and she perceived children’s use of digital media to be solitary and passive. Vicky believed digital media offered little opportunity for children to have input into how they learned compared with the ways children made decisions about their learning in other areas of the curriculum. In this respect, she did not appear to have observed the collaborative ways children used the IWB and PC to complete their chosen games and share technological skills. Vicky believed children’s early oral language skills were a key aspect their later literacy development and highlighted the role practitioners played in fostering language development. There was a strong language and communication focus throughout the classroom which Vicky orchestrated through planned practitioner-directed teaching, practitioner-initiated activities and interventions in child’s play. Vicky’s belief that digital
media hindered children’s talk meant she did not consider the use of the PC or IWB as part of her practice to support children’s language and communication skills.

Vicky’s use of the PC and whiteboard with children was guided by her pedagogical beliefs and concept of digital media as tools that did not support early learning. She had not yet developed a pedagogy for children’s learning with digital media, hence Vicky did not support and extend the ways children interacted with programs and digital games in the same way that she intervened in children’s play elsewhere. Her interventions in children’s digital media use were largely to trouble-shoot problems with the PC or IWB and teach technical skills. Vicky’s only other use of the PC and IWB was during planned whole class teaching when the IWB was used primarily as a form of display rather than as a more flexible pedagogical tool to support learning. Vicky’s infrequent use of the IWB during these practitioner-directed sessions was motivated by a sense of obligation and a desire to develop her use of digital media as part of her professional development and performance management targets.

Pre-intervention findings suggested that the initial design principles would meet Vicky’s needs in developing strategies to integrate digital media into teaching and learning. The belief that the intervention activities would be effective in developing a workable intervention was based on earlier discussions with Vicky and my understanding of the beliefs and approaches that shaped and guided her practice. I therefore suggested that a productive way to enhance children’s more active and agentive engagement with digital media in the classroom would be for Vicky to include a section for ICT on her weekly planning documents (see Figure 5.2) in the second week of Cycle 1 was an important first step in her changing practice. This addition provided a physical space in which Vicky could include an overview of the

**Intervention Cycle 1 – 13 weeks**

**Planning for digital media**

The addition of ICT as a section on Vicky’s weekly planning documents (see Figure 5.2) in the second week of Cycle 1 was an important first step in her changing practice. This addition provided a physical space in which Vicky could include an overview of the
week’s planned use of digital media in the same way that she did for other planned activities across each week.

Adapting the planning sheets was Vicky’s own response to the suggestion that planning might be a way for her to begin to actively consider ways to integrate the IWB and PC more effectively into classroom activities. This addition was a small change, but it had an immediate impact on the way Vicky began to use the IWB during practitioner-directed teaching. As weekly planning was already embedded in Vicky’s practice, including digital media was a natural extension of an element of practice with
which Vicky was already familiar. The aim was to encourage Vicky to consider ways she could include the IWB as part of children’s learning while she planned her teaching rather than as an ‘add on’. The suggested addition of ICT was a small change but had an immediate effect. The day after I proposed this change Vicky approached me in the classroom and said: ‘I now have a section for ICT on my planning’ (discussion 12.12.14). The inclusion of ICT on Vicky’s planning document acted as a visual prompt to encourage her to think about ways to include the IWB as an integral part of whole class teaching sessions. The addition of ICT to Vicky’s planning documents with learning intentions related to the EYFS curriculum was indicative of how the curriculum became embedded as part of her pedagogical decision-making process. The prominence of the EYFS framework in curriculum planning also demonstrated how government policy initiatives shaped aspects of practice in the classroom.

Following the addition of ICT to Vicky’s weekly planning documents there was a noticeable change in the way she planned to use the IWB during directed teaching times and also as part of practitioner-initiated activities during free-flow play (see Table 5.1). Planning documents showed that IWB was used more frequently to introduce and demonstrate new programs and games to the children than it had been pre-intervention. Vicky also began to interact with children using the IWB during free-flow play by playing and demonstrating games as well as using drawing programs with children.

Table 5.1: Type and frequency of digital media use referred to in 20 nursery weekly planning documents

<table>
<thead>
<tr>
<th>Intervention phase and cycle</th>
<th>Total planned interactive uses of digital media</th>
<th>Interactive game-play during directed teaching(^\text{11})</th>
<th>Interactive non game-play during directed teaching(^\text{12})</th>
<th>Interactive game-play during free-flow</th>
<th>Interactive non game-play during free-flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-intervention (7 weeks)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cycle 1 (13 weeks)</td>
<td>12</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

\(^{11}\) Interactive game-play refers to practitioners playing digital games with children

\(^{12}\) Non game-play refers to the use of activities including drawing programs, and literacy-based activities
Planning direct teaching

Introducing children to a range of on-line games and activities was an early addition to the way Vicky used the IWB as part of practitioner-directed teaching. The IWB was no longer used primarily as a large static display screen and Vicky used whole class teaching times to show children different activities on the newly introduced Busy Things website of interactive games and teaching. All the content on the Busy Things website was mapped to the EYFS or Primary Curriculum and it had won several awards for its innovative content. Busy Things was part of the London Grid for Learning (LGfL) established by the London Boroughs to provide ICT services for schools. The activities on the Busy Things website designed for the early years featured humorous alien-like characters that made ‘silly’ noises, in-keeping with the Busy Things motto to ‘Teach, Laugh, Learn’ (‘Fun Educational Games & Activities: Make Learning Fun’, 2016). The early years section of the Busy Things website had more than 70 curriculum-linked interactive games and activities in the form of easily accessible icons which children could choose from (see Figure 5.3).

Figure 5.3: Busy Things home page of interactive games for early years

13 ICT is the term used by schools and Local Authorities to refer to the diverse range of technological tools and resources used to support learning. The term is used here to reflect its use in educational contexts.
In week five of the pre-intervention phase, the school ICT co-ordinator had shown Vicky the *Busy Things* website during a staff training session and soon after this Vicky had loaded the website on to the PC linked to the IWB. Vicky commented she 'liked' *Busy Things* because of the way she had observed children using the website in social groups and working collaboratively to explore the wide range of games and activities. Following Vicky’s introduction to *Busy Things* my field notes recorded how the IWB was now switched on for use most mornings. Previously children had to ask for it to be switched on. Vicky’s weekly planning also showed how she regularly used the *Busy Things* website during planned teaching sessions and showed children different activities that she could link to the learning intention for the session. When Vicky used *Busy Things* during directed teaching her focus was often on showing children how they could navigate the program using the IWB pen, or how to locate and open different *Busy Things* games. Vicky actively used, and interacted with, the IWB rather than using it to show pictures or play music. The following are examples from Vicky’s weekly planning indicating the way she included the IWB as part of whole class teaching.

**Beginning of the morning: Vicky**

*Busy things programme*¹⁴ – creating firework pictures. Show children how to use the pen and hold to make the firework move. Ask the children to try and describe what the firework is doing. Explore using our bodies

LI: Learn how to use a new program on the IWB.

Begin to use directional vocab (planning 11.11.14)

**Beginning of the morning: whole class**

Introduce friendly Friday explain that today we are thinking about making new friends in a different school.

Introduce Reza¹⁵ school using Mark’s flip chart.

Look at the photos of the children in school and then in their best clothes. Where do they think the children are London?

Encourage the children to talk about what they see. Explain that we will send a Christmas card to these children and that we need to make it. What could we put on our card? Should we send a photo of ourselves or could we draw pictures of ourselves? Show the children samples of Christmas cards to help prompt ideas.

Have a go at making a Christmassy picture on the Whiteboard

LI: learn about the school we are linked with; begin to think about how they might celebrate. Work together (planning 5.12.14).

A field note observation in week 13 recorded how Vicky used the *ActivPrimary* drawing program to draw a Christmas tree and showed children how to tap on different icons to

---

¹⁴ Spelling of ‘programme’ as in original planning document

¹⁵ Ferny Croft’s link school in Ethiopia
select a drawing tool, change colours, load a clean page and other tools needed to use the program so that children could draw their own pictures. This session was typical of the way Vicky demonstrated different programs and activities to children as part of planned teaching during Cycle 1. The IWB was increasingly becoming part of Vicky's visible planning, and the way she used it during practitioner-directed teaching sessions was changing. Her changing practice was most noticeable when Vicky used the programs children were familiar with such as the Busy Things website. Vicky used whole class teaching times to introduce children to new aspects of the website and the operational skills needed to use different aspects of the games and the IWB.

Practitioner interaction

During Cycle 1 Vicky extended her use of the IWB beyond a form of static display. She began to interact with children at the IWB and used it to support operational skills and language development.

Using the IWB during free-flow play

In week 10, Vicky invited me to observe her using the IWB for a literacy-based whole class session planned for the beginning of the morning. Following our discussions about using digital media to support children's literacy development Vicky had spent time searching for suitable activities and found a program on the Times Educational Supplement (TES) iboard website of resources for teachers ('TES iboard shop', n.d.). Vicky explained that she liked the way children could use this program to sequence and write about familiar daily events that included getting dressed; having breakfast; coming to school; going home, and brushing their teeth before bed. The children could choose from ten pictures to sequence by dragging up to six images into spaces at the bottom of the screen. Each image had a one sentence description written underneath it which could be changed by typing in new text. Vicky showed the children how they could add their own words to the pictures using the keyboard on the PC attached to the IWB. Once the pictures had been put into a sequence, a pre-recorded voice on the computer read aloud the words under each picture in the order in which the pictures had been arranged. As shown below the learning intention (LI) for this session referred to children's learning about digital media and literacy:

To begin to sequence events in their day. Understand how they can navigate through a simple program on the whiteboard using the pen. Show an interest in print (planning 15.1.15).
Once the whole class session was finished Vicky remained seated at the IWB to support children who wanted to continue to use the TES *iboard* program. This was the first time Vicky had planned a whole class IWB activity and then remained at the whiteboard to support children who wanted to use a program. The following Extract 5.1 of a videoed interaction between Vicky and Maryam, one of the children who took part in this activity. The extract illustrates the approach Vicky took to using the IWB and the PC and her focus on technical skills Maryam needed to use digital media as part of a literacy activity.

**Extract 5.1: Supporting learning at the IWB**

Vicky supported Maryam to select and drag the pictures Maryam had chosen on the IWB and she and Vicky had moved to the PC to use the keyboard. Vicky was sitting next to Maryam as Maryam typed words underneath the pictures she had chosen. So far Maryam had typed her name as the first word in her sentence.

![Figure 5.4: Vicky and Maryam using the TES *iboard* activity](image)

Vicky: So, you’re going to need a space, a space bar.
Maryam: What?
Vicky: This is your space bar. Vicky points to the space bar and Maryam looks at the keyboard. You press it and look … Maryam does not respond. Press it, tap it. Maryam presses the space bar and Vicky then points to the screen at the place where Maryam has entered a space as part of the sentence Maryam is writing.
Vicky: It gives you a space otherwise it would all be joined up and you couldn’t read it as words it would be one big sound. So, you’ve got ‘Maryam is eating’. Are you happy with that?
Maryam: When you want to take it out you just press that. Maryam points to
the print icon.
Vicky: If we want to print it we just press that and we can go and get it from the top of the school.
Maryam: Yes.
Vicky: So, this one says I’m getting dressed. Vicky points to the original words underneath the picture.
Maryam: I want another one. Maryam indicates she wants to change the text underneath this picture.
Vicky: OK, so click on the add circle and it will take it (the text) away. Maryam deletes the text and clicks in the box to place the cursor in the correct space to start writing.
Vicky: That’s right get your cursor, brilliant. So, do you want to write some words there?
Maryam: I need a big one (a capital letter to begin her name)
Vicky: Ok, so if you want it big you need to hold this arrow down. Vicky points to the shift key whilst you press the m. (observational video 09.40 15.1.15)

During this 15-minute interaction Vicky showed Maryam several skills needed to enter and edit text, navigate around the program and print out work. These were not related to Maryam’s use of the mouse – she was already competent in using the mouse – but related to her ability to read and understand different icons and symbols on the PC screen. Vicky offered suggestions either in response to Maryam’s requests or at strategic moments in the activity as Maryam’s writing progressed. Following this interaction with Maryam, Vicky used the TES iboard activity with two more children spending eight minutes with one child and ten minutes with a second child. Each time Vicky used the program in a way that was led by each child’s individual interest in, and understanding of, the connection between letters and sounds as well as their ability to navigate around the screen using the mouse or pen tool. Reflecting on this session afterwards, Vicky commented on her own learning:

   It was a revelation to me because every child got something different out of it. For Danny it was about the silly sounds the letters made and navigating around the screen. For Maryam it was about using her knowledge [of phonics] to write words and with Niamh it was about putting her words on the screen. (discussion 15.1.15)

The significance of this activity was that it demonstrated how Vicky could initiate an activity at the PC or IWB, but then be guided by children’s individual interests and developing capabilities as she introduced them to both technological skills and different aspects of early literacy. This activity showed Vicky that direct teaching of skills did not mean that children lacked agency and control over the activity or that they could not lead and influence their learning with digital media. Vicky also explained that the TES iboard activity demonstrated how she could embed the teaching of specific skills as part of the way she interacted with children at the PC and IWB. The TES iboard activity
was pivotal in Vicky’s conceptualisation of digital media as tools to support learning and Vicky later described this session as ‘a real transition moment for me’ (interview 11.8.15). Her reflection on this session and the children’s response to her presence, were a powerful indication of the way Vicky’s beliefs and practice were changing. She saw that her presence created opportunities for children to direct learning according to their individual interests, and existing skills and knowledge. She could follow their lead and introduce new skills and knowledge at sensitively chosen moments in the same way she might do in other activities away from digital media. More importantly there was a valuable role for Vicky to play at the IWB.

**Developing operational skills**

Mid-way through intervention Cycle 1 Vicky discussed her changing beliefs about teaching skills and commented:

> My big learning for the half term is that there are things I have to introduce to them [the children] to show them how to use it [the IWB] (discussion 12.2.15).

Prior to the intervention Vicky viewed teaching technical skills as an obligation rather than something that she valued and linked to wider learning opportunities these skills offered in other curriculum areas. Understanding that teaching technical skills was an important part of practice with digital media was a significant change in Vicky’s beliefs and an important first step in rethinking the way she approached using the PC and IWB in the classroom. Prior to the intervention, Vicky’s dislike of skills teaching and the direct approach she assumed this needed was one of the main constraints to her using digital media. Vicky now saw how children’s developing operational skills opened opportunities for them to develop the ways they used digital media and she was able to extend this learning through her interactions. She began to recognise that children’s ability to navigate programs and use the mouse or IWB pen tool gave them access to a wider range of learning opportunities and commented: ‘perhaps it’s also about doing direct teaching to introduce skills, but once they’ve got those skills looking at how they’re using things to think about how we can develop them’ (discussion 12.2.15).

This comment indicated the extent to which Vicky was not only teaching operational skills but also actively observing how children used them, and thinking about next steps in learning.

Vicky’s focus was on her role in children’s use digital media and the impact her presence could have. During discussions about the kind of more direct approach Vicky
believed teaching operational skills needed she suggested that this might be important to facilitate children’s independent use of the IWB in ways she observed had a positive impact on children’s language and communication development. The following comment is indicative of the importance Vicky placed on developing children’s operational capabilities:

I’m already more spontaneous with the whiteboard and using it with the children and seeing the opportunities … I’m able to spot the opportunities, but the opportunities have come thicker and faster cos I’ve introduced them to more [skills and activities]. (discussion 12.2.15)

This statement highlighted an important shift in Vicky’s thinking about the IWB and the ways she used it with children. Vicky was no longer absent from children’s use of digital media and she used her interventions to extend learning based on her observations of children. She was beginning to integrate the IWB into her practice by actively seeking out opportunities to use the whiteboard and be present when children used it. Vicky’s reference to spontaneity also pointed to a growing confidence in her ability to bring the IWB into her practice and find ways to make it part of the classroom learning environment. Her use of the whiteboard was becoming part of her invisible planning around how she chose to spend time alongside children supporting the way they used the IWB in the same way that she did in other areas of the classroom. The IWB was increasingly part of the way Vicky sought out opportunities to support learning through her interactions. Teaching skills was no longer her prime motive for her interactions. Children’s developing technical capabilities were a means to an end and enabled rich opportunities for independent learning and collaborative interaction.

**Supporting language development**

During Cycle 1 Vicky frequently identified children’s language as an aspect of the way she observed children interact at the IWB and collaboratively play and explore new activities and programs. Her observations showed that children’s use of the IWB was frequently a social activity and that children collaborated to construct digital texts and work out how to use different interactive games and activities. Children required a high level of social competence to collaboratively read and create digital texts. When they did so, children used a range of language skills. Discussing observations of children using the IWB, Vicky drew attention to the way children helped each other play the *Busy Things* games and used their interactions to problem-solve, particularly when they were not familiar with a game. Children frequently told each other which icons to tap on, how to load a new game, what an error message on screen meant, and what to
do if a child could not find a particular game they had used before. Children actively shared and communicated to each other their technical skills and knowledge of games and programs. The following Extract 5.2 from a transcript of video interaction between Danny and Sam illustrates how children used oral language to help each other play the games on the screen by sharing their knowledge of the activity.

**Extract 5.2: Children collaborating at the PC**

Sam had been using the PC for 2.5 minutes before Danny sat next to him at the screen. Sam immediately wanted to show Danny a recycling activity he had tried to show Alessandro two minutes earlier. However, Sam had not been able to get Alessandro’s attention as he was reading a book.

**Figure 5.5: Sam and Danny using Simple City together on the computer**

Sam: Can I show you something, can I show you something?  
Danny: Yep

*Sam exits from the program he is using and goes back to the recycling game.*

Sam: Danny Look, Danny! Sam chooses an item to put into a crusher.

Danny: Crush it.

*Sam laughs as the machine crushes the bicycle.*

Danny: Crush it all up.

*Sam selects a table and puts it into the crusher.*

Danny: No, that’s wood.  
*Danny points to where Sam needs to put the table.*

Danny: No is go there.  
*Danny points to the compost bin.*

Worms eating them.

Put this into there.  
*Danny points to an item he wants Sam to choose and indicates where to put it.*
Sam: Ok. That?
Danny: Yes.
Sam puts a tin into the crusher and they both laugh when it gets crushed. Sam then selects a banana skin.
Danny: Bananas go in there. No there. Sam has dragged the banana towards the crusher. Worms all eaten them. (observational video 23.1.15)

Danny was one of several children in the class with additional speech and language needs and he had received a block of speech and language therapy. In this exchange Danny and Sam worked together to complete a recycling activity by choosing objects which had to be placed into the correct recycling bin. To do this Danny told Sam where to place objects using oral language and gestures in order to complete the game. This kind of spontaneous language when children used the PC and the IWB was something Vicky noticed and commented on, particularly in relation to children with speech and language needs.

Vicky actively observed how children used the IWB and PC and she became aware of the language they used to help each other and explain the way games worked, and incorporated this aspect of the way children used digital media into her practice. Vicky described an interaction at the IWB with a child who had additional speech and language needs and how she had used her intervention to focus on language by encouraging the child to explain to her what he was doing:

Vicky: If he tries to talk me through and I can find out where the gaps are then I can say to him... ‘do you mean you are pulling it down using this arrow’ he goes yes. I’m trying to give him that vocabulary as he does it.
Researcher: The language to talk about what he’s doing.
Vicky: Yes. (interview 12.2.15)

Vicky saw her interactions with children using the IWB as valuable opportunities to develop oral language. Her approach to intervening in free-flow play to support oral language was prompted by the way she had observed children use the IWB. Pre-intervention, Vicky’s interventions in child-initiated use of digital media did not support the way children played games and collaborated to share their skills and knowledge. Recognition that children’s language was a feature of the way they used the IWB supported Vicky’s existing beliefs about the importance of young children’s oral language development. She could see a role for herself in supporting and extending language through interventions in children’s self-initiated use of the PC and IWB. Vicky’s discussion of the way she used her interventions to support language development also suggested that she was comfortable with this way of intervening in children’s digital media use. This strategy of intervening to support language appeared
to support Vicky’s existing beliefs about the importance of her role in developing children’s oral language.

**Intentional interventions in digital play**

Interactions between Vicky and children to support language development demonstrated Vicky’s intentionality in choosing moments to intervene that were on the children’s terms and appreciative of their digital activity. She shared the digital spaces created children created by appreciating their game play and the pictures children drew. Vicky’s interactions also extended children’s knowledge of the games and drawing programs within the context of the activities chosen by children. When Vicky used her interventions to extend the way she had observed children naturally explain to each other how to play games she allowed the children to lead their learning with digital media. In these interactions Vicky also positioned the children as digital experts and learned alongside them. Learning how to use digital media with the children rather than before she introduced it to the class was new to Vicky’s practice. Pre-intervention, Vicky felt constrained by her lack of skill and experience using the IWB and the activities on it as well as the need to directly teach children how to use digital media. During Cycle 1, observations showed how Vicky intervened to support children’s skills development as they played games on the IWB and used the digital media to support children’s language development. Observing and discussing Vicky’s integration of digital media during free flow play suggested she was developing a sustainable strategy for her interventions in children’s IWB use, which related to a new belief in digital media as tools to support language development. There was a rationale for her interventions that Vicky could articulate by way of her on-going support of children’s digital media use. This rationale was supported by her existing beliefs about the importance of early language development and the key role practitioners played in supporting language.

Observations of Vicky indicated how she was integrating the IWB into her practice with an intentional focus on language that reflected her practice with other classroom resources. Vicky showed children how to use new activities on the IWB she frequently used a range of open-ended questions which allowed the children to show their knowledge and understanding of different programs and games and the skills required to use them. The following questions are taken from video recordings of Vicky using the IWB in different contexts:
• How do you know it’s a maths game? (practitioner-directed whole class teaching)
• What do you think you have to do? (practitioner-directed whole class teaching)
• Why did you tap on that one? (practitioner-directed whole class teaching)
• How could you put Elsa into your story? (practitioner-initiated IWB story writing using a drawing program)

These questions resemble the earlier examples of Vicky’s questioning recorded during interactions with children engaged in activities away from the IWB. Vicky’s strategy of asking children to share their digital skills and knowledge was different from pre-intervention when an observation of a planned whole class IWB session noted how Vicky seemed to be demonstrating how to use the IWB, rather than first asking children what they thought they might need to do. Vicky’s use of open-ended questions to support oral language was already a feature of her practice and she began to apply this to the way she used the IWB with children. This suggested a change in her approach which allowed children to have some input into the activity and demonstrate their growing skill and understanding of the IWB as a tool for learning. The IWB no longer sat as an ‘add-on’ to Vicky’s practice and she was beginning to use strategies to integrate it into practitioner-directed activities that were already part of her practice. Vicky was using approaches the children were familiar with but in new contexts mediated by the IWB.

Reflecting on change

On-going discussions, and the time and space they provided for reflection on Vicky’s developing practice, were an important feature of the intervention. During Cycle 1, Vicky reflected on what she was learning as a result of her changing use of the whiteboard. More importantly, Vicky reflected on ‘my big learning’ in relation to her beliefs about skills teaching expressed during the baseline phase of the intervention. Reflection took place with the researcher after activities with the PC or IWB and these discussions gave Vicky the time and space to talk about how she had used the IWB and her observations of the impact of this use on both her and the children. During these discussions Vicky began to explore the extent to which her beliefs about teaching technical skills were impacting on her practice. In week nine Vicky reflected on the way she had been teaching technical skills using the IWB and related this to what she already did in the classroom. It was significant that Vicky’s reflection took place in the context of her own beliefs and practice, rather than what she had observed other practitioners do, what she might have read or professional development she had
attended. This allowed reflection to be a personal problem-solving process to address Vicky’s own needs in developing her practice around integrating digital media into the classroom.

Vicky’s direct experience of using the IWB with children, watching them using it and discussing the impact of the changes to her practice gave Vicky new ways to think about digital media and the way she used it:

Vicky: It’s through watching them using it [the IWB] that I’m thinking I can use it for language here, I can use it for understanding there, I can use it for PSED [personal, social and emotional development] here and it helps that it’s that beautiful big whiteboard
Researcher: So it’s changing your thinking isn’t it almost?
Vicky: I’m less concerned about how I’m planning. But the way I’m using it my planning is coming from what I’m seeing them doing with it whereas before I wasn’t really seeing them doing very much with it. (discussion 12.2.15)

Vicky’s ability to ‘see’ what children were doing came about as the result of her watching more keenly in class how children were using the IWB and reflecting on what she observed. Our reflective discussions following Vicky’s observations of children using the IWB collaboratively without practitioners, and helping each other to use activities by sharing skills and knowledge was a strong feature of Vicky’s reflection on the impact of Cycle 1. It struck me that this was something Vicky had not expected to see given her belief that children’s use of digital media was ‘solitary and passive’. Vicky needed direct experience of using the IWB and the opportunity to reflect on what she saw children doing before adopting new beliefs and beginning to change her practice. Vicky also suggested that because she had ‘introduced them to more’ the children were making increased use of the whiteboard and this was providing her with more opportunities to observe and build on what she saw children doing. As she commented during this same discussion, ‘It’s a bit chicken and egg’ (interview 12.2.15). The more Vicky used the IWB with children, the more their technical capabilities increased so that they could use the IWB more independently and access activities that supported collaboration and problem-solving.

Reflection also provided opportunities for Vicky to link her use of digital media to existing practice. During a discussion at the end of Cycle 1 Vicky related children’s use of digital media outside school to the way she supported their out-of-school interests in the classroom more generally. Vicky commented: ‘it’s what we do outside isn’t it. We say this child’s really interested in this, they’re doing it in this way how can we extend
it? What can we do?’ (interview 12.2.15). Vicky recognised the need to develop and extend children’s interest in digital media in the same way that she did as part of her existing practice when she took note of children’s interest in dinosaurs, mini-beasts, digging in the garden or writing. This significance of this comment is the extent to which it supports the view that Vicky did not see the PC and IWB as wholly separate from her existing practice and beliefs about children’s learning. Vicky was drawing digital media into the way she planned for children’s learning, and beginning to think and talk about the PC and IWB as part of children’s classroom learning experiences. This comment also suggested Vicky was actively thinking about digital media and the positive role her interventions could play rather than seeing her role as one of reacting to problems and teaching mouse skills.

Reflective discussions were also opportunities to discuss the intervention design and consider possible developments based on how Vicky wanted to progress her use of digital media and ways the intervention could support her. Vicky had often commented on children’s collaborative uses of the IWB and the way they shared skills and knowledge. I therefore suggested a more collaborative style of practitioner interaction, whereby Vicky and other practitioners working in the nursery recognised children’s technological expertise and knowledge, might be effective in supporting children’s digital media use. When intervening in child-initiated activity practitioners would ask children to explain what they were doing and how they had made a particular activity or program work. This would give children greater control over learning and what was valued as learning by practitioners. I also believed that this strategy would support Vicky’s use of the IWB and the PC as tools to develop oral language and provide an approach to that was less practitioner directed. Discussion at the end of Cycle 1 suggested that although Vicky was using the IWB more frequently, and planning for ways to integrate it into her practice, she had reached a point where she needed greater researcher support in developing activities to extend children’s interest in and uses of digital media. Vicky felt she was ‘still quite hampered by my lack of familiarity’ (discussion 12.2.15).

A further reason for support with planning was the proposed introduction of an iPad into the classroom. Vicky was not familiar with iPads and wanted support using one. Although not part of the original intervention design, the use of an iPad was something Vicky and the early years educators (EYE’s) requested. As part of the desire to develop
classroom practice it was important that the intervention supported not just Vicky but other practitioners' needs and requests as part of the intervention so that they were able to develop their practice around what would be of use to them too. The use of an iPad could also be justified on the grounds that it would be used in a way that fitted in with the intervention design principle of making the contexts for learning relevant and meaningful to the children and providing more occasions for teachers to support child-initiated digital play. It seemed that this development of the intervention would provide opportunities to further integrate digital media into Vicky’s practice in a way that would support what she already did rather than introducing something new that might not be sustainable post-intervention. Vicky suggested that this ‘planning together time’ could be used to support her in identifying ‘where I can be using ICT to enhance their learning and in what ways I can do it’ (discussion 12.2.15).

Summary and intervention development
During Cycle 1 Vicky added a section for ICT to her weekly planning documents and began to use the IWB as a pedagogical tool to support learning rather than as a form of static display. She used practitioner-directed teaching sessions to introduce the children to new IWB skills and activities, and also began to interact with children using the IWB during free-flow play. Vicky used these interactions as opportunities to develop children’s oral language and extend their digital skills. These interactions were successful when Vicky felt that she was able to follow children’s lead and extend their knowledge and skills by allowing children choices in their learning. Reviewing planning documents and observing Vicky’s use of the IWB indicated that the starting point for Vicky’s developing practice was for her to integrate the IWB into what she was already doing with children, rather than using the technology because it was available, and thinking about extending children’s use of the IWB in the same ways that she did during interventions in free-flow play. Reflective discussions provided a valuable way to discuss the changes taking place in the classroom and how they affected Vicky’s beliefs and practice. These on-going discussions highlighted the impact of the intervention on the classroom learning environment and Vicky’s shifting beliefs.
However, there was no evidence of the early years practitioners (EYEs), who worked alongside Vicky, spontaneously interacting with groups of children at the PC or the IWB during free-flow play in the same way they did in other areas of the classroom. Vicky was the only practitioner who regularly used the IWB or the PC with children, and the changes to practice and the classroom learning environment were not securely
embedded to the extent that all practitioners were changing their practice in the ways that Vicky was beginning to do. Having discussed the way her own beliefs and practices had begun to change as a result of watching how children used the IWB and PC Vicky suggested the EYE might benefit from doing this too. She suggested this might help them to see how children used digital media as a first step to developing their own practice. The key changes to the intervention for Cycle 2, therefore, were to introduce an iPad into the classroom and encourage all practitioners to use digital media alongside children during free-flow play. The intervention was modified in the following ways:

- EYE to ‘stand back’ and observe children using the whiteboard and think actively about ways to interact to extend learning.
- Practitioners to interact with children using digital media during child-initiated play. Vicky to include planned sessions for the EYE in daily planning sheets to encourage this. Adopt a model whereby all practitioners encourage children to explain how to play the games in the way children did naturally during their collaborative IWB use. When using the computer with the children practitioners would ask children to explain what they were doing, how they had made a program work etc. Skills and language were then developed in response to what the children needed to complete a game and could, therefore, be considered more meaningful.
- Researcher to lend Vicky an iPad to use as part of free-flow play.
- Planning together time with Vicky and the researcher.

**Intervention Cycle 2 – six weeks**

**Planning for digital media**

Although intervention Cycle 2 was seven weeks shorter than Cycle 1, Vicky’s planned use of the IWB as part of group teaching did not significantly decrease, and there were more examples of other forms of digital media being integrated into free-flow play (see Table 5.2). There was also an increase in the number of opportunities Vicky planned to use digital media during free-flow play to support individual children particularly those with additional speech and language needs.
Table 5.2: Type and frequency of digital media use referred to in 26 nursery weekly planning documents

<table>
<thead>
<tr>
<th>Intervention phase and cycle</th>
<th>Total planned interactive uses of digital media</th>
<th>Interactive game-play during directed teaching</th>
<th>Interactive non game-play during directed teaching</th>
<th>Interactive game-play during free-flow</th>
<th>Interactive non game-play during free-flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-intervention (7 weeks)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cycle 1 (13 weeks)</td>
<td>12</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cycle 2 (6 weeks)</td>
<td>11</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

Vicky’s planning documents indicated she was using digital media in response to children’s developing needs and interests in addition to its use planned around curriculum-based learning intentions. Vicky’s planning for other practitioners to use the digital media during free-flow play were often recorded as handwritten additions to her weekly planning documents (see Figure 5.6).

Figure 5.6: Vicky’s handwritten additions to nursery planning directing early years educators to use Busy Things on the IWB (planning 25.2.15)
These changes or additions to planning frequently occurred following observations of children using the IWB or assessments of children’s individual needs, and directed practitioners to use specific games or programs with children. Handwritten additions and changes to weekly planning suggested Vicky was using her written plans to ensure that she was thinking about how IWB, PC or mobile tablets could be used in response to children’s developing capabilities. Planning was not a static process, but one which responded to children’s developing needs and interests across the week. Including these additions on the planning sheets was a way of ensuring that Vicky and the other practitioners in the classroom remembered to use digital media as the weekly plans were displayed in the classroom. Annotations to planning demonstrated how different digital media were being used more spontaneously and becoming an integral part of teaching and learning. Vicky adapted weekly plans in response to ongoing observations of children in the same way she did in other areas of learning and used the IWB and mobile tablets to meet individual children’s needs. Handwritten changes to planning also showed how Vicky was actively considering her use of the IWB for whole class planned teaching and integrating it into practitioner-led activities during free-flow play.

What was notable about Vicky’s planning during Cycle 2 was the way she began to plan with a clear rationale for why and how she wanted to use a greater range of digital media. She included the IWB and mobile tablets that were introduced during Cycle 2 into her practice and their use linked to a new belief in digital media as tools for language development, as Vicky’s planned use of an iPad demonstrated. Vicky had been introduced to an iPad story writing app – Our Story (Open University, 2011) – by the researcher during the pre-intervention phase and strongly indicated she wanted to use the app in the classroom. Our Story is a picture-based app which allows users to create digital texts using pictures, writing and audio recorded sound. When Vicky discussed using Our Story she clearly articulated why she wanted to use this app and how it would enhance children’s language and literacy learning:

They [children] can put text and begin to understand that stories are about the words and that the words can come out of your mouth and can be written down and that they can come from them [the children]. That’s what I’d like to do, make that connection. (discussion 11.3.15)

This comment suggested Vicky was actively thinking about ways different digital media could support particular aspects of children's literacy learning.

The iPad offered the ability for children to record their voices and hear back what they
had said. With Vicky’s support children could also type those words and begin to make a connection with the way speech can be represented as written text.

**Planning for other practitioners**

Vicky’s developing concept of digital media as tools for language and literacy not only guided her own use of them, but also how she directed other practitioners with a planned focus in accordance with her changing beliefs. When Vicky directed the EYEs and EAL teacher to use digital media it was frequently as part of planned literacy or language activities. During week four of Cycle 2 Vicky asked Lauren - the EAL teacher - to use the iPad with a group of children in the school garden. The planned activity was for children to use the *Our Story* app to take photographs of flowers and then record their voices talking about what they did and saw outside. Before Lauren took the children outside Vicky told her: ‘It’s about getting them to talk, not about using the iPad,’ (field note 27.3.15). This comment indicated Vicky was using the iPad because it provided a way for children to record and hear their voices and sequence what they did outside using the pictures as prompts, rather than children learning how to use the iPad. Activities planned by Vicky for the EYEs to use the IWB or iPad were also intended to support language development. The weekly planning documents for two days during the first two weeks of Cycle 2 show how Vicky planned a practitioner-directed activity for Karen to use the IWB with children to draw pictures related to the week’s literacy text: *The Magic Paintbrush* (Donaldson, 2003). The description for this activity on the weekly planning suggested a clear language and literacy focus for children to create a narrative around the pictures they drew and to see their words written down.

Karen – *Magic Paintbrush* pictures using whiteboard – encourage the children to create stories around their pictures – practitioner as scribe on separate paper (planning 24.2.15).

Vicky’s desire to use this session to support language development was underlined when she reflected on the activity later the same day and mentioned that if she (rather than Karen) had done this activity she would have given it a greater language focus.

Vicky’s direction to other practitioners to use the IWB and iPad using outcomes and approaches she used in her own digital practice indicated digital media were becoming more embedded in the classroom learning environment. Vicky’s decision to direct Lauren and Karen with a rationale for using digital media and a clear focus on the learning intention further suggested a growing confidence in her own use of diverse
digital devices and the way they supported children’s learning. This growing confidence was something Vicky noticed in herself when she discussed the changes taking place in the classroom.

Researcher: There is a huge change in your classroom.
Vicky: I’m quite proud of myself.
Researcher: You should be.
Vicky: I looked at myself this morning and I thought look at me iPad, LearnPad, whiteboard. (discussion 20.3.15)

Vicky was not only integrating digital media into her own practice but beginning to create a presence for it in the wider classroom environment. She encouraged all practitioners in the classroom to engage with different forms of digital media and with different learning intentions as these examples of practitioner-initiated activities planned by Vicky for the EYE s indicate:

Karen to use Busy Things maths activity. LI listen and understand instructions (planning 25.2.15).

Karen on the whiteboard with Busy Things. 1-1 correspondence and numeral recognition (planning 26.2.15).

Karen small group whiteboard using Busy Things: Feed the monkey. LI developing 1-1 correspondence and numeral identification (planning, 5.3.15).

Huma focus group using iPad creating a story they make with photos taken using the puppet theatre (planning 19.3.15).

When practitioners other than Vicky began to use the IWB and iPad with children and integrated them into their practice it changed the children’s experience of who used digital media with them as well as the different learning situations in which they were used with practitioners. It was not only Vicky who valued children’s use of digital media and actively helped them play their chosen games. Other practitioners the children regularly saw in the classroom supported the ways they interacted with the PC, IWB and tablets in the same way they supported play in other curriculum areas.

Practitioner interaction
During Cycle 2 Vicky began to use mobile tablet technologies and this led to her extending practice around the use of digital media as part of free play.

Integrating tablet technologies into free-flow play

Vicky viewed the use of an iPad as way of relating digital media use more closely to children’s interests; her anecdotal evidence and my discussions with children indicated
that the majority of children in the class used an iPad at home. Vicky also believed the Our Story app, which was freely available for the iPad, would allow children to ‘be more creative’ and to develop their own input while still allowing a focus on language. Vicky’s goal was that would eventually be able to use the iPad independently to record their own work and interests indoors and outdoors. The introduction of a new form of digital media might have been too great a change to be considered a development of the original intervention, rather than a new intervention. However, I considered the original design principles were still relevant, as was the analysis at the end of Cycle 1 which led to the changes to the intervention and the need for more practitioner interventions in free-flow play.

Vicky’s first use of the iPad was planned as a practitioner-directed activity with two boys – Matt and Alessandro – during free-flow play (see Extract 5.3). Although Matt was familiar with iPads and said he used them at home to play games and watch films, my observation of Alessandro using the iPad during this activity suggested he was less familiar with this technology. This view was supported by Alessandro’s mother during a home visit when she said, ‘Alessandro hasn’t really got to grips with the iPad,’ (interview 6.3.15). Vicky had planned for the two boys to take pictures of each other dressed as pirates and then write or audio record something on the iPad using the Our Story app.
Extract 5.3: Practitioner-initiated activity using *Our Story* on an iPad

Vicky invited Alessandro and Matt to sit at the table with her and use *Our Story* on the iPad to record information about pirate day. The two boys took pictures of each other and Vicky then wanted the boys to place the pictures into the app and add text and/or words.

![Image of Vicky, Alessandro, and Matt using *Our Story* on an iPad](image)

**Figure 5.7: Vicky on pirate day using *Our Story* with Alessandro and Matt**

Vicky: It says drag your image here (pointing to the words). So can you drag your... which photo do you want to start with Matt. Drag it on to there.  
*Matt tries to drag the pics down several times until he is successful while Alessandro watches the screen.*  
Vicky: There, so that’s the first one in the story. So Alessandro, which one do you want to choose?  
*Alessandro tries to tap and drag a photo but because he taps it twice trying to grab it, but the picture opens up full screen.*  
Vicky: Ooohh it’s got very big. *Alessandro smiles and takes his hand away.*  
*Matt immediately taps on the X to close the picture and return to the main screen.*  
*Alessandro lifts his hand to tap on the photograph he wants again. He tries three times to drag the photograph.*  
Matt: Shall I do it Alessandro?  
Vicky: Tell Alessandro how to do it Matt.  
*Matt points to the photograph to drag and Alessandro tries again himself.*  
Vicky: Do you have to keep your finger on it when you press it? Is it like a tap?  
*Alessandro tries again and double taps inadvertently as he attempts to grab the photograph to move it and a large image opens again. Matt reaches over with his finger towards the screen.*  
Matt: Press there.  
*After three attempts Alessandro is still unsuccessful and Matt drags the picture into place. Vicky continues to tell the boys what to do.*  
Vicky: Can you see the photos at the top?  
*Matt points to the photos at the top*
of the screen. It says drag your image here. Vicky is pointing to the words on the screen. So can you drag your... Which photo do you want to start with Matt? Drag it on to there. (observational video 6.3.15)

This episode lasted 13 minutes and Vicky took the lead telling Matt and Alessandro which icons to tap on, how to take a picture and record their voices, where to tap, and where to put their fingers to slide pictures. Vicky also spent time showing the boys how to drag pictures to the correct place in the app, getting the record button to work and taking the pictures. Vicky had to do much of this herself rather than the boys doing it.

Prior to using the iPad, Vicky had a clear idea of how she wanted to use the Our Story app and the learning that it could support; it required a lot of input from Vicky to achieve her objective. Reflecting on this activity afterwards Vicky said: ‘I realised I need to do more input’ (discussion 11.3.15) before children might be able to use it independently. This comment, and my observation of the activity, indicated that children needed more operational skills to use the iPad and individual apps. Observing this activity there appeared to be little chance for children to exercise agency and lead the activity and it struck me that the role Vicky played on this occasion was similar to the way she had taught children mouse skills at the PC and her distaste of this. Vicky’s focus with Matt and Alessandro was directed towards the skills the boys needed before they could benefit from using the program.

The following week, Vicky planned a second practitioner-directed activity with a small group of children using the iPad during free-flow play. She indicated she wanted a session more integrated into free-flow play than when she had used the iPad with Matt and Alessandro. Vicky used the iPad outside in the nursery garden and wanted children to create their own version of Goldilocks and the Three Bears using pictures of story props taken by the children and children’s recorded voices retelling the story. Like Matt and Alessandro, the children did not have the technical skills to operate the program and most of this had to be done by Vicky. The observation of this session recorded in my field notes suggested it was a more structured activity than I had seen in the nursery to date when children were not part of whole class teaching sessions.

Following these two sessions, Vicky discussed using the iPad and Our Story with a group of children as part of a planned, adult-initiated carpet session. She commented that this had been more successful in previous uses of the iPad and showed me the stories the children had created using photographs and children’s recorded words. The crucial difference on this occasion was that Vicky had used the iPad as part of an
activity during the morning teaching time when children had experience of this type of more structured directed learning.

Reflecting on her iPad use, Vicky commented, ‘I guess it taught me that it doesn’t work as part of free-flow. It needs to be a group activity or a whole class carpet session’ (discussion 25.3.15). This reflection suggested Vicky realised that she had used the iPad in a way children were not expecting during free play. This kind of practitioner-directed activity with a pre-determined outcome was a feature of whole class teaching rather than free-flow play. When Vicky attempted to ‘impose’ this type of more structured learning outside group or whole class sessions children did not ‘tolerate’ it as this comment recorded later highlights:

They [the children] very much see free-flow as free-flow play and they claim that very strongly as their time to do. That’s not our time and we do call them to do things and generally they come and do it. They’re also aware that sometimes that’s an invitation … and so when I start imposing my [inaudible] during that time there’s confusion. I suspect if I did that same thing during a carpet session in a small group then they would be very accepting of that because … it’s about managing expectations, isn’t it? (interview 27.5.15)

Vicky also commented that, ‘this was my agenda and not the children’s’ (discussion 25.3.15). These reflections, and Vicky’s reference to ‘my agenda’, suggested children’s ability to express their agency and make choices about how to carry an activity forward was at issue in these two instances. In order for children to use the iPad in the way Vicky had planned, she had to directly teach a set of skills needed to operate and navigate the Our Story app. These two iPad activities had been unsuccessful in Vicky’s view because they were not part of her existing approaches to organising teaching and learning, and the classroom learning environment these approaches created.

Discussions with Vicky on her developing use of the IWB and the iPad indicated that using practitioner-directed teaching sessions to introduce new skills and activities on the IWB followed by more individual interactions with children to develop the activity according to their interests was an effective model of integrating these devices into the classroom. This approach, Vicky indicated, would allow children to become more knowledgeable about an activity or app in a familiar and ‘safe environment’ so that they could then use the IWB and iPad independently with strategic input from practitioners. This supported Vicky’s changing belief that there may be a need for more structured direct teaching of skills as part of planned teaching times, in addition to practitioner interactions to extend children’s learning using digital media.
Introducing LearnPads in the classroom

One of the intervention developments for Cycle 2 was the introduction of 15 LearnPads into the classroom. The LearnPads were bought by the school for the foundation stage and year one classes to use, and presented an opportunity for children to have access to several mobile tablet devices. Vicky was keen to use the LearnPads because there were enough for several children to use together. There was also a perception by Vicky of slight pressure from the school for her to begin to use the LearnPads in the classroom as her comment on an email from the deputy head teacher suggested:

So, Charlie’s given us a (pause) me a nudge. He sent a thing [email] round phrasing 'it would be really lovely to see how they're [LearnPads] being used'.
(interview 12.2.15)

Access to only one iPad had restricted what Vicky could do with it and although she expressed an interest in trying to get more iPads for the classroom the availability of 15 mobile LearnPad tablets pre-empted this. However, Vicky’s experience of using the iPad and her reflection on the way she had used it influenced how she chose to introduce the LearnPads into the classroom. The decision to purchase LearnPads for the early years classes was linked to their cost compared with iPads and because it was easy to restrict content and prevent children from using particular features such as printing and the internet. Vicky acknowledged that using the iPads as part of a practitioner-directed activity during free-flow play had not been successful, and she took a different approach with the LearnPads which was facilitated in part by the availability of 15 devices. Her reflection on using the iPad suggested that integrating LearnPads into the classroom required a different approach and one that more closely met children’s expectations of the way practitioners behaved in the classroom during free-flow play. Vicky was also keen to encourage children - particularly girls - she did not see using the whiteboard to use digital media and make these technologies more accessible to them. One strategy Vicky felt would be more successful was to use the LearnPads in less formal way than at a table and in a space children frequently gathered to play.

When Vicky first brought the LearnPads into the classroom she put them in the book area and sat on the floor with the LearnPads next to her. The book area was next to the home corner and groups of girls in the class regularly used the book area as a space in which they gathered to socialise. Groups of girls made beds, played with the dolls, played at being a family and generally gathered here to play together in
friendship groups. The LearnPads had an immediate and dramatic impact on the way the girls, and some boys who I had not observed use the whiteboard, began to use digital media and the impact these devices had on their social language. It was their ‘success as a group and shared activity in the way that it prompts spontaneous language’ (discussion 25.3.15) that most struck Vicky. Throughout the time she spent with the LearnPads, Vicky sat on the floor handing out the LearnPads as children approached her asked to use them. Vicky gave little guidance about how to use the new tablets but was guided by the children and what they wanted to do. Vicky encouraged the children to work out how to use the LearnPads with questions such as: ‘What do you think you would like to look at?’ and ‘How do you think you can open it?’ (extract from video transcript, 20.3.15). Vicky also explicitly asked children to help each other and work together when she became aware that some children had more knowledge than others. For example, the following comment was directed towards one girl who had asked for help finding and using a particular game: ‘If you sit next to Fifi you can look at what she’s doing,’ (ibid).

Discussing what Vicky felt was different using the LearnPads from when she had used the iPad, she commented that, ‘I had no agenda other than to introduce the LearnPads’ (discussion 25.3.15). There was no defined learning intention and Vicky had sat with the children and been guided by what they wanted to do with them and the apps and games the children wanted to use. Her role had been to respond to children’s requests for help and facilitate their use of these new resources. Vicky encouraged children to help each other and act as teachers to support each other’s learning of the skills needed to operate the LearnPads. This approach provided opportunities for children’s language development as they explained to each other how to turn on the LearnPads, find and play the apps they wanted, and co-constructed peer learning. In contrast to her experience of using the iPad, it struck me that Vicky used the LearnPads very much as an equal in terms of her knowledge of the technology, and she adopted a different approach from the way she had used the iPad. One that gave children greater agency in how and with whom they used the LearnPads than had been the case with the iPad.

**LearnPads supporting language**

Vicky’s observations of children using LearnPads reinforced the extent to which they encouraged children’s oral language. The games children used frequently prompted
conversations about their experiences outside the classroom as children swapped and showed each other their screens. The digital texts were a starting point for children’s discussion of shared experiences and negotiating meanings. An example of this type of interaction is included here to show the impact the introduction of the LearnPads had on children’s social language. On this occasion four girls were sitting in the book area each with a LearnPad and each using the same colouring app. Although the girls appeared to be focused on their individual screens, at regular intervals one or other of them turned her screen to show the other girls in the group what she had found. This led to a discussion related to the image on the screen. In the following video recorded extract Ellie has coloured a picture of a shark on her LearnPad and she turns it to show Flora who is sitting next to her on the carpet.

Ellie: There I got a shark. *The girls giggle and scream.*
Niamh: I’m scared of sharks.
Flora: Me too. They’re very scary sharks aren’t they?
Niamh: Yeah. I seen a shark before.
Ellie: Some sharks are anyway (pause) you know
Flora: You know, when mummy was married, when I was in her tummy, when I was a teeny weeny baby then (pause) my mummy saw a crocodile, but my mummy and daddy weren’t scared so, but they didn’t run way because they(pause) cos it was just walking so slowly and then they ran back because they were so scared.
Emily: When I was at my mummy’s. When I was at my mummy and daddy’s house I saw a big fish and my mummy said *Emily puts on a different voice to sound like her mum* it wouldn't eat me up and then I ran away run, run, run. *Emily moves her arms like legs running.*
Flora: What was it?
Emily: A big, big, big, big fish. A fish ahhhhhh!

During this same activity the girls also talked about their pets, prompted by one of the girls finding and colouring a picture of a cat.

Ellie: Look I got the dog and the cat
Flora: Oh yea you do. Cats are my favourite animals you know Ellie.
Emily: And mine. My cat is [inaudible]. I’m gonna buy a cat for my birthday and then you come and play.
Flora: I’m gonna call my cat… my cat is gonna be a girl and my cat....
Emily: And my cat is gonna be a girl too.
Flora: My cat is gonna be called...
Emily: (interrupting) Shall I tell you something…
Flora: (interrupting) Can I tell you something....
Niamh: Flora, you know I got a hamster at my house.

In these two extracts, the LearnPads offered opportunities for stimulating and enhancing the kind of naturally occurring social language that relied on interaction between the girls and their ability to draw on experiences outside the classroom. The girls entered into extended dialogues during which they listened to each other with
interest and responded appropriately to what they heard by joining in the conversation. When they joined in the conversation the girls drew on relevant experiences, which demonstrated a sophisticated understanding of the nature of this type of social interaction and their ability to respond to ideas expressed by others. The girls’ responses also demonstrated their awareness of the listeners’ needs and interests by relating their comments to what they heard and connecting their comments accordingly. Vicky often commented on this type of naturally occurring language and how she believed it was a feature of the way children used the IWB and LearnPads. Episodes of this type demonstrated to Vicky how digital media supported language and communication development in a way that she had not observed pictures in books doing when groups of children looked at books together in the book area. Vicky could support this social interaction by making the LearnPads available for children to use and through her interventions in children’s digital play.

Reflecting on change

At the end of Cycle 2 I discussed the intervention with Vicky and what she thought was enabling her to make changes to her practice. Listening to what Vicky had to say it struck me that the presence of a researcher was a more important element of the intervention, and Vicky’s ability to adopt new practices, than initially anticipated. This view is highlighted by the following comment:

I’ve embraced it [digital media] because I can see lots of social learning and lots of possibilities and that’s what having you there (pause) you know sometimes it just takes having somebody else there to make me (pause) I’m thinking Charlotte’s [the researcher] coming in, what’s she seeing, what will she want to see when she walks in. (discussion 20.3.15)

This comment was one of the first indications that my presence as part of the intervention had a direct impact on Vicky’s practice. It encouraged Vicky to think about the different digital media she had and how she was using them with children, and then make changes to what she did and how she thought about the learning that took place when children used the IWB, the iPads and the LearnPads. My presence as a researcher also provided opportunities for a critical reflection on Vicky’s own beliefs and changing practice in a supportive environment:

You [the researcher] being in and me being made to articulate my end of it it’s making me think about what I’m doing and what I’m seeing and actually stepping back and thinking (pause) and actually that’s made the biggest difference to me. (discussion 11.3.15)
Although the presence of a researcher was effective in encouraging change and providing time and space for reflection, more direct support in the form of the planning together time introduced for this cycle of the intervention was less effective. At the end of Cycle 1, Vicky indicated that she felt she needed more researcher support in planning for digital media and thinking about where she could be using the IWB and PC to support children’s learning. Although this planning time took place in the first week of Cycle 2, it became clear that this was not an effective way of supporting Vicky’s integration of digital media. Time and space after an activity to reflect on her use of the IWB or LearnPads to reflect on what had, or had not worked, and why, seemed to be more helpful for Vicky. These discussions allowed Vicky to articulate her own learning and incorporate this learning into her future uses of digital media.

Reflective dialogue about specific activities also meant that discussions were directly related to the use of the different digital media available in the classroom and allowed Vicky to think about how she and the children responded to these resources as tools for learning. As the handwritten additions to Vicky’s weekly plans suggested, planning was an on-going process as practitioners responded to children’s developing interests and knowledge and Vicky adjusted planning throughout the week. Researcher support was most effective when it followed an activity when Vicky had tried a new approach to using different forms of digital media. Finding an appropriate time to plan together also proved to be difficult as Vicky did not always plan the weeks’ activities at a set time and often her initial plans changed. This made it difficult to find a mutually suitable time to sit together and plan ways digital media could be integrated into teaching and learning.

Reflective dialogue encouraged and supported Vicky in making change by providing a space in which she could talk about the changes she saw in the classroom and her own part in those changes. It showed Vicky that: “I really do have to be thinking about this… I see so many things that they’re getting out of it.’ (discussion 11.3.15). Making the changes was not enough. Vicky needed to actively think about what was happening in the classroom in order to see and understand the impact the integration of digital media was having in whole class teaching and free-flow play, particularly when she introduced a new form of digital media such as iPads or LearnPads. Through the process of action followed by reflection, Vicky began to understand the impact on children’s learning, as well as her own beliefs and practice, of the new strategies she adopted around digital media. The cycle of making a change, observing the consequences of that change on children’s learning and then reflecting on the change
and its impact, was an effective model of introducing new practices into the classroom learning environment. The presence of the researcher in this cycle was of particular value to Vicky in supporting her and providing a space for reflection and observations on practice with an ‘outsider’ tuned into the classroom environment and with an understanding of Vicky’s beliefs about digital media and early years pedagogy. The researcher also had a role to play in supporting Vicky and enabling her to acknowledge the changes that had taken place during the first two cycles of the intervention.

**Summary and intervention development**

Vicky’s planned use of the IWB during practitioner-directed teaching and free-flow play increased, and she used the IWB to support learning with a clear rationale for its use. Vicky also began to plan for other practitioners to use digital media during free-flow play with outcomes that were often related to language development. Annotated planning documents showed evidence of Vicky’s more spontaneous use of the IWB and mobile tablets in response to how she observed children using them. The introduction of mobile tablets during Cycle 2 was most effective when Vicky integrated LearnPads in ways that did not ‘disrupt’ children’s understanding of the way she interacted with them during free-flow play. On these occasions there were no strong pre-determined learning outcomes and Vicky was guided by the children and how they wanted to use the LearnPads. The presence of the researcher enabled Vicky to make change and supported her in critically reflecting on the impact of change. At the end of Cycles 1 and 2 there was little evidence of the IWB and LearnPads being embedded into practice more widely as part of all practitioners’ spontaneous interactions with children’s digital play. Classroom use of digital media tended to be planned either on the weekly planning sheets or transmitted orally by Vicky to the EYEs and specialist support teachers. The kind of spontaneity observed in Vicky’s developing practice was not yet established throughout the day and the early years educators did not interact with children using the IWB, PC or LearnPads unless directed to do so.

The key changes to the intervention for Cycle 3 were for Vicky to include specific times on the weekly planning documents when EYEs would intervene in children’s use of the IWB or LearnPads during free-flow play and for the LearnPads to become more fully integrated into the classroom environment. The intervention had also indicated that using mobile tablet technology was not effective in structured practitioner-initiated groups during free-flow play and so this was discontinued. Planning for the IWB was
effective and this continued, as did Vicky’s planned interventions using the IWB and LearnPads for one-to-one interventions for children with additional language needs. The intervention was, therefore, modified in the following ways:

- LearnPads to become part of continuous provision every Friday
- Practitioners to ‘play’ alongside children with LearnPads
- Plan in ‘ICT’ support for EYE s during free-flow play

The final two points listed above were taken directly from a Post-it note Vicky wrote for herself following a discussion at the end of Cycle 2. This discussion reviewed intervention Cycle 2 and considered ways to develop the intervention for Cycle 3. The use of the word ‘play’ is Vicky’s and strongly suggests she saw the LearnPads as an integral part of the classroom learning environment given her beliefs about the importance of play in young children’s learning.

**Intervention Cycle 3 – eight weeks**

**Planning for digital media**

Table 5.3 shows the pattern of planned digital media use for Cycle 3 compared with Cycles 1 and 2 and the pre-intervention phase. This table shows that the IWB was planned as part of whole class teaching less often than in Cycles 1 and 2 and that use of digital media during free-flow play fell from seven to four planned incidences. This could be due to this being the summer term and children spending an increased amount of time outside. It might also be that Izzy was now using the IWB and LearnPads more spontaneously as part of her practice rather than needing to plan for their use. This view is supported by an observation I recorded on one of my last visits to the nursery in which Vicky integrated the IWB into a whole class teaching session without explicit, written planning. Figure 5.8 shows that the activity was a handwritten addition to Vicky’s weekly planning and did not refer to her using the IWB.
Table 5.3: Type and frequency of digital media use referred to in 34 nursery weekly planning documents

<table>
<thead>
<tr>
<th>Intervention phase and cycle</th>
<th>Total planned interactive uses of digital media</th>
<th>Interactive game-play during group teaching</th>
<th>Interactive non game-play during group teaching</th>
<th>Interactive game-play during free-flow</th>
<th>Interactive non game-play during free-flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-intervention (7 weeks)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cycle 1 (13 weeks)</td>
<td>12</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cycle 2 (6 weeks)</td>
<td>11</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Cycle 3 (8 weeks)</td>
<td>11</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Vicky planned to read the story *Monkey Nut* (Rickerty, 2013) about two creatures who each find creative uses for a monkey nut by turning it into a skateboard, a hat and a boat. The learning intention for the session was for children to use their own creativity and imagination to find different uses for a banana. After reading and discussing the book with the children Vicky used ActivPrimary to draw the shape of a monkey nut on the IWB. She then showed the children how to use one or two of the program tools before suggesting they could use their imagination to turn the image on the screen into whatever they wanted. When I later looked at Vicky’s planning for this session (see Figure 5.8) I noticed that she had not included the use of the IWB. This suggested Vicky’s decision to use the IWB was a spontaneous one and that she was able to integrate the whiteboard into her teaching without always having to explicitly think about and plan ways to do this as part of her weekly written plans. It struck me that the whiteboard was now more naturally part of Vicky’s thinking about teaching and learning than it had previously been.
Figure 5.8: Handwritten addition to weekly planning (planning 26.6.15)

This kind of ‘unplanned’ use of the IWB also pointed to Vicky’s growing confidence in incorporating digital media into her teaching and her ability to act spontaneously when she recognised opportunities to include the IWB into planned teaching times. During this same whole class session, as Vicky was showing the class how to use the fill tool on ActivPrimary to colour in a shape, Flora called out to tell Vicky that she had done something wrong because, ‘you’ve forgotten to use the pointy bit’ (observation recorded in field note 26.6.16). Vicky immediately acknowledged her mistake and selected the correct ActivPrimary tool to complete her picture. Flora’s comment was a powerful indication of the way the interaction between Vicky and the children during practitioner-directed teaching using the IWB had changed. Children’s confidence in their digital skills meant they could point out Vicky’s mistake. Pre-intervention Vicky seldom interacted with the IWB during practitioner-directed teaching and children had little opportunity to demonstrate the skills and knowledge. As Vicky began to use directed teaching times to demonstrate new skills and programs and invited children to use the IWB children not only developed new skills but were also encouraged to take on the role of teacher.
Practitioner interaction

One of the features of Cycle 3 was the use of the IWB and LearnPads by the EYEs and spontaneous interventions in children’s digital game play. This was facilitated by the way Vicky planned for EYES to use different digital media. Cycle 3 also highlighted some constraints to further integration.

All practitioners using digital media

During week four of Cycle 3 Vicky planned for Huma, one of the two EYEs, to support children’s use of the LearnPads during free-flow play (see Figure 5.9). This was the first example of Vicky directing one of the EYEs to interact with children during free-flow play without specifying a particular activity or game that was linked to a particular learning outcome. This was an important step in embedding technology into the classroom as it meant that Vicky was no longer the only practitioner who regularly intervened in child-initiated uses of digital media.

<table>
<thead>
<tr>
<th>Friday</th>
<th>AM session</th>
<th>PM session</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Huma</td>
<td>Vicky</td>
</tr>
<tr>
<td></td>
<td>Introduce</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Friendly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Friday, sit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the children</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with a new</td>
<td></td>
</tr>
<tr>
<td></td>
<td>friend, hold</td>
<td></td>
</tr>
<tr>
<td></td>
<td>their hand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>look at them</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and say hello.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘Row row row your boat’</td>
<td>action song in pairs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karen</td>
<td>Huma</td>
<td>Vicky</td>
</tr>
<tr>
<td></td>
<td>LearnPads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>during</td>
<td></td>
</tr>
<tr>
<td></td>
<td>free-flow</td>
<td></td>
</tr>
<tr>
<td>Karen</td>
<td>Huma</td>
<td>Vicky</td>
</tr>
<tr>
<td></td>
<td>Introduce</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Friendly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Friday, sit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the children</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with a new</td>
<td></td>
</tr>
<tr>
<td></td>
<td>friend, hold</td>
<td></td>
</tr>
<tr>
<td></td>
<td>their hand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>look at them</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and say hello.</td>
<td></td>
</tr>
<tr>
<td>Karen</td>
<td>Huma</td>
<td>Vicky</td>
</tr>
<tr>
<td></td>
<td>LearnPads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>during</td>
<td></td>
</tr>
<tr>
<td></td>
<td>free-flow</td>
<td></td>
</tr>
<tr>
<td>Karen</td>
<td>Huma</td>
<td>Vicky</td>
</tr>
<tr>
<td></td>
<td>Introduce</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Friendly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Friday, sit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the children</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with a new</td>
<td></td>
</tr>
<tr>
<td></td>
<td>friend, hold</td>
<td></td>
</tr>
<tr>
<td></td>
<td>their hand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>look at them</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and say hello.</td>
<td></td>
</tr>
<tr>
<td>Huma</td>
<td></td>
<td>Vicky</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.9: Weekly planning directing Huma to use LearnPads during free-flow play (planning 11.5.15)

Directing early years educators to support children using technology was also an important factor in their changing practice as the following discussion indicates:

Huma: I’m not using it as much as I should. I still haven’t got to that bit. But I am using it more and Vicky kind of plans me in. But it just comes

16 Highlighted names in original document
around that if I’m planned in I will do it.
Researcher: I did notice you’d been planned in a couple of times with the LearnPads.
Huma: Yes, so I was doing that.
Researcher: How do you find that?
Huma: That’s fine, they [the children] just get on with it and I’m just there to support them.
Researcher: So how do you think you’re supporting them?
Huma: With language. Cos they’ll talk to me and they’ll say ‘look at this’ and I can extend their language while I’m talking to them. But generally they’re navigating themselves or they’re showing me how to use it.
Researcher: Do you find they’re doing that?
Huma: Yes, cos I’ll ask them how do you do this, how do you do that?
(interview 14.7.15)

When Vicky planned for Huma to spend time with children using LearnPads during free-flow play this action took on the same importance as when Vicky included the EYE as part of planned practitioner-directed teaching times. Directing practitioners during free-flow play in this way was not a feature of Vicky’s practice. When she directed the EYE to use the IWB or LearnPads it underlined her growing belief in the importance of supporting and extending the ways children used these devices in the classroom. Listening to the way Huma discussed supporting children using the LearnPads, it struck me that her description of using her interventions to develop children’s language was similar to the approach Vicky had adopted during cycles one and two. Huma was, in some ways, following Vicky’s lead in the way Vicky approached supporting children’s interactions with the IWB and LearnPads. Huma was letting the children lead with the LearnPads and act as experts by asking open questions and encouraging children to show her how use the LearnPads.

**Spontaneous interventions in digital games**

During Cycle 3, I observed Vicky more frequently intervene in children’s digital play in the same way she did in other areas of the classroom when she played alongside children and joined in their games. The following video-recorded Extract 5.4 is an example of an intervention in one child’s digital game which was used as a language opportunity for a child with additional speech and language needs. The interaction took place one during a morning when Vicky had been in the area of the classroom where the IWB was positioned. Although Vicky was also supporting other children nearby her focus for much of her time in on this occasion was towards children using the IWB. She moved to and from the IWB as she saw strategic moments in their game play to
enhance learning by demonstrating IWB tools, new aspects of a familiar game or asking children to talk about a game they were playing.

**Extract 5.4: Supporting child-initiated digital play**

Vicky had helped Danny load the *Busy Things* website and he had been playing a game on his own for seven minutes before Vicky approached him and asked Danny to explain to her how to play a game she had earlier observed him using.

![Danny interacting with Vicky at the PC](image)

**Figure 5.10: Danny interacting with Vicky at the PC**

Vicky: Ok, can you show me the garden one? Can you remember what you did? *Danny opens the garden game.* So what do you have to do Danny?
Danny: All that. *He uses the mouse to move the cloud above a flower.*
Vicky: So are you moving the cloud?
Danny: no, not me's (pause) just the flowers.
Vicky: Click on it. So if you click on it (pause) use the mouse it will water, it will rain over the plants. How do you get him to use the watering can?
Danny: You just press on the flowers.
Vicky: What do I need to do now? So you’re pressing on the cloud to make it bigger. We need the bird to come don’t we to eat that caterpillar. Is there anything we can do to make the bird come?
Danny: No it just (pause) aahh (the bird appears and drops a seed)
Vicky: So do we have to grow them before the caterpillar can eat them? *Danny continues to water the flowers as they grow so that they don’t droop and die.*
Gosh, you’re having to work quite fast aren’t you to stop them being droopy. And then what about growing this one here at the end?
This exchange lasted six minutes and Vicky used Danny’s familiarity and enjoyment of this game as an opportunity to extend his language by asking him to explain his understanding of the game and tell her how to play it. Vicky positioned herself as the learner in the game rather than the teacher. She allowed Danny to take the lead in showing and explaining to her how to play this game and gave him the chance to demonstrate his technological competency but also his understanding of how the game works and what he needs to do to complete it successfully. Vicky’s intervention gave Danny the words to explain this which he did not have. This extract is typical of the way Vicky sought out opportunities to use the IWB and planned her interventions as opportunities for oral language development. It also demonstrates it was not only Vicky’s direct support that encouraged learning with digital media but her indirect actions in choosing to be near the IWB and alert to opportunities to support children. This was an aspect of her practice that I had not observed in connection with the IWB before and suggests she was applying her pedagogy to digital media.

**Embedding digital media into the classroom**

Integrating the LearnPads and IWB into whole class teaching and free-flow play was a regular feature of Vicky’s practice. These devices were increasingly embedded in classroom activities when practitioners other than Vicky used the IWB and LearnPads during free-flow play. In week six of Cycle 3, I recorded an observation of Huma using the LearnPads with a group of children during free-flow play and discussed with Huma how it was the first time I had seen her do this. My reflection on this discussion recorded afterwards noted how ‘matter of fact’ Huma’s response to my comment seemed to be when she said: ‘Yes, we now have them out every Friday,’ (discussion recorded in field notes 12.6.15). This was an indication of the extent to which other practitioners working in the classroom increasingly viewed the LearnPads as just another classroom resource children could choose to use. Reflecting on this comment by Huma I confirmed a belief that the LearnPads were now integrated into nursery continuous provision in a way that I had not observed before. On previous occasions, practitioners had brought out the LearnPads during the morning session or children had been invited to use them by a practitioner. I had never observed them as freely available with equal status alongside other resources that practitioners set out for children to use. This impression of the LearnPads becoming embedded in practice was strengthened when I visited the classroom and observed five LearnPads set out on the
writing table in the same way that practitioners set out paper and pens on this at the beginning of each nursery session (see Figure 5.11).

![Figure 5.11: LearnPads put out by practitioners in the writing area](image)

Placing the LearnPads on the table in this way in an area the children used for drawing and writing implied the LearnPads could be used in the same way as paper and were of equal value to paper to support literacy and creative development. This struck me as a strong statement relating to Vicky’s beliefs about digital media and its value for learning. Making the LearnPads available in this way was an important shift in how Vicky thought about digital media and their position as tools to support learning beyond operational skills.

**Constraints to integration**

Although the LearnPads were regularly available in the classroom, there were technical constraints to further integration in the ways Vicky wanted to use them, which she felt unable to resolve alone, and Vicky frequently mentioned the shortcomings of these tablets. One of these shortcomings was the quality of the apps available to use on the LearnPads, with a limited selection of apps and games listed by the LearnPad...
suppliers that could be loaded by practitioners. Vicky described these apps as ‘prescriptive’ and offering ‘closed learning opportunities’ (discussion recorded in field notes 20.3.15). She commented that ‘the children are quite keen, but we’ve got quite limited resources on them’ (interview 11.8.15) and how ‘what’s on there is fairly poor, low quality and even the counting thing’s too simple. It’s too closed’ (interview 27.5.25). This was not a complaint Vicky had ever levelled at the Busy Things website. The way LearnPads had been set up to function in a primary school environment, rather than an early years setting, also created technical problems. Only one set of games could be on the LearnPads at any one time and when different teachers loaded new content anything previously loaded was removed. This was a feature of the LearnPads Vicky struggled with:

Last time I used the LearnPads I loaded them up and then I saw additional things and I thought well I’d like to try and put that on because that might do this and this one might be a good one for this and I thought I had loaded them on but then when we opened it wasn’t there. The problem is…if you put stuff on it and another teacher uses them before you do it can wipe your planning off. (Interview 27.5.25)

The LearnPads were set up so teachers could use them to create and load lessons and resources children could access and use independent of the teacher. Vicky wanted to load a range of games that children could choose from in the same way that they did when children used the IWB. Although she was increasingly able to use different approaches to integrate digital media into the different classroom learning situations, Vicky still felt she needed greater knowledge around how to use the digital media devices that she had in the classroom. She particularly wanted support around appropriate apps and programs to extend and deepen children’s learning with digital media. Deputy head teacher Charlie, who had chosen the LearnPads for the nursery, was also beginning to question whether they had been the right devices to buy. One of the reasons for the school choosing LearnPads for the early years classes was that ‘they were quite controlled’ and because:

One of the appeals of them is that you’re not going to accidentally come across … inappropriate content. You’re almost kind of locked into a learning space and the only options you’ve got are those activities. So that was an attractive feature. (Charlie interview 18.6.15).

This comment suggests concerns for safety had led the choice of technology rather that usefulness for pedagogy or understanding of how early years practitioners might want to use them. After observing the LearnPads used in the classroom and talking to teachers, Charlie acknowledged that, 'in reality seeing them I’m not sure that’s
necessarily the best’ (interview 18.6.15). Part of the problem, he suggested, was that unlike the iPads and Hudls used in the rest of the school, the LearnPads were set up by the supplier to perform in a particular way and practitioners were severely limited in what they could do with the LearnPads outside the settings installed on them. Practitioners also needed more experience of the LearnPads than they did with devices such as the iPads and Hudls to use them effectively as a pedagogical tool.

In retrospect, I can see that they [the LearnPads] will be less successful than Hudls and iPads … because there’s more training involved. You have to learn a whole new program and a whole new software in order to get onboard with them. Whereas the other tablets you can just pick it up as you go and become more creative. (Charlie interview 18.6.15)

The constraints Vicky experienced using the LearnPads meant she was hindered in her in efforts to develop the use of the LearnPads further. Vicky was unable to grasp the potential she believed mobile tablets offered because of the way the tablets available to her operated and could be used by practitioners, and a lack of support in finding ways around these problems.

**Lack of appropriate training**

Many of the on-going problems Vicky and other teachers in the school faced with the LearnPads can be related to a lack of effective training tailored to teachers’ pedagogical needs. Vicky and Catherine, the school ICT co-ordinator, commented that the training they had received from the company supplying the LearnPads gave them little support in understanding how to use LearnPads to support learning. Vicky was particularly vocal about the lack of relevant training practitioners had received before the LearnPads were introduced into the early years and key stage one classrooms. I observed the 40-minute training session led by a salesperson which focused on the technical skills teachers needed to plan lessons with the LearnPads. The trainer was unable to answer many of the questions teachers had around how they could use the LearnPads in their classroom as part of teaching. The training session focused on how to load games for children to practice skills or how to give children access to sets of resources that were part of teacher created lessons. The training was not tailored to the needs of the kind of early years environment where children’s exploratory play was the focus of learning rather than structured whole class teaching. Two weeks after this training session, Vicky commented that one of the reception class teachers had told her, ‘I’m not using the LearnPads because all that thing was a

---

17 Hudls are mobile touch screen tablet computers running Android and Windows software
bit above me how to load things on it’ (discussion 20.3.15). In this instance, the purchasing decisions taken by the deputy head teacher were impacting pedagogy and Vicky’s ability to integrate them into the classroom in ways that supported early learning and a play-based pedagogy. Vicky was developing an approach to using digital media based on observations of children using digital media and her professional expertise but further development was hampered by the technology available to her.

Vicky compared the training for the LearnPads to the training practitioners had received before using the Hudls in the classroom for children’s assessments. The Hudls were touch screen tablet devices bought by the school for early years practitioners’ to record their observations of children’s learning and take photographs of their work. The software on them was designed for this purpose and training for the Hudls was led by a teacher who had used Hudls in the classroom. Vicky commented that the trainer was able to answer specific questions the early years staff had about how they wanted to use the Hudls in their classrooms. What Vicky found particularly valuable about the Hudl training session was the opportunity to discuss the use of the Hudls with a practitioner who had direct experience of using Hudls in the classroom and could offer practical solutions to real life problems. When training in digital media was not targeted to practitioners’ needs it did not encourage the integration of new devices into the classroom. The result of such targeted training was that all the nursery staff used the Hudls for observations the day after the training and commented how much time the new devices were saving. It was several weeks however, before the LearnPads were first used and only after the ‘nudge‘ from the deputy head teacher. The decision to purchase the LearnPads taken by the deputy head teacher had implications for their use in the classroom. The LearnPads were designed and set up for use with older children and the training reflected the way teachers planned and delivered lessons in key stage one rather than approaches to learning in the early years classrooms. This constrained the use of the LearnPads in the early years classes and practitioners were unable to apply their professional expertise to integrate them effectively into learning.

Reflecting on change

Discussing the intervention with Vicky a month after its completion reiterated the importance of reflection as one of the design principles.
I think it’s been incredibly valuable having you [the researcher] come and do the research and sometimes poking me in a little way that makes me think ‘ooohh have I thought about ICT this week’. But actually it’s been good because I was so uncomfortable with it before and I feel that by having to engage with it, that having you there as a sounding board has been very good because I feel that as a teacher I need to reflect on what I do and just being able to do that makes me think about well, ok, that worked and that didn’t work and why didn’t that work. Why am I not comfortable with it? What can I do next? And that's all been helpful. (interview 11.8.15)

Vicky’s ability to embed the changes she made around digital media depended on her understanding of their impact on children’s learning. Key to that understanding was the critical reflection on Vicky’s own beliefs about digital media and young children’s learning. Critical reflection, as opposed to reflection more generally, required Vicky to question her previous beliefs and use reflection on her practice as a problem-solving act. This kind of reflection allowed Vicky to see the impact on children’s learning of the ways she used different digital media. When Vicky began to reflect on her previous beliefs about the PC and IWB within the context of her observations of children using the IWB and LearnPads she described her pre-intervention view of digital media as a ‘reactionary’ one. Embedding digital media into all aspects of Vicky’s classroom practice was frequently related to her willingness to make changes that she was initially uncomfortable with, but then being open to seeing how these changes affected children’s learning. For Vicky, an essential factor in this reflective process was the presence of the researcher as a critical friend to support her in making change and then providing a safe space in which to reflect on the impact of those changes.

   It took my understanding, me seeing, my watching, my watching, watching and you [the researcher] going poke, poke, poke and my going right ‘what am I seeing’. (interview 27.5.15)

This comment indicated how it was often the reflective, dialogic space created by the researcher’s presence, along with personalised and responsive support when needed that was instrumental in the changes Vicky made to the way she used the IWB, iPad and LearnPads. During a reflective discussion at the end of Cycle 3, Vicky suggested that there were occasions when she had felt uncomfortable making the changes she did, but that the presence of the researcher had ‘forced’ her to make changes which provided new episodes that became the focus of critical reflection.

   Having you [the researcher] in [the classroom] has at times been slightly uncomfortable because it’s forced me to [use technology]. But actually I’m over the forcing and quite enjoying the doing. (interview 27.5.15)
This comment was the first indication that Vicky had at times been uncomfortable with the changes introduced by the intervention and it emphasized the strength of her underlying pre-intervention beliefs about digital media. The two above-mentioned comments underline the importance of on-going action and reflection as part of the process of embedding change. The comments suggested that the presence of the researcher was a key factor in instigating the changes Vicky needed to make in order to reflect on ‘what am I actually seeing’ and the way in which practitioner interactions changed children’s learning with digital media.

The role of the researcher in prompting change and reflection was also indicated by Huma during an interview at the end of Cycle 3 to discuss her response to the intervention and its impact on her practice. Huma suggested that the way she used the IWB and LearnPads with children, and her awareness of these devices as tools to support learning were connected to the intervention and presence of the researcher. As part of the intervention Vicky had directed the early years educators to use the IWB and LearnPads with children and become involved in their use of different digital media. In order to do this Huma had to directly address how she interacted with children using the IWB and LearnPads and think about what she did and said in a way that she had not before as the following discussion about Huma’s use of the LearnPads indicated:

Researcher: Would you have done that last year? Would you have gone up and said how are you doing this, how are you doing that?
Huma: I would have cos I think that’s just a general early years practice to ask lots. But the fact that I’m now subconsciously aware of it [digital media] is a different thing and that’s because of your presence. I think in this environment you’ve made us more aware of it. Whereas at home it’s always there. It’s always being used. (interview 14.7.15)

The presence of the researcher implementing the intervention directed Huma’s attention towards digital media and how she acted at the IWB or LearnPads when she used them with children. Huma’s practice when she supported children using the IWB or LearnPads was not different from the way she behaved in other areas of the classroom, but she now actively adopted these same strategies with digital media. When Vicky directed Huma to support children’s use of the IWB or LearnPads during free-flow play Huma had opportunities to reflect on what she was doing within the context of using these devices in an early years learning environment.
Summary and design principles revisited

During Cycle 3, Vicky planned times when the EYE would support child-initiated digital media use during free flow play and they began to reflect on how they used the IWB and LearnPads with children. The EYE began to adopt an approach to supporting children’s language development that Vicky used in her own interactions with children using different classroom digital media. The classroom learning environment around children’s understanding of the way Vicky used the IWB and LearnPads changed and children turned to her to support their use of these devices. Interestingly, I did not observe Vicky use the classroom PC with children as part of their play. Children used the PC collaboratively in the same way they did the IWB and LearnPads but practitioners either did not observe this or chose to direct their interventions to the IWB and LearnPads. This might have been because the location of the PC meant Vicky’s back was to the classroom making it hard for her to be aware of what was happening or because Vicky believed the Learnpads and IWB offered more than the PC as tools for learning. However, this lack of PC use was not discussed and it is hard to speculate why the IWB and Learnpads appeared to have replaced the PC when practitioners interacted with children using digital media in the nursery. The introduction of 15 LearnPads provided increased opportunities for Vicky to support children’s use of digital media. At the end of Cycle 3 the LearnPads had a physical presence in the class and were regularly available for children to use during free-flow play. The way the LearnPads were embedded into classroom practice and routines extended to the way practitioners used them around the classroom to support different aspects of learning. Further integration of the LearnPads was limited by technical constraints and a lack of effective support and training to meet the Vicky’s needs. The presence of the researcher was crucial in forcing the change which provided valuable opportunities for critical reflection by Vicky and other practitioners in the classroom.

The design principle to include digital media as part of planned practitioner-directed teaching was effective. Adding a space for ICT on weekly planning documents actively directed Vicky’s attention to digital media and the ways it could support learning. Planning allowed Vicky to develop a pedagogical strategy for her use of the IWB to support learning in all areas of the curriculum. Vicky used the IWB to introduce new technical skills which children could use to extend the ways they collaboratively used the IWB during free-flow play. Planning was also a way to direct other practitioners to interact with children using digital media and use their interventions during free-flow
play to support and extend learning. When Vicky directed those working in the classroom to use the IWB or LearnPads with children these interactions became embedded in the classroom routines and practices of all practitioners.

Interacting with children using the IWB and LearnPads as part of directed teaching and during free-flow play was also effective. This design principle provided opportunities for Vicky to develop pedagogical strategies to support children’s learning with digital media. Vicky recognised direct teaching of technical skills as part of an approach that focused on interventions in child-led use of digital media to support and extend the learning she observed taking place when children used digital media in social groups. By directly interacting with children and becoming part of the way they used digital media Vicky could observe the impact of her interactions on children’s learning. The effectiveness of Vicky’s interventions was supported by the intervention design principle related to reflection and the need to create the time and space for critical reflection on her developing practice. Reflective conversations with the researcher allowed Vicky to actively discuss the changes she made as the result of the intervention; what was and was not effective and why. Reflection was most effective when it took place following a change to her practice and the use of new approaches to using digital media.

The intervention was hindered by institutional factors which limited the degree of change possible. Vicky’s desire to develop the use of mobile touch screen technologies was constrained by a lack of training to support the ways in which she wanted to use the LearnPads. The school’s decision to purchase LearnPads for the early years classrooms and the way they had been set up constrained Vicky from using them in ways that supported her new beliefs about children’s use of digital media. Vicky had developed effective strategies to support children’s learning, but was unable to enact change to integrate the LearnPads in the ways that she believed could further extend and deepen children’s meaningful learning experiences with mobile touch screen technologies.

The next Chapter 6 reviews the intervention findings and changes to classroom practice that supported the effective integration of digital media into free play and planned teaching sessions. This chapter builds on Chapter 5 by developing thematic
findings across the different intervention stages and cycles. These themes foreground the key elements that were shown to be instrumental in enabling change, and the development of effective pedagogical approaches to integrate digital media into teaching and learning.
Chapter 6

Factors enabling change and the impact on practice

Findings presented in this chapter focus on the outcome of the intervention and the activities that were effective in enabling digital media integration. The chapter consists of two substantive sections which summarise findings presented in Chapter 5 and links them to: 1. the factors enabling the integration of digital media, and 2. the pedagogical approaches shown to be effective in supporting learning. In section one the following topics are addressed: practitioner beliefs about digital media; digital media supporting language and communication; the relationship between beliefs and pedagogy, and the importance of critical reflection. Section two describes the impact of reshaped beliefs on Vicky's practice and the approaches she adopted to integrate diverse digital media into free play and directed teaching. The section addresses the following topics: interventions in free play; congruence between beliefs and practice; integrating digital media into practitioner-directed learning; the supportive role Vicky adopted, and distal interactions supporting integration. The chapter concludes with a description of the classroom learning environment created around Vicky's reconstructed beliefs about digital media and the practices that supported their integration.

Factors enabling change

The intervention findings identified several factors that hindered digital media integration and addressed these through the design principles. This section discusses changes to Vicky's beliefs about digital media and the shifting relationship between beliefs and pedagogy. Table 6.1 shows the initial five design principles that supported changes to practice and how they were developed over the course of the intervention phases and cycles. These modifications and developments responded to Vicky's developing practice with digital media and her shifting beliefs. A key aspect of the intervention was the way it addressed the beliefs that shaped the decisions Vicky made about the integration of digital media.
Table 6.1: Summary of design principles showing developments and modifications during the intervention

<table>
<thead>
<tr>
<th>Design principle</th>
<th>Theme</th>
<th>Modifications and developments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Practitioners to interact with children using digital media during free-flow play</td>
<td>Interaction</td>
<td>Practitioners followed children’s way of interacting with peers to support game play. Interactions during free play supported operational skills as part of game play. Plan for times to be present at digital media during free play. Direct other practitioners to support game play and ‘play’ alongside children.</td>
</tr>
<tr>
<td>2. Practitioners should follow children’s interests</td>
<td>Interaction</td>
<td>Showed children new apps and games on LearnPads and Busy Things website. Supported children to complete their chosen task or game.</td>
</tr>
<tr>
<td>3. Vicky to plan to use digital media with children</td>
<td>Planning</td>
<td>ICT added to weekly planning document for whole class teaching activity. Planning extended to small group activities during carpet sessions. LearnPads planned as part of continuous provision. Planning included other practitioners' using digital media during free play. Discontinued use of iPad during free play in structured groups with pre planned learning intentions</td>
</tr>
<tr>
<td>4. Planning should take into account what digital media can add to learning</td>
<td>Planning</td>
<td>Planning for digital media included learning outcomes. Planning extended to individual children with speech and language needs. Modelled on how children teach and explain to each other</td>
</tr>
<tr>
<td>5. Provide time and space for reflection on the intervention and changing practice</td>
<td>Reflection</td>
<td>Increased reflection opportunities. Reflection after different episodes of digital media use. Reflection developed into ‘professional conversations’.</td>
</tr>
</tbody>
</table>

**Turning beliefs on their head**

Post-intervention, Vicky’s beliefs about digital media and their use as tools to support learning and development had undergone a dramatic change. Prior to the intervention, Vicky’s lack of interaction with children using digital media was attributable to the fact that she saw little value in what or how children learned when using the classroom PC or the IWB. Vicky believed digital media were in some respects detrimental to young children’s learning and development. She did not have a concept of the IWB and PC as tools that could support learning through play or children’s co-construction of their own learning. Vicky’s observations of, and interactions with, children using the IWB and
LearnPads enabled her to reconstruct her strongly negative beliefs around what she saw. The following comment indicates how Vicky’s beliefs changed:

Initially I started off feeling that as it was children had too much screen time at home (pause) didn’t really see the value and was worried that it was stopping them from talking and being creative and actually that’s completely turned on its head. (interview 11.8.15)

Not only had Vicky’s beliefs changed, but in this comment she indicated that her pre-intervention beliefs were based on a ‘feeling’ rather than knowledge in the form of actual observations of children using digital media. Taking the time and space to stand back and see how children used the IWB and LearnPads enabled Vicky to realise that her assumptions and preconceptions might not always be correct. Vicky’s reference to her beliefs being ‘turned on their head’ indicated she was acutely aware of the extent to which her beliefs had changed and that this change was, for her, a radical transformation. In the comment above Vicky also referred to there being some value to children’s use of screens which suggests that post-intervention she recognised how digital media could relate to children’s learning.

Discussions with Vicky indicated that the value she attached to digital media related to their use as pedagogical tools and the way digital media could support individual children’s learning and development. Digital media offered what Vicky described as a, ‘great opportunity for learning’, and she referred directly to digital media as tools for learning, for example, when she described the IWB as ‘an additional part of my toolkit’ (interview 27.5.15), and commented how, ‘I now see the computer very much as a tool, whereas I didn’t see that before’ (interview 11.8 15). The shift in Vicky’s conceptualisation of digital media as pedagogical tools was illustrated compellingly by comments during a post-intervention discussion in which she referred to her pre-intervention concept of digital media as ‘something that sucked the life force’ (interview 11.8.15). This graphic description underlines the strength of Vicky’s pre-intervention negative views and concept of digital media as having any value to support learning. Later in this same discussion Vicky described how the intervention had, ‘forced me [Vicky] into taking quite a reflective, rather than a reactionary response to it [digital media]’. In both these comments Vicky acknowledged the strength of her pre-intervention beliefs and implied that the way she had previously conceptualised digital media was a strong factor in determining her approach to using the IWB and PC. Vicky’s practice with digital media was shaped by beliefs she held about their appropriateness for young children and the detrimental impact on children’s language
and communication development. These beliefs held more weight than the need to meet the curriculum outcomes related to children’s development of operational skills. Vicky’s negative view of digital media and the fact that she attached little value to the IWB and PC as resources that could support young children’s learning hindered their integration into free play and practitioner-directed teaching. Post-intervention discussions with Vicky, and classroom observations of her using the IWB and LearnPads with children indicated Vicky no longer believed children’s use of these devices offered limited learning experiences. Pre-intervention beliefs about digital media were replaced with new ones because Vicky’s previous beliefs were no longer compatible with what she observed. It was possible for Vicky to reshape her beliefs because they proved unsatisfactory as she came to understand how the IWB and LearnPads could support the educational goals of the classroom. These goals were shaped by strong beliefs about the activities that best supported learning and the means by which to achieve these goals.

Vicky’s concept of digital media as tools to support learning beyond the operational skills referred to in the EYFS curriculum was demonstrated when she included observations of children’s digital media use as part of her assessment practices. During a weekly visit to the classroom I discussed an observation Vicky had recorded of a group of girls using the LearnPads and she indicated that she had used this activity as evidence for children’s individual learning journeys. Learning journeys were a physical record of each child’s developmental milestones and consisted of written observations, photographs and samples of work as evidence of their achievements in the relevant EYFS curriculum learning outcomes. These learning outcomes were established by the EYFS Profile that sets out the goals children are expected to reach by the end of the Reception year. Although nursery is not a statutory phase of education Vicky was obliged to assess children’s progress and development against statutory outcomes for the first year of compulsory education and the end of the EYFS stage. This aspect of Vicky’s practice was driven by government policy developments related to later phases of education. The pedagogical decisions she made took account of national assessment requirements as well as the needs and interests of the children and building a curriculum to address each of these aspects of curriculum and practice. Statutory requirements of the curriculum and assessment ran alongside Vicky’s beliefs and were incorporated into her practice.
Prior to the intervention, Vicky referred to her recorded observations of children using the PC as opportunities to ‘tick off’ learning outcomes for the curriculum area of technology and not as evidence of learning in other curriculum areas. On this occasion Vicky had used an observation of children’s social communication around the LearnPads as evidence of learning beyond operational skills. Observations related to children’s social uses of digital media underlined the fundamental change in Vicky’s beliefs about their impact on children’s learning. When she included observations at the IWB or LearnPads to support evidence of wider learning digital media not only became integrated into her practice, but it was further evidence of the value Vicky attached to them beyond technological skills. Post-intervention Vicky believed children’s collaborative engagement with digital media could provide meaningful opportunities where there was clear evidence of children learning with digital technologies as well as learning about them.

**Digital media supporting language and communication**

Children’s social and collaborative use of the IWB and LearnPads and the language-learning opportunities this provided were a factor in changing how Vicky conceptualised digital media. Post-intervention, Vicky summed up this view in the following way:

> The main thing that’s changed is my understanding and acknowledgement of how valuable use of the computer, and whether it be iPads or LearnPads, can be in developing children’s language’ (interview 11.8.15).

Vicky referred to the way children using the IWB or LearnPads frequently used social language to communicate their intent and interact with peers. In discussion Vicky affirmed the value of digital media but the value she attributed to them was constructed within her existing beliefs about language development. Vicky’s post-intervention comments emphasized the extent to which this belief had changed from her prior concern that the PC and IWB were ‘stopping them [children] from talking’. Vicky described being, ‘blown away by the level of social interaction that was happening and all the skills that were coming out of that’ (interview 11.8.15) when she observed children using the IWB or LearnPads. Discussions of Vicky’s observations of children using digital media did not focus on what children used the IWB or LearnPads for but how they used them and the language and communication skills that resulted. Vicky frequently referred to the oral language-learning opportunities children's social use of digital media provided. Vicky expressed the impact of her observations in the following way:
That's made the biggest difference to me … not to see it in terms of what we do on the ICT but to see that whole social [pause] that whole language development has made me realise what a great tool it can be for my children who are both having speech and language therapy and who don't have this [speech] possibility. (discussion 11.3.15)

In this comment Vicky refers to children using the IWB in social groups and directly links these child-led activities to opportunities for oral language development rather than the learning linked to the games children played. The fact that Vicky has identified children with additional speech and language needs underlines her shifting concept of digital media from one that hindered talk to a view of them as tools that supported language and social communication.

Post-intervention Vicky identified how digital media could support different aspects of early language development. Children developed extended dialogues around their uses of digital media and positioned themselves as digital experts leading the use of the different digital media with their peers and practitioners. Vicky several times referred to the ways she observed children using the IWB or LearnPads ‘teaching each other’ far more often than they did in other areas of the classroom and the kind of social interaction this required. The following observation of a group of three boys shows how children intervened at strategic moments to support gameplay and is typical of the way children taught each other unprompted. Two boys – Matt and Danny – were using the same colouring app on individual LearnPads and a third boy – Chris – was sitting between them without a LearnPad, watching closely what Matt and Danny were doing on their screens. The researcher was sitting next to this group of boys.

Danny: [Turning to the researcher] What can I do now?
Researcher: Do you want to change the colours?
Chris: [To Danny] Press on those if you want another colour. Chris indicates a group of icon colours at the side of the screen.
Danny taps on an icon and loads a full screen of more than 40 different colours to choose from. Chris then turns to look at Matt’s screen and watches him trying to change colours.
Chris: Press on that and it will get loads of colours. Chris indicates the icon he had just seen Danny use.
Matt: Yeay. I did it. (observational video 26.6.15)

In this observation Chris acted as the teacher and demonstrated his confidence and ability to extend his friends’ use of the colouring activity they were using. Despite the presence of the researcher Chris had the confidence to take the lead in this interaction and explain to his friends what they needed to do. Children using the different digital media in the classroom identified the problems of others and collaborated to share their
developing knowledge of the devices so that children could successfully use and complete their chosen games and activities.

When children explained how to play a game or navigate their way through a program they used the kind of language for thinking and explaining that Vicky often focused on during her interventions in children’s play and as part of adult-directed teaching. She frequently used open-ended questions that provided opportunities for children to articulate what they were doing or thinking. Vicky understood that her intentional interventions in their digital play could extend learning by encouraging and extending children’s language for thinking. Vicky commented how, ‘I can absolutely see the speaking and listening opportunities and the thinking and reasoning it [the IWB] offers’ (interview 27.5.15). Children were actively exploring and learning when they used the different digital media devices in the classroom and this was facilitated by their collaborative endeavours, mediated by language. Vicky’s strong pre-intervention beliefs about language, and her belief that digital media prevented children talking, suggest her reconceptualisation of the IWB and LearnPads as pedagogical tools to support children’s language development was an important factor in Vicky’s ability to integrate digital media into the ways she organised teaching and learning. She needed to see the positive impact the IWB and LearnPads could have and link this to one of her wider goals for young children’s learning before she could find ways to support learning through her own actions.

**Making it fit: the relationship between beliefs and pedagogy**

The findings demonstrate a strong relationship between Vicky’s beliefs and her teaching practice. This relationship shaped Vicky’s use of digital media and the strategies she used to integrate them across the curriculum. Vicky’s pre-intervention concept of digital media created tension with her core beliefs about young children’s learning. Post-intervention there was no longer tension between children’s use of digital media and the child-centred, play-based learning environment shaped by Vicky’s pedagogical beliefs. Vicky described children’s use of digital media as ‘very much child-led, child-initiated’ (interview 11.8.15) and commented that ‘this was a big eye opener for me’ (interview 11.8.15). These comments implied Vicky believed children’s learning with digital media could be led by them rather than by the digital games they played. This new belief about digital media was compatible with Vicky’s existing beliefs about young children’s learning and the practices she employed in the classroom.
Through observation, Vicky came to realise that children’s meaningful interactions with the IWB and LearnPads, and the learning that resulted from their active engagement with digital media, were not limited to the activities they played on screen. Vicky observed how digital media could support the kind of child-led learning environment that was already embedded in her pedagogical beliefs. This pedagogical congruence between Vicky’s beliefs about digital media and those shaping her practice required a shift in beliefs and attitudes so that she could approach using digital media in the same way as she did other classroom resources. The digital technologies themselves were not the instruments of change as they did not in and of themselves prompt changes to Vicky’s practice. Rather, it was Vicky’s beliefs which changed through observation and reflection and these beliefs in turn changed the way she acted.

Congruence between Vicky’s beliefs about digital media and her core beliefs about early years practice were crucial to her ability to develop ways to integrate digital media into the classroom learning environment. Vicky expressed the importance of making digital media ‘fit’ with her beliefs about pedagogy in the following interview extract:

Researcher: As soon as you could find a way that computers fitted in with your existing beliefs around early years practice, then that was key.
Vicky: Yes, yes, yes because if it didn’t fit in with what I consider good early years practice then I wouldn’t use it. Because there’s lots of things I would like, but actually they don’t fit in with practice, so I’m reluctant to use them.
(interview 27.5.15)

Vicky needed a rationale for using digital media that was compatible with her pedagogical beliefs in children learning through self-directed play and the role of practitioners in supporting learning. Given Vicky’s strongly expressed pre-intervention beliefs about the PC and her comments about teaching mouse skills, it was unlikely Vicky would have changed her approach to using digital media in the classroom without a shift in the way she conceptualised them as tools to support early learning.

The importance of congruence between Vicky’s beliefs and practice is underlined in the following interview extract:

Researcher: You strongly believe that early years is as much about language and language development and, therefore, because a computer can fit in with that, that’s why you’re happy to embrace it. So in a sense it fits in with your own – agenda is too strong a word – but it fits in with your own mo...
Vicky: I have a rationale which I didn’t have. I couldn’t see the rationale. I had no rationale for it and therefore if I don’t see the point or the purpose I’m very unlikely to do it. But if I can understand a point and a purpose and I can see that it’s a valuable thing.
Researcher: But that purpose fits in with something that you’ve already got.
Vicky: That purpose fits in with something I already believe. (interview 27.5.15)
Vicky attributed value to digital media and a rationale for using the IWB and LearnPads because she saw how they could support something she already believed to be an important element of her practice. In both of these comments Vicky clearly states that her willingness to use digital media is because she can see ways in which their use can support things that that strongly shaped her practice - the importance of early language development and beliefs about good early years practice. Vicky needed a rationale for her interactions with children using digital media that she could connect to her beliefs. Given Vicky’s strongly expressed pre-intervention beliefs about the PC and her comments about teaching mouse skills, it was unlikely Vicky would have changed her approach to using digital media in the classroom without a shift in the way she conceptualised them as tools that were congruent with the learning environment she believed supported early leaning. Seeing children’s playful uses of the IWB and LearnPads as a learning opportunities was crucial to Vicky’s acceptance of digital media as this comment highlights:

I can embrace it [digital media] and think oh yes I can do that and learn to use the mechanics. But I need to know that they [children] can get something out of it. (discussion 20.3.15)

Believing children could ‘get something out of it’ was key to the way Vicky reconceptualised digital media and, more importantly the way children used them. Embedding digital media into all aspects of Vicky’s classroom practice was possible once there was no longer a gap between her beliefs about pedagogy and beliefs about children’s engagement with digital media.

**Using evidence to support reflection**

Vicky’s classroom observations of children using the IWB and LearnPads were a crucial element in her ability to shift beliefs. The time she took to stand back and watch children using the IWB and LearnPads provided tangible evidence of their technology-mediated learning. These observations of children using and learning with diverse digital technologies were the basis for Vicky’s critical reflection on what she observed and how this related to her beliefs about digital media, young children’s learning, her pedagogy and the kind of learning environment she sought to create to support early learning and development. Critical reflection on all these beliefs and practices as they related to digital media and observations of children was a crucial factor in her shifting beliefs and conceptualisation of digital media. Her observations showed that children’s use of classroom digital media was not a ‘solitary or passive’ activity as she had
previously believed. Vicky saw children collaborating, problem-solving and exploring around digital media. She observed children making choices about their learning when they logged out of games loaded by practitioners and selected the games they wanted to play. Vicky also referred to her observations of the IWB and LearnPads mediating children’s use of social language when they discussed the images they saw and created and the games they played to their experiences out of the classroom.

Standing back and watching children using digital media provided relevant and meaningful opportunities for critical reflection which Vicky related to her pre-intervention beliefs. When these reflections took place within the context of her prior beliefs Vicky acknowledged how her pre-intervention perceptions had influenced her practice and ability to integrate the IWB and PC into the classroom in ways that supported children’s learning. Reflection provided opportunities for Vicky to become aware of her beliefs and their validity, or invalidity, given new evidence about children’s learning with digital technologies. Post-intervention Vicky no longer exclusively focused on children’s use of different digital media devices themselves and their technological capabilities. It was the ways she observed children using and exploring the IWB, iPad and LearnPads and the individual learning that resulted from their uses of digital media that Vicky reflected on and not just the need for operational skills. In a post-intervention discussion Vicky referred to the children using the IWB in the following way:

…it’s so much more than an ICT skill of being able to use a pen or a mouse and it’s not the same for all children but for one child it might be a great opportunity for language for another child it might be a great opportunity for counting or problem solving and how I also now see it very much as a group activity for many of our children a social activity rather than an individual one. (interview 11.8.15)

The way Vicky discussed children’s interactions at the screen and referred to the learning that took place was a powerful reminder of how far her beliefs had changed. Post-intervention, Vicky commented on the ways in which the IWB and LearnPads provided opportunities for social interaction and problem solving, and children’s active engagement in their learning that she did not appear to have seen prior to the intervention. Whereas pre-intervention Vicky’s beliefs about digital media were based primarily on presupposition, her new beliefs about children’s use of digital media to support language and social communication were based on what she had observed and reflected on. When those new beliefs were built on evidence and direct experience they were harder to refute those based on presupposition.
Effective practices supporting integration

The following section draws together the different strategies and approaches to using digital media developed over the course of three intervention cycles. These practices supported the integration of digital media into free play and practitioner-directed activities and whole class teaching.

Establishing a presence during free play

A crucial change to Vicky’s practice was her presence at the IWB and children’s use of LearnPads during free play. Vicky’s interactions with children during the TES iBoard activity and the several occasions on which she joined children using the LearnPads or IWB during free play were powerful indications of the importance Vicky attached to her interactions with children using digital media. A year after the end of the intervention Vicky commented how she was still interacting with children and described how she realised that, ‘just having the whiteboard on is not enough. I need to be there too’ (interview 24.6.16). ‘Being there’ and recognising that there was a role for her to play was an important step in Vicky developing new approaches to teaching and learning with digital media. Post-intervention, Vicky’s focus was no longer directed towards teaching children operational skills and preparing children to use the PC in the reception class. Vicky planned times when she supported children using the IWB and LearnPads during free play. She used her spontaneous interventions in child-initiated play to support the ways children used digital media and extend learning by following their interests and developing capabilities in other areas of the curriculum.

Interacting with children using digital media during free play was a change to Vicky’s pre-intervention practice and critical to developing new practices. Her interactions showed there was a vital role for her to play in supporting children’s use of the IWB and LearnPads. This realisation was grounded in the actions Vicky took during the intervention to be present when children used digital media and recognising the impact of those interactions on individual children’s learning as the following extract from an interview indicated:

Vicky: I think the other big thing that has changed for me is understanding that my intervention is really, really important because first of all I saw this great social stuff happening and I thought OK but I don’t really see my role in this social stuff happening cos that’s what I’m seeing. But then reflecting again, when I was seeing this happening I understood that by moving in I could really, really extend what was happening and it was differentiated by virtue of these children leading and then I could extend. So for one child it might be he’s
fascinated in phonics or sounds. Another child it might be they were really interested in stories and another child it might be they really wanted to draw but didn’t have the confidence, but with me there could draw and tell a story and would be immensely proud of the result and delighted in that one-to-one interaction.

Researcher: So there was a role for you?
Vicky: Absolutely. I didn’t see that at first and it took me standing back.
(interview 11.8.15)

In this post-intervention interview Vicky discussed using the IWB during free play and the different strategies she used with individual children. This discussion indicated how Vicky understood that her presence allowed children to explore their individual interests in reading, story-telling or drawing. Vicky used her presence at the IWB to focus on the learning related to children’s exploration of the activities on screen. In this interview Vicky also referred to occasions when she had shown children new technical skills such as how to use the IWB pen tool, the different keyboard strokes needed for capital letters and spaces between words, and how to change the colour of the pen. Although these were important operational skills the focus of Vicky’s interactions was directed towards children’s learning and developmental goals additional to those goals related to technological competency.

Vicky’s presence during free play supported children’s game play and enabled them to complete their chosen game, draw a picture of their family or write a story. Her sensitive interventions followed children’s lead and she was alert to their developing interests and capabilities. There was a pedagogical role for her to play and Vicky used her skill to recognise and take advantage of teaching moments in the same way that she did away from digital media when she supported children’s activities during free play. Vicky’s references to her ability to ‘extend through it [IWB]’ (interview 27.5.15) and ‘extend what was happening’ (interview 11.8.15) were significant because they suggested Vicky used interactions to support the way children learned with digital media and let them have some control over what and how learning took place. Post-intervention, Vicky’s interactions did not neglect what the children were doing as she had prior to the intervention when her focus was on technological skills. Vicky saw technology-mediated learning as a valuable addition to the classroom and she was able to use her presence at the IWB and LearnPads to support and extend child-led learning.
**Congruence with classroom practice**

Post-intervention, Vicky’s use of the IWB and LearnPads was congruent with her practice in other areas of the classroom. Vicky extended the pedagogical skills that were in evidence in other areas of her practice to digital media. Discussions of the ways Vicky used digital media with children suggested she had developed a pedagogical role that reflected the way she acted away from digital media to support language and communication.

I use it much more as a social tool when I’m intervening. So if I’m watching and doing it I will quite often say ‘oh can you just explain to so and so cos they’re not sure’. Or ‘can you ask Danny what to do’ and to try and get them to [inaudible] the language … So I’m trying to develop and extend their language through that. Through them using it and using their skills. (interview 27.5.15)

This comment shows how Vicky used her presence to extend what she observed children doing but with a pedagogical intent linked to language development. Vicky recognised the ways digital media mediated how children acted as teachers and worked co-operatively, and the language learning implications of these interactions, and she built this new understanding into her practice with digital media. Vicky was able to integrate digital media into the way she planned for and extended children’s language learning because she could see a point in doing so. She developed a rationale for using digital media in the classroom that was linked to a core belief about constructing a classroom learning environment in which there was a range of adult- and child-initiated opportunities for children to develop and extend their language skills. Vicky linked the use of digital media, to an element of her practice that featured strongly in her beliefs about early learning and the fact that, ‘I’m a great believer in talk, talk, talk, talk’ (interview 27.5.15).

Vicky’s early years practice did not need to change to accommodate the effective use of the IWB, PC and LearnPads. Rather, it was Vicky’s conceptualisation of digital media that changed so that she was able to accommodate them into her beliefs about young children’s learning and adapt her practice accordingly. Vicky’s beliefs about digital media shifted rather than the stronger beliefs about pedagogy and the practices that supported her beliefs about teaching and learning. Vicky attached greater weight to her pedagogical beliefs that those about digital media. Hence it was beliefs about children’s use of technology that were more receptive to change. The core beliefs shaping Vicky’s approach to teaching and learning as part of a play-based pedagogy and the use of child-initiated and practitioner-led activities did not need to change.
substantially once her practice was filtered through new beliefs about digital media. Vicky could apply her pedagogical skills and expertise to the ways she used the IWB and LearnPads to support individual children's interests and focus on the outcomes of their learning with digital media. Her decisions to become part of child-initiated digital media activities were carefully judged based on her pedagogical skills, and knowledge of individual children as a guide to recognising when her intervention could support and extend learning. She was also clear in which curriculum learning outcomes her interventions could support. When Vicky began to make those same decisions about the IWB and LearnPads it indicated that she was integrating these devices into her practice and using digital media in ways that matched her practice and the approaches she adopted to support teaching and learning. These approaches and strategies included sensitive interventions in play that followed children’s lead, the use of open-ended questions to extend thinking, and using her interactions to support children’s language and social communication development.

Integration into practitioner-directed learning

Vicky’s presence included practitioner-directed activities that integrated the IWB and LearnPads into planned whole class teaching and practitioner-led activities during free play. Vicky’s weekly planning documents showed how practitioner-directed uses of digital media changed. Planning was an integral part of Vicky’s pedagogy and changes to planned use of the IWB was one of first ways Vicky used her interactions to support children’s learning with digital media. Weekly planning documents showed Vicky was actively including children in whole class teaching with the IWB by ‘inviting children to come up and help to create patterns’ (planning 28.4.15) or ‘inviting children to help navigate through the Talking Stories18 program’ (planning 10.6.15.). During planned teaching times Vicky asked children to explain and demonstrate how to play specific games as well as explain some of the concepts behind the games. Vicky allowed children to demonstrate their skills and knowledge to the class before she intervened to give her support, when she judged they needed it as in the case of Harry who hesitated because he seemed unsure what to do to find the right answer during a maths-based session using a Busy Things activity. Vicky prompted Harry to tap on one of the icons on the IWB to get help. Post-intervention, the IWB was no longer primarily used as a form of static display and when Vicky included the IWB in weekly plans she actively

18 Talking Stories is an online collection of interactive books on a range of topics produced for the London Grid for Learning by educational software providers 2Simple.
considered ways its use could enhance learning. Vicky showed children new technical skills and programs they could use independently, and she used activities on the *Busy Things* website with learning intentions linked to maths or CLL. Vicky also physically connected the iPad to the IWB to share the stories children created using *Our Story* and demonstrated how to use this app (planning 18.3.15). These planned sessions extended the technical skills and range of games children could use independent of practitioners.

Children were familiar with practitioner-directed carpet sessions and their participation when called to do so, but post-intervention Vicky extended this approach to integrate the IWB into planned teaching sessions. Including digital media as interactive, rather than a static, tools changed the way Vicky integrated the IWB and tablet technology into directed teaching sessions. This change established new classroom rules around how digital media was used by practitioners and children during structured teaching times. Post-intervention, Vicky recognised children’s knowledge and expertise when she invited them to demonstrate to the class and children responded to the shift in norms when they pointed out Vicky’s mistakes. Vicky’s integration of the same games the children chose during free-flow play into directed teaching times legitimised the children’s use of the IWB and demonstrated to the children that she valued the games and activities on the IWB as learning opportunities. Digital media were no longer resources that children used without practitioners, but they used the IWB and LearnPads with Vicky to play the same games they played with their friends.

**A ‘supportive’ pedagogy**

Vicky’s interventions supported the way children used digital media rather than directing or hindering child-led activity. Supportive interactions did not regulate or guide an activity, but enabled children’s game play as part of their wider learning. Pre-intervention, Vicky’s focus on teaching technical skills was motivated by her perceived need to prepare children for reception and ensure children met curriculum outcomes for technology. In this instance, knowledge of the curriculum guided her practice more strongly than beliefs about the importance of child-centred learning and the practices that best supported it. Pre-intervention observations showed Vicky’s interactions did not support children’s chosen activity or their digital game-play in the same way she skilfully did in other curriculum areas. Post-intervention children’s interests and chosen activities guided Vicky’s involvement. Her interventions in free play did not direct
children’s activity but she remained in the background and was guided by the children themselves and her knowledge of individual children’s developing capabilities and interests. Vicky was part of the dialogue around children’s game play, but on the terms of the children and the game medium. Her interventions frequently supported children’s ability to complete the games and activities they chose such as drawing a picture of a favourite film character or asking more knowledgeable children to explain to others how to play a game.

Vicky’s supportive role included learning how to use the IWB and LearnPads with the children and asking them to teach her how to play games and find and load new programs. Children contributing to others’ learning and demonstrating their digital capabilities and expertise was an aspect of children's digital media use Vicky had commented on. In post-intervention discussions, Vicky described how she used her interventions to encourage children to teach her in the same way she observed children teach each other. She referred to this way of supporting children’s digital media use on several occasions and commented, ‘I am doing more with the kids on the computer and learning how to use it with them,’ (field notes 5.12.14) and referred to how, ‘I don’t have the time to work out how to learn everything so if I see a child do something new I get them to explain to me what they did’ (discussion 24.6.16). This second comment was 12 months after the completion of the intervention and suggested that her strategy of encouraging children to share their developing expertise and skill was embedded in Vicky’s practice and one that she was comfortable with. When Vicky asked children to teach her she invited herself into children’s use of digital media but on their terms. She positioned children as experts and herself as the less knowledgeable participant in activities initiated by children. This was a role reversal from her pre-intervention approach of using interactions to teach operational skills.

Post-intervention Vicky’s observation of children’s expertise and capabilities governed her involvement rather than a perceived need to teach skills. Children did become more confident using digital media as the result of their growing competency, but this was not the main motive behind Vicky’s interventions in their activity. Vicky brought digital media into her practice rather than seeing them as an obligation and an add-on to meet curriculum goals for technology. Her beliefs shifted from a view of digital media to meet nationally determined curriculum goals to one which recognised the value of children developing skills as a way to extend their use of digital technologies across the curriculum. As her beliefs were reshaped Vicky was able to bring digital media into her
practice without the conflict that constrained her pre-intervention use of the IWB and classroom PC.

Vicky’s supportive interventions included eye contact and appreciative comments that demonstrated her understanding of children’s digital media use. She commented on children’s pictures on screen and showed her appreciation when she asked children to share their developing knowledge and skills with others. Vicky also introduced children to new games on the IWB during adult-directed teaching sessions and demonstrated how to play some of the games on the Busy Things website the children frequently loaded themselves. When Vicky explored new games and forms of digital media with children or asked children to explain to her how to play games she asked questions such as: ‘So what happens if we,’ or ‘So do we have to grow them,’ and ‘We need the bird to come down don’t we’. Using the pronoun ‘we’ emphasized the joint nature of the activity and her active presence as part of the game. When Vicky first used the LearnPads in the classroom she was present to provide support and asked children how they wanted to use the LearnPads and what games they wanted to play. She sat with a group of children on the floor in the reading area and waited for children to approach her and then responded to their requests and questions but always on the terms of the child and the game medium.

Post-intervention, Vicky’s supportive role included her awareness of children using diverse digital media around the classroom. She used her pedagogical skill to be alert to children’s initiatives and responded to them by joining children using the IWB, PC or LearnPads. At certain points in the day Vicky maintained a presence near the IWB or positioned herself near areas where children were using the LearnPads. In this way children using digital media were part of Vicky’s periphery vision and her indirect planning for learning. These occasions were sometimes detailed in Vicky’s written plans and indicated her awareness and response to children’s needs and interests more generally through on-going observations during free play. Although Vicky did not visibly plan interventions in children’s digital media use she was aware of children using the different digital media available in the classroom in a way that she had not been pre-intervention and could, therefore, respond to children’s digital play. On several occasions during the intervention I observed Vicky either move to and from the IWB to support a child drawing on the screen or join children for longer periods of time to support their game play or drawing activity. These seemingly unplanned
interventions were part of Vicky’s invisible planning for children’s learning. Post-intervention digital media was part of that process of being aware of children’s engagement with digital media around the room and responding as she did in other areas of the classroom.

**Extending pedagogy to operational skills**

Vicky’s distaste of direct teaching operational skills was an aspect of her practice that pre-intervention was one of the key factors constraining her use of the IWB and PC with children. However, discussions of the way Vicky approached teaching in other areas of her practice, notably phonics and use of scissors, indicated that she had found ways to accept direct teaching of specific skills when she saw their value to wider learning and child-led play. Post-intervention Vicky acknowledged that some practitioner-directed teaching with digital media was necessary and commented, ‘It is absolutely fine to do direct teaching of skills,’ and that children could then ‘have a little play with it [the IWB and new games] afterwards’ (interview 11.8.15). Later in this discussion Vicky acknowledged that, ‘there does need to be some direct teaching of skills’, and that, ‘the children aren’t going to magically develop them without support’. Vicky’s several references to the need for ‘direct teaching of skills’ seemed to imply that this was an element of her practice that was now acceptable, and even desirable. Post-intervention, Vicky began to recognise that operational skills were a means to an end and allowed children to use different programs and games in ways that she valued as part of her early years practice and strong belief in child-led learning through play.

During the intervention Vicky actively sought out and planned occasions to teach children some of the operational skills needed to use different forms of digital media and the apps and games on them. Vicky’s new beliefs about the way children collaborated and supported shared use of games and activities suggested this was linked to children’s growing technological capabilities. This belief supported the need for some direct teaching to give children access to the skills and knowledge they needed to use and navigate their way around diverse forms of digital media. Without this knowledge children did not always have the confidence to fully participate in technology-mediated learning environments and take advantage of the opportunities they provided for collaborative learning and social interaction. Observations of Vicky using the IWB to support children using ActivPrimary to draw and write and introducing new technical skills suggested she was comfortable with this type of intervention and
that she saw it as part of her role in supporting children’s access to the IWB and the activities on it. Post-intervention, the direct teaching of skills was no longer an aspect of her practice around digital media that caused tension with Vicky’s early years pedagogy. Teaching children how to use the IWB and LearnPads provided opportunities for children to make choices about how they used the IWB or LearnPads. With their developing digital skills children could begin to exercise greater agency over their choice of activities, the digital texts they created and how they chose to use the IWB or LearnPads with others in the classroom. Rather than focusing on teaching the skills to prepare children for reception, the skills Vicky taught were the starting point for children's further learning rather than the end point. Children’s developing technological competence provided access to a greater range of programs and they could share their capabilities with others.

Vicky’s weekly planning documents showed how she included opportunities to teach skills children needed to play new games and use new forms of digital media such as an iPad. She described how ‘I've introduced them to this program Busy Things … and every now and again I introduce them to a new aspect of it’ (interview 12.2.15). Direct teaching exposed children to an extended range of games and activities requiring different digital skills on the LearnPads and IWB, and children's increasing confidence to ‘teach’ their peers – and Vicky – is evidence of their increasing digital competency. Vicky’s approach to intervening in children’s use of the IWB and LearnPads also supported their developing expertise and extended children's digital skills. Children sharing their skills and knowledge was an aspect of digital media use that Vicky and other practitioners commented on more frequently during the intervention as well as in post-intervention discussions. I also noted children’s increased sharing of digital skills and knowledge of games and programs over the course of the intervention. These observations and Vicky’s comments suggested that digital media and Vicky’s approach to making it part of classroom learning were instrumental in providing opportunities for children to develop and share their digital competency.

**Distal interactions supporting integration**

Interventions in children’s digital media use included the way Vicky indirectly supported learning through her distal interactions. Distal interventions did not involve direct, face-to-face interactions with children, but they affected the ways children used and learned with digital media. Indirect interactions included the ways Vicky organised the provision
of digital media and arranged access to them; how she constructed a classroom environment to support learning and monitored children’s use of digital media; and how other practitioners were deployed to support children’s learning at the IWB and LearnPads. Pre-intervention the IWB was not always switched on for the children to use and there was only one program that could be loaded without practitioner support. Over the course of the three intervention cycles I noted how Vicky, or one of the EYEs, switched on the IWB every morning and regularly loaded the Busy Things website. The IWB was available to use throughout the nursery session equally with resources such as sand, water, bicycles, construction blocks and the other equipment children could choose to play with indoors and outside in the garden. Later, when the LearnPads were available Vicky decided to put them out in the classroom each Friday. Vicky no longer restricted children’s access to digital media or monitored the amount of time children spent at the screen. The only exception to this was one or two children who Vicky said, ‘are particularly focused on ICT and we will limit some of that screen time to ensure they’re playing outside and that they’re engaging in a range of activities’ (interview 11.8.15). However, most children regulated their own time at the screen and were equally engaged with other activities indoors and outdoors.

Distal interactions included the way Vicky – and other practitioners in the classroom – made choices about when to intervene in children’s use of digital media during free play. Vicky made intentional choices based on her knowledge of individual children’s development and her identification of the next steps in their learning. These distal interactions were linked to the pedagogical beliefs and practices that shaped the roles Vicky adopted in the classroom. When Vicky chose to intervene in children’s play with digital media it was because she saw the value of these interactions and how they could support specific learning outcomes. These interventions were also linked to Vicky’s implicit beliefs about early years learning theories and practices. As those beliefs changed with regard to digital media, so did the nature of Vicky’s distal interactions in support of children’s digital media use. Her interactions were mediated by knowing the next steps in children’s learning and using the IWB and LearnPads to support them, rather than the perceived need to ‘tick off’ ICT goals on the school’s target tracker or teach mouse skills to prepare children for reception.

Decisions about where to use the LearnPads were also evidence of Vicky’s distal interactions enabling digital media use. Delila’s initial decision to use the LearnPads in
the book area or on the carpet rather than at tables established a pattern for their use that children continued. Vicky wanted to develop children’s social and collaborative use of digital media she had observed at the IWB and the book area and carpet areas were spaces children chose to play in social groups when they organised picnics, developed role play or worked collaboratively to make large constructions. Vicky recognised how children used these spaces and the way particular groups of children used them as social spaces and this was part of the way she chose to support children’s use of the LearnPads. She understood the need to put LearnPads out in groups as this was how she observed children using them. Children’s social use of digital media was something that Vicky observed and commented on and her observations had a direct impact on the way she developed the use of the LearnPads with a focus on children’s social interaction.

Vicky’s planning for, and direction of, EYErs and support teachers to use digital media with children was a form of distal interaction related to how she indirectly influenced the way digital media were integrated into the learning environment. Planned activities were evidence of Vicky’s beliefs shaping her decision-making process. Beliefs about actions to support teaching and learning were a form of knowledge that affected Vicky’s planning, her direction of other practitioners, and the choices she made about interventions in child-initiated digital play. This decision-making process was shaped by beliefs about digital technologies and the distal interactions that supported their integration. Pre-intervention the EYErs did not interact with children at the IWB or PC during free-flow play and it was only when Vicky began to include the EYErs on weekly planning that they began to use the IWB and the LearnPads to directly support children’s learning. These changes were framed by Vicky’s reshaped beliefs about digital media and the importance of practitioners supporting digital play to enhance learning. Ensuring all practitioners were using digital media during free-flow play and adult-initiated teaching activities was an important step in fully integrating technology into all aspects of the way teaching and learning was organised in this classroom.

Huma’s comment during a discussion at the end of the intervention that she was, ‘more conscious of using it, putting the whiteboard on, making sure children have access to everything’ (interview 14.7.15) is indicative of the ways in which practitioners other than Vicky were using their distal interactions to support digital media integration. During this same discussion Huma also referred to the way she used her interventions to support children’s language and commented: ‘They'll talk to me and they'll say “look at
this" and I can extend their language while I'm talking to them'. This comment seemed to suggest that Vicky’s distal interaction extended to the way she guided practitioner’s use of digital media to the extent that they began to adopt an approach similar to her in the way Vicky used her interventions at the IWB and LearnPads to support children’s oral language development.

**New classroom environment for digital media**

Vicky’s post-intervention beliefs and ways of supporting children's activity at the IWB and LearnPads created a new classroom learning environment for digital media, but it was one that the children were already familiar with in other areas of learning. When Vicky used strategies and approaches to integrating digital media that reflected her practice away from these resources it closed the gap between her practice with and without digital media. Children experienced the differing ways Vicky acted in different learning situations and this had an impact on the way they behaved at different times throughout the day. Children behaved differently according to ways Vicky and the EYEIs interacted during free-flow play and whole class teaching times. Children’s understanding of these roles and their impact on the way they responded and behaved was underlined following Vicky’s use of an iPad in intervention Cycle 2. Vicky believed these activities had been unsuccessful because the more structured approach she had used was not one the children were familiar with during free-flow play. She commented that it was her ‘agenda’ not the children’s and that the children seemed, ‘more interested in seeing pictures of themselves’ (field notes, 25.3.15). Vicky had taken a strong lead in activities using *Our Story* with groups of two or more children which was motivated by her choice of learning intention for children to create a digital text combining pictures, written words and a voice recording.

Vicky’s use of the iPad during a free play session was outside the social norms for the way children expected Vicky to act as they had little experience of her taking a strong lead in activities during free play sessions. Children did not see these iPad activities as part of their free play and were not actively engaged in learning. This suggested that the integration of digital media into free play was most effective when governed by the rules for children’s participation in free play rather than those that more closely resembled the rules for practitioner-directed teaching. The integration of the LearnPads was effective because Vicky’s interactions more closely followed the expected norms for free play. She allowed children’s interests to guide her interactions and waited for
children to approach her rather than selecting children to take part in an activity she thought they would be interested in. Post-intervention, Vicky’s interactions during free play shifted the lead from her to the children and interventions were not restricted to technical problem-solving and teaching children how to use the digital media. The rules that guided Vicky’s supportive role allowed children's interests and capabilities to guide her interactions rather than a strong learning intention. These rules reflected Vicky’s post-intervention beliefs about the way children used digital media and its compatibility with her teaching philosophy. New rules around the way Vicky acted when using the IWB, PC and LearnPads encouraged, rather than hindered, children’s post-intervention interactions with digital media. Crucially, these were the same rules that governed the way practitioners acted away from digital media. Post-intervention the unspoken behaviours children expected adults to conform to in different learning contexts applied equally to activities with and without digital media. The classroom rules that encouraged learning in other areas of the classroom applied to digital media.

New patterns of behaviour that governed the way Vicky and other practitioners acted when they used digital media affected the division of labour between practitioners and children. Pre-intervention, adult-child interactions with the IWB and PC were governed by Vicky and the way her beliefs determined her actions. Post-intervention, Vicky’s interactions with children at the IWB gave them a greater degree of choice in how and what they learned. The division of labour between Vicky and the children changed from Vicky primarily delivering knowledge about how to operate the IWB or PC to a shifting division of labour according to the role Vicky adopted at different points in her interactions. The crucial difference was that Vicky could identify and respond to the different contexts for learning with digital media and the different roles she and the children adopted. This was part of Vicky's pedagogical skill and her ability to identify and respond to teaching moments. In this respect the division of labour for digital media post-intervention resembled that for her practice more widely. The difference was that it now applied equally to the way Vicky acted with and without digital media. Integration of digital media was effective when it met children's expectations of the way Vicky acted in all other areas of the classroom and there was no longer a gap between the way she acted with the IWB and LearnPads, and the way she acted in other areas of the classroom and with other resources.
Post-intervention, children’s actions and comments indicated they saw Vicky as part of the way they used digital media and invited her into their digital play. Prior to the intervention, I observed children frequently walked away from the PC when they had problems or they approached me for help. Children were rarely observed asking Vicky or other practitioners for help using the PC or IWB. Children did not appear to associate Vicky with their use of digital media in the same way they did when asking for help putting clothes on dolls, building sandcastles, writing their name or making a mask. Children invited her support using verbal and facial communications and they saw Vicky as an expert they would turn to for support. Six months after the end of the intervention Vicky discussed her ongoing use of the digital media in the classroom; the children’s response to her new approaches, the way she interacted with children at the IWB, and using the LearnPads. During this discussion Vicky described overhearing children using the IWB tell each other, ‘Mrs Lake can help’ (discussion 2.12.15). Vicky also mentioned an occasion on which a child had told his mother ‘Mrs Lake knows how to do it’ when the child had been trying to explain to his mother something he had been doing on the IWB at school (discussion 2.12.15). These comments indicated that children saw Vicky as someone who supported the way they interacted with digital media and actively sought her help in way that I did not observe pre-intervention.

Summary

Vicky reconceptualised digital media from her initial belief about resources that offered limited opportunities for meaningful learning to later beliefs that they were valuable tools that could support young children’s learning and development. New beliefs about digital media were incorporated into core beliefs about pedagogy and appropriate strategies to support young children’s learning and development. Vicky’s use of digital media was filtered through these belief systems. New beliefs were grounded in observations of the ways children used the IWB, PC and LearnPads. Vicky’s beliefs centred on how children learned collaboratively and supported by peers. Vicky had a rationale for using digital media as part of teaching and learning. Her concept of digital media as tools to support language and communication was a crucial factor in shifting beliefs. Observations showed how digital media could support different aspects of children’s language and communication development. Vicky’s new beliefs were compatible with the strong focus on children’s language development that was a vital part of her early years curriculum. There was no longer tension between Vicky’s beliefs about digital media and her pedagogical beliefs. Vicky’s reconceptualisation of digital
media, and the way children used them, was congruent with her approach to early years learning. She was able to ‘embrace’ digital media in the classroom once the gap between beliefs about the way children used digital media and her pedagogical beliefs narrowed. This pedagogical congruence was a factor in her ability to integrate digital technologies into her practice. Observations of children using the IWB and LearnPads showed that Vicky’s prior assumptions were not borne out by children’s use of digital media. These observations were valuable opportunities for Vicky’s critical reflection on her changing beliefs and conceptualisation of digital media. When Vicky related her observations and reflection to prior beliefs she acknowledged how pre-intervention assumptions had shaped her practice.

New beliefs enabled Vicky to integrate digital media into teaching and learning and shaped the approach she took to their effective integration into classroom routines and activities across the curriculum. She established a presence at the screen and developed a role during child-initiated play. Vicky supported individual children’s learning beyond technological competence and was led by children’s interests and knowledge. Vicky’s interventions and interactions around the IWB and LearnPads were similar to the ways she acted in other areas of the classroom. Vicky extended her pedagogical skills to digital media and brought them into her practice. Interventions focused on extending children’s language and demonstrated how Vicky linked digital media to a core element of her practice. Vicky planned adult-directed activities using the IWB and interacted with activities and games rather than using the IWB as a form of display. She used the IWB to enhance learning with outcomes related to the EYFS curriculum. When Vicky played digital games with children she signalled her approval of their digital media play and supported the ways they used the IWB and LearnPads. Vicky’s presence meant using digital media was no longer an activity children undertook largely without practitioner support. Vicky adopted a supportive role and was alert to children’s use of digital media. When Vicky used her pedagogical skills to support, rather than direct, the way children used digital media she acted in accordance with her teaching and learning philosophy rather than pre-intervention beliefs about digital media.

Vicky’s belief in the need to teach operation skills no longer constrained her use of digital media through the way her beliefs shaped decision-making about how and when to use technology. Developing children’s digital competencies was a desirable part of
her practice and one she was comfortable with. The skills children developed gave them confidence to participate more fully in technology-mediated learning and use digital media to support wider learning. Vicky integrated skills teaching into adult-directed activities and free play. Vicky’s distal interactions indirectly supported children’s use of digital media. She provided on-going access to the IWB and the LearnPads by making them available for children to use throughout the day. Distal interactions included the intentional choices Vicky made about intervening in children’s digital media play. Vicky also directed other classroom practitioners to use digital media during free play and adult-directed activities. When all practitioners began to routinely use digital media they become embedded into the classroom learning environment. Post-intervention beliefs and ways of interacting around the IWB and LearnPads created a new classroom learning environment for digital media. The rules and division of labour that established the norms for digital media use no longer differed substantially from those governing learning in other areas of the classroom. Vicky’s interactions supporting digital media use during free-flow play and whole class teaching sessions were the same as her interactions around other classroom resources. Post-intervention there was little evidence of a mismatch between the environment for learning with and without digital media. Renegotiated roles around digital media were evident when children invited Vicky into their digital media play and actively sought out her support.

Having discussed the key factors enabling change to support the integration of digital media and the impact of the changes on classroom practices, the following chapter relates the findings presented in Chapters 5 and 6 to the theoretical framework and published literature.
Chapter 7

Discussion and conclusions

The research reported in this dissertation addressed the under-researched area of the integration of digital media into early years education. It contributes research-informed knowledge about the challenges facing practitioners in their digital media use and how these challenges were, and can be, overcome. The chapter begins by returning to the conceptual framework underpinning this research. This section revisits the theoretical framework outlined in Chapter 2 and the gap in empirical research identified in Chapter 3. The twofold contribution to knowledge as part of a design-based approach to research is outlined. This introductory section is followed by four sections that discuss: 1. factors influencing digital media uptake; 2. the classroom learning ecology shaping digital media use; 3. pedagogy reflecting effective integration, and 4. use of explicit and implicit mediation.

The first substantive section begins with a discussion of the findings in relation to practitioner beliefs as encountered in this study and as reported in recent literature about the ways beliefs may hinder or support the integration of digital media. A nuanced understanding of the relationship between beliefs and early years practice that underpins the uptake of digital media is presented. In particular, the complex relationship between early years pedagogy and practitioner beliefs about digital media is examined. The impact of this relationship on Vicky’s practice and her understanding of how and what children learned with digital media is also discussed. This is followed by reflection on the ways in which Vicky’s reconceptualisation of digital media reshaped her practice and changed her pedagogy. In the second section, the idea of pedagogical congruence is introduced to describe how changing beliefs enabled Vicky to accommodate digital media in her practice as part of directed teaching and interventions in children’s free play. The discussion outlines how Vicky’s approach changed from lack of interaction to supportive interventions during free play. This section also describes how Vicky supported digital literacy development and developed a contextualised understanding of children’s digital media use.

In the final section, mediators shaping digital media activity are addressed. The classroom contexts for digital media are discussed along with how the changing
classroom learning environment mediated digital media uses. Activity theory is used to show how Vicky’s perception and uses of digital media were shaped by, and in turn shaped, the digital practices in her classroom. Elements of a classroom learning ecology (Cobb et al., 2003; Gravemeijer & Cobb, 2006) are discussed in relation to activity theory as a way to conceptualise the complex and changing interactions between these elements and their relation to contexts for learning. The discussion considers how the classroom norms, and the contexts for learning they established, hindered and enabled the effective integration of digital media so that their intentional use became visible throughout the curriculum during free play and direct teaching. The concepts of implicit and explicit mediation (Wertsch, 2007) are drawn on to illustrate how mediators included the intervention design principles and the way Vicky interpreted the wider social and cultural discourse around early years pedagogy and practice. The chapter concludes with reflection on the use of design research, the limitations of this study, and discussion of the implications of the research for classroom practice in early childhood education, as well as for future research.

Returning to the problem
The conceptual framework underpinning this research views learning as mediated activity in which the use of social and cultural tools shapes how children learn. The use of these cultural artefacts mediates learning through their direct impact on the way children behave as well as the way they shape the physical environment in which children learn. This view of learning means children learn not only as the result of their interactions with adults but also through participation in contexts shaped by the use of different mediators. Dynamic interacting elements present in early learning environments are key factors in the ways children learn in different socio-cultural contexts. In this dissertation these factors are used to conceptualize aspects of early years settings that mediate how and what children learn with digital media. In other words, there is a need to understand not just how children learn through direct interaction with practitioners, but how classroom contexts mediate learning. Practitioners’ indirect actions and beliefs mediate learning in addition to their direct interactions. This is particularly relevant to early years settings where practitioners hold strong beliefs about digital technologies and appropriate pedagogy. Empirical research reviewed in Chapter 3 identified teacher beliefs and the nature of pedagogical interactions as key factors hindering the effective integration of digital media in early years classrooms. Practitioners’ core beliefs about the practice of teaching shape their
actions and the decisions they make about teaching and learning. These beliefs are hard to change and may need to be challenged before they can be replaced by new beliefs. There is a lack of research that has investigated early years practitioner beliefs about digital media and how these beliefs mediate pedagogy. Few studies have used an intervention to challenge existing beliefs and replace them with new beliefs that will support practitioners in developing new pedagogy for digital media. As a result of carrying out this research it appears that practitioners need real experiences and informed personal understanding of the potential of digital media in children’s learning if they are to develop effective pedagogy to support this learning (Billington, 2016; Flewitt et al., 2014). Early years practitioners play a key role in supporting young children’s learning with digital media and to date there is a lack of research-informed examples that practitioners can draw on to inform their pedagogy.

The conceptual framework constructed for this research necessitated the need to address practitioner beliefs, their pedagogical interactions and the classroom learning environment as part of research to develop practice that supports effective integration of digital media into early years classrooms. This conceptual framework was used to investigate the problem of a lack of effective pedagogy to support learning with digital media outlined in Chapter 3, and develop an intervention designed to address practitioner beliefs which was tested in the classroom. The research questions were shaped by the design-based research approach used and its aim to produce both theoretical understanding of the problem that can be applied to other settings (Question 1) and usable solutions to classroom problems tested in context (Question 2). The design principles described in Chapter 4 were ‘tested’ and developed through an intervention to address the problem as it occurred in one nursery class.

The main findings of the research, in relation to the research questions, were as follows:

Question 1. What factors influence the integration of digital media into early years pedagogy?
- The relationship between beliefs and practice
- Practitioner beliefs mediating learning
- The concept of digital media as a resource supporting early learning
- Elements of the classroom learning environment
Question 2. What pedagogical approaches reflect effective integration of digital media into early years settings?

- Congruence between pedagogy for digital media and pedagogy for other curriculum areas
- Supportive interactions and interventions in children’s digital media use
- Reshaping the classroom learning environment for digital media
- Different types of mediation supporting integration

The contribution to knowledge is twofold:

1. Theoretical understanding of the factors hindering digital media use. This knowledge takes the form of a nuanced understanding of the relationship between beliefs and practice and the role practitioner beliefs play in constructing the contexts for digital media use that mediate children’s learning.

2. Evidence-informed design principles that could be used in similar settings. These provide a workable classroom-based intervention to integrate digital media based on planning for practitioner-directed teaching, interactions during free play, and reflection on practitioner beliefs and developing practice around digital media. The product of the research is a set of design principles that can be ‘scaled up’ and tested in similar classrooms in order to develop a set of practices that have been refined to work in early years classrooms. These practices are: planning for digital media; practitioner interventions in children’s digital play; practitioner-led digital media activities, and practitioner reflection.

Factors influencing digital media uptake

Vicky’s integration of the IWB, PC and LearnPads was related to her beliefs about digital media and how these beliefs linked to her pedagogy. This finding is consistent with literature showing that practitioner beliefs are a strong factor in their adoption of digital technologies in the classroom (Ertmer, 2005) and research demonstrating that practitioners integrate technology in accordance with their pedagogical beliefs (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). There is also a close relationship between early years practitioners’ attitudes about digital media and how they are integrated into early years settings with a commitment to child-centred principles and play (Edwards et al., 2016). However, literature has not explored sufficiently the relationship between early years practitioner beliefs about pedagogy and their uptake, or lack thereof, of digital media. Studies investigating early years
practitioners’ beliefs frequently adopt a survey design which does not allow for a nuanced understanding of how beliefs mediate practice in classrooms (Blackwell et al., 2014; Blackwell, Lauricella, Wartella, Robb, & Schomburg, 2013; Jack & Higgins, 2018; Kerckaert et al., 2015; Nikolopoulou & Gialamas, 2015). Existing research also provides a contradictory view of the relationship between constructivist pedagogies and technology use. Teachers with constructivist and child-centred pedagogies are more likely to demonstrate effective uses of technology than practitioners with a transmission approach (Ertmer et al., 2015; Hermans, Tondeur, van Braak, & Valcke, 2008).

However, empirical research also shows the constructivist, child-centred approach of early years teachers does not support, and may hinder, the integration of digital media (Stephen & Plowman, 2008).

This research provides findings illustrating how the constructivist pedagogies of early years practitioners may support technology uptake once practitioners’ beliefs change. The findings question previous literature and show that constructivist pedagogies can support technology uptake in the early years when practitioner beliefs are congruent with their use. This points to the need to look beyond teacher beliefs about pedagogy alone to consider how beliefs about digital media in relation to early years pedagogy may hinder or support technology integration. Early years practice has a strong focus on children’s social and communication development. The suggestion that technology may be detrimental to both these (Cordes & Miller, 2000) has frequently shaped early years practice and acted as a barrier to the integration of digital media across the curriculum rather than their use to support specific maths and literacy skills and develop operational competencies. It is beliefs about technology in relation to teacher beliefs more generally that underpin early years pedagogy and practice that support or hinder technology integration rather than one or the other alone. This research extends existing literature on early years practitioner beliefs about digital media. It demonstrates how beliefs are context bound and may shape technology use in different ways when they are enacted in early years classrooms. Vicky’s beliefs about digital media only came to the fore when they were applied to an early years classroom founded on principles of exploration and child-initiated play. Vicky recognised that children used smartphones, iPads and laptop computers and she wanted to find ways to recognise the interest in digital media children brought from home. However, her beliefs about the detrimental nature of technology caused tension with what she
believed to be the educational purpose an early years classroom. In particular, the focus on language and communication development.

The findings extend literature that establishes the complex relationship between beliefs and practice (Nespor, 1987; Pajares, 1992) and that beliefs are a significant factor in determining the uptake of digital technologies (Hermans et al., 2008). This research revealed a complex set of factors influencing the relationship between beliefs and practice and the way Vicky used resources, including digital media, to support learning. Vicky’s use of digital media was shaped by her beliefs about the types of learning experiences they offered and the ways she could support and extend children’s learning through her meaningful interactions, and interventions in play. This finding is consistent with literature demonstrating how beliefs about the importance and value of a task are central to the way beliefs shape practice (Pintrich, 1990). Vicky did not believe learning with digital media had value beyond the development of operational skills. The tasks Vicky believed children engaged in during digital play were not yet valued in the educational context of the classroom. Vicky’s strong belief in the value of children’s language and communication development and the importance of collaborative learning held greater weight than beliefs in the goal of preparing children for reception. Vicky’s perceived need for a practitioner-directed approach, and a belief in the solitary and passive nature of children’s use of digital media conflicted with Vicky’s pedagogical beliefs centred on the importance of collaborative, co-constructed learning. Digital media did not support, and even hindered, the ways Vicky believed young children learned best. At the heart of Vicky’s beliefs about digital media was the view that they offered little value as tools to support meaningful learning and could in fact hinder development of social interaction and language. Dissonance between Vicky’s perceived use of digital media by children and beliefs about appropriate ways to support learning hindered her from using the IWB and classroom PC alongside children and integrating them effectively into her pedagogical decision-making.

**Beliefs about digital media shaping teaching and learning**

Literature reviewed in Chapter 3 showed practitioners are frequently ‘absent’ from children’s use of digital media and do not play an active role in digital media play (Plowman & Stephen, 2007; Howard et al., 2012; Carlsen et al., 2016). When practitioners do use digital technologies alongside children it is most often to support operational skills (Howard et al., 2012) or to use maths and literacy games that practise
and extend cognitive skills and conceptual understanding (Vangsnes & Økland, 2015; Carlsen et al., 2016). While consistent with existing research on practitioner interactions, the findings presented here extend this literature and contribute knowledge as to why early years practitioners do not support children’s digital media activity through their interactions in the same way they support play and collaborative learning in other curriculum areas. Vicky was an experienced practitioner with expertise in early years pedagogy. Her reluctance to intervene in digital play was not related to a lack of pedagogical skill. It was Vicky’s beliefs that hindered her decision-making process in deciding whether or not to use digital technologies. Vicky’s beliefs about appropriate pedagogy to support children’s play-based learning were stronger than her beliefs about the ways digital media might be able to support her educational goals. These core beliefs prevented her from seeing beyond preconceptions about how young children used digital technologies to view them as tools that could support learning through play.

Prior to the intervention, Vicky’s approach to using the IWB and PC was based on assumptions about how children used them and the type of learning opportunities digital media offered. Vicky’s concept of digital media was not one that supported a view of purposeful learning through child-initiated play and open-ended exploration. She perceived children’s use of the IWB and PC as passive and solitary, and believed digital media provided few opportunities for agentic learning and collaboration. Vicky’s conceptualisation of digital media as classroom resources related their use to acquire operational skills. She had not yet developed a concept of digital media as tools to support wider learning and her interactions focused on children’s learning about, rather than with, the IWB and PC. Children required physical skills to operate different digital media devices and navigate the programs on them, but once mastered Vicky did not believe these skills led to any valuable learning experiences. Vicky viewed operational skills as entirely separate from other types of learning that she saw as more relevant and meaningful. Her view of children’s digital play did not support the educational purpose of the classroom; hence Vicky was reluctant to extend her pedagogical skills to enable or support children’s use of the IWB or classroom PC. This stood in contrast to other curriculum areas where Vicky’s pedagogical practices were shaped and guided by her goal to provide opportunities for purposeful and meaningful learning through child-initiated play. Classroom observations showed that Vicky’s intentional interventions skilfully supported and extended the learning opportunities offered by
children’s active involvement in play. On these occasions, Vicky’s pedagogical decision-making responded to children's interests and enquiries.

Vicky’s classroom practice was not always congruent with her beliefs, but where it was not she had drawn on her experience and knowledge of children’s developing needs, capabilities and interests to navigate any tensions between her personal beliefs and the practices she was required by the school and EYFS curriculum to follow. Previous research has shown there may be inconsistency between beliefs and practice as teachers do not always act in accordance with their beliefs (Fang, 1996). This inconsistency may be due to practitioners’ inability to act in accordance with their beliefs given the complexities of classroom life and constraints that may be imposed by policy initiatives related to the curriculum and statutory assessment practices. These contextual factors may have an impact on teachers’ beliefs and their classroom practice (Fang, 1996). This research demonstrates the impact of the conflict in beliefs in an early years classroom. The tensions between beliefs and practices observed in this classroom also show evidence of the way government policy initiatives may mediate practitioners’ pedagogical decision-making. For example, Vicky discussed the conflict she felt between her beliefs about early years practice and creating an appropriate learning environment, and the need for children to achieve prescribed learning goals set out in statutory EYFS assessment documents. Central to this conflict was the role of the practitioner and the need to maintain a balance between child-initiated and practitioner-led learning in achieving these outcomes. Vicky acknowledged that some direct teaching was necessary to meet curriculum outcomes as well as school and statutory assessment practices, but this more structured approach was largely confined to planned teaching, rather than being part of children’s free play. Vicky believed actions in support of children’s digital media use required her to direct learning rather than be guided by children’s interests in and explorations of different games and programs. The process of reflection and action Vicky had undertaken that allowed her to overcome tensions she described in relation to some aspects of the curriculum were not yet in evidence in relation to digital media. Here Vicky's deep-seated beliefs shaped how she used the IWB and classroom PC during free play and planned teaching. Vicky had not had the time, training or professional impetus to reflect on her approach to digital media in the same way as she had with other aspects of learning and elements of the EYFS curriculum that were incongruent with her pedagogy and beliefs, such as the focus on phonics teaching. Any training
Vicky had received for digital media was how to operate the IWB or LearnPads and demonstrations of games rather than any pedagogical strategies to integrate digital devices into teaching and learning.

**Focus on direct teaching**

Vicky’s conceptualisation of digital media as separate from her early years pedagogy, and her inability to see them as relevant to what she considered appropriate for early years education, is consistent with published literature describing teachers’ views about digital media (Edwards, 2016; Marsh, Kontovourki, Tafa, & Salomaa, 2017). In the absence of a rationale for the use of digital media that supported her pedagogical beliefs, Vicky relied on curriculum and assessment requirements to guide her use of the IWB and PC rather than her existing early years expertise and knowledge. Prior to the intervention, planning documents and discussions showed that Vicky’s infrequent interactions with children using digital media were defined by the EYFS curriculum outcomes for technology and the needs of later schooling rather than led by children’s interests and discoveries. She focused on practitioner-directed teaching of operational skills through her interventions during free play and used the IWB as a form of dynamic display. Vicky did not perceive a meaningful role for herself using digital media other than to teach mouse skills and even this role conflicted strongly with how she acted in support of children’s play at other times. Her infrequent interventions were not in support of the way children chose to use digital media and Vicky did not include the IWB and PC in free play or practitioner-directed learning in the kind meaningful ways observed elsewhere when she intervened to support children’s indoor and outdoor play. Vicky did not use her pedagogical expertise to extend children’s digital play either through face-to-face interactions or distally by the way she planned activities and organised classroom routines. Planned uses of the IWB as part of whole class directed teaching did not recognise or seek to extend children’s developing digital skills and knowledge beyond operational competency.

Vicky did not yet view digital media as tools that could support the core areas of the EYFS curriculum and related educational goals of the classroom, particularly children’s social communication and language development. Consequently she saw limited opportunities for meaningful learning with digital media or for interactions that supported children’s collaboration and communication. Vicky did not attach any significant value to digital media to support the kind of meaningful learning children
achieved through a balance of educationally purposeful play and practitioner-directed teaching. In the absence of concept of digital media that could be applied to her strong early years pedagogy Vicky had not been able to bring the IWB and PC into her strong early years practice in any meaningful ways. When using digital media with children Vicky did not adopt the same kind of supportive role she did when she interacted with children at the water tray or in the construction area, for example. In other areas of the classroom and during outdoor play, Vicky was frequently invited by children to join their play through their body language, gesture or verbal requests. The absence of such invitations in relation to digital media became more noticeable as children became accustomed to the researcher's interest in their digital play and began to approach her for support rather than Vicky or other classroom practitioners. Vicky justified her limited interactions by positioning digital media to support curriculum-led outcomes related to technology. This approach enabled Vicky to meet school-based assessment requirements and prepared children for later schooling but it did not support child-led digital play and exploration.

**Lack of understanding of children’s digital practices**

Vicky’s infrequent interactions and her focus on technological competencies and curriculum goals suggested she lacked awareness of the ways children chose to use digital media and the learning that took place around these devices. In this respect, Vicky’s use of digital media could potentially be described as less mature than the children’s. She lacked a contextualised understanding of how children used digital technologies and the socio-cultural contexts for learning created by children’s uses of diverse digital media devices. The theoretical framework underpinning this dissertation views learning as a socio-cultural activity and uses the concept of mediation (Vygotsky, 1978) to explain how learning emerges in relation to social institutions in which that learning takes place (Leont’ev, 1977). The socio-cultural contexts for learning mediate how and what children learn (Leont’ev, 1977). In this research, early years classrooms are conceptualised as socio-cultural contexts for learning constructed by the way children and practitioners behave (Daniels & Edwards, 2010) and the reasons for their behaviours (Leont’ev, 1977). Findings showed that the classroom contexts for learning were shaped, and reshaped, by the ways Vicky used digital media according to her shifting beliefs. New approaches to bringing digital technologies into Vicky’s pedagogy showed contextualised awareness of children’s uses of the IWB and LearnPads and how learning emerged as a result of their social interaction around digital media. This
research uses Vygotsky’s (1978) theory of cognitive development to show how children’s digital play was a social activity that resulted in individual knowledge about the devices themselves and supported children’s wider social communication and collaborative discovery. Children learned new ways to use digital media and developed their use as social tools by using them collaboratively supported by their peers. Pre-intervention, Vicky was not part of this social context for learning as she did not view digital play as a social activity. The notion of learning as an individual cognitive process and the fundamental role of interaction with the community through their use of social tools is consistent with Vygotsky’s theory of cognitive development as both social and individual. Vicky’s pre-intervention interactions supported individual children’s operational skills rather than constructing digital media as social tools shaping the ways children learned as well as what they learned.

Prior to the intervention, two or more children using the IWB or PC without practitioners typically did so with a shared understanding of the goal of their activity. For example, successfully completing a level of a game in order to win reward stars or the joint creation of a pattern on the IWB. There was often little dialogue heard between up to five children using a program or playing a game but children worked collaboratively to achieve their aim. For example, children demonstrated a silently shared understanding of a task and its goal when one child pointed at an icon and others in the group understood what was being suggested and why. Children demonstrated their understanding by positioning the icon correctly in order to move to the next level in the game. Although a skilled and experienced practitioner, in the absence of a contextualised understanding of children’s digital media learning Vicky’s practice did not support the ways children used digital media. Vicky did not support collaborative learning or engage in game play in ways that supported children’s goals rather than her own. Her interactions and interventions in digital play were not linked to children’s desire to complete a game or successfully use a program to achieve their chosen outcome. Vicky’s focus on operational and mouse skills suggested she did not see beyond a skills-based goal to the ways in which her interactions could support the wider learning that took place when children used digital media. Furthermore, her belief that digital play was passive and solitary showed Vicky did not appear to understand or recognise the contexts for child-led digital media use created through children’s collaborative activity and how these contexts supported learning. Pre-intervention, Vicky’s actions created contexts for children’s digital media learning that were different
from those established by the children. As a consequence, she was reluctant to support and extend the ways children used the IWB and PC to take advantage of the teaching and learning opportunities they could provide through her active involvement.

**Constraining digital literacy development**

Vicky did not recognise the way the contexts created by children's collaborative digital media play supported their digital literacy development. Digital literacy is a key aspect of technology use and is best defined as a social practice that involves reading, writing and meaning-making using a range of digital technologies (Sefton-Green et al. 2016, Bennett and Daniels, 2016, Marsh et al., 2014). Digital literacy includes the acquisition of skills related to accessing and using digital media as well as traditional skills related to alphabetic print (Marsh, 2016). This concept of digital literacy as multi-dimensional draws on Green’s 3D (2002) model of literacy which suggests there are three dimensions to literacy - operational, cultural and critical. Children’s use of digital media demonstrated the social and critical dimensions of media use articulated by Green (2002), but prior to the intervention Vicky had not observed and recognised these dimensions in relation to children’s developing digital literacy. Digital literacy is shaped by particular social and cultural contexts and children are encultured into ways of using and understanding digital texts through their participation in, and experience of, digitally mediated events. This dissertation shows that the absence of practitioners supporting and guiding children’s participation in digital media play meant learning with and about digital technologies was limited to what children could achieve independent of practitioners. Although there was evidence of some children developing digital literacy skills and competencies, in the absence of practitioner participation many children either did not use the IWB and classroom PC or opportunities for extended learning were not maximised.

Observations of children showed how their use of the IWB, LearnPads and PC was frequently social and provided opportunities for communication mediated by the digital texts. The classroom digital media were shared resources where children could see and comment on their peers’ work on screen. The digital texts children created on the IWB could be seen in printed displays around the classroom, and individual LearnPads provided opportunities for children to exchange their texts with others in the group. Children communicated through what they drew and wrote on screen and when they talked about and described their texts to others. Children also communicated when
they read digital texts in order to play games or used their existing digital skills to explain to others how to play the games. The shared, collaborative nature of digital media use supported children’s interpretations of the images on screen. Children questioned each other about what they saw, and interpreted the digital texts created by others within the context of their own experience and knowledge of the way texts worked. Vicky had not observed or reflected on children’s use of digital media and was not aware of the socio-cultural contexts in which children developed their understanding of technology beyond operational skills. Vicky’s focus on operational skills was driven by an understanding of contexts for digital media use that were different from the contexts constructed by the ways children used digital technologies.

Classroom learning ecology for digital media

Literature has begun to show the importance of understanding the classroom contexts in which digital media is used and how these contexts are constructed as learning ecologies (Arnott, 2016; Edwards et al., 2016). These contexts for learning mediate the use of technology and shape the ways children and practitioners use digital media in different learning approaches. In this dissertation activity theory (Leont’ev, 1977) is combined with the concept of a classroom learning ecology to focus on the key elements in classrooms that shape the contexts mediating learning with digital media. The use of activity theory links Vygotsky’s (1978) concept of mediation to the socio-cultural contexts for learning and how the physical environment mediates learning. It is the way classrooms are constructed as learning environments that mediates how and what children learn. Classrooms are complex ecosystems and there are many factors behind why something does or does not happen (Selwyn, 2019). However, defining these factors is problematic particularly as literature does not describe them in relation to elements that support development of effective early years pedagogy for digital media. This dissertation contributes contextual understanding of how teaching and learning is related to different factors that mediate the use of digital technologies. The findings focus on key elements found to shape, and reshape, effective practice; practitioner beliefs and classroom norms.

Vicky’s decisions about how and why to use digital media were individual choices, but these choices could not be separated from culturally formed beliefs about young children’s learning and the way these beliefs mediated and defined her practice. This is consistent with Wertsch’s (1988) description of the way individual use of mediation can
enable or constrain action and indicates that practitioner beliefs are strong mediating factors. Using activity theory to analyse her practice shows that Vicky's use of digital media was related to the shifting nature of joint activity and how the changing object of activity (Leont’ev, 1977) defined what she considered valuable and meaningful learning with digital media. Pre-intervention, Vicky and the children each had a different understanding of learning with digital media and therefore used the IWB and PC differently. Vicky viewed learning as acquiring technical skills whereas for children digital media allowed them to collaborate, communicate and create meaning through their use of games and construction of digital texts. These differing conceptualisations of digital media mediated their use and shaped how Vicky and the children used the IWB and PC as tools for learning. There were, therefore, two contexts for digital media use in the classroom; one shaped by children's interactions and one related to the way Vicky used, or did not use, digital media with children.

**Elements of a learning ecology**

Viewing integration through the lens of activity theory and the heuristic of an ecological triangle highlights how digital media activity was shaped by the wider flow of classroom activities, adult/child interactions, classroom routines and institutional factors as well as Vicky's conceptualisation of digital media as learning resources. Although Vicky’s beliefs were a key component in her pedagogical decision-making (Pajares, 1992), the findings reported here show how these beliefs influenced aspects of classroom practice related to digital media use. It was not Vicky’s beliefs *per se* that mediated digital media uptake, but their impact on particular aspects of classroom practice. An ecological triangle can be used to show how changes to individual elements of the classroom learning ecology related to changes in children’s digital media activity. This model of an ecological triangle and the dynamic relationship between its elements is consistent with the concept of a classroom learning ecology in which designed contexts are conceptualised as multi-layered, interacting systems influencing learning (Gravemeijer and Cobb, 2006). The interacting elements represented in an ecological triangle constitute the shifting socio-cultural contexts in which digital media were used, and bring to the fore practices that at first hindered, and then supported, learning with digital media. Figure 7.1 and Figure 7.2 show ecological triangles for pre-intervention activity with and without digital media respectively; elements of the classroom learning ecology are shown in red.
Pre-intervention activity with digital media was different from other forms of classroom activity. The conflict hindering digital media integration is shown as the differing objects towards which Vicky’s teaching activity was directed. The object of activity defined different classroom discourses around learning with and without digital media that influenced how and what children learned and what Vicky counted as valuable learning. In both contexts – with and without digital media – activity was mediated by established beliefs about early years pedagogy and what Vicky considered good practice to support young children’s learning. However, Vicky’s constitution of the object gave these beliefs different meaning when directed towards activity with and without digital media. When Vicky’s strong early years beliefs were directed towards curriculum outcomes and preparation for reception (see Figure 7.1) they conflicted with her pedagogy. Conflict arose due to the way Vicky constructed the object of technology-mediated activity based on her pre-intervention beliefs about digital media. The outcome of this activity was a classroom discourse in which the ability to operate digital media counted as learning rather than children’s collaborative problem solving, reasoning and sharing of knowledge and skills. In this discourse, there was no room for recognition of children’s knowledge and capabilities beyond the EYFS curriculum outcomes for technology and preparation for using the ICT suite in the reception class.
Pre-intervention activity with digital media showing the relationship between elements of a learning ecology in red

Vicky’s use of digital media during free play contrasted with the way she interacted with children during child-initiated play in other areas of the classroom. Figure 7.2 demonstrates how children’s interests and developing capabilities guided Vicky’s interactions to support and extend child-led learning and constituted the object of mediated activity. The outcome of her interactions, and the ways Vicky intervened in children’s play created a discourse around learning which recognised children’s interests and the choices they made during free play. Practitioner presence in their play was accepted by children as long as it supported and extended their chosen...
objectives. When practitioners tried to impose their own agenda and direct play to their own object children frequently left an activity or indicated their disinterest.

Figure 7.2: Pre-intervention activity without digital media showing the relationship between elements of a learning ecology in red

**Norms of participation hindering integration**

One element of a learning ecology is the classroom norms of participation (Cobb et al., 2003; Gravemeijer & Cobb, 2006) and analysis of norms helps understand learning as it occurs in the social contexts of classrooms (Plomp & van Nieveen, 2013). Norms of participation describe the different patterns of interaction between adults and children at different points of the day and they may be renegotiated between practitioners and
children according to the way each behave in different classroom learning situations. Norms are related to the pedagogical beliefs practitioners hold that determine the roles they play in supporting learning. Findings reported here contribute knowledge about effective early years pedagogy to support digital media. They show that practitioners’ interactions can support and/or hinder digital media use through the establishment of norms of participation that shape different socio-cultural contexts mediating learning. The different ways Vicky interacted during child-led play and practitioner-led activities constructed the classroom contexts that mediated learning. Digital media integration during free play was effective when Vicky’s pedagogical interactions recognised the social norms negotiated around child-led activities. Observations, planning documents and practitioner interviews showed there were different learning situations and that the roles adults and children expected to perform during free play and practitioner-directed activities differed. The effect of classroom norms for different learning contexts was a strong separation in the minds of the children and Vicky between direct teaching and free play as shown by the ways they behaved during these different learning situations. Vicky acknowledged this separation when she referred to the way ‘my [Vicky’s] agenda’ shaped her actions during a practitioner-led activity using an iPad and discussed children's expectations of her in different learning situations.

Vicky’s interactions during free play supported child-led learning and she was responsive to children’s interests and enquiries. During practitioner-led activities learning was most often led by curriculum goals and school assessment requirements. These norms of participation were linked to Vicky’s pedagogy and reflected her strong belief in the kind of learning environment that best supported early learning. Pre-intervention, there were different norms of participation for digital media and other classroom resources, and for free play and whole class teaching. These norms shaped, and were shaped by, the ways practitioners and children used digital technologies and how they behaved at certain times of the day. Prior to the intervention, Vicky’s interactions at the IWB and PC were not as an equal partner in support of children’s chosen activity in the same way that her interactions frequently were both indoors and outdoors. Vicky’s interventions in child-initiated digital media play suggested an approach closer to that for directed teaching times when learning was planned and typically led by Vicky, and often linked to curriculum outcomes. These different norms and children’s expectations of the ways practitioners acted hindered learning with digital media. Vicky’s absence from children’s digital media play and her
focus on teacher-directed operational skills meant children did not seek out her participation as they did with other resources and Vicky’s interactions did not support child-led learning. Pre-intervention norms established around the use of digital media constrained their integration into teaching and learning. These norms reflected Vicky’s strong beliefs about digital media and their incompatibility with her teaching philosophy.

**Reconstructing the classroom learning ecology**

The intervention enabled construction of new beliefs about digital media congruent with Vicky’s strong early years pedagogical beliefs. Extending classroom practices to digital technologies enabled renegotiated norms that supported effective learning and teaching. The relationship between reconstructed beliefs, norms and new practice for digital media can be shown through an ecological triangle. Figure 7.3 shows the post-intervention object for digital media activity mediated by Vicky’s reconstructed beliefs.
Figure 7.3: Post-intervention activity with digital media use showing the relationship between elements of a learning ecology in red

A new object is closely aligned with that for activity without digital media (see Figure 7.2) and shows how the focus of attention shifted from curriculum outcomes to supporting child-initiated learning with diverse digital media through sensitive interventions in play. The pre-intervention conflict between beliefs and pedagogy that hindered integration was overcome when the object of activity was mediated by Vicky’s reconstructed beliefs about the value of digital media to support purposeful and meaningful learning through play. Vicky’s individual actions when using the IWB and LearnPads often appeared little changed, but post-intervention when she showed children how to use the mouse or pen tool to tap and drag an icon, the reconstituted
object of her actions suggested a new discourse for digital media and a new form of mediated activity. When Vicky sat with children using LearnPads or intervened with children’s game play at the IWB her object was to support language development or extend collaborative thinking and problem solving. Learning could also be linked to curriculum goals such as letter formation, social communication or speaking and listening skills but, unlike Vicky’s pre-intervention interactions around digital media, this learning was the outcome rather than the object of her actions. By aligning the goals of activity with and without digital media Vicky aligned her practice with that for other areas of the curriculum. Consequently, she was able to accommodate digital technologies in her pedagogy with little outward sign of changes to her practice. Vicky intervened in digital play as she did in child-initiated play elsewhere in the classroom and with similar objectives. Pre-intervention, Vicky’s interventions were infrequent and directed teaching was focused on curriculum outcomes. Following the intervention there was a crucial shift in the object of Vicky’s interventions in digital play and this had an impact on the way she acted in support of children’s learning with digital media.

**Renegotiated norms**

This dissertation extends analysis of norms to aspects of the intervention and particular practices that that were unsuccessful in supporting digital media integration. This helps to understand why certain practices were not successful. Integration was most effective when new practices renegotiated norms for digital media that were congruent with existing classroom norms for direct teaching and free play. Vicky’s contextualised understanding of children’s digital media use enabled renegotiated norms of participation that supported the intentional integration of digital technologies as pedagogical tools to support learning through play. Post-intervention, new classroom norms encouraged and supported child-led uses of the IWB and LearnPads. These norms were renegotiated through Vicky’s changing practice in support of children’s digital media use; her interventions in free play and directed teaching. Although Vicky’s interactions were new ways of behaving with digital media, they were not substantially different from the pedagogical approaches observed and recorded in other areas of the classroom. The norms for digital media use were renegotiated as part of those that already existed in the classroom.

Children’s experience of social norms as part of the classroom learning ecology and the impact of norms on their behaviour was underlined following Vicky’s use of an iPad.
in intervention Cycle 2 (see Extract 5.3). On this occasion, Vicky believed the activity using the Our Story app had been unsuccessful because the more structured approach she chose was not one children were familiar with during free play. Vicky’s intention for this activity was for children to create a digital text that combined photographs, alphabetic text and children’s voices. Children required direction from Vicky to show them how to use the iPad and the app. Children had experience with this type of practitioner-directed activity during whole class teaching times and structured small group activities, but it was outside children’s experience of the way Vicky behaved during free play. Vicky believed she had spent too much time demonstrating how to use the app rather than allowing the children to create a text about pirate day. Vicky’s use of the iPad was outside the norms that governed interactions between her and the children during free-flow play. Following this activity, Vicky changed her approach to work alongside and support children’s exploration of the newly introduced LearnPads. Vicky allowed children’s interests and knowledge to guide her interactions. She supported their game play and exploration and learned to use the LearnPads with the children. This was a different approach to using digital media during free play, but one that was aligned with the way Vicky interacted with children at other times during their play such as when she helped children make a zoo from construction blocks or build a den outside in the nursery garden.

The integration of digital media into free-flow play in the pirate day activity was governed by the norms negotiated for children’s participation in play rather than those for whole class teaching sessions. When Vicky’s interactions supported the way children used digital media during their play and responded to their choices and interests she followed existing norms for the way children expected her to act as part of free play. Vicky’s presence and the roles she adopted established norms that encouraged children’s use of digital media. Post-intervention the ways children interacted with Vicky and invited her participation in their activity showed the children understood these norms to be congruent with those governing practitioners’ behaviour outside their use of digital media. The unspoken behaviours children expected practitioners to conform to in different learning situations applied equally to activities with and without digital media. This study shows that the renegotiation of the classrooms norms around digital media was an essential element for their integration into teaching and learning. Integration was effective when uses of digital media took
account of the different situations for learning and how children understood and responded to them.

**Pedagogical congruence supporting effective integration**

Congruence between pedagogy and beliefs enabled the application of early years pedagogy to digital media and supported their effective integration across the curriculum and as part of child-initiated and practitioner-led learning. Research has demonstrated the key role of adults in supporting children’s learning with digital media (Billington, 2016; Flewitt et al., 2014). In this study Vicky’s lack of belief in the potential of digital media constrained their use as part of her pedagogical interactions in support of learning. Vicky lacked a personal understanding and real experiences on which to base her judgement of the potential of digital media hence it was not part of her practice. Existing literature has established the importance of practitioners’ reflection on, and awareness of, their beliefs as part of the process of replacing existing beliefs with alternative ones (Nespor, 1987). This research contributes to knowledge about the role of reflection in changing beliefs by using an intervention co-designed by teacher and researcher to explicitly challenge pre-existing beliefs in order to develop new practices for digital technologies.

The intervention afforded Vicky the time and space to reflect on her beliefs and develop her practice in the light of evidence about how children used digital media. In this study real experiences and informed personal understanding provided vital evidence of the potential of digital media in children’s learning. Vicky used this understanding to inform her personal pedagogy and establish practical ways to develop her role in supporting learning with digital media. The intervention made Vicky aware of and reflect on congruence and incongruence of her beliefs and practices. The use of an intervention contributes to knowledge about how early years practitioner beliefs can be reshaped to support integration of technology congruent with existing beliefs about practice. This knowledge can be used to inform the use of digital media in similar settings. Findings report the direct and indirect practices that supported intentional integration of digital media in ways that were in harmony with a commitment to child-centred principles, play and discovery learning.

Direct experience of how children’s use of digital media was congruent with her pedagogical beliefs enabled Vicky to align reconstructed beliefs about digital media
with those shaping her practice. As the conflict between pedagogical beliefs and her concept of digital media lessened, Vicky could apply her established pedagogy to digital technologies. A shift in beliefs enabled her to pro-actively support children’s digital media use and integrate digital technologies into her practice with little visible change. Post-intervention, Vicky’s presence and her interactions supported children’s more playful and enquiry-based uses of digital media and their integration into all aspects of teaching and learning, including free play. The research demonstrates the importance of adult/child interactions that support the way children chose to use digital media in addition to a focus on learning how to use diverse digital technologies. The intervention design foregrounded the importance of practitioner presence to support and facilitate children’s digital play, and critical reflection on these interactions. Through these changes to practice, Vicky came to see how children’s use of digital media could support the core educational goals of her classroom.

**Critical reflection supporting change**

The process of change was complex, and required Vicky to deconstruct her pre-intervention beliefs about digital media and to construct new beliefs about them as tools that supported her existing practice, particularly a strong belief in the importance of her role in developing children’s language and communication. Vicky gained experience and confidence in judging when it was appropriate to integrate digital media. She applied her existing pedagogical skills and repertoire to the IWB and LearnPads when she made decisions about when and how to integrate digital technologies in free play and directed teaching. Through a process of observation, action and dialogic reflection with myself as researcher, Vicky developed a clear rationale for encouraging and supporting children’s use of digital media and different ways to do this. The presence of the researcher was important to create opportunities for reflection that addressed Vicky’s beliefs and practice. Although Vicky had overcome her dislike of direct teaching in some areas of the curriculum, notably phonics, the deep seated nature of her beliefs and assumptions about digital media suggested similar change would not have occurred without support. Critical reflection encouraged by the researcher’s presence enabled Vicky to value the way children learned with the IWB and LearnPads, to recognise the impact of her presence in that learning process, and to understand how this related to her own goals for young children’s learning. Vicky actively experienced how children learned through their use of digital media not just from them. Digital media supported how children chose to collaborate, experiment and
problem-solve. Vicky observed and valued the learning that took place when children co-operated and communicated, and shared their knowledge in order to successfully reach their intended goal.

Findings reported in this dissertation confirm research showing that there is no one model for the integration of technology into early years classrooms (Hesterman, 2011). Effective pedagogy needs to take into account the multiple ways early years classrooms are constituted particularly through pedagogical beliefs and practice. Practitioners need to find ways to negotiate the realities and constraints of early years practice and beliefs in order to develop what may be a personalised approach to digital media integration. Like the practitioners in Hesterman’s (2011) study, Vicky’s developing practice was enabled by reflection on how she defined learning with digital media and how this related to her practice. Reflection allowed Vicky to make connections between how she observed children learning with the IWB and LearnPads and core beliefs about language and communication and high quality early years learning based on children’s engagement in meaningful experiences and activities. Seeing these connections Vicky could accommodate diverse digital media within her pedagogy and classroom approaches to supporting learning. She focused her interactions on how children used digital media rather than what they learned when they played particular games or used specific apps. This shift in her approach was key to Vicky’s ability to integrate digital media so that they became integral to all classroom routines and practices. The IWB, LearnPads and PC were fully integrated in the classroom learning environment when they became part of the different approaches to learning observed in this classroom: free play, interventions in child-led play and planned practitioner-directed teaching. The integration of digital media was still governed by the relationship between Vicky’s beliefs about digital media and her pedagogical beliefs. However, her reconceptualisation of digital media was constructed within her existing concept of early years pedagogy and the philosophy underpinning it. Vicky’s classroom practice did not visibly change, rather it was a change in beliefs that opened the way for digital media to become part of that practice. It was Vicky’s use of digital media that was reshaped rather than her pedagogy.

**A ‘supportive’ pedagogy for digital media**

Post-intervention, Vicky developed a role focusing on a ‘supportive’ (Vangsnes & Økland, 2015) pedagogy during free play and practitioner-directed teaching which
extended and supported the way children used digital media as a collaborative endeavour. The teaching and learning approaches Vicky adopted to support children’s use of digital media were consistent with those observed in other areas of the curriculum and enabled digital media to become part of how Vicky organised teaching and learning. Vicky had pedagogical approaches that could support effective use of digital media, but prior to the intervention did not associate these approaches with her conceptualisation of digital media and they ways they could support learning. This research extends published literature on effective pedagogy for young children’s technology learning by offering evidence of a ‘supportive’ pedagogy to encourage the use of digital media as pedagogical tools through their integration in free play and directed-teaching activities. Literature has shown that practitioners are frequently absent from young children’s technology use (Plowman & Stephen, 2007; Howard et al., 2012; Carlsen et al., 2016) or that they use their presence to focus on operational skills (Howard et al., 2012). The intervention findings showed that Vicky developed a pedagogical approach based on being present during children’s use of digital media. Vicky’s presence during free play and directed teaching activities supported and extended the ways children used digital media as tools for communication as well as their operational skills. Vicky’s supportive pedagogy extended to the way she guided the other practitioners working in the classroom to extend their practice and interact with children using different digital media. Vicky’s leadership supported and encouraged the EYE and EAL teacher to adopt new practices around their use of digital media. Post-intervention the EYE more often intervened in children’s digital play and developed the confidence to apply their pedagogy to digital media in ways that supported and followed children’s interests. When practitioners extended their practice to the IWB and LearnPads they were guided by Vicky’s changed behaviours that modelled new ways of interacting around digital media devices that other staff saw and imitated.

New practices with digital media enabled Vicky’s developing awareness of children’s contextual and conceptual understanding of digital media. Recognition of the ways children used and learned with digital media showed Vicky how she could extend their collaborative and social uses of digital technologies. For example, she frequently asked children to share their knowledge of how to play games and use different programs with her as well as their peers. Vicky played games alongside children using an approach that was supportive of the ways the children were using digital media rather
than focusing on the cognitive skills acquired through counting or letter recognition games. She explored digital media devices and games with children and was led by them rather than organising the learning so that curriculum-based outcomes and skills were dominant. Vicky demonstrated a contextualised understanding of the ways children used digital media and developed her practice around this new understanding.

Her understanding of these contexts was evident when Vicky modelled the use of new *Busy Things* games and the LearnPads during directed teaching sessions. Post-intervention Vicky’s use of the IWB expanded beyond its function solely as a form of dynamic display. She interacted with the IWB and invited children to do the same during whole class planned teaching times. Vicky’s interactions developed children’s understanding of how to operate games and supported their ability to complete games and win on-screen rewards for completing them successfully. She understood that children’s digital game play afforded opportunities for learning based on collaborative problem solving, peer tutoring and social interaction. Giving children the technological capabilities to do this indirectly facilitated and expanded these learning opportunities and defined children’s use of digital media. Vicky’s recognition of the value of children’s digital competency and its role in supporting wider learning enabled a new found understanding of the importance of some practitioner-directed skills teaching. Prior to the intervention her distaste of direct teaching was a key factor in Vicky’s ‘absence’ from digital media and the way she struggled to find an acceptable pedagogical role.

**Supporting digital literacy**

Post-intervention, Vicky’s interactions supported children’s developing digital literacy and preparation to use digital media beyond the operational dimension Vicky envisaged when she discussed preparing children to use the ICT suite in the reception class. Developing digital literacy required Vicky’s support in guiding children’s participation in the use of digital media as a practice that included the operational, cultural and critical dimensions of literacy (Green, 2002) applied to digital media (Sefton-Green et al., 2016). Post-intervention, Vicky used her presence at the IWB and LearnPads to support children’s participation in this kind of social practice and extend their view of digital media to see it as situated in broader social and cultural practices. Teaching operational skills enabled children to successfully access resources in the ICT suite and use the IWB, but it did not equip them with the critical and creative
practices and competencies recognised as essential features of children’s wider digital literacy education. These skills go beyond the ability to access digital technologies to include the skills that will equip children for learning with digital media in the 21st century. Vicky’s pre-intervention interactions failed to see children’s use of digital media in a wider context that stretched beyond their ability to log on, use the mouse or pen tool and navigate a program. While these were important skills Vicky did not link them to the access they might give to wider learning.

Post-intervention, Vicky’s supportive presence reconstructed contexts for learning with digital media that included collaboration between practitioners and children in meaningful activities based around a shared understanding of digital media as tools for communication. When children’s reading and writing of digital texts was supported by practitioners they acquired greater digital skills than they could independently. With Vicky’s support, children designed digital texts that combined photographs, alphabetic text and audio recorded text. Children extended their capabilities when creating digital narratives through the use of images, symbols and marks (see Extract 5.3). With Vicky’s participation children acquired creative digital competence and were able to draw on their own experiences and interests to design digital texts that expressed their meanings (see Extract 5.1; Appendix 9, Cycle 2, clip 10). Vicky’s presence encouraged children to extend their digital skills beyond game play. She introduced elements of programs that allowed children to create texts that expressed what they wanted to communicate whether it was a story about a dragon, a picture about a favourite film or a drawing of their family with a new baby.

By showing children how to use the IWB, iPads and LearnPads to be creative in their digital text making, Vicky enculturated them into the use of digital media not just as means of communication but also creative and reflective meaning making. When children used the drawing program ActivPrimary, Vicky encouraged them to talk about and describe what they drew on screen and introduced new features of the program as part of the activity. New tools on the program were introduced to meet children’s interests to develop and extend both the digital text and their accompanying oral narrative. On these occasions, the focus of Vicky’s pedagogy was not technological or operational skills but the social and cultural practice of literacy (Green, 2002) as communication through the combined use of digital texts and oral language. This more holistic view of digital literacy moves beyond a focus on traditional skills related to
alphabetic print to include the ability to access and use digital technologies to construct meaning using a range of digital and non-digital practices (Sefton-Green et al., 2016).

**Explicit and implicit mediation enabling change**

The findings of this research show that the routine integration of digital media into existing classroom routines and practice relied essentially on two different types of mediation as part of the process of change: explicit mediation and implicit mediation (Wertsch, 2007). In this dissertation I expand Wertsch’s (2007) notion of implicit and explicit mediation to create a framework within which to analyse different elements of the intervention and their relationship to one another and Vicky’s beliefs. The findings contribute practical examples of implicit and explicit mediators that were part of a workable intervention tested in the classroom to develop pedagogy to support digital media integration. The intervention findings show that complementary roles were played by explicit and implicit mediation in the process of developing effective practice. In this dissertation explicit mediation refers to aspects of the intervention introduced purposefully into the classroom, whereas implicit mediation refers to changes to the classroom discourse that influenced the way Vicky acted to support or hinder digital media use. In this discussion, the description of two types of mediation supports Wertsch’s (2007) concept of explicit and implicit factors mediating learning and uses this concept to understand the effectiveness of the design principles introduced to implement change to beliefs and practice.

This research demonstrates the use of explicit mediation through the use of an intervention which directly addressed Vicky’s practice and facilitated new practices that supported effective digital media integration. The intervention design principles were purposefully introduced into the classroom and Vicky’s practice with the aim of bringing about change. Explicit mediation was present in the form of the researcher, new planning tools and new forms of digital media which helped to change how Vicky thought about and acted with digital technologies. The presence of the researcher as an agent of change introduced changes to practice in the form of new planning tools and digital media, and suggested approaches to adult/child interactions. The researcher also facilitated the reflective dialogue which afforded Vicky the time and space to address the pre-intervention beliefs and practices that hindered her effective use of digital media to support children’s learning. The addition to planning documents of a section for ICT was a form of explicit mediation that led to important changes in
practice. The visible presence of ICT as a section on her weekly planning prompted Vicky to consider ways to integrate the IWB, iPads and LearnPads into planned teaching sessions in ways that she had not done prior to the intervention. Post-intervention digital media became part of Vicky’s planning with learning intentions related to curriculum areas other than technology rather than using the whiteboard screen as a form of display. Explicit mediation was also present in the form of an iPad introduced by the researcher. Although the activities Vicky undertook with the iPad were not successful, its use was a crucial factor in her developing pedagogy with digital media. Activities undertaken with the iPad led to new ways of thinking and acting with the LearnPads that proved more successful. Vicky’s observations of children, reflection on their learning with diverse digital media, interventions in free play and pre-planned uses of digital media were visible changes to practice that resulted from the intervention and ‘remediated’ the ways Vicky chose to use diverse digital technologies.

**Implicit discourses shaping practice**

Findings demonstrated a relationship between explicit mediation in the form of the design principles and the early years discourse that implicitly mediated Vicky’s practice. Reflection and professional conversations with the researcher explicitly mediated changes to Vicky’s beliefs and practice, and her conceptualisation of digital media. A key aspect of these conversations was Vicky’s shifting beliefs about digital media and her pedagogical philosophy and how these positioned her within the discourse of early years practice. This view of discourse shaping digital media learning is consistent with Hicks (2003) description of classroom discourse and demonstrates how the classroom discourse was situated within the wider discourse of early years pedagogy. In this dissertation I expand Wertsch’s (2007) concept of implicit mediation to the mediational role played the classroom discourse that reflected Vicky’s ideologies, beliefs and social practices (Hicks, 2003).

The early years discourse of free play and free choices promotes a curriculum based on children’s needs, interests and patterns of behaving (Wood, 2014). Discussion of Vicky’s beliefs, and observations of classroom practice showed evidence of her enculturation into early years teaching as a cultural practice shaped by professional beliefs in the primacy of a child-centred approach to learning through play and the importance of social communication skills. Within this discourse there was little room to accommodate a concept of digital media as offering limited value to early learning.
given Vicky’s belief in their negative impact on child-led learning and social communication (Li, 2006). Vicky’s ability to apply her early years pedagogy to diverse digital technologies was linked to the way her pedagogic beliefs positioned her in this culturally constructed discourse. Actions that supported or hindered the integration of digital media were implicitly mediated by the way Vicky understood and interpreted the wider discourse of early years pedagogy and practice and related this discourse to young children’s learning generally and their learning with digital media more specifically. Vicky’s interpretation of the early years discourse shaped her use of digital media in different learning situations and constituted the contexts for their use.

Prior to the intervention, Vicky’s use of the IWB and desktop PC was related to the way she conceptualised them as having little value to support social communication and collaborative learning. These beliefs conflicted with the pedagogical beliefs that were a powerful factor in determining Vicky’s use of digital media and their position as classroom resources. Vicky’s pedagogic practices in support of child-centred learning through play, the structure of her interactions and relationships, and her generation of the criteria by which she judged children’s developing skills and abilities shaped Vicky’s acceptance or rejection of different pedagogic actions. She rejected the use of direct, structured teaching except during planned practitioner-led sessions and her interactions focused on sensitive interventions in children’s play. How Vicky behaved in the classroom around digital media and the way she enacted teaching and learning was determined by her concept of learning with digital media and how this positioned her in relation to her understanding of the discourse of early years pedagogy. The pre-intervention contexts constructed for digital media use conflicted with the wider contexts for learning implicitly mediated by Vicky’s culturally constructed view of early years pedagogy and practice. Vicky conceptualised early years pedagogy as separate from the IWB and PC, so there was no place for these technologies as part of early learning in this classroom.

A remediated position

Vicky’s reconceptualisation of digital media as tools to support early learning remediated her position within the early years discourse and enabled their accommodation within her practice. This dissertation demonstrates how Vicky’s concept of digital media shifted from an operational approach that equipped children with specific technical skills, to a view of digital media that was compatible with her
beliefs about the importance of developing children’s communication and language skills. Teacher beliefs vary in strength and kind (Nespor, 1987; Pajares, 1992) and the ease with which they may be changed is related to the strength of beliefs being challenged (Prestridge, 2017). This research has demonstrated that Vicky’s beliefs about early years pedagogy were stronger than those for digital media. She was, therefore, able to replace beliefs about digital media with new ones that allowed for ‘new’ pedagogy for technology that was in keeping with core beliefs shaping her pedagogical decision-making. The findings therefore question the view that practitioners lack pedagogical strategies to integrate digital media. Practitioners may have the strategies but they are yet to be applied to digital media.

Post-intervention, reconstructed beliefs about digital technologies as tools to support social communication were accommodated within Vicky’s understanding of the early years discourse which implicitly mediated her approach to integrating digital technologies into classroom activities. Explicit actions supporting digital media integration were shaped by the early years discourse that implicitly mediated Vicky’s organisation of teaching and learning and the approaches she believed appropriate to support young children’s development. Vicky’s uses of the IWB and LearnPads became part of her early years pedagogy and the beliefs mediating learning rather than irksome tasks she felt professionally obliged to fulfil. It was not Vicky’s conceptualisation of early years pedagogy that required fundamental change, but the beliefs about digital media as part of Vicky’s pedagogy that implicitly mediated learning. The pedagogic discourse mediating digital media was (re)shaped to include the ways in which children learned with diverse technologies as well as what they learned about them. This locally-shaped discourse regulated how Vicky generated her position within the wider early years discourse and supported the integration of digital media into the classroom learning environment.

There was a reciprocal relationship between the forms of explicit and implicit mediation that shaped the integration of digital media into the classroom. The explicit actions Vicky undertook to change planning documents and in response to the presence of the researcher, derived the evidence and experience Vicky drew on to inform the changing conceptualisation of digital media that shaped her approaches to teaching and learning. Explicitly introduced changes to practice, and reflection on the impact of those changes, constructed new contexts that implicitly mediated children's use of digital
media. Reshaped contexts for digital media use provided opportunities for further reflection and the introduction of new practices that supported the ways children used digital technologies. The researcher provided a ‘safe’ space for Vicky to explore and reflect on her pre-intervention beliefs and practices. Vicky’s observations of children, reflection on their learning with diverse digital media, interventions in free play and pre-planned uses of digital media were changes to practice that resulted from the intervention and ‘remediated’ the ways Vicky chose to use digital media. These new practices supported Vicky’s reconstruction of her concept of digital media which was accommodated within her early years pedagogy to create new contexts for teaching and learning. This is consistent with Vygotsky’s (1978) thesis that humans create and are created by the contexts in which learning takes place, and supports Wertsch’s (2007) view of two types of mediation as part of human development and learning. This dissertation demonstrates how a combination of explicit and implicit mediation supported the integration of digital media and development of effective approaches to teaching and learning through their impact on contexts for learning and the pedagogic discourse that mediates teaching.

Conclusions

This section addresses the implications of the research for classroom practice and future research. Included are reflections on the use of design research and the limitations of the study.

Implications for classroom practice

Despite the huge changes in digital technologies and their presence in early years classrooms, practitioners remain ambivalent about their presence and frequently struggle to incorporate technology into their pedagogical decision-making. This dissertation shows that practitioner beliefs may be a key factor in shaping how digital media are, or are not, integrated into early years classrooms. Beliefs about digital media and their relationship to one early years teacher’s strong early years pedagogy determined her approach to digital media integration. A crucial factor in this relationship was the teacher’s conceptualisation of digital technologies as pedagogical tools. This implies the need for a nuanced understanding of early years practitioner beliefs about diverse forms of digital media as part of an early years learning environment and how these beliefs relate to the way practitioners construct their personal pedagogy. The uptake of digital technologies in the early years is best achieved by taking account of
the ways pedagogy and approaches to teaching and learning are individually constructed in relation to practitioner beliefs and pedagogy. If individual beliefs mediate learning, then deconstructing those beliefs in order to make way for the integration of digital media must involve an element of personalisation rather than a top down, ‘one size fits all’ approach to professional development. To date, strategies to increase the uptake of technologies in early years settings have often focused on the external barriers to uptake, for example as identified by Ertmer (1999, 2012). Although providing access to interactive whiteboards and tablet technology, and giving practitioners the technical skills to use them has gone some way to supporting the use of digital media in early years settings, the ecological elements of early years classrooms have hindered true integration (Arnott, 2016; Ljung-Djärf, 2008). There is a need to account for the particular early years contexts in which diverse forms of digital media are used, and to understand how integration is implicitly mediated by practitioner beliefs about digital technologies and their beliefs about early learning pedagogy. For many early years practitioners it is their play-based approach to learning that distinguishes this phase of education, and approaches to encouraging digital media uptake should recognise how these beliefs and the discourses that frame them may impact the use of digital media in early years settings.

This dissertation has shown that for one early years practitioner effective pedagogical actions included interventions in free play and planned teaching sessions to extend and support children’s use of diverse digital media. The study suggests practitioners pay close attention to the ways they support children’s use of digital media as part of play and practitioner-directed teaching. Research to date has frequently focused on the integration of digital media in children’s play (Edwards, 2016; Plowman & Stephen, 2005; Vangsnes & Økland, 2015). However, effective early years provision includes a proportion of practitioner-directed learning as part of a play-based learning environment (Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004). This research addressed the use of digital media in all aspects of teaching and learning. Findings showed integration of digital technologies was effective because practitioners considered their use to support and extend learning as part of free play and practitioner-directed teaching. This finding implies that practitioners consider how they support the use of digital media as part of pre-planned learning as well as through planned pedagogical interventions in free play. The study findings suggest that for children to develop the operational, critical and cultural dimensions of digital literacy, teachers need to be present for some time, although not all the time, to work alongside
children when they are using digital media in different learning situations. When practitioners become aware of what children are learning, when they interact with digital media and look beyond the apps and games on screen to observe how children use digital technologies, then there are multiple opportunities where practitioners can apply their pedagogical expertise to child-led activity.

The findings showed that the presence of the researcher acting as a critical friend was an important factor in enacting change. On-going dialogue and reflection introduced as part an EDR intervention were key factors in changing practitioner beliefs and practices. Reflection on, and responses to, how a practitioner and the children used digital media were core elements in determining how beliefs about digital media were deconstructed, and then reconstructed within the practitioner’s strong early years pedagogy. Self-reflection is essential to aligning beliefs and practices (Potaro & Georgiadou-Kabourodis, 2009) and the researcher facilitated discussion of the inconsistencies and tensions in practice and new approaches to using digital media with children as these approaches emerged and developed during the intervention. The presence of the researcher was important in supporting reflection as strong practitioner beliefs, and conflict between different types of beliefs may make it difficult to change practice without the space for supported reflection. When practitioners discuss tensions, then inconsistencies are brought to the fore and beliefs and/or practices can be modified (Phipps & Borg, 2009). Early years practitioners need to become aware of, and reflect on, the range of beliefs they bring to the classroom and how these may inform the pedagogical actions that support and/or hinder children’s meaningful uses of diverse digital media. In this research, the practitioner benefitted from the presence of the researcher acting as a critical friend. The researcher introduced change to the classroom and provided time and space to discuss the impact of changes on teaching and learning as well practitioner beliefs. The importance of a critical friend demonstrates the need for early years practitioners to develop communities of practice or peer-to-peer networks which provide the space and support to discuss uses of diverse forms of digital media contextualised within an early years setting. These networks provide opportunities to share concerns and approaches to navigating the conflict between beliefs and practice.

Not all children have equal access to, and opportunity to use, diverse forms of digital media and children come to school with a range of different digital skills and
capabilities. In this study, children’s use of digital media was shown to encourage social communication, oral language and collaborative problem solving. Vicky’s presence at the screen supported all children’s ability to use digital media so that they could be part of the learning that happened when they engaged in technology-mediated activity. The implication of this finding is that practitioners need to become aware of the learning opportunities digital technologies offer when children have the skills and confidence to use them, but also recognise that not all children have opportunities outside the classroom to develop these skills. Early years practitioners are skilled at recognising the ways in which learning takes place when children play, and in seizing on opportunistic moments to extend that learning with new skills and opportunities. Practitioners now need to consider what actions they might need to take to support children’s learning with digital media and plan for next steps in their learning and development.

An important aspect of this research was the finding that children’s understanding of the way practitioners behaved in different learning situations had implications for the use of different digital media and their integration in different classroom routines. This suggests that the use of digital media is more effective when their use is carefully considered as part of existing classroom norms. Practitioners should understand how their pedagogical actions impact on the classroom learning environment and children’s understanding of how practitioners behave at different points of the day. The ways in which digital media devices are part of classroom routines and practices should not differ substantially from existing routines and practice but be integrated in everyday practice so that their use is ‘routine and transparent’ (NAEYC, 2012). Digital media should be integrated in such a way that they do not disrupt the norms that govern the way children and practitioners act at different points of the day. This becomes possible when practitioners understand how their interactions during free play or directed teaching may relate to the use of digital media. Practitioners’ supportive actions should take account of children’s experience of classroom norms and not try to change them without some form of renegotiation over time. When Vicky attempted to introduce change too quickly and used an iPad in ways children were not familiar with it was unsuccessful. Reflection on this activity enabled Vicky to develop different approaches to achieving the same outcomes.

In this research children’s use of digital media was also supported through distal interactions to integrate them into the learning environment. Planned uses of digital
media as part of practitioner-directed learning provided on-going access to a range of
digital media and directed other practitioners to use them with children. These actions
supported the integration of digital media into teaching and learning so that they
became embedded in existing classroom practices. The implication of this is that
practitioners consider all the ways in which their actions support children’s learning
using digital media and create a classroom learning environment in which digital media
is an integral part. This might involve explicit reference to digital media devices as part
of classroom planning, actively directing early years practitioners to intervene in digital
play or seeking out opportunities to include the use of digital media as part of
assessment other than for ICT. In this way practitioners are actively considering their
use, or lack thereof, of digital media.

**Implications for future research**

The implications discussed here are directly related to classroom practice and the
beliefs and attitudes informing practice in the early years classroom studied. While the
findings and ideas discussed in this dissertation might resonate with other early years
practitioners and be useful for early years practice with digital media more widely, this
needs further research. The intention of EDR is to produce a set of practices that can
be used in contexts where similar problems have been identified. In this research, the
core design principles consisted of a set of five elements that can be implemented in
other early years settings. They do not represent substantial change to existing
practice but are designed to be used to prompt new ways to consider the use of digital
media as part of existing classroom practice. The design principles can be introduced
as part of professional development or whole school changes to practice around the
use of digital media. They are workable because the changes are part of a classroom-
based intervention designed to work alongside existing practice but explicitly applied to
digital media use. Reflection can take place between teachers in individual schools or
existing clusters of schools. It can also be part of wider conversations as part of
professional development in schools.

Given the limitations of research conducted in one classroom further research in more
settings would establish whether the same intervention and teaching and learning
strategies could be effective in similar early years settings. The aim of such research
would be to develop a professional development model for effective integration that
has been designed and tested in real classrooms with practitioners. This study has
shown that in one classroom, practitioner interventions in child-led digital play, inclusion of digital media in planned, practitioner-directed teaching, and on-going reflective discussions were effective in integrating diverse digital technologies in such a way that they became part of Vicky’s pedagogical repertoire. This intervention needs to be tested further to determine whether the design principles are effective in settings with similar, as well as differing, approaches to teaching and learning as in the classroom studied here. Future research in more, and more diverse, contexts will be needed to consider how transferable the findings may be and which of the initial design principles may need to be modified.

Further research is also needed to determine whether the barriers to the use of digital media identified in this setting pertain to other early years classrooms. In particular, the ways practitioner beliefs frame digital media use as part of different approaches to teaching and learning. In this classroom, the relationship between beliefs about pedagogy and those relating to children’s digital media use at first hindered and then encouraged integration. Vicky’s beliefs about digital media and their relationship to her pedagogy mediated the changing use of digital media in the classroom. Further research is needed to understand more fully the relationship between beliefs and digital media use in the early years and the impact of this relationship on other elements of the classroom learning ecology including classroom layout and access to forms of digital media other than those used in this study. This research would demonstrate whether beliefs are the main barrier or whether there are other factors that should be accounted for in policy initiatives and professional development aimed at encouraging the uptake and integration of digital media. Given that research to date has focused on digital media as part of play-based learning, there is also a need to investigate how teachers use different forms of digital media as part of planned, practitioner-directed activities to understand the roles practitioners adopt and how these roles might influence children’s learning.

Research with practitioners in other phases of the foundation stage is needed to determine whether there are different factors affecting the uptake of digital media among practitioners working with children younger than three years old and with children aged four to five years in reception classes. Given that most children in England start compulsory schooling at four years old and that there are statutory assessments for children in reception classes, it is important to know what factors may impact the use of digital media. There is frequently a greater range of pedagogical
approaches in reception classrooms and this might impact teaching and learning with digital media and the ways they are integrated in the classroom learning environment.

This study did not set out to measure the impact on children's outcomes of digital media integration in the classroom studied by using pre- or post-tests as this was not considered this appropriate in this classroom, or necessary in the study design. However, the findings showed how practitioner interventions supported language and communication and digital literacy development. This suggests there may be value in conducting research to measure the impact of practitioner interventions on the development of children's digital literacy, and to further gauge the impact of practitioner interventions on children's learning outcomes, as compared with no practitioner interactions. At present, research that provides evidence of children’s measurable outcomes pre- and post-intervention has been largely concerned with the use of specific games and apps and their impact on children’s cognitive development (Korat & Shamir, 2012; E. B. Miller & Warschauer, 2013; Roskos & Burstein, 2012). There needs to be further research that evaluates the impact of practitioner interactions in this type of intervention.

**Methodological reflections**

As used in this study EDR was an effective approach to designing and implementing a naturalistic, classroom-based intervention in an early years setting. EDR provided an overarching framework within which to collect data in the challenging and ‘messy’ contexts of an early years classroom, and to answer the research questions. Design-based research is aimed at changing practitioners' practice and potentially transforming the classroom learning ecology (Bradley, 2013). In this research EDR developed theory and practice to support the integration of digital media into classroom routines and practices in ways that were in keeping with the values, cultures and beliefs of the practitioner involved in this study. The collaboration between practitioner and researcher that is a feature of design research approaches (Design Based Research Collective, 2003; Mckenney & Reeves, 2012; Reinking & Bradley, 2008) and its ability to help practitioners confront their beliefs (Bradley, 2013) is a strong feature of design research. EDR allowed the researcher to develop and refine the theories of teaching and learning by applying them to the realities of early years classroom practice and evaluate what did, and did not, work and why. EDR also provided an overarching framework within which to collect data in the challenging and ‘messy’ contexts of an early years classroom, and to answer the research questions. One of
the critiques of design research is that despite collaboration between researcher and practitioners as one of its overarching principles, the approach lacks attention to who drives the research agenda; the classroom practitioner or the researcher (Engeström, 2011). Engeström (2011) implies that design research provides little space for participant agency, and that solutions are designed by researchers for practitioners to deliver. The crucial issue seems to be the nature of the collaboration between researcher and practitioner and the extent to which this collaboration is accounted for in the reporting of research. Published design-based research studies do not tend to highlight the ways collaboration takes place and how it might be part of the overall design and development of an intervention.

In this research ongoing discussions between the practitioner and the researcher were important in the successful use of EDR and were instrumental in developing the intervention to ensure its ‘fit’ with the observed classroom learning ecology. The original intervention designed by the researcher and based on published literature included the use of pre-planned activities using different forms of digital media. However, observations of classroom practice and discussions about pedagogy and beliefs revealed this approach was not a good fit in the classroom studied. As the findings in relation to the use of and iPad in intervention Cycle 2 demonstrated, this element of the intervention was not congruent with the learning environment and pedagogical approach observed in the classroom. As such it was not successful in integrating digital media in the classroom and not sustainable once the research was completed. For this reason, the element of the intervention related to more practitioner-directed use of digital media during free play was not continued and the researcher focused on approaches that were more in keeping with the classroom environment and pedagogical philosophy underpinning practice. The implication of this finding is that design research would do well to play closer attention to who drives the agenda throughout the research process if changes to classroom practice are to be sustained once the researcher is no longer present. McKenney, Kirschner, & Voogt, (2012) call for ‘compatible innovations’ which consider existing values, cultures, beliefs and practices of practitioners if an intervention is to succeed. In the current research, this was achieved by researcher and practitioner exploring issues together and confronting beliefs through close collaboration and reflective dialogue. A collaborative approach also required the researcher to develop the intervention to take into account those
beliefs, values and practices and the ways in which they were externalised through their construction of the classroom learning environment.

**Limitations of the research**

As with all research, there were limitations to the design and implementation of this study. The most obvious limitation is the fact that this research was conducted in one classroom and focused on one early years practitioner. This raises questions as to the generalisability of the findings to other settings. Although the dissertation included data on other practitioners which suggested the importance of their role in digital media integration this data was limited and needs further exploration. The original intention was to observe the teacher and the two early years practitioners in this classroom in equal measure. However, it became clear early on that the teacher’s role as the team leader was pivotal in guiding and influencing the use of digital media in this classroom. This pivotal role was demonstrated by interviews and daily planning documents which revealed the ways she directed the early years educators and EAL teacher working in the classroom. The limitations of a study of one practitioner were also mitigated by providing an in-depth description of the intervention findings. Hence the two findings chapters: one which documents the linear process of conducting EDR and a second chapter to present a thematic analysis of the findings. This structure makes it possible to describe the context of the research and how it affected the implementation of the intervention as well as the practitioner’s on-going reaction to and reflection on the impact of the intervention on herself and on the classroom learning environment.

Design-based research is also conceptualised as on-going iterative cycles of intervention development, and scaling up research conducted on a small scale is built into these approaches to conducting research (Plomp, 2013). The expectation is that future research will build on the findings of the current research by extending the revised design principles to different classroom contexts and larger sample sizes (McKenney & Reeves, 2012). In the current research, possibilities for scaling up the findings are helped by explaining the intervention, its modifications and the classroom contexts in detail. It is up to the future user to decide how transferrable the findings may be (McKenney & Reeves, 2012).

The initial research design considered the use of video-stimulated recall (VSR) interviews. This would have provided an opportunity for the teacher to view and respond to her changing approach to interacting with technology as part of teaching and learning. This data would have provided an additional perspective on the use of
digital media and the process of critical reflection. However, time constraints meant the use of VSR was not possible. Using VSR would have meant practitioners spending time after the end of the nursery session and following discussion with practitioners it was felt that this was not possible due to the other tasks practitioners had to perform at the end of the session. In practice, the use of VSR would have meant practitioners staying after school or missing some of their lunch break. VSR would also have avoided the potential issue of memory and reflecting on teaching episodes some time after the event. However, this was mitigated by the fact that discussions with Vicky regularly took place during or immediately after the teaching and learning activities being discussed.

A further limitation of this study was the use of one video camera in a classroom with three digital media devices available for children to use; an IWB, mobile tablets and a desktop PC. This meant that it was not possible to capture all the interactions that took place and there were occasions when I was unable to record interactions that could have provided valuable data. On occasions, I was aware that I was missing the opportunity to capture valuable data as I was recording a different activity. If this study were conducted again I would consider the use of a fixed video camera positioned to record one screen plus a hand-held camera. However, the use of two cameras has to be balanced against the practicalities of analysing large amounts of video data collected during the course of a year-long intervention.

In view of the way in which this research considered children’s use of digital media as a collaborative learning process the study could have benefitted from data collected in children’s homes. This would have explored their home uses of digital media and the diverse contexts in which this took place. Research conducted in children’s homes could have provided useful data to understand children’s interactions with digital media at home and how this related to the way they used different forms of digital technology in the classroom. This could then have been included in the intervention design. Data was collected in six children’s homes but this focused on parent interviews rather than observations of children using digital media. Data collection in children’s homes to show how digital media were used was part of the original research design, but gaining access took time and interviews had to take place immediately after the morning nursery session. This meant it was not possible to observe children using digital media with family members including older and younger siblings in order to see how this might relate to their classroom use of these technologies.
This research used EDR to implement a naturalistic, classroom-based intervention with a view to finding a solution to a real-life problem: the need to understand and address the factors hindering or supporting the effective integration of digital media into early years classroom practice. The research has yielded practice-oriented findings for early years practitioners to support the integration of digital media in teaching and learning, offering a greater understanding of the barriers to digital media uptake in early years education. True integration occurred when the focus of practitioner interactions was on the ways children used digital media rather than the technology itself and when practice was congruent with the classroom learning ecology. When practitioners reconstruct beliefs about digital media they can apply their early years pedagogy to these forms of digital technology.

Not all early years practitioners have a strong belief in technology as part of their pedagogy and practice, and this study suggests that the absence of appropriate pedagogy hinders the uptake of digital media in early years classrooms. The relationship between teacher beliefs and pedagogy is complex and although there is never a perfect match between beliefs and practice there is always a relationship (Buehl & Beck, 2014). This research has shown that the epistemological beliefs of early years practitioners in relation to digital media and pedagogy are closely intertwined. Practitioner beliefs about digital media were a factor in her practice, but it was the particular relationship between beliefs about digital media and knowledge of pedagogy that were instrumental constructing the concept of digital media that mediated learning in this classroom. This research demonstrated how beliefs about digital media interacted with one practitioner’s pedagogy and beliefs about young children’s learning and hindered or encouraged learning with technology. It showed how reconstructed beliefs can mediate the construction of a classroom learning environment in which the use of diverse digital media devices supports children’s social communication and oral language development as well as the different dimensions of digital literacy.

This dissertation reports research that investigated the under-researched area of identifying effective pedagogy to integrate digital media into early years settings. It reports research that addressed practitioner beliefs about digital media and pedagogy in relation to the use of digital technologies in the early years classroom. As such, it offers a unique contribution to knowledge about teaching and learning strategies to address the contemporary, worldwide pedagogical challenges that practitioners face.
when integrating technology in the early years classroom. The study has shown how the shifting interaction between beliefs and pedagogy informed the classroom norms and discourses that were part of the classroom learning ecology. Rather than suggesting there is one ‘ideal’ pedagogical approach to achieve the integration of diverse technologies into early learning, this study has found that a core dimension of successful and enduring practice is the creation of a reflective and discursive space for teachers to reflect on how digital media can be incorporated into the existing classroom ecology for teaching and learning. This pedagogical approach is summed up by Vicky in the following reflective comment:

   Perhaps it’s also about doing direct teaching to introduce skills but once they’ve got those skills looking at how they’re using things to think about how we can develop them. Because it’s what we do isn’t it (pause) we say this child’s really interested in this (pause) they’re doing it in this way (pause) how can we extend it (pause) what can we do. (Discussion 12.2.15)

This study therefore contributes to literature on teacher beliefs by providing a nuanced understanding of the contextualised factors supporting and hindering the integration of digital media in an early years setting. It demonstrates that the socio-cultural contexts in which digital media are used define how children and practitioners engage with them. Classroom contexts are an ecology of learning constituted through interaction, beliefs, the use of artefacts and classroom discourse. On-going dialogue and reflection on developing practice and beliefs around digital media enabled changes in these factors, and had an impact on the classroom learning ecology that mediated children’s learning with digital media. The social and cultural contexts for learning with digital media that constituted the learning ecology shifted during the course of the intervention and provided new opportunities for children’s learning with diverse digital technologies. The intervention enabled Vicky to develop new beliefs, adopt new practices and reflect on her use of digital media pre- and post-intervention. The study addresses the under-researched area of the relationship between beliefs and pedagogy to integrate technology into early years settings. It contributes to knowledge about teaching and learning strategies to address the pedagogical challenges practitioners face when integrating digital technologies in the early years and how beliefs shape these practices.
References


services/research-reports/how-digital-technology-can-support-early-language-and-literacy-outcomes-early-years-settings-review-literature/


Clarke, L., & Abbott, L. (2016). Young pupils’, their teacher’s and classroom assistants’ experiences of iPads in a Northern Ireland school: “Four and five years old, who would have thought they could do that?” *British Journal of Educational Technology, 47*(6), 1051–1064.


https://doi.org/10.1207/s15430421tip3903_2


https://doi.org/10.1016/j.compedu.2012.02.001


https://doi.org/10.1080/10901027.2014.905808


https://doi.org/10.1080/03004430500131338


https://doi.org/10.1177/1468798414533560


NAEYC. (2012). *Technology and interactive media as tools in early childhood programs serving children from birth through 8*. Washington DC: National Association for the Education of Young Children & Fred Rogers Center for Early Learning and Children’s Media at St Vincent College.


https://doi.org/10.1080/03004430.2013.772991


https://doi.org/10.3102/0034654306298273


284


Appendices

Appendix 1: bibliography of all papers considered for review


Clarke, L., & Abbott, L. (2016). Young pupils’, their teacher’s and classroom assistants’ experiences of iPads in a Northern Ireland school: “Four and five years old, who would have thought they could do that?” British Journal of Educational Technology, 47(6), 1051–1064.


Donohue, Chip; Schomburg, Roberta. (2017): Technology and Interactive Media in Early Childhood Programs: What We’ve Learned from Five Years of Research. Policy and Practice. Young Children; Washington Vol. 72, Issue 4, 72-78.


Ingleby, E. (2012). "How can you survive in the world if you can't use a computer?" Exploring the vocational education and training needs of early years practitioners in England. Journal of Vocational Education & Training, 64(4), 475-490


Miller, David; Robertson, Derek; Hudson, Alison; & Shimi, Jill. (2012). Signature Pedagogy in Early Years Education: A role for COTS Game-Based Learning. Computers in the Schools ; New York Vol. 29, Issue 1-227-247.


Appendix 2: Summary of empirical research included in the review of literature

<table>
<thead>
<tr>
<th>Paper</th>
<th>Date</th>
<th>Focus of research</th>
<th>Ages and country</th>
<th>Data collected</th>
<th>Participants</th>
<th>Type of technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ljung-Djärf, A., Åberg-Bengtsson, L., &amp; Ottosson, T.</td>
<td>2005</td>
<td>Practitioner ways of relating to computers, learning environment for computer use</td>
<td>3-6 Sweden</td>
<td>Video observations of computer use, practitioner interviews</td>
<td>60 children, 9 practitioners</td>
<td>Personal computers</td>
</tr>
<tr>
<td>Plowman, L., &amp; Stephen, C.</td>
<td>2005</td>
<td>Children's use of technology, integration into free play and adult-led activities</td>
<td>3-4 Scotland</td>
<td>Video observations of computer use, practitioner interviews</td>
<td>8 nursery classrooms</td>
<td>All forms of technology</td>
</tr>
<tr>
<td>O’Hara</td>
<td>2008</td>
<td>Children’s ICT experiences and capabilities</td>
<td>3-5 UK</td>
<td>Observations and interviews with children, practitioner interviews</td>
<td>4 foundation stage classrooms</td>
<td>All forms of technology</td>
</tr>
<tr>
<td>Wood, E., Specht, J., Willoughby, T., &amp; Mueller, J.</td>
<td>2008</td>
<td>Use of technology, how it might/might not fit with existing pedagogical approach</td>
<td>2-5 England</td>
<td>Survey and focus groups</td>
<td>50 practitioners</td>
<td>Personal computers</td>
</tr>
<tr>
<td>Morgan, A.</td>
<td>2010</td>
<td>Pedagogical approaches to IWB use, how is it used as part of planned and free play</td>
<td>3-7 Wales</td>
<td>Observations and interviews</td>
<td>30 foundation stage classrooms</td>
<td>IWB</td>
</tr>
<tr>
<td>Name(s)</td>
<td>Year</td>
<td>Methodology</td>
<td>Age Range</td>
<td>Data Collection/Analysis</td>
<td>Participants</td>
<td>Technology/Tools</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>--------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Hesterman, S.</td>
<td>2011</td>
<td>Action research investigating effective pedagogy for technology use to support multiliteracies</td>
<td>4-5 Australia</td>
<td>Observations, interviews</td>
<td>2 practitioners</td>
<td>All forms of technology</td>
</tr>
<tr>
<td>Howard, J., Miles, G. E., &amp; Rees-Davies, L.</td>
<td>2012</td>
<td>How play and learning with ICT can be integrated. How children interpret adult involvement.</td>
<td>3-7 Wales</td>
<td>Teacher and child interview, classroom observations of children</td>
<td>Practitioners in 12 schools, 422 children</td>
<td>IWB, PC, laptop</td>
</tr>
<tr>
<td>Vangsnes, V., Økland, N. T. G., &amp; Krumsvik, R.</td>
<td>2012</td>
<td>The pedagogic challenges teachers face and their reaction to them when interacting with game play.</td>
<td>4-5 Norway</td>
<td>Observations of teacher interactions</td>
<td>One practitioner</td>
<td>Personal computers</td>
</tr>
<tr>
<td>Roberts-Holmes, G.</td>
<td>2013</td>
<td>Use of computers to support learning, ICT pedagogic practices teachers used</td>
<td>3-4 England</td>
<td>Observations and teacher interviews</td>
<td>150 children, four practitioners</td>
<td>Touch screen personal computers</td>
</tr>
<tr>
<td>Vangsnes, V., &amp; Økland, N. T. G.</td>
<td>2013</td>
<td>Teacher roles in children's computer game play</td>
<td>4-5 Norway</td>
<td>Video observations</td>
<td>4 practitioners</td>
<td>Personal computers</td>
</tr>
<tr>
<td>Fenty, N. S., &amp; Anderson, E. M.</td>
<td>2014</td>
<td>Practitioner knowledge, beliefs and practices</td>
<td>3-5 USA</td>
<td>Observations, interviews, survey</td>
<td>17 practitioners</td>
<td>All forms of technology, primarily IWB</td>
</tr>
<tr>
<td>Flewitt, R., Messer, D., &amp; Kucirkova, N.</td>
<td>2014</td>
<td>The potential of iPads to support early literacy learning</td>
<td>3-5 England</td>
<td>Observations of interactions, practitioner interviews</td>
<td>46 children, 6 practitioners</td>
<td>iPad</td>
</tr>
<tr>
<td>Bourbour, M., Vigmo, S., &amp;</td>
<td>2015</td>
<td>Practitioner use of</td>
<td>3-6 Sweden</td>
<td>Video observations</td>
<td>2 schools, 4 practitioners</td>
<td>IWB</td>
</tr>
<tr>
<td>Authors</td>
<td>Year</td>
<td>Research Area</td>
<td>Country</td>
<td>Participants</td>
<td>Data Collection Method</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
<td>-------------------------------------------------------------------------------</td>
<td>---------</td>
<td>--------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Samuelsson, I. P.</td>
<td>2015</td>
<td>Technology in maths learning, nature of interaction at the screen</td>
<td>Norway</td>
<td>131 practitioners</td>
<td>Practitioner interviews</td>
<td></td>
</tr>
<tr>
<td>Kerckaert, S., Vanderlinde, R., &amp; Braak, J. van.</td>
<td>2015</td>
<td>Beliefs and uses of technology, the factors influencing its use</td>
<td>Belgium</td>
<td>232 practitioners</td>
<td>Practitioner survey</td>
<td></td>
</tr>
<tr>
<td>Nikolopoulou, K., &amp; Gialamas, V.</td>
<td>2015</td>
<td>Beliefs and uses of technology</td>
<td>Greece</td>
<td>134 practitioners</td>
<td>Practitioner survey</td>
<td></td>
</tr>
<tr>
<td>Thorpe, K., Hansen, J., Danby, S., Mohamed Zaki, F., Grant, S., Houen, S., Davidson, C., Given, L. M.</td>
<td>2015</td>
<td>Beliefs and uses of technology</td>
<td>Australia</td>
<td>131 practitioners</td>
<td>Tablets, PC, laptops, IWB and TV</td>
<td></td>
</tr>
<tr>
<td>Clarke, L., &amp; Abbott, L.</td>
<td>2015</td>
<td>Evaluate the impact of iPads in maths and literacy teaching; phonics, writing and maths concepts,</td>
<td>Ireland</td>
<td>4-5 N Ireland Practitioner interviews, pupil group interviews</td>
<td>iPad</td>
<td></td>
</tr>
<tr>
<td>Yelland, N.</td>
<td>2016</td>
<td>Investigation of effective pedagogies, ways of integrating iPads into early years curricula</td>
<td>Australia</td>
<td>4-5 Australia Observations of children</td>
<td>iPad</td>
<td></td>
</tr>
<tr>
<td>Arnott, L.</td>
<td>2016</td>
<td>Impact of ecological factors on children’s experiences of digital play</td>
<td>Scotland</td>
<td>3-5 Scotland Observations, practitioner interviews</td>
<td>All forms of technology</td>
<td></td>
</tr>
<tr>
<td>Carlsen, M., Erfjord, I., Hundeland, P., &amp; Monaghan, J.</td>
<td>2016</td>
<td>roles teachers adopt at the screen for maths teaching, pedagogical uses of technology in maths teaching</td>
<td>Norway</td>
<td>4-5 Norway Observations, video stimulated practitioner reflection</td>
<td>IWB</td>
<td></td>
</tr>
<tr>
<td>Authors</td>
<td>Year</td>
<td>Title</td>
<td>Country</td>
<td>Participants</td>
<td>Methodology</td>
<td>Data Sources</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
<td>-----------------------------------------------------------------------</td>
<td>---------</td>
<td>--------------</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Edwards, S., Henderson, M., Gronn, D., Scott, A., &amp; Mirkhil, M.</td>
<td>2016</td>
<td>Understanding the influence of socio-ecological settings of home and school on technology use</td>
<td>3-6 Australia</td>
<td>6 parents, 2 practitioners</td>
<td>Participant observation sheet, photos of children, interviews</td>
<td>All forms of technology</td>
</tr>
<tr>
<td>Palaiologou, I.</td>
<td>2016</td>
<td>Dispositions towards role of technology in play-based pedagogy, intentions when using technology</td>
<td>(no data for age) Kuwait, England, Luxembourg, Greece, Malta</td>
<td>920 practitioners</td>
<td>Online survey, focus group interviews</td>
<td>All forms of technology</td>
</tr>
<tr>
<td>Bourbour, M., &amp; Masoumi, D.</td>
<td>2017</td>
<td>Practitioner views on use of IWB in maths, how they structure its use</td>
<td>3-6 Sweden</td>
<td>4 pre-school teachers</td>
<td>Observations, interviews</td>
<td>IWB</td>
</tr>
<tr>
<td>Tsumura, L., &amp; Robertson, L.</td>
<td>2017</td>
<td>action research to investigate effective practitioner integration of technology into child-centred teaching</td>
<td>5-6 Canada</td>
<td>2 kindergarten teachers</td>
<td>participant discussions and reflections</td>
<td>iPad</td>
</tr>
</tbody>
</table>
Appendix 3: Nursery medium-term planning

Nursery Medium Term Planning - Autumn 1

Ongoing throughout the settling half term –
Settle from carer with support and encouragement
New beginnings. I know I belong to my class. I know the people in my class
Use language as a powerful means of sharing feelings, experiences and thoughts
Dress with help, can usually manage the washing of hands
Dress with help, can usually manage the washing of hands

| Continuous provision- | Respond to simple instructions
Learn new words very rapidly and uses them in communication
Learn/ explore with support using the different areas and how to look after themselves |
---|---

<table>
<thead>
<tr>
<th>Week 2 8.9.14</th>
<th>Week 3 15.9.14</th>
<th>Week 4 22.9.14</th>
<th>Week 5 29.10.14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Visits /Old children</strong></td>
<td><strong>Home Visits/ Settling new children. Ourselves</strong></td>
<td><strong>Settling new children Owl babies</strong></td>
<td><strong>Settling new children Special family times So Much/ Eid celebration</strong></td>
</tr>
<tr>
<td>PSE- Can usually adapt behaviour to different events, social situations and changes in routine.</td>
<td>PSE- Shows understanding and cooperates with some boundaries and routines</td>
<td>PSE- Show affection and concern for people who are special to them (use feelings &amp; family board)</td>
<td>PSE- Confident to talk to other children when playing, and will communicate freely about own home and community</td>
</tr>
<tr>
<td>PD- Moves freely &amp; with pleasure and confidence in a range of ways</td>
<td>PD- Focus on self-care skills for new children, washing hands, using toilets, using their pegs Travel with confidence and skill around, under, over and through balancing and climbing equipment</td>
<td>PD- Uses simple tools to effect changes to material (making playdough party food, cooking)</td>
<td>PD- Uses simple tools to effect changes to material (making playdough party food, cooking)</td>
</tr>
<tr>
<td>L&amp;A Shows interest in play with sounds, songs and rhyme</td>
<td>L&amp;A- Joins in with repeated refrains and anticipates key events and phrases in rhymes and stories</td>
<td>L&amp;A- Listens to stories with increasing attention and recall</td>
<td>L&amp;A- Listens to stories with increasing attention and recall</td>
</tr>
<tr>
<td>U- Sp- Uses language as a powerful means of sharing feelings, experiences and thoughts.</td>
<td>U- Sp- Responds to simple instructions (support with makaton)</td>
<td>U- Sp- Uses vocabulary focused on objects and people that are of particular importance to them</td>
<td>U- Sp- Uses vocabulary focused on objects and people that are of particular importance to them</td>
</tr>
<tr>
<td>L- R- W-</td>
<td>L- R- W-</td>
<td>L- R-</td>
<td>L- R-</td>
</tr>
<tr>
<td>EAD- Enjoys joining in with dancing and ring games</td>
<td></td>
<td></td>
<td>EAD- Creates movement in response to music</td>
</tr>
</tbody>
</table>

---

303
- Getting to know each other (ball and parachute games)
  - Phonics: singing and rhymes

*Old children*- remembering the rules, taking on a caring role with new children.
*Remembering and talking about their holidays/summer*
*Creating a minibeast hotel for the garden*

- W-Sometimes gives meanings to marks as they draw and paint (encourage children to stick their work up throughout the setting)
  - M-Uses positional language (using the obstacle course to describe their position, game where’s teddy?)
  - UW-
  - EAD-Sings a few familiar songs. Taps out simple repeated rhythms. Begins to move rhythmically
  - Phonics: singing and rhymes

- EAD- Uses simple tools and techniques (printing-hands/feet)
  - Phonics: Listening walk
  - Key groups start- introducing the children to different areas exploring how to use them and how to look after them

- Phonics-Noisy neighbours song/activity tuning into sounds
  - Black History Month
Appendix 4: Summary of intervention phases and modifications

| Phase 1: Pre-intervention baseline - 7 Weeks (September 8, 2014-October 17, 2014) |
| --- | --- | --- |
| **Data collected and analysed** | **Findings** | **Intervention** |
| *Planning* |  |  |
| Written weekly and medium term planning | ICT not included as a section on written planning sheets | include planning for ICT as whole class sessions thinking about activities to make it more meaningful to children |
| Informal discussions with Vicky | Planned use of ICT restricted to using the whiteboard as a screen to display pictures and videos |  |
| Classroom observations of computer and non-computer activities | Planned ICT activities do not develop other areas of learning | plan for ICT use to support language and literacy |
| Interviews with Early years educators | Adults using computers with children |  |
| Observational field notes | no meaningful or relevant uses of computers to support learning | adults to use the computer with children during free-flow play |
|  | teachers don’t interact with children using the computer or collaborate with them |  |
|  | computer use directed by the teacher in whole class sessions |  |
|  | teacher uncomfortable with perceived need for direct approach when interacting with children during free flow play |  |
|  | use of computer lead by teachers beliefs as to its lack of value as a classroom resource | include time for teachers to reflect on practice as part of cycle of change |
| **Reflection** | include time for teachers to reflect on practice as part of cycle of change |  |
## Phase 2: Development - cycle 1: 13 weeks (October 27, 2014-February 13, 2015)

<table>
<thead>
<tr>
<th>Data collected and analysed</th>
<th>Findings</th>
<th>Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informal discussions with the teacher</td>
<td>teachers included section for planning on weekly planning sheet</td>
<td>continue to do this and adopt children's way of interacting with peers at the computer</td>
</tr>
<tr>
<td>Informal discussions with Huma and Vicky</td>
<td>whole class sessions used to develop skills for game operation. This encourages children to use this to 'teach' friends</td>
<td>extend to use of iPad and Our Story</td>
</tr>
<tr>
<td>Classroom observations - all activities</td>
<td>teacher planning activities that use computer for reading development (icons and symbols and game navigation) and micro aspects of reading contextualised within computer use</td>
<td>continue to do this and extend to planning for use in focus group sessions as part of freeflow</td>
</tr>
<tr>
<td>Video recordings - of use of interactive whiteboard and desktop computer</td>
<td>teacher beginning to think and plan for uses outside whole class sessions</td>
<td>intro use of iPad and Our Story app</td>
</tr>
<tr>
<td>Written weekly and half termly planning</td>
<td>activities not relevant and meaningful to children</td>
<td>extend language development through the computer, modelled on way children teach and explain to each other. Gives children the opportunity to lead learning rather than adult directing</td>
</tr>
<tr>
<td><strong>Adults using computers with children</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations of children's use showed its value for developing language as children worked collaboratively to 'teach' friends new skills and use of games</td>
<td>teacher to plan for other adults</td>
<td></td>
</tr>
<tr>
<td>Other adults not interacting with children</td>
<td>teacher beginning to use the computer during freeflow play, learning to use it with them</td>
<td>continue this and other adults to do the same</td>
</tr>
<tr>
<td>Teaching led by adult choices</td>
<td>interact during child-initiated computer use</td>
<td></td>
</tr>
<tr>
<td><strong>Teacher reflection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My presence made her use the computer even when she felt uncomfortable doing so, using and observing digital media use provided episodes for reflection</td>
<td>suggested planning together time and more discussion opportunities</td>
<td></td>
</tr>
</tbody>
</table>
She wanted a way to use computer that gave children to create their own input and language development.

**Phase 2: Development - cycle 2: 6 weeks (February 23, 2015-April 1, 2015)**

<table>
<thead>
<tr>
<th>Data collected and analysed</th>
<th>Findings</th>
<th>Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informal discussions with Huma and Vicky</td>
<td>written plans for ICT use linked to learning outcomes regularly used</td>
<td>continued use of planned whole class sessions/ no modifications suggested</td>
</tr>
<tr>
<td>Classroom observations—all activities</td>
<td>planning for groups using the iPad during freeflow play was unsuccessful</td>
<td>discontinue use of iPad in structured groups with pre decided learning intentions</td>
</tr>
<tr>
<td>Video recordings—of use of interactive whiteboard, LearnPads and desktop computer</td>
<td>whole class sessions to demo use of iPad app was successful.</td>
<td>continue to do this with all computers</td>
</tr>
</tbody>
</table>

| Written and half termly weekly planning | other adults not interacting | Vicky to plan for them using LearnPads during free-flow and with individual children |

<table>
<thead>
<tr>
<th>Interview with deputy head teacher</th>
<th>Adults using computers with children</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>intro of LearnPads and use alongside children encouraged girls use and encouraged children language interactions</td>
<td>integrate LearnPads into continuous provision one day a week, find more apps for them to use on LearnPads</td>
</tr>
<tr>
<td></td>
<td>continued use of Vicky encouraging children to teach her and other children and adopting this strategy with ipads and LearnPads</td>
<td>continue to do this</td>
</tr>
<tr>
<td></td>
<td>adults not using games spontaneously with children without pre-determined learning outcome</td>
<td>adults to 'play' alongside children</td>
</tr>
<tr>
<td></td>
<td>Teacher embraced LearnPads as they prompted valuable language by children particularly girls, also noted how more children to used them who did not use the other computers</td>
<td>include LearnPads as part of continuous provision one day a week</td>
</tr>
<tr>
<td></td>
<td></td>
<td>continue to plan discrete computer use for individual children</td>
</tr>
<tr>
<td>Data collected and analysed</td>
<td>Findings</td>
<td>Modifications</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td><strong>Planning</strong></td>
<td><strong>Findings</strong></td>
<td><strong>Modifications</strong></td>
</tr>
<tr>
<td>Informal discussions with Huma and Vicky</td>
<td>LearnPads planned as part of continuous provision planning</td>
<td>No modifications to planning</td>
</tr>
<tr>
<td>classroom observations-all activities</td>
<td>LearnPads included in written planning for individual children with named adults</td>
<td></td>
</tr>
<tr>
<td>video recordings-of use of interactive whiteboard, LearnPads and desktop computer</td>
<td>active invisible planning around whiteboard and LearnPad use with varying outcomes and adult roles</td>
<td></td>
</tr>
<tr>
<td>Audio recorded reflective conversations with Vicky</td>
<td><strong>Adults using computers with children</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Huma using LearnPads with children</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vicky using open questions with children using LearnPads, particularly by getting children to teach her</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vicky encouraging children to share skills on LearnPads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vicky using LearnPads regularly alongside children</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increasing use of skill modelling and introducing children to new programs in whole class sessions</td>
<td>greater use of this to intro new apps followed by supporting groups using them during free flow</td>
</tr>
<tr>
<td><strong>Constraints</strong></td>
<td>increasing constraints around LearnPad integration</td>
<td>more support needed based on experience of using LearnPads</td>
</tr>
</tbody>
</table>
Appendix 5: Staff and parent consent forms

Parents' consent form

Please read and sign this consent form if you are happy to take part in the research.

Title of research project: Integrating digital media into learning at school
Name of researcher: Charlotte Vidal-Hall

I have read the information letter and had the opportunity to ask any questions about the research.

I am happy for my child to take part in the research and understand that I am free to withdraw my consent at any stage. Any recorded data including my child will then be destroyed.

I understand that the data gathered in this project will be used as part of a PhD thesis.

I understand that my child may be video recorded.

I have talked to my child about the research and discussed what they will be doing.

I understand that my child's name will be not be used in any report.

Child's name

Parent's signature Date

Parent's name

Researcher's signature Date
Staff consent form

Please read and sign this consent form if you are happy to take part in the research

Title of research project: Integrating digital media into learning at school

Name of researcher: Charlotte Vidal-Hall

I have discussed the research and had the opportunity to ask questions.

I am happy to be video and audio recorded and understand that only the researcher and I will have access to the data.

I understand that the data gathered in this project will be used as part of a PhD thesis.

I understand that all data is confidential and that my name will be not be used in any report.

I consent to taking part in this research project.

Participant's signature          Date

Participant's name

Researcher's signature          Date
Appendix 6: Information letter sent to parents

Using computers to improve young children’s learning

My name is Charlotte and you may have seen me in the nursery on Friday mornings. I am conducting a research project with Ms Lake as part of my PhD at the Institute of Education. This letter is to let you know more about the research and to invite your child to be part of the project. Please take some time to read this letter carefully so that you understand what the research involves before signing the consent form to say that you are happy for your child to take part in this project.

The aim of the project is to investigate how we can use computers better in the classroom as part of children’s learning. I also know that a lot of the children are skilled at using computers and touchscreens out of school and I want to find out how we can use what they already know in the nursery. We will be using computers in different ways and for different activities to find out what works best and what the children enjoy when they use computers as part of learning to read and write. We hope that we will be able to show you what we do in the classroom so that you can help your child at home on the computer.

All the children will have an opportunity to take part in the activities and we hope they will enjoy them and develop new skills. As part of the research I will be talking to the children about the kinds of things they do on computers, iPads and touch screen phones at home and what they use the computer for at school. This will help me find out how we can improve the way we use computers in the classroom and make sure that we are using computer technology effectively in the nursery. Before I start the research I will talk to the children with Ms Lake to explain what we will be doing so that they can ask questions and decide if they want to take part.

I will be in the nursery one or two mornings a week from now until June next year to work in the classroom with the adults and children. As part of my research I will be occasionally video recording the children while they use the computer and audio recording the discussions we have. I will always ask the children if they are happy for me to video them and if they say no I will not record them. Children taking part in the research will not be recognisable on the videos and no children’s names or faces will be used in the final report. The recordings will not be available to anyone apart from myself and the nursery staff and all videos will be kept in a password protected computer stored in a secure location.

I will also let the children know they can change their mind about taking part at any time and that I will only record them if they are happy for me to do so. You can also change your mind at any point in the project and decide that you do not want your child to take part. Your child will still be able to take part in all the activities and all recordings of them will be deleted.

I hope you and your child will agree to take part in this project as I think it will be an enjoyable experience and I am looking forward to developing new ways to use computers in the nursery. Please feel free to contact me should you have any questions or concerns or if want any further information before you sign the consent form. You can contact me by email at cvidalhall@btinternet.com or speak to me at school.

Charlotte Vidal-Hall
Appendix 7: Pre-intervention questions for nursery staff

What are your views and feelings on the use of new technology in the classroom and young children's lives?
What do you see as the advantages/disadvantages of providing children with a computer and digital technologies?
What do you think 'literacy' means these days for young children?
How do you think literacy is best developed in the early years?
What is your approach to using digital texts and computer technology in literacy teaching?
How do you view your role in helping children to learn from and with new technologies in your setting?
Is there anything that may be affecting the way technology is currently used in the classroom?
Would you describe yourself as a confident computer user? How often do you use a computer, what type of technology do you use and what for?
### Appendix 8: Example of video log

| Video title and date | Learnpads 1- Suzy, Fifi, Michelle, Vicky  
March 20 2015 |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>participants</td>
<td>Vicky, Fifi, Suzy, Aryan, Michelle</td>
</tr>
<tr>
<td>activity</td>
<td>Vicky had decided to use the LearnPads for the first time in the reading area and some children have joined her</td>
</tr>
<tr>
<td>description</td>
<td>She starts by asking the children what they might need to do to get it started. Fifi and Suzy have LearnPads and as soon as Suzy finds something interesting she goes to show Fifi and Vicky encourages her to sit next to Fifi. The two girls start chatting to each other about what they are doing and the games they have found. When Fifi finds something she likes she shows Vicky. Aryan comments on something he sees that he has at home. Fifi sees something Suzy has and asks Vicky how to find it. She eventually uses a process of trial and error to find what she wants and then tells Vicky she did it. Fifi and Suzy then both have 3 pigs story and they frequently look at each other’s screens. Michelle asks how to find the counting activity Fifi had earlier and tells her when she manages to find it. As new children join she tells them how to switch on, find the home button, use different taps etc. lots of technical instructions. The children are telling each other what they have found, asking how to find things they have seen other children use, and explaining how to find things, looking to see what others have without prompting. When Fifi loads a counting app to count and find the correct numeral to match candles on a cake Vicky uses this as an opportunity the develop 1-1 corr and number recognition. She is following Fifi’s lead. Michelle gets a LearnPad and creates a group with Fifi and Suzy asking them how they found apps, what she needs to press etc. Suzy uses story language of the 3 little pigs. Felicity and Maryam are doing the same in a dyad. Vicky sees Farhad has closed the LearnPad and is not using it but is still sitting with it. Vicky asks if he wants help. She chooses a counting program. Flora and Emily and Ellie join and share with each other what they find and what they are doing sometimes copying each other.</td>
</tr>
<tr>
<td></td>
<td>Compare this with video of Fifi and Suzy outside with Vicky using <em>Our Story</em></td>
</tr>
</tbody>
</table>
| Themes               | Asking questions learning questions children sharing reading symbols  
Giving tech instructions home/school child tech learning sharing iPad children asking ICT reading child selecting  
Child scaffolding using story language children showing Trial and error |
| Episode/s for analysis | motive - subject - Tools - Outcome - |
## Appendix 9: Table of video clips transcribed for analysis

### Cycle 1

<table>
<thead>
<tr>
<th>Clip number and context</th>
<th>topic</th>
<th>theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 boys at the whiteboard</td>
<td>Using Busy Things</td>
<td>Egs of the ways children naturally use the computer in groups. Helping each other, explaining how to play a game, giving instructions.</td>
</tr>
<tr>
<td>2 Fifi and Ellie at the whiteboard</td>
<td>Using Busy Things to create a pattern</td>
<td>collaboration, exploring a new game, giving each other instructions, creating and sharing meaning</td>
</tr>
</tbody>
</table>

### Cycle 2

<table>
<thead>
<tr>
<th>Clip number and context</th>
<th>topic</th>
<th>theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Vicky and Mack mask making</td>
<td>telling him how to write his name,</td>
<td>1-1 direct teaching</td>
</tr>
<tr>
<td>2 Vicky, Cameron, Maryam</td>
<td>phonics group session, making cvc words, nonsense words</td>
<td>direct teaching</td>
</tr>
<tr>
<td>3 Huma</td>
<td>whole class phonics session with Scrap program</td>
<td>carpet session</td>
</tr>
<tr>
<td>4 Matt and Chris roly balls</td>
<td>showing Chris an ‘a’, explaining the game to me</td>
<td>children alone, teaching, language for explaining and thinking, sharing literacy knowledge</td>
</tr>
<tr>
<td>5 Cameron and Alessandro</td>
<td>Cameron showing Alessandro what to do, Alessandro learning by watching</td>
<td>Cameron showing Alessandro what to do, developing language for thinking and explaining as he demonstrates to Alessandro and answers my questions. His interest in the computer provides the motivation and he explains to me how the game works.</td>
</tr>
<tr>
<td>6 Flora and Mack</td>
<td>Jack tracing letters, Flora watching and commenting on the letters</td>
<td>Motivation of reluctant learner, Children sharing letter and phonic knowledge with adults present and each other. This was something they might do on paper when an adult was present, but less of ten than on screen</td>
</tr>
<tr>
<td>7 Whole class</td>
<td>TES session</td>
<td>Demo of new program but LI related to literacy skills, provided an opp for 1-1 with children,</td>
</tr>
<tr>
<td>8 Danny and Vicky</td>
<td>TES session</td>
<td>Following his interests, not worried about mouse, PA, child leading the activity</td>
</tr>
<tr>
<td>9 Danny and Maryam</td>
<td>TES session</td>
<td>Following Maryam interests and existing knowledge, extending it, developing word processing skills too</td>
</tr>
<tr>
<td>10 Vicky and Ellie’s Frozen pic</td>
<td>Vicky joining Ellie drawing at the computer, child-led activity</td>
<td>Used as an opp to work with a child with sp and lang delay, bilingual. Ellie could talk about her pic prompted by Vicky’s questions and Ellie’s interest in Frozen. Also an opp to extend computer skills</td>
</tr>
<tr>
<td>11 Sam and Danny</td>
<td>Together using Simple City</td>
<td>Danny explaining to Sam, Sam showing Danny. Language for explaining, sharing knowledge, Jack valuing this new knowledge and putting it into practice. Practitioners saw this for themselves and valued it,</td>
</tr>
<tr>
<td>12 Ellie, Zita</td>
<td>Using w/b to create a pattern</td>
<td>Sharing technical knowledge, giving a meaning to what they produce, creating meaning, recognising the expertise of peers,</td>
</tr>
<tr>
<td>13 Cameron, Zac, Zita, Sam</td>
<td>Jan 23</td>
<td>Using the Busy Things on the whiteboard</td>
</tr>
<tr>
<td>14 Fifi, Suzy, Vicky etc</td>
<td>Learnpads outside for language adult led activity</td>
<td>Children’s difficulty in mastering technical skills and using the app.</td>
</tr>
<tr>
<td>15 Matt, Alessandro, Vicky</td>
<td>iPad for pirate story</td>
<td>Vicky lets Matt led at times to show her and Alessandro how to make the app work. Exploring the app with the boys sometime leading. Asking for their help. Making it relevant to the children? What interested them. Letting them lead the activity sometimes</td>
</tr>
<tr>
<td>16 Vicky and girls – Fifi, Suzy and Michelle</td>
<td>First use of LearnPads</td>
<td>Jointly exploring the LearnPad, asking them what they need to do, children sharing knowledge, teaching each other. Language for explaining, extending talk opportunities, children sharing new knowledge with peers, children asking each other for help rather than the teacher. Using as an opp to extend children’s learning-maths, language for sp and l children.</td>
</tr>
<tr>
<td>17 Vicky, Ellie, Flora, Emily, Zita</td>
<td>First use of LearnPads</td>
<td>Asking each other for help, sharing knowledge and skills, Vicky asking children to explain and demonstrate, Flora’s use of adult language with peers. Discussion prompted by screen pic.</td>
</tr>
<tr>
<td>18 Emily, Flora, Ellie, Niamh</td>
<td>Using LearnPads</td>
<td>Social language, sharing their experiences, discussion of scary animals, Flora and Ellie telling Lola how to use it</td>
</tr>
<tr>
<td>19 Michelle and Fifi</td>
<td>Using my iPad</td>
<td>Taking the lead in showing me, confident, explaining how to use it,</td>
</tr>
</tbody>
</table>

**Cycle 3**

<table>
<thead>
<tr>
<th>Clip number and context</th>
<th>topic</th>
<th>theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Vicky and Zita</td>
<td>Vicky joins Zita at ActivPrimary</td>
<td>Danny giving Zita instructions what to do, telling Danny what she has drawn, Working together to create a picture with Danny making suggestions for icons to press. Exploring ActivPrimary together. Vicky intervening to show new tools.</td>
</tr>
<tr>
<td>2 Maryam and Felicity</td>
<td>Using ActivPrimary</td>
<td>Maryam passing on to Felicity knowledge given by an adult, language for communication</td>
</tr>
<tr>
<td>3 Vicky and Danny</td>
<td>Vicky joins Danny using Busy Things</td>
<td>Danny telling Vicky how to do log into Busy things. Vicky asking Danny about the game and him explaining, language for explaining, children as experts, Vicky extending his language</td>
</tr>
<tr>
<td>4 Mounir and Danny</td>
<td>Using Busy Things</td>
<td>Danny telling Mounir how to play a game, Mounir listening to him and valuing his help. Danny’s lang. for explaining, Mounir asking questions.</td>
</tr>
</tbody>
</table>
Appendix 10: Formatted weekly planning document

Ferny Croft Primary School Weekly Planning
Class: Teacher: Term: Week:

Special events:
Key vocabulary:
Maths focus:
Song(s):
Key texts:

Interventions:
<table>
<thead>
<tr>
<th></th>
<th>Beginning of the morning</th>
<th>Morning adult roles</th>
<th>End of the morning</th>
<th>Beginning of the afternoon</th>
<th>Afternoon adult roles</th>
<th>End of the afternoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Vicky, Huma, Karen</td>
<td>Vicky</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen, Vicky</td>
</tr>
<tr>
<td>Tuesday</td>
<td>Vicky, Karen, Huma</td>
<td>Vicky</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Vicky</td>
<td>Huma, Vicky</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Vicky, Huma, Karen</td>
<td>Huma</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
</tr>
<tr>
<td>PPA</td>
<td>Vicky, Huma, Karen</td>
<td>Huma</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
</tr>
<tr>
<td>Thursday</td>
<td>Vicky, Huma, Karen</td>
<td>Huma</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Vicky</td>
</tr>
<tr>
<td>Friday</td>
<td>Vicky, Huma, Karen</td>
<td>Huma, Karen</td>
<td>Huma, Karen, Vicky</td>
<td>Huma, Karen, Vicky</td>
<td>Huma, Karen</td>
<td>Huma, Vicky</td>
</tr>
</tbody>
</table>
Appendix 11: Final code book used for analysis

<table>
<thead>
<tr>
<th>First order code</th>
<th>Subcode</th>
<th>code frequency</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children and ICT</td>
<td>children-baseline</td>
<td>12</td>
<td>children using the PC and IWB pre-intervention</td>
</tr>
<tr>
<td></td>
<td>children-skills</td>
<td>21</td>
<td>children demonstrating and developing technical and operational skills and knowledge</td>
</tr>
<tr>
<td></td>
<td>children-language use</td>
<td>20</td>
<td>using the PC, IWB and tablets to develop language-speaking, listening, reasoning, explaining etc</td>
</tr>
<tr>
<td></td>
<td>children-teaching</td>
<td>16</td>
<td>children telling/showing how to operate a game or app, teaching new skills to others</td>
</tr>
<tr>
<td></td>
<td>children-freeflow</td>
<td>18</td>
<td>Practitioner references to and observations of children using digital tech without adults</td>
</tr>
<tr>
<td>Home</td>
<td>parents-home reading</td>
<td>4</td>
<td>the type of reading adults do at home</td>
</tr>
<tr>
<td></td>
<td>parents-apologising</td>
<td>3</td>
<td>for their children being allowed too much screen time</td>
</tr>
<tr>
<td></td>
<td>parents-home use</td>
<td>19</td>
<td>refs to the ways parents used digi tech</td>
</tr>
<tr>
<td></td>
<td>children-home reading</td>
<td>15</td>
<td>kind of reading children do at home</td>
</tr>
<tr>
<td></td>
<td>children-home use</td>
<td>13</td>
<td>refs to children's home use of digi tech</td>
</tr>
<tr>
<td></td>
<td>children-home toys</td>
<td>3</td>
<td>the kind of non-digital things children did at home</td>
</tr>
<tr>
<td>Constraints</td>
<td>constraint-adult skills</td>
<td>8</td>
<td>refs to lack of adult skills and knowledge, need to develop skills before use with children</td>
</tr>
<tr>
<td></td>
<td>constraint-curriculum</td>
<td>7</td>
<td>what the curriculum requires and lack of guidance</td>
</tr>
<tr>
<td></td>
<td>constraint-planning</td>
<td>7</td>
<td>need for tech use to be part of planned activities, and planned as part of an activity, need for planning for other adults</td>
</tr>
<tr>
<td></td>
<td>constraint-school</td>
<td>14</td>
<td>school requirements re use of tech, lack of ways to purchase apps etc</td>
</tr>
<tr>
<td></td>
<td>constraint-time</td>
<td>4</td>
<td>needing time to work out how to use the technology and apps and program</td>
</tr>
<tr>
<td>Constraint Category</td>
<td>Frequency</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------</td>
<td>------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>constraint-training</td>
<td>10</td>
<td>lack of training and support, training no good</td>
<td></td>
</tr>
<tr>
<td>constraint-technical</td>
<td>5</td>
<td>technical problems with digi tech</td>
<td></td>
</tr>
<tr>
<td>constraint-operational</td>
<td>27</td>
<td>limitations of the tech and software for what teachers wanted to do</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ICT beliefs pre-intervention</th>
<th>88</th>
<th>staff beliefs about digi tech in the nursery before the intervention and how they used it in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>desires</td>
<td>14</td>
<td>how she wants to use ICT, how it could be used effectively in the classroom</td>
</tr>
<tr>
<td>interaction</td>
<td>1</td>
<td>ICT used as a way to interact with and target particular children.</td>
</tr>
<tr>
<td>mark making</td>
<td>1</td>
<td>to encourage otherwise reluctant children to mark make using ICT</td>
</tr>
<tr>
<td>mouse</td>
<td>11</td>
<td>need for children to develop mouse control for reception class</td>
</tr>
<tr>
<td>ICT teaching beliefs</td>
<td>9</td>
<td>what she believed teaching needed to be like for ICT</td>
</tr>
<tr>
<td>ICT teaching use</td>
<td>20</td>
<td>ways in which computers were used in the class for teaching</td>
</tr>
<tr>
<td>parents-ICT beliefs</td>
<td>27</td>
<td>views on the use of computers in schools</td>
</tr>
<tr>
<td>Huma-ICT beliefs</td>
<td>5</td>
<td>beliefs about use of and place for computers in school</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Literacy beliefs</th>
<th>69</th>
<th>beliefs about teaching and learning of early literacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>language</td>
<td>17</td>
<td>importance of developing language in the nursery, language for thinking, language for explaining etc</td>
</tr>
<tr>
<td>language in literacy</td>
<td>8</td>
<td>the importance of language including speaking and listening in early reading and writing development and talking about what they do in correct sequence, explaining, thinking, telling stories</td>
</tr>
<tr>
<td>phonics</td>
<td>24</td>
<td>use of phonics and teaching phonics and PA as part of reading development, reading symbols and signs. linking sounds to symbols, views on phonics teaching</td>
</tr>
<tr>
<td>sequencing</td>
<td>2</td>
<td>activities and events as part of literacy development</td>
</tr>
<tr>
<td>understanding</td>
<td>2</td>
<td>the ability to read and understand not just words, making sense of what children see from pictures, symbols, signs etc</td>
</tr>
<tr>
<td>parents-literacy beliefs</td>
<td></td>
<td>what they know of how children learn to read and what reading consists of</td>
</tr>
<tr>
<td>children reading</td>
<td>16</td>
<td>children’s views on what they think reading and being a reader involves, children reading and responding to books</td>
</tr>
<tr>
<td>Practice beliefs</td>
<td>37</td>
<td>Practitioner beliefs about what constitutes good EY practice, own pedagogy and beliefs and approaches to teaching</td>
</tr>
<tr>
<td>-----------------</td>
<td>----</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>beliefs-adult-led</td>
<td>2</td>
<td>Adult-led and initiated activities</td>
</tr>
<tr>
<td>beliefs-adult role</td>
<td>10</td>
<td>adults role in teaching- implicit pedagogy and effect on learning-making resources available, attitudes, guiding not directing children, modelling</td>
</tr>
<tr>
<td>beliefs-child led</td>
<td>18</td>
<td>free flow nursery with adults extending children through their interactions and providing activities and experiences related to their interests, children’s deep engagement</td>
</tr>
<tr>
<td>beliefs-direct teaching</td>
<td>3</td>
<td>need to directly teach skills and language</td>
</tr>
<tr>
<td>beliefs-planning</td>
<td>1</td>
<td>type of planning used in the nursery</td>
</tr>
<tr>
<td>beliefs-planning</td>
<td>3</td>
<td>whole class teaching and carpet sessions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching-non tech</th>
<th>48</th>
<th>different types of teaching used in the class not using computers</th>
</tr>
</thead>
<tbody>
<tr>
<td>adult-non tech</td>
<td>7</td>
<td>during freeflow play session adult led and chosen activities, directing children to an activity</td>
</tr>
<tr>
<td>carpet-non tech</td>
<td>10</td>
<td>adult led whole class and small group sessions during am and pm carpet times</td>
</tr>
<tr>
<td>child led-non tech</td>
<td>3</td>
<td>child chosen activity with no adult intervention, children playing together in groups</td>
</tr>
<tr>
<td>child led+adult-non tech</td>
<td>4</td>
<td>child led activities with adults interacting with child</td>
</tr>
<tr>
<td>literacy-non tech</td>
<td>21</td>
<td>non phonics-based approaches to teaching of reading and writing in the class, and oral language teaching</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value of computers</th>
<th>96</th>
<th>the value of computers in the class for teaching and learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>rationale</td>
<td>10</td>
<td>how tech used could fit with EY practice and be a valued part of it and finding a way to make it work for her</td>
</tr>
<tr>
<td>value-active</td>
<td>1</td>
<td>recognising the computer as active learning, not children passively sitting watching</td>
</tr>
<tr>
<td>value-adults</td>
<td>3</td>
<td>value for adults use in the class ie for assessment, recording observation</td>
</tr>
<tr>
<td>value-language</td>
<td>31</td>
<td>computers as a tool to develop language</td>
</tr>
<tr>
<td>value-learning</td>
<td>14</td>
<td>comments on the use of tech in relation to children’s learning other than skills ie mouse control. The value Vicky attached to it for teaching and children’s learning and outcomes</td>
</tr>
<tr>
<td>value-motivation</td>
<td>5</td>
<td>how the computer could encourage and motivate reluctant learners</td>
</tr>
<tr>
<td>value-social</td>
<td>22</td>
<td>the value of computers for social learning, groups working together</td>
</tr>
<tr>
<td>value-tool</td>
<td>10</td>
<td>refs to its use as a tool for learning</td>
</tr>
<tr>
<td>Teaching-tech</td>
<td>176</td>
<td>approaches to teaching using computers</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>adult-tech</td>
<td>25</td>
<td>adults leading an activity with ICT, directing children to the computer</td>
</tr>
<tr>
<td>carpet-tech</td>
<td>22</td>
<td>whole class sessions using computers</td>
</tr>
<tr>
<td>child led+adult-tech</td>
<td>40</td>
<td>children and adults working together at the computer, extending children, types of interaction</td>
</tr>
<tr>
<td>physical planning-tech</td>
<td>34</td>
<td>computer use being included on planning sheets, planned teaching using computers</td>
</tr>
<tr>
<td>metaphorical planning-tech</td>
<td>19</td>
<td>way teachers thought about tech during teaching, ‘following’ children, extending them at the computer</td>
</tr>
<tr>
<td>practical-tech</td>
<td>7</td>
<td>tech used for printing, internet searching, emailing, typing etc</td>
</tr>
<tr>
<td>restricting-tech</td>
<td>3</td>
<td>making sure children do not spend too much time on the computer in the classroom</td>
</tr>
<tr>
<td>teaching skills-tech</td>
<td>17</td>
<td>introducing children to new program, aspects of familiar programs, technical and operational skills</td>
</tr>
<tr>
<td>Huma-ICT use</td>
<td>8</td>
<td>Huma’s use of computers in the nursery</td>
</tr>
<tr>
<td>freeflow adult group</td>
<td>3</td>
<td>adult led groups during freeflow sessions</td>
</tr>
<tr>
<td>Reflection</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Vicky</td>
<td>31</td>
<td>reflection on what she saw happening, on her practice with ICT, on what she could do with the tech, on and in practice, importance of reflection</td>
</tr>
<tr>
<td>me</td>
<td>28</td>
<td>on the intervention: its progress and modifications, my role in the class, use of ICT in class</td>
</tr>
<tr>
<td>Huma</td>
<td>15</td>
<td>codes relating to other practitioners in the class</td>
</tr>
<tr>
<td>Huma-home use</td>
<td>1</td>
<td>how she uses computers at home</td>
</tr>
<tr>
<td>Huma-background</td>
<td>1</td>
<td>teaching experience</td>
</tr>
<tr>
<td>Huma-ICT beliefs</td>
<td>5</td>
<td>Beliefs about ICT at home and school</td>
</tr>
<tr>
<td>Huma-ICT use</td>
<td>8</td>
<td>Her use of ICT in the classroom</td>
</tr>
<tr>
<td>Ungrouped codes</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>assessment</td>
<td>11</td>
<td>the role assessment played in the classroom, assessment requirements</td>
</tr>
<tr>
<td>Hudl use</td>
<td>2</td>
<td>codes relating to the use of Hudls the classroom by practitioners</td>
</tr>
<tr>
<td>me intervening</td>
<td>6</td>
<td>me working with children at the computer</td>
</tr>
<tr>
<td>Children</td>
<td>199 codes related to individual children and case study* children</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Aaron</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Mounir</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><em>Alessandro</em></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Felicity*</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Zarina</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><em>Chris</em></td>
<td>29</td>
<td></td>
</tr>
<tr>
<td><em>Flora</em></td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Danny*</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Niamh</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td><em>Michelle</em></td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Maryam*</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 12: Development of codes and sub codes for different stages of analysis

<table>
<thead>
<tr>
<th>Baseline codes</th>
<th>Cycles 1-3 codes</th>
<th>Retrospective codes</th>
<th>Final codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plans</td>
<td>Intervention</td>
<td>Planning types</td>
<td>Merged into</td>
</tr>
<tr>
<td>ICT reading</td>
<td>Development</td>
<td>ICT</td>
<td>Teaching with ICT</td>
</tr>
<tr>
<td></td>
<td>Interaction</td>
<td>active</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mobile tech</td>
<td>visible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Models</td>
<td>invisible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My role</td>
<td>Non ICT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>planning</td>
<td>invisible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>visible</td>
<td></td>
</tr>
<tr>
<td>Constraints</td>
<td>Constraints/</td>
<td>Constraints</td>
<td>Constraints</td>
</tr>
<tr>
<td>technical</td>
<td>encouragements</td>
<td>Adults</td>
<td>Adult skills</td>
</tr>
<tr>
<td></td>
<td>Adults</td>
<td>Assessment</td>
<td>Curriculum</td>
</tr>
<tr>
<td></td>
<td>Technical</td>
<td>Curriculum</td>
<td>Planning</td>
</tr>
<tr>
<td></td>
<td>Motivation</td>
<td>Planning</td>
<td>School</td>
</tr>
<tr>
<td></td>
<td>mouse</td>
<td>School</td>
<td>Time</td>
</tr>
<tr>
<td></td>
<td>training</td>
<td>Technical</td>
<td>Training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Training</td>
<td>Technical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type of ICT</td>
<td>Operational</td>
</tr>
<tr>
<td>Models of</td>
<td>Models of</td>
<td>Developed into</td>
<td></td>
</tr>
<tr>
<td>learning</td>
<td>learning</td>
<td>Teaching non tech</td>
<td></td>
</tr>
<tr>
<td>Adult-led</td>
<td>Adult-led</td>
<td>Teaching with non tech, Teaching with ICT, Practice beliefs, Children and ICT</td>
<td></td>
</tr>
<tr>
<td>Whole class</td>
<td>Whole class</td>
<td>ICT</td>
<td></td>
</tr>
<tr>
<td>1-1</td>
<td>1-1</td>
<td>Practice beliefs</td>
<td></td>
</tr>
<tr>
<td>Children alone</td>
<td>Children alone</td>
<td>Children and ICT</td>
<td></td>
</tr>
<tr>
<td>Free flow</td>
<td>Free flow</td>
<td>Children and ICT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With me</td>
<td>Children and ICT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-teaching</td>
<td>Children and ICT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td>Children and ICT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>children</td>
<td>Children and ICT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>language</td>
<td>Children and ICT</td>
<td></td>
</tr>
<tr>
<td>Teaching non tech</td>
<td>Adult</td>
<td>Adult</td>
<td>Adult tech</td>
</tr>
<tr>
<td></td>
<td>Carpet</td>
<td>Carpet</td>
<td>Child-led</td>
</tr>
<tr>
<td></td>
<td>Child-led + adult</td>
<td>Child-led + adult</td>
<td>Child-led</td>
</tr>
<tr>
<td></td>
<td>Child-led</td>
<td>Child-led</td>
<td>Teaching literacy</td>
</tr>
<tr>
<td>Teaching with ICT</td>
<td>Adult</td>
<td>Adult</td>
<td>Teaching literacy</td>
</tr>
<tr>
<td></td>
<td>carpet</td>
<td>Carpet</td>
<td>Child-led</td>
</tr>
<tr>
<td></td>
<td>Child-led + adult</td>
<td>Child-led + adult</td>
<td>Child-led</td>
</tr>
<tr>
<td></td>
<td>Free-flow adult led</td>
<td>Free flow adult group</td>
<td>Teaching literacy</td>
</tr>
<tr>
<td></td>
<td>Teaching skills</td>
<td>Teaching skills</td>
<td>Metaphorical</td>
</tr>
<tr>
<td></td>
<td>Metaphorical planning</td>
<td>planning</td>
<td>planning</td>
</tr>
<tr>
<td></td>
<td>Physical planning</td>
<td>Physical planning</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>Practical</td>
<td>Restricting</td>
</tr>
<tr>
<td></td>
<td>Restricting</td>
<td>Restricting</td>
<td></td>
</tr>
<tr>
<td>Practice beliefs</td>
<td>Practice beliefs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult-led</td>
<td>Adult-led</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult role</td>
<td>Adult-role</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child-led</td>
<td>Child-led</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct teaching</td>
<td>Direct teaching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>Planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class</td>
<td>Whole class</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ICT beliefs pre-intervention</th>
<th>ICT beliefs pre-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desires</td>
<td>Desires</td>
</tr>
<tr>
<td>ICT teaching beliefs</td>
<td>ICT teaching beliefs</td>
</tr>
<tr>
<td>ICT teaching use</td>
<td>ICT teaching use</td>
</tr>
<tr>
<td>Interaction</td>
<td>Interaction</td>
</tr>
<tr>
<td>Mark making</td>
<td>Mark-making</td>
</tr>
<tr>
<td>Mouse</td>
<td>Mouse</td>
</tr>
<tr>
<td>value</td>
<td>Value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value of tech</th>
<th>Value of tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale</td>
<td>Rationale</td>
</tr>
<tr>
<td>Active learning</td>
<td>Active learning</td>
</tr>
<tr>
<td>Adults</td>
<td>Adults</td>
</tr>
<tr>
<td>Language</td>
<td>Language</td>
</tr>
<tr>
<td>Learning</td>
<td>Learning</td>
</tr>
<tr>
<td>Motivation</td>
<td>Motivation</td>
</tr>
<tr>
<td>Social tool</td>
<td>Social tool</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Children and ICT</th>
<th>Children and ICT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Baseline</td>
</tr>
<tr>
<td>Skills</td>
<td>Skills</td>
</tr>
<tr>
<td>Language use</td>
<td>Language use</td>
</tr>
<tr>
<td>Teaching</td>
<td>Teaching</td>
</tr>
<tr>
<td>Free flow</td>
<td>Free flow</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Home</th>
<th>Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home reading</td>
<td>Home reading</td>
</tr>
<tr>
<td>Apologising</td>
<td>Apologising</td>
</tr>
<tr>
<td>Home use</td>
<td>Home use</td>
</tr>
<tr>
<td>Home toys</td>
<td>Home toys</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reflection</th>
<th>Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>ICT</td>
</tr>
<tr>
<td>Language</td>
<td>Language</td>
</tr>
<tr>
<td>Models of teaching</td>
<td>Models of teaching</td>
</tr>
<tr>
<td>Models/ICT</td>
<td>Models/ICT</td>
</tr>
<tr>
<td>Pedagogy reflection</td>
<td>Pedagogy</td>
</tr>
<tr>
<td>Planning</td>
<td>Planning</td>
</tr>
<tr>
<td>Reflection value</td>
<td>Reflection value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reflection</th>
<th>Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vicky</td>
<td>Vicky</td>
</tr>
<tr>
<td>Me</td>
<td>me</td>
</tr>
</tbody>
</table>

*Other codes moved into Practice beliefs, ICT beliefs pre-intervention, value and Literacy beliefs, Teaching with ICT*
<table>
<thead>
<tr>
<th>Reading</th>
<th>Reading</th>
<th>Developed into codes for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>Adult</td>
<td>Language, Teaching</td>
</tr>
<tr>
<td>Adult/ict</td>
<td>Adult/ict</td>
<td>non tech and Teaching</td>
</tr>
<tr>
<td>Adult/language</td>
<td>Adult/language</td>
<td>with ICT</td>
</tr>
<tr>
<td>Child</td>
<td>Child</td>
<td>Language in literacy</td>
</tr>
<tr>
<td>Child/phonics</td>
<td>Child/phonics</td>
<td>Phonics</td>
</tr>
<tr>
<td>Child/screen</td>
<td>Child/screen</td>
<td>Reading</td>
</tr>
<tr>
<td>Teach</td>
<td>Teach</td>
<td>Sequencing</td>
</tr>
<tr>
<td>Teach/phonics</td>
<td>Teach/phonics</td>
<td>understanding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Misc</th>
<th>Ungrouped codes</th>
<th>Ungrouped codes</th>
<th>Ungrouped codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Busy things</td>
<td>Writing</td>
<td>Hudl</td>
<td>Assessment</td>
</tr>
<tr>
<td>Curr.</td>
<td>Busy Things</td>
<td>Me intervening</td>
<td>Hudl</td>
</tr>
<tr>
<td>Gender use</td>
<td>Curriculum</td>
<td></td>
<td>Me intervening</td>
</tr>
<tr>
<td>Intervention</td>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ipads</td>
<td>iPads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My role</td>
<td>my role</td>
<td></td>
<td></td>
</tr>
<tr>
<td>training</td>
<td>individual children</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remaining codes deleted or merged</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 13: Intervention diary extracts referring to reasons for intervention developments

January 18 2015
Does the video show that perhaps the teacher's role is more of a facilitator and there to intervene when children show signs of needing help rather than intervening from the outset. Need to consider this as a change to the intervention.

Should we let the computer have a greater role in mediating particularly when groups of children are working together cooperatively and scaffolding each other through existing knowledge and the use of the symbols on screen. This may well depend on the programmes and apps used. Is the use of tech more effective when children have a shared object and the teacher understands it and works towards the shared object and skilfully introducing new knowledge when she realises the children cannot themselves solve a problem. Need to check for evidence of this in activities with and without tech. ie do we need to intervene less but still be present to extend children when necessary.

February 3 2015
As a result of talking to her and observing children and adults using the computer the design principles that guide the intervention may have to be changed slightly. Children working together at the computer seem to be more happy to give and receive direction from each other in a way that I am not sure happens in other free flow play activities. They share their existing knowledge with others and those controlling the mouse or whiteboard pen are often willing to accept their suggestions. Even when those observing the action do not have prior experience or knowledge those controlling the screen will accept others' suggestions when they themselves do not know what to do or their actions do not produce the results wanted or expected. Are the children deciding what they consider to be valid knowledge. They are able to decide for themselves based on their understanding of how they think the game works. Could consider this as an approach for adults to follow in the way children support each other and adapt the intervention accordingly.

February 24 2015
This makes it possible to use the way Vicky has incorporated ICT in to planning as a pilot of the whole idea of using a planning approach. It has been successful in that she quickly adopted the idea of planning for ICT in her weekly and medium term plans even though I only suggested this in an informal discussion with her. It suggests that this is an easy and appropriate way forward for teachers as planning is part of their regular teaching and learning and therefore does not require any additional work, it also shows that when Vicky planned for ICT with learning intentions it happened. As a result of using ICT teachers then began to change their views on computers in the nursery as a result of seeing the learning that happened. So planning as the intervention is successful as a starting point.
However, there were obvious limitations and the intervention needs to be revised in the light of these.
- Only teacher is using computers with children. Need to include EYEs
- Computer so far only used with whole class and one-to-one. Needs to be group, collaborative use
- Still related to LIs from the EYFS rather than children’s interests and activities meaningful to them
- Need more instruction of skills if computers are to become more child initiated activity and if they are to use them for more open ended activities ie not games
- no spontaneous use of teacher computer use all related to existing learning intentions/planning even when original planning did not include ICT ie story telling in 1st term. Computers therefore not used as part of other activities

Adaptations to the intervention
- Intro support of researcher at planning phase and use of a planning framework that allows teacher to consider and address how ICT is used in the classroom related to theory.
  (see intervention notes)
- more group use of ICT
- find ways to support EYE use of ICT, maybe through use of researcher support and time for reflection and Vicky planning for them initially
- intro use of LearnPad (part of a school initiative) and teach skills to use particular programmes as a group activity
- continued use of newly introduced computer activities ie children drawing stories using ActivPrimary, TES sequencing and writing activity. This should allow children to become more familiar with activities having done them with adults so that they may then use them in groups with other children and scaffold their learning.

March 17 2015
Could the intervention focus on the researcher as a resource that is the change that is being introduced in to the classroom. (see Raval, MKenney and Pieters 2014). After a meeting with Dom it seems that the intervention could be the presence of a researcher who provides technical knowledge and advice, a space for reflection and well as the impetus for change and the ability to jointly problem solve. The change in the intervention is a more strategic role and more strategic planning following discussion of what the objective is using computers, what the children will be doing and the adults role as well as discussion of what went well and what didn’t as well as next steps.

March 27 2015
Talked to Vicky about where we go next. She wants to persevere with Our story and build on the social aspects of the computer particularly the learnpads. Therefore she will try and get more stories on the learnpads and also our story on the learnpads. She also says that as the learnpads are a shared resources it would be best to book them out on a regular day each week.
Therefore the change to the intervention will be the introduction of learnpads regularly with more stories for the children to share in groups regularly and extend to use of Our
Story so that children can get better at using it themselves and explore what it can do with the support of an adult or other children.

April 26 2015
One of the things that analysis of the first phase has shown is that the initial design principles were probably not very relevant in some cases. In that sense the first phase has been instrumental in understanding the nature of the problem in order to better develop the initial design principles and adapt the intervention. This is reflected in the literature review that notes the lack of EY pedagogy surrounding the use of ICT in classrooms. Given the lack of this the design principles were largely derived from literature and theory relating to EY pedagogy in general particularly that related to reading, while those related to ICT were derived from studies of primary ICT use. While some of these were relevant to the initial design others were less so. Hence the need to have a longer first intervention and develop the second intervention after a fairly detailed analysis of the data. I also drew more on my own experience as an EY teacher as well as that of Vicky in order to develop the initial design principles and a working hypothesis as to what may be needed. I.e. the suspicion that there needed to be some direct teaching of ICT skills.

Need to decide which were relevant and which less so. Planning with use of LIs particularly seems to be a problem area. It works for whole class modelling and maybe for 1-1 ICT use. But not for small groups as seems to reduce spontaneity.
## Appendix 14: Date and type of digital media use referred to in weekly planning documents for 2014/2015

<table>
<thead>
<tr>
<th>Term week and date</th>
<th>Description of activity on weekly planning documents</th>
<th>Type of use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline phase: Autumn term 2014</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 2</strong>&lt;br&gt;Sept 10 (six children)</td>
<td>Vicky - Introduce new coding program on the whiteboard, explore how to use this program with the children&lt;br&gt;LI Understand how to use the new program first steps in simple coding, Turn taking and problem solving</td>
<td>Interactive¹ (non game)</td>
</tr>
<tr>
<td><strong>Week 4</strong>&lt;br&gt;Sept 19</td>
<td>LI: identify numeral to 10, order numerals to 10/5&lt;br&gt;Sing 10 little owls using the whiteboard/or puppets</td>
<td>Static²</td>
</tr>
<tr>
<td><strong>Week 4</strong>&lt;br&gt;Sept 24</td>
<td>Feelings photos on the IWB for children to identify</td>
<td>static</td>
</tr>
<tr>
<td><strong>Week 5</strong>&lt;br&gt;Sept 29</td>
<td>Show-Learn about Shapes with Shawn's Roller Coaster Adventure YouTube cartoon with 3D and 2D shapes&lt;br&gt;LI: Begin to identify and use some 2D &amp; 3D shape names</td>
<td>static</td>
</tr>
<tr>
<td><strong>Week 5</strong>&lt;br&gt;Oct 3 (Friday)</td>
<td>Simple City recycling program - get children to name real objects, sort into recycling bags. Show this on the board&lt;br&gt;LI: begin to identify materials, make the connection between items in the game and real life items</td>
<td>Interactive (game)</td>
</tr>
<tr>
<td><strong>Week 8</strong>&lt;br&gt;Oct 20</td>
<td>Whole class-Cbeebies Divali story&lt;br&gt;LI enjoy a significant story from another culture told in a different way. Begin to understand that we can read, tell, act out stories in different ways</td>
<td>Static</td>
</tr>
<tr>
<td>Oct 23</td>
<td>Show the children how they can use the program on the whiteboard to make Rangoli patterns. LI Developing vocabulary 'pattern' begin identify simple patterns.</td>
<td>Interactive (game)</td>
</tr>
</tbody>
</table>
**Cycle 1: Autumn term**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Activity</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 9</strong></td>
<td>Nov 3</td>
<td><strong>Space created for ICT on weekly overview planning sheet</strong>&lt;br&gt;Whole class—Show images of different houses/homes on the whiteboard. LI Opportunities for talking. Show an interest in how other people live, begin to understand the differences and similarities between us.</td>
<td>static</td>
</tr>
<tr>
<td><strong>Week 10</strong></td>
<td>Nov 11</td>
<td><strong>ICT on weekly overview: Busy Things - creating firework pictures</strong>&lt;br&gt;Show the children clip on whiteboard of a firework display. <strong>split into 3 groups</strong>&lt;br&gt;Invite the children to talk about whether they have seen fireworks. Explore using our bodies. Starting off small and shoot upwards, spin around, explode, use our voices to create firework sounds to support the movement. Explore making and playing with sounds and words. Develop positional and directional vocab—spin, turn, up, down, side to side, small, big, bigger. Use bodies &amp; movement to represent an experience.</td>
<td>Static</td>
</tr>
<tr>
<td><strong>Nov 12</strong></td>
<td></td>
<td>Busy Things program—show how to use pen tool to make firework image move. LI :to learn how to use a new program, use directional vocab</td>
<td>Interactive game</td>
</tr>
<tr>
<td><strong>Week 11</strong></td>
<td>Nov 19</td>
<td><strong>Karen - small group using Education City-Bottle Alley</strong>&lt;br&gt;LI - begin to Count and match quantity to numerals</td>
<td>Interactive game—adult-initiated group</td>
</tr>
<tr>
<td></td>
<td>Nov 19</td>
<td><strong>Huma small group - Espresso- Know the number 0-5</strong>&lt;br&gt;Say the number the children have to tap on 0 grow the flower the children then take turns to find the number you have said&lt;br&gt;LI begin to identify numerals 0-5</td>
<td>Interactive game—adult-initiated group</td>
</tr>
<tr>
<td></td>
<td>Nov 28</td>
<td>Vicky whole class&lt;br&gt;Prompt children to recall main characters from gingerbread man.</td>
<td>static</td>
</tr>
<tr>
<td></td>
<td>(Friday)</td>
<td>Show children a range of images on the whiteboard&lt;br&gt;Writing our own version of the gingerbread man on paper&lt;br&gt;Choosing from a range of images on the board to create our own version of the story. LI begin to be aware of story structure, can recall main characters &amp; events.</td>
<td></td>
</tr>
<tr>
<td><strong>Week 12</strong></td>
<td>Dec 1</td>
<td><strong>Show children a circus clip, to get vocab before new book about circuses</strong>&lt;br&gt;Espresso flat shapes in the supermarket video</td>
<td>Static</td>
</tr>
<tr>
<td></td>
<td>Dec 2</td>
<td>Pull out shapes from the junk modelling. Can we name the shapes&lt;br&gt;Offer the children familiar objects can we name the shapes&lt;br&gt;LI begin to use names for 3D shapes</td>
<td>Static</td>
</tr>
<tr>
<td></td>
<td>Dec 5</td>
<td>Annotated plan—whiteboard planned for use with a group of children for gross motor and letter formation&lt;br&gt;Planned for whole class session to intro pics of link school and make a Christmassy pic on the whiteboard to send to the Ethiopian children</td>
<td>Interactive group non game</td>
</tr>
<tr>
<td><strong>Week 13</strong></td>
<td>Dec 8-12</td>
<td><strong>ICT on weekly overview: Busy Things -alphabet forming letters</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Week 14</strong></td>
<td>Dec 8</td>
<td>YouTube Cbeebies clip for , , and in small group to intro post box, postman, letters etc re sending letters and cards</td>
<td>Static</td>
</tr>
<tr>
<td><strong>Week 14</strong></td>
<td>Dec 11</td>
<td>Karen &amp; Farah with -Busy Things</td>
<td>Interactive game</td>
</tr>
</tbody>
</table>

19 Handwritten annotations and/or changes to planning made by Vicky during the week.
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 14</td>
<td>11.12.14</td>
<td>Model decorating the Christmas tree, show children how to tap &amp; drag. Show children how to use this program, save &amp; print off the results.</td>
<td>Interactive non game adult initiated group</td>
</tr>
<tr>
<td>Week 15</td>
<td>Dec 15-19</td>
<td>ICT on weekly overview: Busy Things</td>
<td>Static</td>
</tr>
<tr>
<td>Spring term</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 2</td>
<td>Jan 14</td>
<td>ICT on weekly overview: TES iboard: my day sequencing activity</td>
<td>Static</td>
</tr>
<tr>
<td>Week 2</td>
<td>Jan 15</td>
<td>LI begin to sequence events in their day. TES activity to sequence pictures and add words to describe them. Understand how they can navigate through a simple program on the whiteboard using the pen. Show an interest in print Targets [ , ] 1:1 for this with her</td>
<td>Interactive non game</td>
</tr>
<tr>
<td>Week 3-22.1.15</td>
<td></td>
<td>YouTube boogie beebies video</td>
<td>Static</td>
</tr>
<tr>
<td>Week 3</td>
<td>Jan 20</td>
<td>Would you eat it if we gave you… encourage the children to come up with daft ideas in line with the humour of the story. Scribe the children’s ideas on the board LI enjoy a funny story. begin to understand that they can use their own ideas to add to or create their own stories</td>
<td>Interactive non game adult-initiated group</td>
</tr>
<tr>
<td>Week 3-23.1.15</td>
<td></td>
<td>Annotated plan Vicky had added the use of Busy Things maths game for identifying numbers and matching to a number of objects</td>
<td>Interactive game</td>
</tr>
<tr>
<td>Week 4</td>
<td>Jan 26-30</td>
<td>Vicky small group Whiteboard Counting song Old Mr Fox came strolling along Use the whiteboard to support with visuals, plastic ducks and numerals and a fox puppet</td>
<td>Display</td>
</tr>
<tr>
<td>Week 5</td>
<td>Feb 2-6</td>
<td>ICT on weekly overview: Introduce programs on TES iPlayer- music composition</td>
<td></td>
</tr>
<tr>
<td>2.2.15</td>
<td></td>
<td>Student teacher planned in to work with individual children with maths counting game on Busy Things. Children who needed extra support to meet expected outcomes [ , , ] ff 3 adult-initiated game</td>
<td></td>
</tr>
<tr>
<td>Week 6</td>
<td>9.2.15</td>
<td>Karen Targeted use for maths game and mark making with boys who did not do this much</td>
<td>ff adult-initiated game</td>
</tr>
<tr>
<td>12.2.15</td>
<td></td>
<td>Karen using Flipchart software with small group as aid to counting activity. Writing numerals under a group of objects LI count to 5, identify numerals to 5, understand quantity get less when we take something away</td>
<td>ff adult-initiated non game</td>
</tr>
<tr>
<td>13.2.15</td>
<td></td>
<td>Showing pattern video</td>
<td>Static</td>
</tr>
<tr>
<td>Week 7-24.2.15</td>
<td>Karen using whiteboard to create pics related to <em>Magic Brush</em> book on the whiteboard, encourage children to create stories around the pic and scribe them on paper</td>
<td>Ff adult-initiated Interactive non game</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------</td>
<td></td>
</tr>
<tr>
<td>Week 7-Feb 25</td>
<td>Annotated plan - Karen to use Busy Things maths activity. LI - listen and understand instructions targets one child for this pm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 7-Feb 26</td>
<td>3 maths groups with Karen on the whiteboard with busy things. 1-1 correspondence and numeral recognition. Karen small group Whiteboard-Busy things Feed the monkey LI Developing correspondence &amp; numeral identification -10</td>
<td>Interactive game group</td>
<td></td>
</tr>
<tr>
<td>Week 8 March 2-6</td>
<td><strong>ICT on weekly overview</strong> - Intervention with iPad for sp and lang children</td>
<td>Overview</td>
<td></td>
</tr>
<tr>
<td>March 6 (Friday)</td>
<td>Vicky iPad – Our Story  with</td>
<td>Ff interactive non game</td>
<td></td>
</tr>
<tr>
<td>Week 8-March 3</td>
<td>PPT version of <em>Bear Hunt</em> story at group session. LI Identify the same structure as bear hunt and Lion hunt. LI - Enjoy a new version of a familiar story. Begin to understand that they can change stories</td>
<td>display</td>
<td></td>
</tr>
<tr>
<td>Week 9 March 9-13</td>
<td><strong>ICT on weekly overview</strong>: Trialling app Our Story on an iPad Interventions for named SEN language children- iPad- my story</td>
<td>Overview - Ff non game</td>
<td></td>
</tr>
<tr>
<td>Week 9-9.3.15</td>
<td>Child-led writing on the whiteboard. Writing and blending sounds into simple cvc words</td>
<td>Interactive group non game</td>
<td></td>
</tr>
<tr>
<td>Week 10 March 16-20</td>
<td><strong>ICT on weekly overview</strong>: Trialling app Our Story on an iPad Individual interventions for named children</td>
<td>Overview- Ff non game</td>
<td></td>
</tr>
<tr>
<td>Week 10-18.3.15</td>
<td>Modelling use of Our Story on whiteboard, support children in creating a story with prepared pics. Ask if they want to record or write words. LI begin to understand how we can use Our Story. Understand they can take a photo and add their own words verbally or orally Huma - focus group using the iPad creating a story they take with photos taken using puppet theatre</td>
<td>Interactive non-game</td>
<td></td>
</tr>
<tr>
<td>Week 10-19.3.15</td>
<td>Cbeebies video clip of Barnyard Boogie to dance along to</td>
<td>display</td>
<td></td>
</tr>
<tr>
<td>Week 10-19.3.15</td>
<td>Annotated plan for Vicky to use LearnPads/ipads during key group session for maths and ‘navigating through observing’ different groups of children</td>
<td>Ff interactive game</td>
<td></td>
</tr>
<tr>
<td>Week 11 March 23-27</td>
<td><strong>ICT on weekly overview</strong>: introduce iPad photo story of the children on the whiteboard. iPad and our story for Individual interventions for named children</td>
<td>Overview</td>
<td></td>
</tr>
<tr>
<td>25.3.15</td>
<td>Vicky focus group using iPad to retell and record trad stories using props</td>
<td>Ff interactive non-game</td>
<td></td>
</tr>
<tr>
<td>27.3.15</td>
<td>EAL teacher to use Our Story outside with a focus on children's language development</td>
<td>Ff non game</td>
<td></td>
</tr>
</tbody>
</table>
### Cycle 3: Summer term

<table>
<thead>
<tr>
<th>Week</th>
<th>Overview</th>
<th>ICT on weekly overview</th>
<th>Activity</th>
<th>Ff</th>
<th>Interactive game</th>
<th>Non game</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 2</strong></td>
<td>ICT on weekly overview: Wild animals PPT</td>
<td>Wednesday April 27-May 1</td>
<td>Model making patterns on the whiteboard on Busy things. Invite children to come up and help create patterns. Can they talk about the patterns they have made?</td>
<td>LI begin to understand that a pattern is a repeated shape, picture colour or number</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 3</strong></td>
<td>ICT on weekly overview: Leampads</td>
<td>Wednesday May 15</td>
<td>Huma - LearnPads during free-flow</td>
<td></td>
<td>Ff interactive game</td>
<td></td>
</tr>
<tr>
<td><strong>Week 4</strong></td>
<td></td>
<td>Wednesday May 18-22</td>
<td>You tube video</td>
<td></td>
<td></td>
<td>display</td>
</tr>
<tr>
<td><strong>Week 5</strong></td>
<td></td>
<td>Wednesday 20-22 4.6.15</td>
<td>PPT of park outing pics</td>
<td></td>
<td></td>
<td>display</td>
</tr>
<tr>
<td><strong>Week 6</strong></td>
<td>Annotated plan - Huma with S&amp;L using the LearnPad supporting language structure (S&amp;L)</td>
<td>Wednesday 20-22 4.6.15</td>
<td>IWB talking stories. LI understand how to navigate through a program</td>
<td></td>
<td>Interactive new game</td>
<td></td>
</tr>
<tr>
<td><strong>Week 7</strong></td>
<td>ICT on weekly overview: Annotated plan - ICT-Busy Things garden shop and the garden, navigating and Talking Stories</td>
<td>Wednesday 20-22 4.6.15</td>
<td>Vicky with S&amp;L Mark making on the whiteboard talking about what is happening turning the picture into a story</td>
<td></td>
<td>Ff interactive non game</td>
<td></td>
</tr>
<tr>
<td><strong>Week 8</strong></td>
<td>Intro taking stories on the whiteboard-invite children to help navigate through the program. LI understand how to navigate through Talking Stories</td>
<td>Wednesday 20-22 4.6.15</td>
<td>Vicky with S&amp;L Mark making on the whiteboard talking about what is happening turning the picture into a story</td>
<td></td>
<td>Ff interactive non game</td>
<td></td>
</tr>
<tr>
<td><strong>Week 9</strong></td>
<td>Vicky using the whiteboard Busy Things. Monkey counting &amp; numeral recognition</td>
<td>Wednesday 20-22 4.6.15</td>
<td>Whiteboard Show the children pictures of Caribbean islands</td>
<td></td>
<td>Interactive group game</td>
<td>display</td>
</tr>
</tbody>
</table>
| Week 9  
| June  
| 26.6.15 | (Not written on to planning)- whiteboard used to draw a monkey nut for children to turn into something as done in class book | Interactive non game |
| **Week 9-** June 22 | Video of sea | Display |
| **Week 9-** June 22 | Vicky and S&L Mark making on the whiteboard talking about what is happening turning the picture into a story | Ff interactive non game |
| **Week 9-** June 23 | Cbeebies clip of carnival celebrations | display |
| **Week 9-** June 25 | Cbeebies go manga video clip | display |
| **Week 11-** July 6-10 | Watch espresso video: Finding patterns 1 Pause the video and hold up the 2D shape you are looking at in the video and reinforce its name. | display |
| June 7 | YouTube shape video | display |

1 Interactive-practitioners interacting with digital media in various learning situations  
2 Display- IWB used as a form of static display, no practitioner interaction with programs, apps etc  
3 Ff - practitioners using digital media with children during free-flow play