“A Tool not a Substitute”: A Multiple Case Study Investigation of Technology Use in the Early Years Foundation Stage

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Dedication

To my son Steven, for his patience and words of wisdom throughout this process. He will always be my greatest achievement.

Declaration

This thesis has not been submitted in support of an application for another degree at this or any other university. It is the result of my own work and includes nothing that is the outcome of work done in collaboration except where specifically indicated.

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Abstract

The increasing availability of digital resources accessible to young children and their engagement with technology is often portrayed in a negative manner. Early years teachers are in an ideal position to address this by introducing technology to young children as a tool for learning. This study investigates the use of digital resources in a cross-case analysis of four early years settings.

This multiple case study utilised the Technological Pedagogical And Content Framework (TPACK) (Mishra and Koehler, 2009) to shape the metrics for the study. Qualitative data in the form of interviews, observations and documentary evidence was collected to gain an overview of current practice. Consequently, the TPACK domains and intersections were deconstructed and associated to early years practice. Criteria for each domain and intersection were derived from this and provided the themes for Direct Content Analysis.

The findings of the study revealed that personal experience and views of technology use, impact on the equity of children's experience of technology across the settings. The availability of support and training was noted to impact the use of technology as well as the influence of external pressures such as fabrication and social desirability. Thus, it was revealed that teacher confidence and understanding of the capabilities of digital resources available is an important factor in the pedagogical use of technology with young children.

The data highlights the need for staff development through bespoke training programmes that consider the pedagogy of early years technology. The need to adapt the TPACK framework to ensure it supports early years practice was also raised. The TPACK-EY offers a framework that promotes self-assessment and highlights areas for development. TPACK-EY enabled identification and analysis of activities in which participants combined their knowledge of technology, content and pedagogy to provide effective, play-based activities which enhanced the children's learning experiences.

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List of Abbreviations

DCA	Direct Content Analysis
ECERS	Early Childhood Environment Rating Scale
EPPE	Effective Provision of Pre-school Education
EYFS	Early Years Foundation Stage
ICT	Information and Communication Technology
IEP	Individual Education Plan
IT	Information Technology
IWB	Interactive White Board
OfCom	Office of Communications
Ofsted	Office for Standards in Education
PC	Personal Computer
PECS	Picture Exchange Communication System
PVI	Private, Voluntary and Independent
TEL	Technology Enhanced Learning
TPC	Tablet Personal Computer
TPACK	Technological, Pedagogical And Content Knowledge
TPACK-EY	Technological, Pedagogical And Content Knowledge - Early Years

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Chapter 1 - Introduction and Background

1.1 - Introduction

This chapter introduces the context of the research and explains my rationale for conducting this investigation. It discusses the increasing ubiquity of digital resources taking place in early years settings and explains my interest in the pedagogical adaptations that need to develop alongside. An outline of the study will be presented and the research questions will be introduced. Early years education in nurseries and pre-school is unique in its approach to enabling children to engage in active learning through play-based activities (Palaiologou, 2016). Active learning is one of the Characteristics of Effective Learning, which will be discussed in more depth in Chapter 3. It is an approach which enables all children, regardless of age or ability, the opportunity to actively engage with materials, resources and concepts through play, thereby developing their learning (Woods, 2015). The learning, in this study relates to the knowledge, skills, and understanding the children acquire when engaging with an activity. An important aspect of this is the value of process over product (Edwards et al., 2010), the problem solving and investigation inherent to a play-based approach that allows children to gain an in depth understanding of basic concepts and develop their ability to adapt this to new situations. To establish an understanding of the current early years context, this chapter presents an overview of how the current philosophies of young children's learning have been developed. This chapter also introduces an overview of the Technological, Pedagogical And Content Knowledge (TPACK) framework and the rationale for its use as the theoretical framework to support the analysis of the findings. Chapter 1 also explains the importance of this research and the potential impact of the study.

1.2 - Context behind the research

When researching the use of technology as part of my PhD programme, I became interested in Koehler and Mishra's (2009) work on Technological, Pedagogical and Content Knowledge (TPACK). Their study investigated how the pedagogy behind the use of digital technologies could impact on children's learning experiences. TPACK provided a framework for the topic I was interested in researching, the use of technology with young children (3-5 years).

While the use of technology has gradually increased in early years provision over the last thirty years, it has had erratic support from the teachers involved. Siraj-Blatchford and Whitebread (2003) explain that because of the active nature of early years pedagogy, many early years teachers believe that by using technology, children become 'passive recipients' of content rather than active learners. The House of Lords Select Committee report (2015) highlighted that early years teachers are not developing the adequate confidence and skills with technology that are required to teach it at a sufficiently high standard. This is contrary to the usual approach to other areas of the curriculum and is a major concern this research aimed to investigate. These issues have an important impact on teaching technology in the early years. An understanding of early years pedagogy is essential in order to discuss the practice observed in depth and is expanded on in Chapter 2.

One issue early years teachers may have with the use of technology in early years provision is the belief that it is something to replace active learning experiences or an extra burden to budget for, plan for and spend precious time on (Ertmer et al., 2012).

Siraj-Blatchford and Whitebread (2003: 93) suggest:

> 'It would probably be a good idea if the educational technology was integrated into educational activities to the extent that it 'disappeared', so that it became unnoticed in just the same way as we no longer notice paper and pencil when it

> comes to writing. We simply take them for granted, and the new technology should probably be the same.'

While this statement appears to be a positive step forward, past experience in this area, both teaching in early years settings and teaching early years students in higher education, leads me to believe that without educational technology being a distinct requirement of the Early Years Foundation Stage (EYFS) it would be ignored in many settings. This is discussed in detail in Chapter 2.

No matter what an individual's feelings or opinions about the use of digital technology are, or how they feel about its use in education, technology is part of modern day life. It is being used by all age groups from young babies to very mature adults (Judge et al., 2006). Änggård (2015) comments on how technology gives children new experiences and opportunities to play in a different way, while Craft (2012:174) highlights how children are more connected because of technology and that technology is 'integrated with their lives'. McPake et al. (2007) found in their research that the vast majority of young children (97% of 346 children) were growing up in a home that at least had a mobile telephone. There is also the view, however, that technology has not delivered on its promises to improve children's outcomes, (Kim et al., 2013; Buckingham, 2007). Buckingham (2007) emphasises that computers have been in classrooms for three decades, and that learning has not changed; he expresses his disappointment at this, not blaming the technology, but the 'unimaginative, functional and misguided' way it is used (ibid: 3). It is clear that technology is here to stay and children are using a wide variety of digital resources in their everyday lives (McKenney & Voogt, 2010). While many children have access to technology at home the type and access varies greatly. This may be due to parental enthusiasm, beliefs, and concerns (Lepičnik-Vodopivec & Samec, 2012), financial circumstances (Judge et al., 2006; McKenney & Voogt, 2010) or the

child's own interests (McPake et al., 2013). An important feature of early years education is building on the child's existing knowledge and understanding (Fisher, 2013). Understanding these home experiences is important when designing appropriate learning experiences for the child in the classroom. Levy (2008) found that the young children in her study had knowledge and skills with technology that the teachers were unaware of. Serriere (2010) highlights the need for teachers to build on children's own experiences to create meaningful learning because children have a wide range of technological experiences from a very early age. Knowing what digital resources the child has access to and how much support they have can enable teachers to have good communication with parents and carers, which are essential in developing a full picture of the child's strengths and interests. The teacher's understanding of these will influence their planning to ensure the child is interested and engaged (Basquill et al., 2011).

There is also the question of how the teacher views the use of technology (Swaminathan & Wright, 2003). It is no longer necessary to question whether technology is important in children's learning (Gialamas & Nikolopoulou, 2010), but the teacher's confidence and understanding of the technologies is of paramount importance (Maddux & Cummings, 2004; Judge et al., 2006). Sime and Priestley (2005: 131) discussed how policy makers recognise the importance of this at the highest level to meet the needs of a 'digital generation' of learners. This can be seen in the EYFS framework which early years settings in the United Kingdom (UK) must follow (DfE,2017), requires children to understand the variety of technologies used and select appropriate resources for a specific reason (DfE, 2017). The Office for standards in education (Ofsted) have also highlighted the use of technology as a priority, publishing a report on 'ICT in Schools: 2008 – 2011' (Ofsted, 2013).

Education professionals have a propensity to grasp any new fads or ideas and implement them without adequate research (Falloon, 2013). While the EYFS and Ofsted promote the use of technology, it is considered as separate from the rest of the curriculum (Edwards, 2013) and this split can lead to discrepancies in children's technological experiences in school (Judge et al., 2006). In their research, Hedman and Gimpel (2010) investigated the hype surrounding technologies in schools and their findings supported the hypothesis that rather than the actual potential of the technology, it was adopted because of the excitement, popularity and prestige it was afforded. Couse and Chen (2010) found that young children preferred using tablets for art work as colours did not smudge and mix, and the process was less messy and required fewer skills, for instance colour mixing. Whilst there are clearly benefits to enhancing children's confidence, it is important to question if this is a good reason for using the tablets when the process of mixing colours, using paintbrushes and the associated sensory experiences are important elements of a child's learning experience (Lile Diamond, 2018).

Difficulties integrating new technologies into the classroom may occur; firstly, the learners' attitudes towards it, as a contributory factor to its success or failure; secondly and possibly more importantly, the teachers' attitudes and experience with it (Ifenthaler & Schweinbenz, 2013). Ifenthaler and Schweinbenz's research emphasised the effect teachers' expectations have on the success of the devices used with those with fewer expectations delivering poorer experiences for the children. They also discussed how even those with high expectations cannot provide improved experiences for the children unless they have a deep understanding of the technology and its potential. A final issue raised in their research was the importance of '… a smoothly running infrastructure as a pre-requisite for TPC [Tablet-Personal Computer] use' (Ifenthaler & Schweinbenz, 2013: 533), suggesting appropriate

resources, IT support and staff training are required, which has implications for the quality and accessibility of training in this area.

Koehler and Mishra (2009) discussed the challenges of teaching with technology. Their framework concluded a five-year longitudinal study on teacher professional development and faculty development in higher education. They highlight how traditional pedagogical technologies have a ‘specific' use such as using a pen to write with, they are ‘stable,’ little about them changes over time and they have ‘transparency of function' in that they do what they were designed for. In contrast, modern electronic technologies are less well defined, they are ‘protean' - they can be used in many different ways, ‘unstable' as they are constantly changing, quickly out of date and ‘opaque' as few understand their internal workings (Koehler & Mishra, 2009: 61). The use of technology is often imposed upon teachers (Mumtaz, 2000) and frequently there is a lack of training opportunities to enable them to embrace the full potential of the technology they are required to use.

1.3 - Aim of the research

With the introduction of ‘Computing’ as a subject in the English National Curriculum (DfE, 2013), developing technological skills in pre-school children takes on an added importance (Manches & Plowman, 2017). Edwards et al. (2018: 1) refer to young children as ‘Digitods’, the first generation of children to be fully online from birth. Marsh et al. (2017) expressed a concern that despite the proliferation of technology and the need for young children to have access and to develop a confident, creative approach towards it, there remain concerns regarding the lack of progress in this area by early years teachers.

The aim of this study was to investigate how the early years teachers' technological, pedagogical and content knowledge influenced the everyday use of digital technologies with

young children (aged 3-5 years). This was investigated using a cross-case analysis involving four early years settings. Each case study was situated in a different type of early years provision and offered alternative perspectives into how digital technology was included in the curriculum and why. The case studies involved in this research, while all focusing on early years provision, had different contexts, pressures and priorities, offering a range of outcomes for discussion.

The theoretical framework chosen to support this work was the Technological, Pedagogical And Content Knowledge (TPACK) framework (Koehler & Mishra, 2009). I realised during the research design that this was created for educational technology in general, I have designed a modified version, to be applied to early years provision which will be presented in Chapter 4.

The resulting discussion in Chapter 5 considered how the teachers' engagement with these elements impacted on the children's experiences of digital technology. Considering whether the early years teachers involved in the research were combining their knowledge of the technological capabilities of the resources available with the content they wished to deliver and the pedagogical approach they used to enhance the children's learning experiences.

1.4 - Background to the research

My experience as an early years teacher for over 10 years, then as Senior Lecturer in Early Years undergraduate and postgraduate degree programmes has given me an in-depth understanding of the philosophies and principles of early childhood education and care, which I elaborate on in Chapter 4. Throughout, I have had a personal interest in the technology I could use to enhance the children's learning experiences. Understanding when

and how technology could enhance the children's experiences enabled me to plan its use to incorporate an alternative approach towards a variety of curriculum areas which encouraged engagement and developed self-confidence in the children. Parents regularly commented on their children's skills with technology and their progress was recorded in their learning journeys.

As a Senior Lecturer, I visit a variety of early years settings and have observed that the use of technology varies greatly and is influenced by the teachers' confidence in its use and the digital resources they have access to. It may consist of a lone Personal Computer (PC), which sits in a corner and is rarely if ever used, to a wide range of programmable toys, interactive whiteboards (IWB), cameras, video and tablets all being planned for and used effectively to enhance children's learning (Plowman et al., 2010a). Early years pedagogy encourages the children's individuality, curiosity and independence in all areas of the curriculum and technology should be included in this approach (Fisher, 2013; Bruce, 2012). Siraj-Blatchford and Whitebread (2003) suggested that being given this opportunity is part of children's rights as they are growing up in a technological world. There are a wide variety of digital resources available to early years settings, such as those mentioned above, as well as a constant stream of new devices coming onto the market (Appendix 1). These have the potential for children to develop their independence and extend their understanding of all areas across the curriculum. It appears from the literature reviewed and personal experience, that many early years settings do not take advantage of the possibilities technology can offer; this research study investigated why this does not appear to happen on a regular basis in all early years settings.

1.5 - The Study

Investigating the issue of using technology in early years education led me to find some passionate responses to the topic. I posted a supportive message on a blog in response to a teacher whose setting catered for 2-year-olds and had said that she was purchasing iPads for them to use. The replies were heated, with opinions such as children should not use technology until they are 10 years old and that it would be used as a substitute for play. These responses developed my interest in the need for positive attitudes towards technology, an issue also highlighted by Ertmer et al. (2012). This also encouraged me to understand the real need to investigate if experiences and attitudes have any influence on the way technology is used in early years settings. This then led me to question the pedagogical approaches used and the content that early years teachers deliver through the use of digital resources.

The following question was developed from these issues and from my reading into the use of technology in educational settings, which will be discussed in detail in Chapter 2:

'How does the Technological, Pedagogical and Content Knowledge (TPACK) of early years teachers influence their use of technology to enhance learning experiences for young children?'

Underpinning this question are three supporting questions, the answers to which will inform the conclusion. These questions were formed as a result of previous research, as discussed in Chapter 2.

1. In what way does the range of experience and understanding of the use of technology held by early years teachers affect the provision for children in the setting?
2. How can the use of technology enhance the children's learning experience?
3. How can a teacher's understanding of technology, pedagogy, and content support learning opportunities for young children to enable them to move confidently to the next steps in their learning?

Research Question 1 was designed to interrogate the data to establish whether or not personal confidence had any effect on how teachers approached technology with the children in their setting. The second research question investigated if technology can be used as an effective tool to stimulate children's engagement with content, add depth to their understanding, and extend their learning. The final research question sought to establish if there were any examples of the teachers combining their knowledge of the content to be delivered with their understanding of the technology available and adaptation of their delivery to enhance the children's learning experience.

1.6 - Early years pedagogy

Early years education has developed over time and this section will explain the development of education for young children in the UK and how research into the way young children learn underpins the current approach which encourages children to be actively engaged in play. This is an important factor in my research as will be discussed throughout the thesis. To understand the specialised way in which young children are educated, it is important to examine the journey this phase of teaching has travelled. In England, the EYFS is the national framework that all early years settings must follow (DfE, 2017). The EYFS framework covers birth to five years; however, how early years teachers deliver the content varies across settings due to a range of factors which will be discussed in Chapters 2 and 5. An important issue affecting the use of technology with young children is the early years teachers' belief in an active, play-based curriculum (Moylett et al., 2012; Fisher, 2013, Palaiologou, 2016). With increasing pressures from governments for children to start school at age four and Ofsted recommendations that children are made 'School Ready' before this,

the time children are allowed to learn through play is diminishing. It is important to establish how the treatment and education of young children has developed over time, in order to understand how and why current practice has evolved and why early years teachers believe this is the best approach. This is important to understand when considering the barriers to the use of technology which will be extended upon in Chapter 2 and discussed in relation to the data analysis in Chapter 5.

1.6.1 - The evolution of early childhood education

The education of young children has long been considered a sensitive and essential process, as John Locke, an influential 17th century theorist explained:

> The little, or almost insensible impressions on our tender infancies have very important and lasting consequences: And there 'tis, as in the foundations of some rivers, where a gentle application of the hand turns the flexible waters into channels, that make them take quite contrary courses… I imagine the minds of children as easily turned this or that way, as water itself… (Locke, 1752: 2).

In this section, I explain the development of early childhood education, from the earliest times when the concept of education was being developed across all ages to the 20th century, when research began to demonstrate that very young children needed a more bespoke approach to lay the foundations of their learning. This section highlights a selection of the pertinent factors that are known about the development of education for young children in England and explains how the foundation for current early years philosophy was laid.

It is difficult to understand the roles that children played in the distant past; there are no documents to describe how they were treated. What is apparent is that even in the earliest known communities, children were playing alongside adults. Finger flutings have been discovered in Rouffignac Cave which were made by a young girl estimated to be four or five

years of age. These date to the Upper Palaeolithic period some 20,000 to 11,000 years ago. She used both hands at the same time, so torches must have been stabilised somewhere and her family content for her to make her patterns (Children and Youth in History, 2014). There are many examples of these within the cave system, which would seem to indicate whoever she was with was happy for her to play and be creative. Cooney (2011), an archaeologist working in the caves, described how the flutings were created by both adults and children, suggesting that the children were an important part of the group. She went on to describe how one cave seemed to be a special place for the children, where their creativity appears to have been encouraged due to the abundance of artwork and suggests that this could have been a pre-historic pre-school. Moving forward in time, education became of interest to scholars - Confucius (551 – 479 BCE), Socrates (469 – 399 BCE) and Plato (427 – 347 BCE) developed theories regarding education in general, which highlighted the need for problem solving approaches (Rowe, 2001) and understanding the students' interests (Cooper, 2001) to develop effective learning. Problem solving is considered an important skill which develops a resilient and flexible approach (Sarathy, 2018). Developing problem solving skills enables individuals to assess issues, use their experiences to find solutions, and understand the need for trial and error, evaluating the process and adapting it until they achieve their goal (Lile Diamond, 2018). Over time, these educational constructs became the basis for children's education. By the 17th century, the education of young children as a specific area, was gaining the interest of scholars.

John Locke (1632 – 1704) was one of the first authors to consider pedagogy for young children and some of his theories are still in use today. In his treatise on the education of gentlemen, *Some Thoughts Concerning Education* (1693) he said :

> …another thing that is of great advantage to everyone‘s health especially children’s, is to be as much in the open air and as little as may be by the fire even in winter. (Locke, 1752: 10).

And:

> How then shall they have the play games you allow them, if none must be bought for them? I answer, they should make them themselves or at least endeavour it and set themselves about it (Locke, 1752: 193).

This philosophy of outdoor play and creating their own games was further developed by Jean Jacques Rousseau (1712 – 1778). Rousseau began to look deeply into childhood and the ways children learn and believed that children were inherently good, a belief which led him into exile, as the church at the time had very different views (O’Hagan, 2001). O’Hagan continued to explain that Rousseau objected to babies being swaddled because he felt that they learnt through movement and interacting with their surroundings. As children grow, he wrote, they must learn by doing, preferably outdoors, not in a classroom with textbooks. Tröhler (2001) discussed how Johann Heinrich Pestalozzi (1746 – 1827) built on Rousseau’s ideas and encouraged teachers to allow children to engage in investigation and active learning. He promoted the idea of using children’s interests to direct learning and giving them the space to draw their own conclusions. These examples demonstrate how educationalists have developed their understanding of how children learn throughout history. Through their insights, the importance of appreciating children’s natural aptitudes and interests when designing approaches to their education became embedded in practice, and influential early years pioneers such as Friedrich Wilhelm Fröbel (1782 – 1852) built on this. Fröbel focused on the psychological development of children through play, believing that education was a holistic process which enabled the child to understand themselves and others, the world around them and God (Fröbel & Herford, 1916). Pound (2011) described how Fröbel used observations of young children to highlight the importance of their mother

in their learning process; this led him to employ female teachers at a time when teaching was very much a male-dominated profession. He developed 'Kindergartens' or gardens for children and provided 'gifts' (play materials) and 'occupations' (activities) (Walsh et al., 2011: 96). Gifts were carefully designed to enable children to develop specific understanding; the next gift would enable them to build and extend this. The occupations were craft activities developing skills appropriate to the individual child's needs (ibid.) Fröbel's ideas in the field of early years education were so successful that he influenced many of the early years specialists who followed, using his philosophical principles to develop their own.

Margaret McMillan (1860 – 1931) and her sister Rachel (1859 – 1917) were two such specialists who developed Fröbel's approaches to ensure young children from deprived areas had access to the outdoors, as their focus was to improve the health as well as education of the children (Pound, 2011). Rudolph Steiner (1861 – 1925) built on the Fröbelian approach to develop children's spiritual understanding. This was a unique philosophy which nurtured each child's life and soul, giving them freedom to relate to the world in a respectful and interested way; it is known as an anthroposophical approach to their education (Oelkers, 2001). Maria Montessori (1870 – 1952) developed her own approach to early years education. She was very interested in children with Special Educational Needs (SEN) and began to study them in depth. Her conclusion was that SEN was a pedagogical issue and that the children's learning experiences were of paramount importance (Roland Martin, 2001). She commented how children were being taught in a 'scientific way' and were 'repressed in the spontaneous expression of their personality till they are almost like dead beings' (Montessori, 1912: 15).

Susan Isaacs (1885 – 1948) was a contemporary of Montessori, while Montessori held that play should be about life experiences, Isaacs explained how she truly believed in the value of play as a 'breath of life to a child' (Isaacs, 1999: 425) and that it helped them to develop their imagination (ibid.). Her staff were trained to be empathetic towards the children, encouraging and supporting them as needed. The children were allowed to follow their own thoughts and investigations, encouraged to learn through problem solving, developing creative and imaginative solutions from their prior experiences.

While many perspectives on the education of young children have evolved through time, the brief illustrations above demonstrate a clear agreement that young children learn through play, problem solving, creativity and imagination. This is evidenced by a commitment to a curriculum which supports young children's learning and development (DfE, 2017). Accompanying the EYFS is a document called Development Matters, this provides guidance on the developmental stages for each area of learning and highlights the Characteristics of Effective Learning, which are Active Learning, Playing and Exploring and Creating and Thinking Critically (Moylett et al., 2012). This supports early years teachers to enable children, at least from birth to five years, to learn through play, have fun, develop their independence, investigate and experiment with the support of caring early years teachers who believe in keeping this approach at all costs. How then can technology be integrated into a play-based curriculum and be used constructively to develop young children's learning?

1.7 - Theoretical Framework

As mentioned previously, the Technological, Pedagogical And Content Knowledge framework had been brought to my attention and I believed that it could support this research study. At the time of designing this research, TPACK appeared to be the only appropriate framework available. Alternative frameworks such as Substitution, Augmentation, Modification, Redefinition (SAMR) (Hamilton, 2015) and International Society for Technology in Education Standards (ISTE-ST) (ISTE, 2017), have since been designed. SAMR represents a continuum of practice, however; it does not consider the intersections of practice. ISTE-ST recommends standards that teachers need to meet, although these would not have supported this research, as this study's questions investigate practice rather than assess it.

Mishra and Koehler (2006) investigated how technology influences the content being taught and the pedagogical approach used and designed a theoretical framework to support their research. They built on the work of Schulman (1986) who had considered three essential domains for teaching successfully: pedagogy, content and knowledge. Schulman claimed that these cannot be considered separately but are all interlinked (Figure 1).

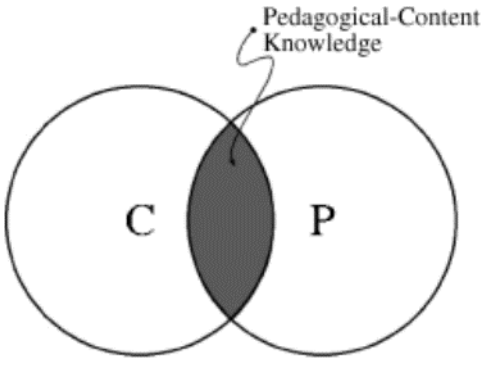

Figure 1: The two circles of pedagogical knowledge and content knowledge are joined by pedagogical content knowledge (Mishra & Koehler, 2006:1022).

Mishra and Koehler (2006) introduced technology into this interplay and explained how content, pedagogy and technology are connected; they considered each element separately as an essential part of the learning and teaching process. They then considered them in pairs, discussing how they interlinked and finally grouped the three elements together as Technological, Pedagogical Content Knowledge (TPCK) (see Figure 2).

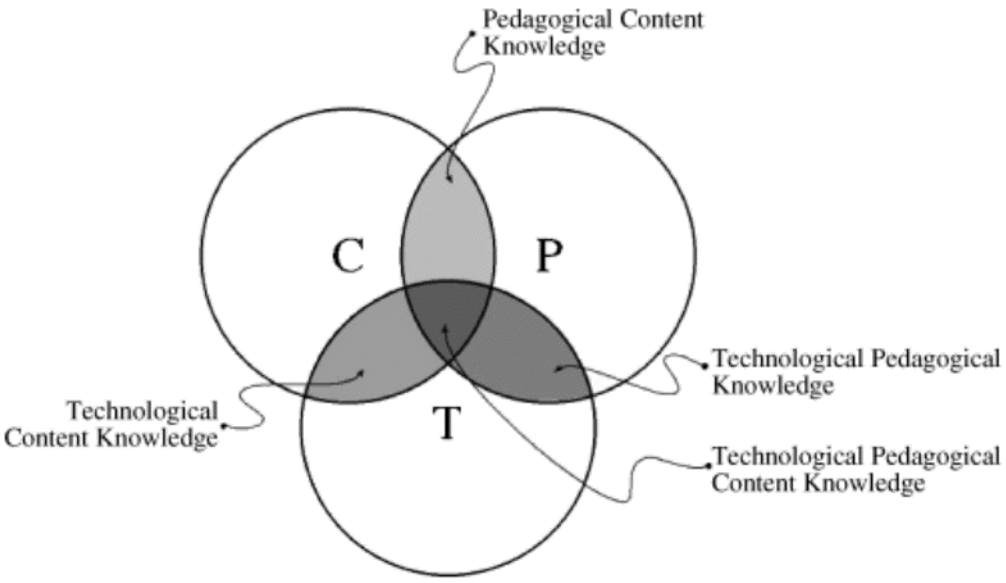

Figure 2: Pedagogical technological content knowledge. The three circles, content, pedagogy, and technology overlap to lead to four more kinds of interrelated knowledge. (Mishra and Koehler, 2006:1025)

> TPCK [sic] is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones.
> (Mishra & Koehler, 2006: 1029)

Archamboult and Barnett (2010) conducted an investigation with nearly 600 online teachers to assess the appropriateness of TPACK. They concluded that it was difficult to define each of the domains of TPACK and for some the results seemed to indicate that in practice they did not exist, as participants did not distinguish them individually. This may have been due to a lack of explanation to the participants or the format of the questionnaire, which was

complex and emphasised the need to create clear definitions of these dimensions when conducting research (Angeli & Valanides, 2005).

Having considered these findings, I used this framework as the basis of my research, but clearly, there was a need to develop definitions to ensure that teaching components were clear for each domain and Chapter 3 explains this in depth. This research looked to examine the elements of TPACK and create clear characteristics for each, using the data collected from the case studies to evaluate the engagement with each of these elements.

1.8 - Research gap

The literature reviewed in Chapter 2 provides a detailed account of research and policy regarding the development of the approach to early years education adopted in the UK and how technology is included. There are research gaps shown within this; the majority of the research focuses on older age ranges (Tallvid, 2016; Craft, 2012; Higgins et al., 2012; Bowers & Stevens, 2011; Abbott et al., 2010; Ertmer, 1999).

This study focuses on early years education for three to five-year-olds. There is research examining the use of technology from when it was introduced into the curriculum from the Effective Provision of Preschool Education (EPPE) report (Sylva et al., 2004), but little since then. Current research highlights the need for 'digital play' to be included in a taxonomy of play (Marsh, 2016) and this research investigated evidence of digital play in the case studies. Palaiologou (2016) and Plowman and McPake (2013) conducted research into the use of technology by young children in their home environments, whilst this study involves the children's experiences in educational settings. Bird and Edwards (2015) investigated how children used technology in their play which, while extremely relevant to this study, does

not consider the impact of technology on the children's experience of specific content to develop subject knowledge which the current study does address. Blackwell et al. (2016) considered TPACK and the use of iPads in early years whereas, this study considers a broad range of digital technologies. Their research was a quantitative study based on findings from 945 online respondents, whereas this study adopts a qualitative, multiple case study approach to examine practice in depth.

Voogt et al. (2013) reviewed the research on TPACK and concluded that there was very little considering its impact on specific subject domains, they concluded that TPACK was a generic framework. This study has established TPACK for early years education (TPACK-EY) and created a specific definition for each of the domains and intersections with regards to this to provide clear guidance on how it relates to early years practice.

A more recent publication by Marsh et al. (2017) reviewed the literature regarding the use of technology by early years teachers. They consider the TPACK approach as part of the study and highlight the need for professional development opportunities to support those working with young children to develop their knowledge, skills and understanding of technology and its potential to enhance children's learning experiences. The current research examines these concepts in depth, in four diverse settings, to analyse the variety of experiences and approaches regarding technology. This has provided an insight into how early years teachers develop a pedagogical use of technology, to add breadth, depth and new approaches, to content across the early years curriculum.

My research aims to address the need for further insights into how technology can support a play-based curriculum and how early years pedagogy can be adapted to include technology which will enhance the children's learning experiences. It also looks to identify

the issues that cause barriers for teachers when including technology in early years provision and consideration of how these can be addressed.

1.9 - Importance of this research

While there is a large amount of research available investigating the use of technology in education, the majority examined tools and techniques and how they can be used (Harris & Hoffer, 2011). This research study investigated how technology was being used in four case studies of early years settings. The teachers' use of technology in the classroom was analysed through observations of the children, documentary analysis and interviews with the teachers. I examined the impact this had on the use of technology and the children's learning experiences. As more settings invest in technology, the findings of this research will support managers, staff, and ultimately children in understanding the importance of the technological, pedagogical and content knowledge required.

1.10 - Potential impact of this study

The marketing skills employed by large companies make technology appealing and while it is very popular, the actual benefits of using it are not well researched (Falloon, 2013). Some educational settings may become caught up in the hype, to improve children's motivation, and become more marketable without considering the practical implications such as staff development needs (Maddux & Cummings, 2004). This research examined current practice in early years settings and identified where there were discrepancies between planning and practice. Technological, pedagogical and content knowledge can be brought together to develop practice thereby improving learning experiences for young children. The research

aimed to highlight the need to have a sound understanding of the technology being used, the pedagogy behind using it and the content being taught in order to enable children to achieve their full potential and make recommendations to early years teachers to support them in enhancing their practice in this area.

1.11 - Summary of Chapter 1

The introductory chapter explained the background to and context of the research and established the development of the pedagogy that underpins the current approach to early years care and education in England. It established my own expertise in this area and the reasons for my interest in the use of technology in the Early Years Foundation Stage. There are gaps in the research regarding this topic and these have been outlined (and are detailed further in the next chapter); this research seeks to provide a greater insight into these areas and provide possible solutions to enhance practice. The aim of the research has been clearly stated and the theoretical framework underpinning the analysis of the data was discussed. From this discussion, three research questions were created, the responses to which will provide a comprehensive response to the investigation I have designed. I have explained why I believe that this is a pertinent investigation and the potential impact from the findings.

1.12 – Overview of thesis

Below is a brief overview of the chapters to follow which will expand on the concepts introduced in this chapter and present and discuss the findings from this piece of research:

- Chapter 2 - an in-depth review of the relevant literature

- Chapter 3 – a discussion of the TPACK framework with reference to early years pedagogy and identification of indicators which will be used to identify each domain in practice during the analysis of the data.
- Chapter 4 – an explanation and justification of the research methodology, methods, data analysis method, and ethical issues.
- Chapter 5 – a presentation of the findings from the data and analysis of their importance.
- Chapter 6 – a discussion of the implications of these findings and a response to the questions asked in Chapter 1.

Chapter 2 - Literature Review

2.1 – Introduction to Chapter 2

Chapter 2 reviews the literature that informs my research. It begins by reflecting on the development of current early years pedagogy and external pressures which can affect this; as well as early years teachers' experiences and approaches towards technology. This is followed by a review of past research into how technology can be used to enhance children's learning experiences. Finally, the chapter examines an overview of the concepts of Technological, Pedagogical and Content Knowledge.

Reviewing the available literature highlighted that there was a limited amount of research into the use of technology in early years settings. Much of what is available was conducted when technology was first introduced into the curriculum (Venkatesh et al., 2003; Siraj-Blatchford & Whitebread, 2003; Smith, 2002). More recent articles tend to examine how it is used in the home (Plowman, 2015; Palaiologou, 2016). For the purpose of this review, research examining the use of technology within all stages of education was considered, as much of the discussion was pertinent to all age phases. This investigation is important because it aids in providing an illustration of current practice in early years settings and in identifying how this can progress in the future.

2.2 - Early Years Foundation Stage – a play-based curriculum

This section begins by examining the current influential theories and frameworks that underpin contemporary practice in early years education. This is included because it is important to have a clear understanding of why early years education is considered

different from education for older children and why early years teachers believe that it should remain that way.

2.2.1 - Contemporary practice – learning through play

Contemporary theories developed following a growing interest by governments as they aimed to improve educational outcomes for all children. Government involvement has also formalised expected outcomes at each stage of learning; including Early Learning Goals at the end of the EYFS (DfE, 2017). These expectations can influence the technology, content, and pedagogy used and have a direct impact on all three of the research questions.

At the end of the last century, there were two distinct types of provision for under five-year-olds, one focused upon education and the other on the care of the child.

The government had become increasingly concerned with the number of children in deprived areas and the cycle of deprivation. As education became a higher priority for successive governments, the pressure on early years settings to achieve high standards and outcomes for children increased. In 1997, the government funded a longitudinal study into how different preschool experiences affected young children. This is known as the Effective Provision of Pre-school Education report (EPPE). Sylva et al. (2004) postulated that the findings demonstrated the value of pre-school education. Importantly, the study found a link between the level of qualification of the leader of the setting and the level of quality of provision. One of the most important findings, however, was that:

> EPPE is the first study to show convincingly that individual pre-school centres have lasting effects on children's development. This thread runs through the theoretical work of educationalists such as Jerome Bruner (1996) but previously had not been empirically demonstrated in a large representative sample. (Sylva et al., 2004: 58)

These findings highlighted just how important early years education was. This study was extended and showed that the effects lasted through to Key Stage 2 (7-11-year-old children), with children who received quality pre-school provision achieving higher Standardised Assessment Tasks (SAT) results than their counterparts (Siraj-Blatchford et al., 2008). These findings are extremely important for this investigation, as they highlight the importance of the pre-school child's experiences. They also highlight the positive impact of well-qualified teachers with an in-depth understanding of child development, in particular when it comes to opportunities for play based learning.

It is difficult to define the word 'play' (Appendix 2). Hutt (1979) defined three types of play, whilst Hughes and Melville (2002) developed a taxonomy that defined sixteen different types of play. Bishop and Curtis (2001) defined it in three further ways (see Appendix 2). Sherwood and Reifel (2010) discuss how 'play' is a commonly-used term, but its definition varies between teachers, an opinion shared by Vu et al. (2015). The authors expand on this by stating that often the definitions may be contradictory. It would seem that play is a subjective topic. With such a variety of taxonomies, beliefs and practices, how can teachers arrive at a singular definition in which technology either fits or does not? The need to update these taxonomies has been addressed by some researchers. The new versions of the above taxonomies do aim to incorporate technology (Bird & Edwards, 2015; Marsh et al., 2016).

The research highlighted above examines young children's development, their learning styles and the most suitable approaches to meet their educational needs. An influential figure in the more recent development of early years pedagogy is Tina Bruce. She studied the Fröbelian approach to early years education and built on his theoretical beliefs. Since

then, she has become a major influence on current policy and practice in early years education. In 2001, Bruce produced 10 principles of early childhood education (Table 1).

1. The best way to prepare children for their adult life is to give them what they need as children.
2. Children are whole people who have feelings, ideas and relationships with others, and who need to be physically, mentally, morally and spiritually healthy.
3. Subjects such as mathematics and art cannot be separated; young children learn in an integrated way and not in neat, tidy compartments.
4. Children learn best when they are given appropriate responsibility, allowed to make errors, decisions and choices, and respected as autonomous learners.
5. Self-discipline is emphasised. Indeed, this is the only kind of discipline worth having. Reward systems are very short-term and do not work in the long-term. Children need their efforts to be valued.
6. There are times when children are especially able to learn particular things.
7. What children can do (rather that what they cannot do) is the starting point of a child's education.
8. Imagination, creativity and all kinds of symbolic behaviour (reading, writing, drawing, dancing, music, mathematical numbers, algebra, role play and talking) develop and emerge when conditions are favourable.
9. Relationships with other people (both adults and children) are of central importance in a child's life.
10. Quality education is about three things: the child, the context in which learning takes place, and the knowledge and understanding which the child develops and learns.

Table 1:Ten Principles of Early Childhood Education (Bruce, 2001)

These ten principles clearly illustrate the consistent findings from early years research. They are the basis of early years teaching, as well as programmes designed to train early years teachers. Manning-Morton (2014) expressed how Bruce's work, both when developing these principles and thereafter, has had an important influence on the development of early years frameworks in England. These principles are fundamental to the early years teacher's approach to teaching young children (Fisher, 2013). Bruce's philosophy and teaching came

at a time, as Palaiologou (2013) explains, in which more and more professionals were focusing on early years education and on developing a research culture. Stephen (2012) expressed concern at the acceptance of principles and theories by early years teachers without questioning them. She extends this concern to local authorities and government that provide curriculum frameworks based on:

> Pre-school educational practices and pedagogy [that] appear to be under-theorised, subject to varying, and sometimes contradictory, ideas and understandings which are often 'taken for granted' and therefore not subject to debate and challenge. (Stephen, 2012: 228)

Whilst focusing on practice in Scotland, she links this to a similar situation in England. Interestingly, while Sylva et al. (2004) emphasised the differences in the level of quality in settings according to the leader's level of qualification, Stephen did not discuss the level of qualification or the amount of experience the practitioners in her study had. There are considerable differences in the depth of understanding between those who have a Level 3 (BTEC) and Level 6 (Undergraduate degree). Early years degrees, which are different from teaching degrees, were introduced into universities following the EPPE report. This led to better qualified staff, as well as the development of research-based evidence regarding the importance of this stage of learning (Palaiologou, 2013). The level of study may thus have a bearing on the participants' understanding of and engagement with technology due to their experiences and opportunities to interact with technology for educational purposes.

The EPPE report highlighted the need for high quality early years provision (Sylva et al., 2004). This in turn led to the creation of a national early years framework that has been frequently updated but consistently emphasises the expectations that a play-based curriculum will be provided (DfE, 2017). Fisher (2013) commented that the EYFS is a detailed document that has the potential to encourage an over-reliance on the expectations of

Development Matters. This is the part of the EYFS that lays out expected skills and understanding children should have at defined age ranges. Stephen (2012) expressed concerns that there are no references to any theory in the documents. Early years teachers believe in the importance of a play-based curriculum, since personal experience has shown that children respond positively to this approach and develop an enthusiasm and love of learning as a result.

As seen from the discussion regarding early years pedagogy learning through play and through first-hand experiences is fundamental to early years principles. (Blackwell et al., 2013) investigated early years teachers 'approach to the use of tablets in the United States of America (USA) and suggested that early years teachers believe that technology prevents play and first-hand experiences from occurring.

Fisher (2010) explains that while research into child development reveals that a change in children's approach to learning happens at around 7 years of age, she has not discovered any research providing evidence of any changes before this age. Many countries understand this and children do not begin formal schooling until they are six years old (Ministry of Education, 2004; Skolverket, 2010; Ministry of Social Affairs and Health, 2004; Kerckaert et al., 2015). In England, however, formal schooling can begin shortly after a child's fourth birthday, which can lead to developmentally inappropriate provision. With formal testing in England feeding into league tables and Ofsted results, there is frequently a top-down pressure for more time to be spent on literacy and numeracy rather than play in Reception. In this uncertain climate, early years teachers are holding onto their values and principles. If teachers do not understand how technology can be used as a tool to enhance the children's learning experiences, they may view technology as a threat to the play-based curriculum they have worked hard to create.

2.3 - Technology in education

The first research question asks about the range of experience and understanding early years teachers have and whether this has any bearing on the way they use it with children. This section will analyse the literature which discusses teachers' attitudes and experiences towards technology in education.

2.3.1 – Technology in early years education

As previously discussed, early years teaching adopts a mainly social constructivist approach, encouraging children to learn through their interests and first-hand experiences. The EYFS discusses the characteristics of effective learning (Moylett, 2014: 5). These are 'Active Learning', 'Playing and Learning', 'Creating and Thinking Critically'. Hutchin (2013) explains that early years teachers are particularly focused on using these approaches, as they understand how important they are in order to engage and excite young children. Research by Moyles in 1989 'demonstrated how, for every aspect of human development and functioning, there is a form of play' (Hayes & Whitebread, 2006: 97). As technology progresses and is incorporated into more and more children's toys, our concept of play needs to change (Yelland, 1999); however, this is a cultural change and there is some worry that technology will replace traditional play (Healy, 2001) which, in turn, is causing it to become a threat to early years philosophies. Marsh et al. (2016) believe that a new dimension needs to be added to include digital play. Kennington and Meaton (2009) posit that the potential of young children to engage with technology is underestimated. Some practitioners are concerned that children will sit and stare at the screen all day playing games mindlessly. If teachers are worried about the sedentary nature of technology, then they need to teach the children health and safety procedures from the very beginning,

including how to sit correctly and the length of time they should spend at a computer (Siraj-Blatchford & Siraj-Blatchford, 2004). These arguments appear to have an all-embracing defeatist attitude. Wheeler (2015) discusses how, when speaking at a conference in New Zealand, he was told by a delegate that they do not use the internet in their school because it was too dangerous. His response was "So you don't teach your children to safely cross the road either – because that's also dangerous?" Wheeler highlights the lack of understanding behind the effective use of technology. As Allvin (2014) explains, there is an all-or-nothing approach and teachers need to use both/and rather than an either/or approach.

Edwards (2013) expresses concern that these negative perceptions are reinforced by the curriculum frameworks for early years education, not just in England but internationally. New Zealand and Sweden, for instance, consider technology separately from other areas of the curriculum. Edwards, however, does not address the issue that, while it is considered separately, there is an understanding that technology is not a singular entity and is used to support and extend learning in other areas of the curriculum (DfE, 2017; Ministry of Education, 2004; Skolverket, 2010). Other frameworks such as those in Finland (Ministry of Social Affairs and Health, 2004) and Belgium (Kerckaert et al., 2015) do not mention technology at all, leaving educators to decide how and when it is introduced. Hobbs (2010) and Siraj-Blatchford and Whitebread (2003) believe that, in a world where technology is ubiquitous and children see its use in such a variety of situations, it should be merged with other areas of the curriculum. While this is theoretically appropriate, with such a wide variation in abilities and attitudes, if it were not a distinct area to be addressed in the curriculum, it might people that those with a negative perspective choose to ignore it, which might lead many children to have even less or no access to it.

Healy (2001) posited that using technology would damage children's development, as it would replace traditional play activities and prevent them from developing necessary social skills. Taking a positive approach towards using technology with young children, Wohlwend (2015) explained her approach to a popular app 'Puppet Pals'. She believed that the definition of literacy is changing to include multiple ways of working, one of which is reading and writing on screens. Her research found that collaborative working was easier to learn through the use of the app and that, while new skills were needed to use it initially, the children were able to then discuss ideas, negotiate problems, work together and share in order to create their own stories. Using technology with young children should not be a solitary activity; they can work together with supervision and scaffolding by adults as and when required (Paciga et al., 2013).

Engaging children in activities is always an issue. The use of technology can encourage this by making activities more exciting and unique (Saine, 2012). Shifflet et al. (2012) suggest that it is the educator's obligation to assess the resources provided and to consider more effective ways of using them. The teacher's understanding of how children view technology is also important. Hayes and Whitebread (2006) consider that children view computers in a different manner to adults, citing the example of how children will learn from their peers through observation; however, adults may view this as being lazy, standing around doing nothing. It could be argued that we expect children to constantly be doing something and time for observation and reflection is not catered for (Pound, 2011; DCSF, 2008), which might be considered a negative aspect of active learning.

I have discussed how often those who are concerned with the use of technology in the early years neglect to differentiate the variety of digital resources. Passey (2013) explains the importance of appreciating the variety of digital resources available, as well as postulating

that there needs to be an understanding of how their different attributes can be used. Each can support differing needs, differing learning approaches and the maxim that learning is a choice, and as such, a one-size-fits-all approach is rarely successful. Considering this raised the importance of ensuring that all children have the opportunity to build on their understanding and develop skills that they may not have had opportunity to learn in their home environment.

Providing equal opportunities for all children is fundamental to early years practice. The EYFS requires equality for all children (DfE, 2017). Article 2 of the United Nations Convention on the Rights of the Child (UNCRC) (United Nations, 1989) requires that all children are treated equally regardless of their differences. Burger (2010) examined a variety of research that investigated the effectiveness of early years provision across Europe and the United States of America. The author reported that all of these studies found that giving children equal opportunities to learn negated any difference or disadvantage, which enabled them to begin their formal schooling on equal terms.

It is the responsibility of early years educators to develop children's 'learning contexts that are meaningful and contribute to children's home digital patterns and habits' (Palaiologou, 2016: 15). This builds on the wide variety of evidence found by Plowman and McPake (2013), who concluded that many early years educators do not appreciate children's understanding and use of technology in their home lives and need to 'extend their vision of the nature of children's technological competences beyond operational skills' (Plowman & McPake, 2013: 31). Children learn by mimicking what they see happening around them (Price & Price, 2009), and even in areas of deprivation, there is often more technology being used in the home than in many early years settings. Additionally, technology is being used in the home in real-life situations (Plowman & McPake, 2013).

A lack of appreciation of children's competency with technology leads to a tendency in certain subjects, such as literacy, to adopt a more didactic approach. Many teachers consider that these skills are far too important for the children to learn through play (Roskos & Hanbali, 2000); Often the fear of losing skills that have been of the greatest priority are cited as the reason for not using technology; book skills, for example. As Hopkins et al. (2013) explain, educators should be rising to the challenge of developing new skills that build on these, rather than eliminating them. Book skills are still required, but children now need to know how to 'navigate through linked content… and interpret visual, auditory and verbal communication at the same time' (Hopkins et al., 2013: 23).

The government's more recent requirement for 'school readiness' has led to the earlier introduction of a more teacher-led approach (Ofsted, 2015). Hayes and Whitebread (2006) explain that teachers should not impose their ideas of what children can and cannot do. In some situations, children can only access certain resources when they transfer to the next class, a concept that relates to Piaget's ages and stages of development. Alternative and more flexible approaches include Vygotsky's Zone of Proximal Development, with support to move on to the next stage as and when they are ready, or Bruner's 'Spiral Curriculum', where children learn skills then constantly revisit them to build and improve on them. Understanding what the child can do is essential in planning for their learning (Bruce, 2001). Consolidating what they can do and supporting or scaffolding their learning of new skills makes the learning experience unique and appropriate for each individual child. Hayes and Whitebread (2006) also observed that the teacher will plan an activity using the technology. They will choose the programme and how it is to be used rather than using their knowledge of the children, giving them the chance to solve problems and make decisions for themselves. Waller et al. (2010) suggest that this situation gets worse as children get older,

since teachers restrict the amount of software available to what the school deems appropriate. Such practice illustrates a move away from play and from the children's interests, which compounds the view that technology interferes with young children's active learning experiences.

Children need to have access to a variety of resources and technology to complement traditional play, extending learning in previously unforeseen ways (Whaller, 2005). Ofsted (2013) highlighted a childminder's good practice using a microscope to observe leaves and skin. The childminder could also print out pictures of what they have observed to share with parents. Without technology, these experiences are unlikely to happen. Often, where technology is concerned, there needs to be a shift in teachers' perceptions of themselves as experts in teaching the children new knowledge and skills towards being learners alongside the child (Feasey & Still, 2006). Kennington and Meaton (2009) explain how the teacher and the child can learn together and experience the awe and wonder technology can offer together.

As discussed earlier, active learning through play with first-hand experiences is considered the best way for young children to learn. As Hallström et al. (2015) suggest, however, use of technology is something to learn and it should not be ignored. Not only is it a skill, it also enables children to discover new learning and to develop new skills. Technology should, therefore, be part of children's play. They should be able to use technology in real-life situations, rather than as an add on, separate from the other areas of the curriculum. The EYFS (DfE, 2017) states that children should be 'resilient, capable, confident and self-assured' (Moylett et al., 2012: 2); Lindahl and Folkesson (2012) express how these types of qualities should be developed not only through traditional methods, but also through technological experiences.

The Effective Provision of Pre-school Education (EPPE) report (Sylva et al., 2004) found that while practitioners were worried about the amount of time children spent using technology, they did not role model good practice. They only found one setting where a parent helper used the computer to keep records of library loans (ibid.). In order for children to learn how to use technology effectively, they need to see its practical uses. Often findings show that practitioners provide positive feedback about how important technology is (Siraj- Blatchford et al., 2006; Sylva et al., 2004; Waller, 2005) but in practice, they fail to integrate it into the curriculum effectively (Siraj-Blatchford et al., 2006; Ertmer et al., 2012). Much of the teaching that was observed by EPPE when assessed by using the Early Childhood Environment Rating Scale (ECERS) was discovered to be inadequate (Siraj-Blatchford et al., 2006). Practitioners supported children for a few minutes, but largely left the children to work independently. When more time was spent with the children, it involved either observing or directing them, with little evidence of encouraging creativity or independence (Sylva et al., 2004).

2.3.2 – Issues with technology use in education

There are many reasons why early years teachers may be reluctant to use technology; so far, this review has considered specific early years teaching; however, there may be other more general issues. Ertmer (1999) described first and second order barriers to teachers' attitudes to technology. First order barriers were considered external barriers, such as access to hardware and software, provision of training, opportunity to practice and institutional policies. Second order barriers were composed of internal factors, beliefs, personal skills, confidence and approach. In follow up research, Ertmer et al. (2012) explained how many of the first order barriers are slowly being eliminated. As Kennington

and Meaton (2009) highlight, however, resources are often available but remain in their box in a cupboard. While such training may not be as accessible in PVI settings, it has still reduced the problem. There continues to be an issue with second order barriers regardless, despite better access to technology and training in its use. Many teachers do not feel confident in using software, hardware and this affects how they include it in their teaching (Aubrey & Dahl, 2008; Plowman et al., 2010c; Kennington & Meaton, 2009). Blackwell et al. (2014) point out that the issue may be that those in charge do not understand the need for technological experiences and this can have a powerful impact on the ethos of the setting. Teaching philosophy also has a powerful effect on the use of technology. Teachers who hold traditional beliefs design a teacher-centred curriculum and are therefore less inclined to engage with technology, whereas those with a more constructivist viewpoint adopt a student-centred approach and will develop ways of integrating technology into their teaching (Ertmer et al., 2012).

It is, however, important to consider the experiences the children have outside of school. Palaiologou (2016) investigated children's (aged from birth to five years) use of technology in the home across England, Greece, Malta and Luxembourg. Her findings were consistent across the four countries; children are becoming 'digitally fluent from a young age' (ibid.:1). From this, it is clear that children are learning to use technology from a very young age. Through interviews with parents, Palaiologou identified a concern that there was a difference between the technological experiences children received at home and those in school/nursery. They posited that this was due to a 'generational divide' (Palaiologou, 2016: 12). Plowman and McPake (2013: 31) observed that teachers tended to focus on using technology for what they could see as educational benefits 'rather than children's awareness of the different cultural and work-related uses of technology'.

Aubrey and Dahl (2008) investigated the use of technology in early years settings and explained that technology can contribute to three main areas of learning:

> • developing dispositions to learning that thread through personal, social and emotional development and across the EYFS in general;
> •extending knowledge and understanding of the world in the broadest sense of communication, language and literacy, problem solving, reasoning and numeracy, creative development and recreational/ playful behaviour; and
> •acquiring operational skills.
>
> (Aubrey & Dahl, 2008: 5)

Using technology in the early years setting can be a great equaliser for young children. A large number of young children will have access to technology of some description, but others may not (Campbell & Scotellaro, 2009). There was also a divide noticed between children who are confident with technology and the adults in settings who are not, since often the children are able to show the adults what to do (Zevenbergen & Logan, 2008). Great concerns are aired on a regular basis regarding the amount of time young children spend looking at a screen (Gurney-Reid, 2013; Bosely, 2012). Sigman (2012) is passionately opposed to children using screens and lists an array of medical issues, such as cardio-vascular disease and type 2 diabetes that could occur because of this. Sigman continues by saying that it is not simply the sedentary nature of looking at a screen, but that the excitement of game playing that causes raised blood pressure. This does not alter even if the games played are of an educational nature; the risks are the same (ibid.). In her article for the Guardian newspaper, Bosely (2012) interviewed a variety of experts about Sigman's claims and they were critical of his impartiality and expertise, as he has never conducted any research into the topic. This highlights how media hype can influence the populace, even when there is no research to support claims.

The issues that are highlighted are usually around the use of screens. This is not limited to computer technology, but also watching television. The American Academy of Paediatrics

(AAP) is frequently cited in articles for their policy, which states that parents should not allow their children access to television if they are under two years of age, though the AAP (Brown, 2011) highlights that, while they do not advocate a complete ban, they have recommended that watching television should be discouraged in this age group. They also state that some children may benefit from watching screens, depending on their ability and the presence of an adult to interact with them (ibid.). Their updated recommendations, however, include the comment 'media— both foreground and background— have potentially negative effects and no known positive effects for children younger than 2 years' (Brown, 2011: 4) indicating that even at this level there is no actual evidence that screens can cause harm. This recommendation has changed in the updated policy (AAP, 2016). The focus has moved to concerns regarding the lone use of screen technology by young children and advocating its use with parents and older children instead in order to prevent over-use and lack of socialisation. It is worth noting that there is a lack of research into the health effects that using technology might have on young children (Aubrey & Dahl, 2008; AAP, 2016). There is, however, research examining the social interaction during storytelling and problem-solving between children and parents that has concluded that using traditional books or digital stories had no bearing on the quality of the interaction (Eagle, 2012). Recently, Harding (2015) published an article regarding a head teacher's criticism of iPads and his belief that children did nothing but play on them, causing upper body weakness which leads to inability to hold a pencil. There was, however, no medical evidence to support this claim and no discussion as to how the children fared with other activities that required similar physical strength. Edwards (2013) researched the use of technology in the home with very young children and considered the attitudes of early years educators who question the effect of technology on:

> …imaginative play and, therefore, questioning whether it has a role in her educational experience, is a bit pointless. It is like asking whether or not using a pencil impacts a toddler's imaginative play and then debating whether pencils should be used in the early years. (Edwards, 2013: 3)

Searching for research into how the use of technology might affect children's educational outcomes proved to be difficult. When no progress was seen, the technology was often blamed instead of the level of training and support the teacher had received to use the resources in a positive way. The 'One Laptop Per Child' research was designed to improve the education of children living in areas of deprivation across the world. According to Warschauer and Ames (2010), the research has not been as successful as anticipated due to a variety of financial and infrastructure issues. Warschauer and Ames go on to point out that the research did not begin with a pilot or an assessment of impact and consider that the belief that giving children a laptop and letting them teach themselves reflects a focus on the technology rather than the children. Cristia et al. (2012) commented that the 'One Laptop Per Child' research appeared not to improve outcomes for children in mathematics or literacy and the authors recommended that government funds be put to better use. The software provided was, however, not tailored to the children's needs. As the authors themselves highlight, there was an 'absence of clear instructions to teachers about which activities to use for specific curricular goals' (Cristia et al., 2012: 3). Trucano (2005) pointed to some pertinent issues in his report, identifying that while there is a strong belief that technology will enhance outcomes for children, there is little evidence of this, indeed, he found that technology is not used as an integral part of education. The report made it clear that one of the greatest issues is that the technology is considered first and how it can be applied is an afterthought. Reasons for this are cited as the lack of an underpinning pedagogy, unclear goals, different uses of ICT between subjects and placement of IT resources. If all PCs are in a computer suite, they can only be used at pre-organised times for

planned purposes, not regularly to enhance learning and skill acquisition. It is interesting to consider findings from research by Mitra (2012), who placed a PC in a wall in Delhi, India, and left it there for children to use independently. He found that within three months, children had taught themselves a wide variety of computing skills by playing, experimenting and working collaboratively. This suggests that the issue in the UK could be the teachers who are controlling the technology.

The lack of conclusive evidence as to whether the use of technology is effective in improving outcomes is not as negative as it first appears. There is also a lack of evidence to state that it does not improve outcomes as well. Piper et al. (2016) explained that technology needs to be appropriate for a particular purpose and that the teacher needs to be trained in its use, as well as taking the learning needs of the students into consideration. Only then can effective learning take place. There may be an issue due to the date of the publications, as digital resources have developed rapidly over the last three decades. Examples of this are Healy (2001), who examined how computers affect children's minds; Brooker and Blatchford (2002) and McGivern et al. (2007) who focused on the software available for young children to access on a PC; Muellar et al. (2008) considered the different approaches and attitudes of teachers who did or did not integrate computers in their classrooms. Gibbons (2006) expanded on this to add televisions and cameras to the discussion. Abbott et al. (2010) only referred to computers, as did Donnelly and Lambourne (2011); Lindahl and Folkesson (2012) and Adams (2011: 21) added 'new technologies, which illustrates a slowly developing awareness that computers are not the only available technologies in settings.

There are a wide variety of concerns regarding the use of technology with young children, ranging from teachers' personal experiences, confidence and beliefs regarding early years pedagogy to concerns about health and development. The research design for this study

ensured that data were collected to allow an insight into these issues and to enable a clear response to the first research question.

2.4 - How can technology support children's learning?

The third research question asks, 'How does the teacher's understanding of available technologies, the need for sound underpinning pedagogy and appropriate content, support learning opportunities for young children to enable them to move confidently to the next steps in their learning?' To develop a response to this, it is necessary to investigate the ways in which technology can be used to support children in their learning. This section examines how technology can be used to make content both more accessible and challenging for young children, including those with Special Educational Needs (SEN).

A growing area of interest, as yet with limited research, is into the use of technologies with children who have SEN. One of the case studies in this research is set in a primary special school and the perspective of the case study on the use of technology provides an insight into its potential to improve learning experiences for young children with SEN. Inclusive practice is promoted throughout the Early Years Foundation Stage (DfE, 2017), and more children with SEN have the opportunity to attend local settings rather than special schools. Thornton and Underwood (2013) differentiate between integration and inclusive practice, as there are important variances.

> Integration is a process of assimilation where the onus is on providing a child who has SEN with teaching or resources to enable them to fit in and succeed in a mainstream school. By contrast, inclusion is seen as a process of accommodation where the mainstream school restructures itself to be better able to meet the needs of all pupils.
>
> (Parkinson, 2015, in O'Donnell & Birch, 2015: 119)

Children with Autistic Spectrum Disorder (ASD) have difficulty understanding social situations. The use of technology can help to address this (Mintz et al., 2012). Research by Hayes et al. (2010) investigated the use of technology to create interactive visual cues. This in-depth, qualitative investigation revealed that the technology used improved communication and interaction between the children and their carers. As ASD may present in a variety of ways in individuals diagnosed with the condition, teachers need to adopt many and varied approaches to develop their learning and using technology can support this (ibid.). Conversely, Foley and Ferri (2012) expressed the concern that, by using technology, the teacher is creating new obstacles to overcome. The authors question if the technology in this case actually supports accessibility or creates a different form of isolation and social exclusion. This is clearly dependent upon the individual's needs, as Porayska-Pomsta et al. (2011) believe that children with ASD may well have an affinity for technology. As it is so adaptable, it is able to support the personalisation of learning for a unique combination of requirements. They do specify the need for the technology to have human characteristics to create more natural interactions. Cook (2011) explains how the use of technologies can provide multiple methods of engagement, action and expression. With the support of teachers who understand how to utilise these qualities to the best effect, all children can be included in the learning process (Lyons & Tredwell, 2015). These qualities are important for all children, as the variety of abilities in every class can be broad. By using digital resources, less able children are able to access content that may not be available to them otherwise (ibid.).

Plowman et al. (2010c: 82) found that in general, practitioners felt that there were three main styles of learning supported through the use of technology, 'extending knowledge of the world, acquiring operational skills and developing dispositions to learn'. In this instance

knowledge of the world refers to subject knowledge of all curriculum areas (ibid.). In an earlier study, Marsh et al. (2005) described how practitioners had identified an unexpected improvement in less able children and children with English as an Additional Language (EAL) in their communication and language skills. Using the technology and games involving characters they knew and liked had given them added confidence and enthusiasm. This had also been apparent in their engagement with literacy activities, with children extending their skills to try new tasks and succeeding (ibid.). Different forms of technology can create learning opportunities, which require children to use a variety of senses (Pasnik, 2007). Barron et al. (2011) concluded that technology best supported young children when it was used to enhance engagement, enable reflection and extend their learning. While Plowman et al. (2010b) found that technologies were used to promote all areas of the curriculum, Stephen (2012) discovered that teachers in their study were far more comfortable using it for maths and literacy, as these were the areas they had been given the most training in. Examining literature for this review identified that there were many examples of research focussing on these two subjects; literacy being a main focus with maths someway behind. This is because, as Hopkins et al. (2013: 24) explain, 'literacy and numeracy are core life skills, the acquisition of which have profound consequences for individuals'. It is, however, important to note that technology has a wide range of capabilities which allow it to support learning across all curriculum areas. A useful tool to support early years teachers in their self-assessment of technological provision is the Early Childhood Environment Rating Scales (ECERS) for ICT (Siraj-Blatchford, 2014), which provides a scale of quality for ICT in early years provision. This scale enables teachers to evaluate their provision and evaluate how they can develop this further. Table 2 sets out the areas for assessment and the indicators of excellent practice.

Access and control of ICT tools	The children are encouraged and supported in information retrieval (e.g. in accessing a CD-Rom encyclopaedia) to help them answer a question).
	The children are encouraged in their play to control a wide range of real and/or pretend technologies (e.g. alarms, washing machines, video recorders etc).
	Computer software is available to support learning in all subject areas across the curriculum.
	Attention is routinely drawn to the programming in the setting and at home
	The children are engaged in problem solving activities that involve programming
Information handling and Communication Skills	Children are encouraged to use ICT to share their ideas and discoveries with peers (e.g. displaying their painting in a display or the centre's web page).
	The children are encouraged to provide initial instruction and to help each other in using new programmes and applications.
	ICT activities are developed in collaboration with parents and carers.
	Children are encouraged to use generic software and other applications for their own purposes (e.g. using a paint programme to make a birthday card for a parent).
	The children are engaged in problem solving activities that involve programming
Learning about the uses of ICT	The children are encouraged to provide narrative accounts of their own and others' interactions with ICT (e.g. of scanning products through a supermarket checkout, using a cash point, ICT at home).
	The staff provide instruction in new applications as a direct response to a child or to a group of children's interests or expressed needs.
	ICT is integrated into a range of socio-dramatic play environments (e.g. in a 'shop' or an 'office' play environment).

Table 2: Indicators of excellent practice ECERS-ICT (327 Matters, 2014)

The original document lists a range of provision, allowing the teacher to assess their provision with regards to ICT. This allows them to see how they can develop their approach and improve children's engagement with digital resources as they play.

Research active early years experts, such as Siraj -Blatchford, Marsh, Palaiologou, Plowman, and Stephen, highlight the need to integrate technology into the curriculum and give credence to the argument. They also provide sound evidence of how it can be used positively to support children's learning. This study adds to the evidence that understanding the way technology, pedagogy and content can be integrated can give young children a positive, constructive understanding of technology as a learning tool.

2.5 - Technological, Pedagogical and Content Knowledge

This section continues to investigate the literature to provide a detailed background to the third research question. To support the response to this question, it is necessary to consider how using the TPACK framework (Figure 3) can help analysis of the interrelations between the teachers' knowledge of the technology, content and pedagogy. The TPACK framework was chosen because it illustrates the relationship technology has with content and pedagogy, along with supporting the idea that technology needs to be considered as a tool to support all areas of the curriculum, to create effective learning experiences for the children. Good understanding of the interrelationship between the three elements can then support this use of technology and encourage the same depth of learning taken for granted with other approaches. Forest schools, where teachers use special outdoor spaces to develop all areas of children's learning and development using the natural environment, are a good example of this. Children are encouraged to risk assess themselves, which allows them to an awareness of safety issues and to explore through play using the outdoor

environment as a resource to extend their learning (Pace, 2014). There are risks associated with the use of technology, internet safety, health, content used. Technology can, however, be viewed as an alternative environment where the same principles can be adopted.

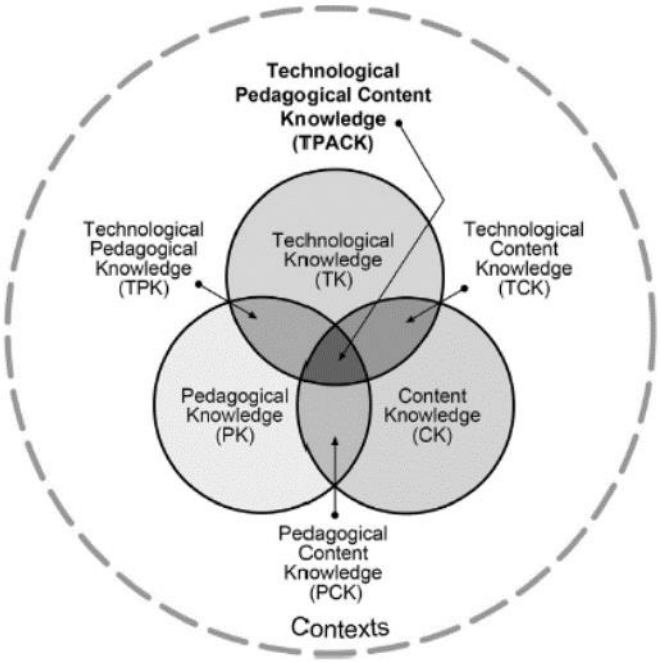

Figure 3: TPACK framework reproduced by permission of the publisher, © 2012 by tpack.org.

Technology has the ability to transform the way tasks can be approached. This has been the key consideration in the design of digital resources (Harris & Hoffer, 2011). The marketing approach is to highlight what software can do, relate it to specific skills and research; training is general to make it accessible to a wide variety of individuals (ibid.). Without specific understanding and clear links to underpinning pedagogy, however, it is clear that these approaches could have a limited impact (Cristia et al., 2012; Abbott et al., 2010; Gibbons, 2006). To highlight the positive capabilities of technology it is essential to consider several areas in depth. For the purpose of this research, the TPACK framework was selected, as it had the necessary components to analyse the data in the most effective manner. This framework has been utilised in many research to investigate practice in a variety of contexts.

In their review of the literature, Kopcha et al. (2014) found a diverse range of definitions for each of the seven domains of TPACK, which led to confusion and lack of consistency in findings. It has been suggested that the framework suffers from the 'Goldilocks Principle' (Brantley-Dias & Ertmer, 2013: 104) in that the framework is too big to consider with such a wide variety of categories. As a result of this, the definitions of the categories are divided into such small sections that they may be indistinguishable from each other. While Hofer and Grandgenett (2012) collected detailed informative data using the TPACK framework, they did highlight the possibility that, without clear guidelines, there was the potential for participants to give too much or too little reflection.

It is important to consider the purpose of employing the TPACK framework in a research such as this. I needed to establish what it could provide to enhance the discussion. Brueck and Lenhart (2015) explained that, while the main domains of technology, pedagogy and content are crucially important components in a teacher's use of technology in the classroom, understanding 'the dynamic, transactional relationship' (ibid.: 375) of the smaller intersections between the domains makes the most impact on the children's experience and learning. In their investigation and analysis regarding the use of social networking sites to deliver a higher education course in Ireland, which was done using TPACK, Glowatz and O'Brien (2015) gave clear definitions to each of the domains and explanations regarding how they would find the evidence. They concluded that TPACK provides a heuristic tool to understand the dynamics involved in engaging students and that the lecturers who understood all the domains achieved a greater impact on the student experience.

Developing a specific taxonomy for the research provided clarity in Harris and Hofer's research into the TPACK framework in action (2011). They ensured that the priority in planning was the content rather than the technology. The content to be delivered and

understanding how specific technologies could support teachers to adopt a 'conscious, strategic and varied' (Harris & Hofer, 2011: 211) approach, addresses Papert's concern regarding technocentricity (Papert, 1987) and will be discussed in more depth in Chapter 3. In an analysis of literature regarding TPACK, Voogt et al. (2013) examined 61 articles. Within them, there were frequent references to the fluidity of the framework (Cox & Graham, 2009; Doering et al., 2009; Bowers & Stephens, 2011), which gives it a flexibility that many frameworks do not possess. This flexibility enables it to be adapted for specific subjects, as aspects for the domains will frequently differ depending on the subject focus (Voogt et al., 2013). The requirements of early years education, with a focus on play and active learning, are different to other age ranges. The flexibility of TPACK lends itself readily to the analysis of practice in this area.

2.6 - Summary of Chapter 2

Considering the demands of the three research questions, this chapter has examined a wide range of previous research. It discussed how the current active learning approach used in early years care and education in England developed. It also investigated the influence of government policies, as they have had a great impact on practice. Discussing these influences was crucial to the literature review in order to provide an in-depth response to the research questions and provide the context for the current research study.

Research into attitudes and issues both for and against the use of technology with young children have been considered, finding that there are barriers pertinent to teachers of all age phases and some more specific to early years. The review has also analysed external influences on the early years curriculum and examined positive approaches, as well as

understandings which highlight the benefits that using technology creatively can have on young children's learning and development. The importance of a play-based curriculum has been discussed and the issue in defining what play is has been highlighted. The above framework gives rise to the question: 'How can technology be included in play?'

The literature also considered how early years teachers aim to build on what the child can do, using information of children's experiences outside of the classroom, except for technology. There were suggestions that teachers underestimate children's understanding and skills with technology and in some cases and limit the children's experiences because of this. Concern was also raised that technology is considered only as a support for other subjects rather than a way forward in and of itself.

The chapter concluded with an overview of the TPACK framework as used in an educational context and aimed clarify how each of the domains and their intersections relate to early years teaching. Chapter 3 will examine each in detail and identify how such practice can be identified in the EYFS. This theoretical discussion clarified current thinking and was critical in the development of the research design, which is discussed in Chapter 4.

Chapter 3 – Technological, Pedagogical and Content Knowledge in the Early Years

3.1 - Introduction to Chapter 3

As discussed in Chapter 1, the TPACK framework provides a clear overview of the essential domains that support teaching with technology. The method of data analysis chosen for the research is Direct Content Analysis (DCA), to be discussed in detail in Chapter 4; however, in order to use this method, a clear definition of how these domains appear in an early years environment was required. I aimed to discover how the range of experience and understanding of the use of technology held by early years teachers affected the provision for children in their settings. Establishing what this may entail enabled me to respond to the first research question, but to do this, I had to establish what 'Technological Knowledge' in this environment might mean. To respond to the second research question, 'How can the use of technology enhance the children's learning experience?' a clear understanding of what constituted Pedagogical and Content Knowledge in early years provision was required. The final question asks how the teacher's understanding of available technologies, the need for sound underpinning pedagogy and appropriate content, and the provision of opportunities for young children enables them to move confidently to the next steps in their learning. An understanding not only of each of the domains, but also of how they interact with each other to develop practice was required.

As was evident from the review of the literature in Chapter 2, the use of technology in education is becoming more prolific. The government is making demands for children to engage with technology (DfE, 2017), businesses (Livingstone & Hope, 2011) and society (Kritt & Winegar, 2010) competently and confidently. All of this, places great pressure on the teachers who are expected to meet these demands and as discussed in Chapter 2, many

barriers may prevent them from doing so. This pressure can lead to the use of technology being a token gesture to meet requirements rather than a useful tool to encourage engagement and extend learning. Use of technology has been somewhat 'technocentric'; Papert (1987) discussed how he used Piaget and Inhelder's (1956) consideration of the 'egocentric' child to arrive at the term. As Piaget and Inhelder were describing the natural character of a young child where all questions are considered from their own perspective, Papert explained that 'technocentric' means that all issues are referred back to the technology. The technology is the important factor and everything is designed around it. In an interview in 2003, Papert expressed the need for this technocentric behaviour to stop and for educationalists to take control of what they need to develop children's learning and to tell the industry exactly what to produce (Papert, 2003).

This chapter will examine all three domains and the four intersections of TPACK (technology, pedagogy, content, technology and pedagogy, technology and content, pedagogy and content, technology, pedagogy and content) and what criteria indicate their presence in an early years context. Each section will conclude with a summary of the indicators that will be used to analyse each element in each of the four case studies in Chapter 5.

3.1.2 Characteristics of TPACK

In order to create a clear picture of the practice using technology in early years settings, I deconstructed each element of the TPACK framework and considered how they relate to early years practice, summarising the characteristics of each. I used Mishra and Koehler's (2006) descriptions as a general basis (Table 3) and considered their meanings in an early years context. This enabled me to classify the data appropriately and justify my conclusions.

Domain or Intersection	Mishra & Koehler (2006) Descriptors
Technological Knowledge	The skills required to operate particular technologies, this includes knowledge of operating systems and computer hardware, and the ability to use standard sets of software tools such as word processors, spreadsheets, browsers, and e-mail. TK includes knowledge of how to install and remove peripheral devices, install and remove software programs, and create and archive documents. The ability to learn and adapt to new technologies
Pedagogical Knowledge	A deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims. This is a generic form of knowledge that is involved in all issues of student learning, classroom management, lesson plan development and implementation. It includes knowledge about techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating student understanding. A teacher with deep pedagogical knowledge understands how students construct knowledge, acquire skills, and develop habits of mind and positive dispositions toward learning. As such, pedagogical knowledge requires an understanding of cognitive, social, and developmental theories of learning and how they apply to students in their classroom.
Content Knowledge	The actual subject matter that is to be learned or taught. teachers must know and understand the subjects that they teach, including knowledge of central facts, concepts, theories, and procedures within a given field; knowledge of explanatory frameworks that organize and connect ideas; and knowledge of the rules of evidence and proof (Shulman, 1986). Teachers must also understand the nature of knowledge and inquiry in different fields
Technological, Pedagogical Knowledge	Knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies. This might include an understanding that a range of tools exists for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies
Technological, Content Knowledge	Knowledge about the manner in which technology and content are reciprocally related. Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology

Domain or Intersection	Mishra & Koehler (2006) Descriptors
Pedagogical, Content Knowledge	This knowledge includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching. PCK is concerned with the representation and formulation of concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology. It also involves knowledge of teaching strategies that incorporate appropriate conceptual representations in order to address learner difficulties and misconceptions and foster meaningful understanding.
Technological, Pedagogical And Content Knowledge	An emergent form of knowledge that goes beyond all three components (content, pedagogy, and technology). This knowledge is different from knowledge of a disciplinary or technology expert and also from the general pedagogical knowledge shared by teachers across disciplines. TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones.

Table 3: : Summary of definitions of domains and intersections of TPACK (Mishra & Koehler, 2006: 1026 – 1029)

3.2 - What is Technological Knowledge in early years education?

Table 3 explains the generic definition of Technological Knowledge (TK). Using technology with young children does not necessarily require such complex skills. It does, however, require an understanding of what technology is and alongside this, an understanding of the digital resources available, confidence and appreciation of technology as a tool, and the ability to role model its use in everyday situations.

Reading through the literature available regarding technology in the early years, a lack of consistency about what technology means to different authors is apparent. This may be due to the date of publication and the rapid advances that occur in technological development and accessibility, as discussed in Chapter 2.

Aubrey and Dahl (2008) began to develop the definition of technology in early years through their review of the use of ICT in early years settings for the British Educational Communications and Technology Agency (BECTA). They collated previous research and presented a clear picture of the types of technologies being utilised in early years settings. Their research demonstrated a wide array of resources (see Table 4).

Voice Recorders	Laptop and Handheld Computers
E Mail	Traffic Lights and Zebra Crossings
Internet	DVD
Digital Cameras	'Walkie-Talkies'
'Smart' Toys	Dance Mats
Camcorders	Electronic Microscopes
Robots	Interactive Whiteboards
Touch Screens	CCTV
Barcode Scanners	Calculators
Cash Machines	Computers
Dishwashers and Washing Machines	Electronic Games and Toys
Microwave Ovens	Photocopiers
Telephones	Television

Table 4: Overview of technology often found in early years settings (Aubrey & Dahl, 2008: 15).

This has been extended progressively since then as new technology becomes available, as evidenced in research by Blackwell et al. (2013; 2014) who included iPods, iPod touch, e-readers, tablets, and light tables. Many have started to use collective terms to refer to these, such as 'technologies'; 'IT'; 'ICT' or 'new technologies' in order to be concise when discussing the topic, however, it is worth considering the effect of this, particularly when reflecting on the sometimes negative attitudes towards 'technology' as a generic term, as mentioned previously. It is therefore important in any research considering technology, to define what the term actually means for the purpose of the research.

This investigation initially focused on the use of tablet technology, but as the research design and processes were being developed, it became apparent that it needed to embrace

wider range of resources. Plowman (2015) clearly identified the technology used in her research as:

> devices such as desktop and notebook computers, mobile phones, MP3 players, televisions and games consoles and the products or outputs—such as DVDs, websites, games and interactive stories—that are viewed, read, played or created on these devices. All the children also had technological toys, including play laptops or robotic dogs. (Plowman, 2015: 34)

Palaiologou (2016: 8) ensured that as part of her data collection, the types of technology were identified, grouping them into 'Television based, computer based and internet-based activities'. When the terminology is defined, it becomes easier to establish the capabilities of different resources.

The variety of early years appropriate technology is constantly growing, and possibly this is why terminology for it in research is vague, using terms such as 'digital technologies' (Palaiologou, 2016; Blackwell et al., 2014; Eagle, 2012); 'educational technology' (Abbott et al., 2010); 'Information Communication Technology (ICT)' (Campbell & Scotellaro, 2009). This loose terminology adds longevity to research; however, as previously discussed, it can be used as a generalisation and this hinders the understanding of the specific capabilities of particular resources.

Clark (2011) discussed the range of technological resources available for young children. The products available range from cameras and camcorders to programmable toys, language resources, instruments, light boxes, dance mats, home corner, and role play, the list is continuously growing (see Appendix 1). Interestingly she does not mention computers, laptops, tablets or software. As previously discussed, opponents of technology in early years education focus on the use of these; Siraj-Blatchford et al. (2006) highlight how using age-appropriate technologies and multipurpose software could lead to far more possibilities than specific programmes that limit experiences. Wohlwend (2015) discusses how she

created a film studio with pre-school children and supported and encouraged them to explore the cameras with teachers who would encourage the children to work independently. Wohlwend does comment on the fact that the adults believed that they needed to be in charge of the technology and that it took some time to convince them to let the children take control (ibid.). This is supported by Hamilton (2015) who suggests that as children gain confidence with digital resources, the teacher loses some control over the activity; this can lead to insecurity as it is a change from normal practice. This raises the question of how adult attitudes have an impact on the digital experiences with which children engage.

Teo (2011:2433) investigated potential constructs which influenced teachers' engagement with technology in the learning environment (Table 5):

Construct	Operational Definition
Perceived usefulness	The degree to which a teacher believes that using technology would enhance his or her job performance (adapted from Davis, 1989).
Perceived ease of use	The degree to which a teacher believes that using technology would be free of effort (adapted from Davis, 1989).
Subjective norm	Subjective norm (SN) The extent to which a teacher perceives that most people who are important to him think he should or should not use technology (adapted from Fishbein & Ajzen, 1975).
Perceived behavioural control	The degree to which person perceives how easy or difficult it would be to perform a behaviour (Ajzen, 1991).
Facilitating conditions	The extent to which a teacher believes that factors in the environment influence his or her decision to use technology (adapted from Thompson et al., 1991).
Attitude towards use	The extent to which a teacher possesses positive feelings about using technology (adapted from Fishbein & Ajzen, 1975).
Behavioural intention to use	The degree of a teacher's willingness to use technology (adapted from Davis, 1989).

Table 5: Constructs influencing teachers' uptake of technology (Teo, 2011:2433)

Teo's constructs illustrate the importance of the teacher's personal thoughts, feelings and attitudes in their engagement with technology.

Resnick (2002: 32) highlights how technology has the potential to create a 'Learning Revolution'. He also suggests that while there is potential for this, it is not guaranteed as evidence points to technology being incorporated into traditional pedagogies rather than instigating new approaches. The adherence to tried and tested teaching styles is highlighted as a difficulty by Hamilton (2015) who raises students' changing expectations. As they become more digitally tethered, that is always available through digital media (Savin-Baden, 2015), they expect teachers to use technology in their lessons (Teo, 2011). While these thoughts relate more to older students, the behaviours and expectations of younger children are also changing. Gutnick et al. (2011) found that children began with a focus on television-based activities and made a shift to computer and internet-based activities at around eight years of age. Palaiologou (2016) revealed in her research that this age had lowered to between three and four years. The increasing accessibility of digital technologies enables children to engage with them at an increasingly younger age; this enables young children to gain increasing confidence in their use. Teachers could utilise this to develop learning opportunities.

3.2.1 - What evidence demonstrates Technological Knowledge?

Considering Mishra and Koehler's (2006) definitions in Table 3, I have identified specific criteria for early years teaching. These will be examined from the data to underpin the discussion regarding the teachers' Technological Knowledge.

From the discussion in the previous section, Technological Knowledge can be defined as evidence of the teachers' own personal use of and confidence with technology. While it is clear that for guidance, research, and publications, using more general terms ensures that texts remain current for longer, for the purposes of practice and promoting the understanding of educators, more specific definitions are needed in order to highlight the particular capabilities of individual technologies. In this study, 'technology' will include electronic games, programmable toys, touch screen devices, personal computers, any resources which can capture images, play and record audio, and devices which can be connected to a PC to allow for greater exploration and learning.

I referred to planning, for its use to engage the children, to support, consolidate and enhance learning. I also established the teachers' experience and confidence with technology. There may have been elements of role modelling and direction initially to ensure the children understood how to use the technology safely and appropriately, but this would assist the children to develop their confidence and lead on to more independent use. This is perhaps the most fluid part of the TPACK framework, as technology may change frequently in quite a short period of time. For the purpose of this research, however, it will enable me to find evidence to construct a detailed response to the first research question in particular and contribute to the second and third.

3.3 - What is Pedagogical Knowledge in early years education?

The way in which early years pedagogy has evolved has been discussed in previous chapters and the current principles and practice established as a play-based curriculum. This chapter will consider the aspects of Pedagogical Knowledge (PK) as defined in Table 3, clarifying the

definition of 'early years pedagogy' and explaining what data will be analysed to provide responses to the research questions.

Pedagogy can be described as 'the art of teaching' according to McInnes et al. (2011: 121); it is not one defined approach however. As with all forms of art, there is a flexibility to adapt to one's beliefs and principles, but within this flexibility is the need to comply with prescribed expectations of other agencies such as Ofsted and government frameworks (Moyles et al., 2001). Pedagogy is frequently interchanged with teaching; however, Beckley (2013) explained the diversity of definitions of the term and Palaiologou (2013) concluded that while teaching is an element of pedagogy, it is the philosophy underpinning the teaching that becomes pedagogy.

Bernstein (2000) expresses the concept of classification and framing as fundamental influences on pedagogy. When there are clear divisions between subjects, the classification is strong; this can lead to difficulty in 'pedagogic discourse' between educators of the different classifications (Bernstein, 2000: 10). In early years education, where children learn through play and active learning, the boundaries between subjects are blurred, so there is a weak classification, but this leads to a rich pedagogic discourse as all early years educators will have commonalities. 'Framing' relates to the communication with the stakeholders involved; strong framing gives the 'transmitter' (teacher) the power and weak framing gives the 'acquirer' (learner) more power (Bernstein, 2000: 13). He expressed the notion that often the acquirer appears to have more 'apparent' power, implying that this may be false, only giving the impression that the control has shifted. The type of classification and framing is particularly relevant to early years settings where the ideal is to have weak framing so that child-initiated play is a priority. This may well only be apparent power, however, as the

adult(s) may have very specific plans because of external demands (Roberts-Holmes, 2015) and may thus be paying lip service to encouraging child-initiated activities.

In 2004, Sylva et al. published the Effective Provision of Pre-school Education (EPPE) report. They researched practice in a wide variety of early years provision (141 different settings) and 3,000 children between the ages of three and seven years. This was a longitudinal study, initially for four years, to investigate how pre-school provision supported children's achievement to the end of Key Stage 1. The findings revealed that 'Sustained Shared Thinking' (SST) was an effective method of interaction (Sylva et al., 2004). Sustained shared thinking is a process many teachers perform when interacting with children. It was defined by Siraj-Blatchford et al. (2002: 8) as:

> An episode in which two or more individuals 'work together' in an intellectual way to solve a problem, clarify a concept, evaluate activities, extend a narrative etc. Both parties must contribute to the thinking and it must develop and extend the understanding.

Purdon (2016) researched the concept of sustained shared thinking and how early years teachers viewed it as a key skill. Her participants understood that it required practice to become proficient at using the technique to encourage young children to extend their thinking. The participants also highlighted another skill required to ensure quality interactions and that was not only to listen to the children, but to also hear what they say. Sargent (2009) explained how SST is based upon Piaget's concepts of children constructing their own learning and Vygotsky's extension of this, emphasising how important social interaction is to enable children to consider new thoughts and concepts. Article 12 of the UNCRC requires adults to listen to the voice of the child (United Nations, 1989) and Malaguzzi (1993) spoke of the 'hundred languages of children' which highlights the many ways young children communicate. Rinaldi (2006: 48) expanded on this, calling it a

'Pedagogy of Listening'; the adult must 'listen' to all the child's methods of communication and use this information to provide learning opportunities which are relevant to individual children, addressing their needs and providing the interest, support and motivation to extend their learning both directly and indirectly. This listening is recorded through observations and is then evaluated and the information acquired used to plan new experiences and activities to help them achieve their full potential (Palaiologou, 2013). The Study of Pedagogical Effectiveness in Early Learning (SPEEL) in 2001 highlighted the main aspects of effective early years pedagogy, defining it as:

> …both the behaviour of teaching and being able to talk about and reflect on teaching. Pedagogy encompasses both what practitioners actually DO and THINK and the principles, theories, perceptions and challenges that inform and shape it. It connects the relatively self-contained act of teaching and being an early years educator, with personal, cultural and community values (including care), curriculum structures and external influences. Pedagogy in the early years operates from a shared frame of reference (a mutual learning encounter) between the practitioner, the young child and his/her family (Moyles et al., 2001: 5).

While this is not a recent document, it is still highly relevant and underpins current practice. Creating a framework of pedagogy involved a year-long study of literature and practice in effective settings. The authors then conducted a thorough analysis of the data and the key findings were shared with participants in the study to ensure that a relevant, concise model was formed (see Figure 4) (Moyles et al., 2001: 4).

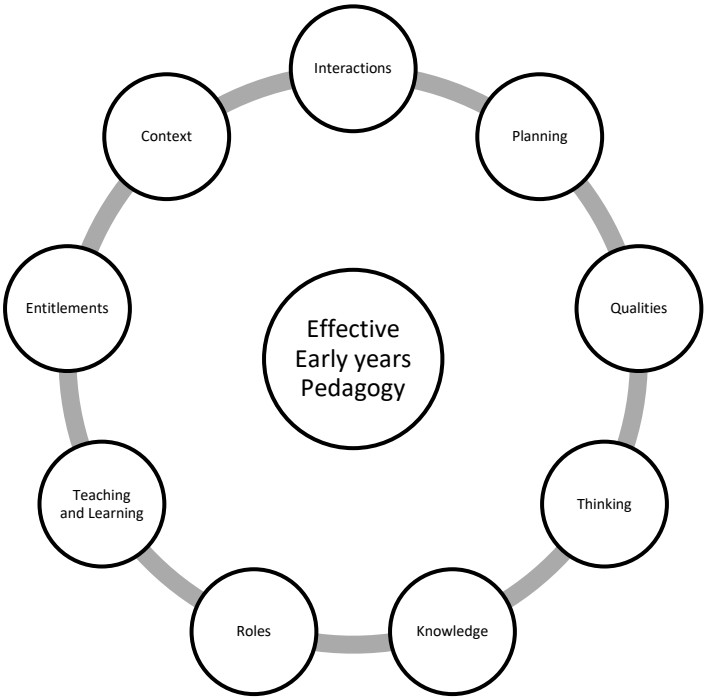

Figure 4: Effective Early Years Pedagogy (Moyles et al., 2001: 4).

Planning for children's learning is a complex process in early years education; it is viewed as a cycle, as seen in Figure 5.

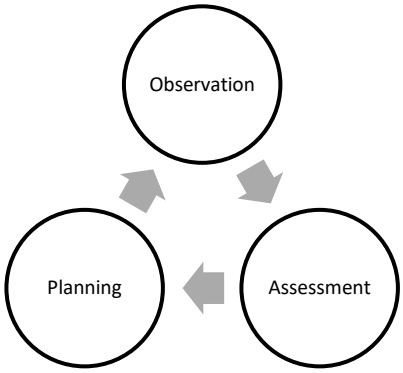

Figure 5: Teaching Cycle (Moylett et al., 2012: 3).

The cycle begins with observations of the individual children. Observations give the teacher a deep understanding of each child's interests, what they can do, and the understanding they currently have. Without this, the provision for the child will be inappropriate (Brodie, 2013b). From these observations, the teacher is able to assess the child's progress in the different areas of the curriculum, identify any gaps in understanding that need to be

supported with further experience, and enable progress against the developmental norms included in the Development Matters document (Moylett et al., 2012). It is, however, important to retain a flexibility in the plans, as often children's interests may take activities in very different directions to those the practitioner had planned (Hutchin, 2013). This information is all required to plan appropriate activities that will engage and stimulate the child to learn. Planning in the EYFS incorporates the Characteristics of Effective Learning, as presented in Figure 6.

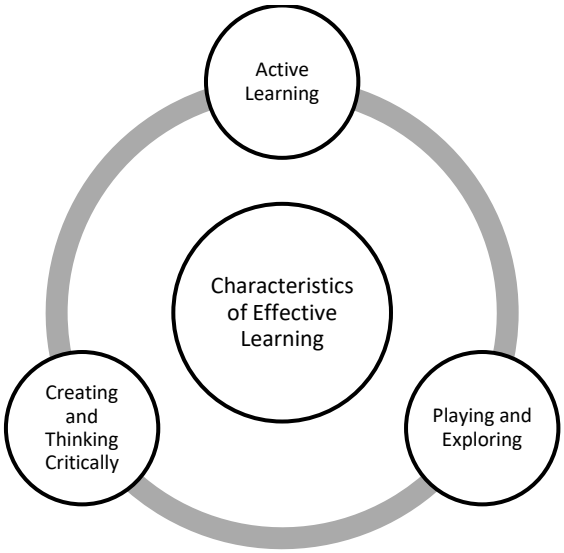

Figure 6: Characteristics of Effective Learning (Moylett et al., 2012).

Potentially, the most important aspect of this is active learning; through playing and exploring alongside opportunities to create and think critically, the children will be actively learning. This is explained as the motivation for engagement with activities; children will be involved and concentrate on what they are doing and when they encounter problems, they will persist rather than give up, gaining a sense of achievement (Moylett et al., 2012). Research in brain development (Perry, 2002; Paredes et al., 2016;) has highlighted the effects of stimuli on a young child's brain. This clearly demonstrates the importance of

active learning and engagement for young children and why early years teachers promote this approach.

Perry (2002) illustrated the importance of this through the use of the photograph below (Image 1):

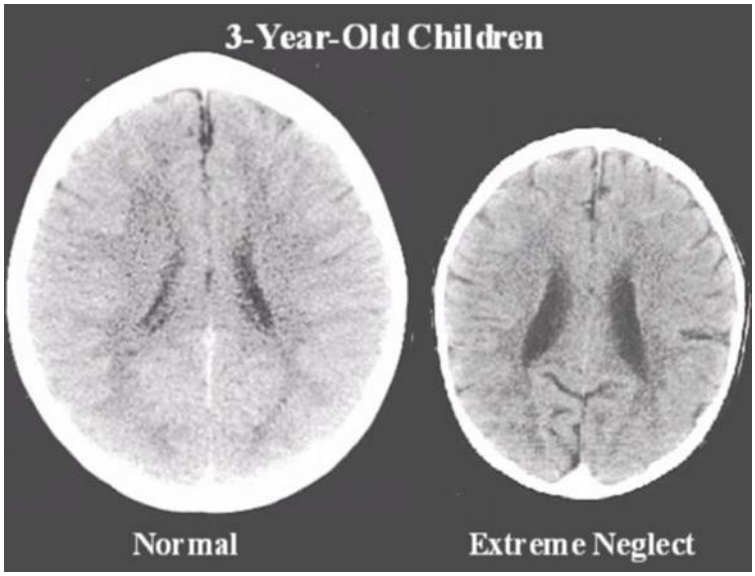

Image 1: Abnormal brain development following sensory neglect in early childhood. These images illustrate the negative impact of neglect on the developing brain. In the CT scan on the left is an image from a healthy three-year-old with an average head size (50th percentile). The image on the right is from a three-year-old child suffering from severe sensory-deprivation neglect. This child's brain is significantly smaller than average (3rd percentile) and has enlarged ventricles and cortical atrophy. (Perry, 2002: 93)

As can be seen from the image, the brain on the left is of a normal healthy three-year-old; the one on the right is of a three-year-old who has suffered extreme neglect. Without the stimulus of attachment, communication, interaction with others, and experiences, the normal development of neurones and synaptic pathways is seriously reduced. Active learning in the early years setting is essential to provide all young children, regardless of their home circumstances, with the opportunity to develop these areas in a healthy environment (Riley, 2007).

Figure 4 highlighted the early years teachers' professionalism and emphasised the need to have a deep knowledge of early years practice. This is achieved through an underpinning strong commitment to professional development. Taggart (2015) considered how early years teachers are in a complex position, torn between official requirements to provide

evidence of children's progress and their moral obligation to care for young children and encourage them to be independent learners. This is expanded on through the consideration of taught early years programmes and the expectation that 'Early Years Teacher trainees will 'understand attachment theory and 'communicate effectively'', but there is no expectation that they will develop in awareness of their capacity to care, the key disposition which gives rise to these same competencies' (Taggart, 2015: 382). Since the EPPE report was published in 2004, the emphasis has been on ensuring that all early years settings have well-qualified staff. Successive governments since 1997 have promoted this concept. While approaches have changed, there is still an acknowledgement that professional development is key to ensuring young children receive the best provision (DfE, 2012).

The discussion above establishes what current early years pedagogy focuses on and is relevant, as early years teachers' pedagogical approach to digital technologies is central to this research. It is accepted that engagement with technology is limited in the early years (Nuttall et al., 2013), but is it teachers' attitudes and lack of confidence that prevent them from engaging fully with technology or are there other reasons? Nuttall et al. (2013) concluded that early years practice has been laid down over many years well before digital technologies were available and that this takes precedence over new resources and their capabilities. Another consideration is that of the professional development available; they suggested that when it is accessed it is specific to certain technology and as highlighted earlier, has a technocentric approach. This may give teachers an overview of what the technology is capable of, but not its practical applications in an early years' environment.

3.3.1 - What evidence will demonstrate Pedagogical Knowledge?

Deconstructing how Pedagogical Knowledge appears in early years education enabled me to establish criteria to search for in the data. This begins with how early years teachers' approach teaching and learning, examining Bernstein's (2000) version of classification and framing in practice. This includes the impact of external influences, such as government directives on the teachers' practices. Evidence that the teachers listen to the children's voices and adapt their approach because of what they hear will also be sought. Considering this will highlight the importance of understanding how children learn and the importance of observation to establish their level of knowledge. Pedagogical Knowledge will also be seen in the teachers' understanding of how to involve children in active learning so that children are fully engaged in the learning process and can access the content being delivered in a purposeful way. This links to Mishra and Koehler's (2006) definition, as early years teachers are required to understand how young children learn and develop constructive attitudes towards learning.

3.4 - What is Content Knowledge in early years education?

Content Knowledge (CK) is knowledge about the subject matter that is to be learned or taught; in this case, the way young children acquire knowledge. How this can be assessed and the way it is taught may vary greatly between children, teachers, and settings. Since 1996 with the introduction of the first early years framework 'Nursery Education: Desirable Outcomes for Children's Learning on Entering Compulsory Education' (SCAA, 1996), there have been government frameworks that have influenced teachers in their choice of content. The settings children attend will use varied approaches to these frameworks depending on

training, experience, and qualifications (Brooker et al., 2010). Currently all settings must use the Early Years Foundation Stage framework to meet the children's learning needs. Knowledge and the nature of inquiry differ greatly among content areas. It is critically important that teachers understand the disciplinary 'habits of mind' appropriate to the subject matter that they teach. As Shulman (1986) noted, 'content' includes knowledge of concepts, theories, ideas, organisational frameworks, methods of evidence and proof. It also refers to established practices and approaches towards developing such knowledge in a particular discipline. In the case of art appreciation, for example, such knowledge would include knowledge of art history, famous paintings, sculptures, the influence of artists' historical and social contexts, as well as knowledge of aesthetic and psychological theories for understanding and evaluating art. The cost of teachers having an inadequate content-related knowledge base can be quite prohibitive; students can develop and retain epistemologically incorrect conceptions about and within the content area (Bransford, 2000).

An important factor to consider is the concept of the 'hidden curriculum'. There are various definitions; Carr and Landon (1999) found seven pertinent ones, and they use words such as 'unintended', 'implicit', 'unofficial', and 'collateral' to reinforce the notion that this is neither planned nor intended. It is the message children see in the everyday behaviour of staff, parents, and peers in the setting and it can send out a strong message. In reviewing literature regarding the hidden curriculum, it was surprising how little research has been carried out to establish its effect. Role modelling is considered very important in early years education through behaviour, thought processes and skills, as children mimic what they see (Marsh et al., 2005; McPake et al., 2005). Newberry et al. (2013) viewed the 'hidden curriculum' as the emotional responses of adults that children may notice and impersonate.

Implications of this may be that the adults' physical responses to their emotions regarding the use of technology could send the wrong message to children.

The framework currently being used to direct the content in early years settings is the Early Years Foundation Stage (DfE, 2017). The curriculum is divided into Prime Areas of Learning – Personal, Social and Emotional Development (PSED); Communication and Language (C&L) and Physical Development. These are regarded as the most important skills to develop in young children, without which the enthusiasm and curiosity required for more specific learning will not occur (DfE, 2017). The remaining four areas are Literacy, Mathematics, Understanding the World (UTW) and Expressive Arts and Design (EAD). These are known as the Specific Areas of Learning. Each area of learning is divided into elements and each of these has an Early Learning Goal, which each child will progress towards or achieve before they move to the National Curriculum Key Stage 1. There is a supplementary document 'Development Matters' (Moylett et al., 2012) which divides each area into developmental stages from birth to five years. This supports the early years teacher to analyse observations of children and assess their stage of learning and then plan to support them to move to the next step.

Interactions between adults and children are important; the teacher should understand the need to give time to develop a trusting relationship with each child (Lee, 2006). Good communication and high-quality interactions develop through these and because the adult has taken the time to develop the relationship. They understand the varying needs of the children they are focussing on and can tailor their approach towards each individual child (Basquill et al., 2011).

Interactions can be:

> Child Initiated – the child initiates a learning activity.
>
> Child Led – the child continues to take the lead throughout the activity.
>
> Adult Supported – Where the adult supports the child's learning by responding and reciprocating with him/her – optimally in a response to a request for support from the child for additional resources or adaptations; although can also be effectively offered through skilful, gentle intervention in order to extend the child's learning.
>
> Adult Initiated – Where an adult introduces an idea or resource to the children, possibly offering instruction or modelling its possibilities.
>
> Adult led – Where the adult takes and maintains a lead in the learning situation with an express purpose in terms of introducing specific ideas and language etc.
>
> (Allen & Whalley, 2010: 91)

While child-initiated play is understood as the most effective approach to young children's learning (Fisher, 2013), the role of adults in play is paramount (Beckley, 2013).

3.4.1 - What will demonstrate evidence of Content Knowledge?

Content Knowledge is evidence of early years teachers' understanding of the curriculum areas and the resources (including technology) that are available to enrich the children's experience and understanding. As will be discussed in this section, there needs to be an understanding of the hidden curriculum and how unintentional messages can influence children's learning. Data will be examined to determine if planned activities are child-led or adult-initiated and how this affects the learning experiences. The early years teacher should be flexible in their approach to ensure they meet the needs and interests of all children and from this provide opportunities to impart content knowledge.

The acquisition of evidence of 'PK' and 'CK' enabled me to develop an in-depth discussion of the second research question, which asked how learning was enhanced by technology.

3.5 - Areas of Intersection

Using the descriptions from Mishra and Koehler in in Table 3, the close examination of the major elements of TPACK and their application to early years education enabled the identification of the components of each intersection. The discussions in the previous sections of this chapter, underpin the intersections between the three domains, these will be considered in conjunction with the definitions in Table 6. This section will clarify the evidence for each element that will be considered in the data analysis.

Mishra and Koehler's (2006) definition of Technological, Pedagogical Knowledge (TPK) highlights the need to understand the capabilities of different technologies and the potential of these to change the teaching approach required. In the early years context, it means the understanding of how learning can change when a specific technology is introduced into a learning situation. The teacher will adapt their approach accordingly and develop children's skills in the use of the technology as a tool to enhance their understanding of the subject. I established the teachers' attitudes towards the use of technology in early years education, what training they had accessed to support them in using technology, how they planned for technology, and whether technology was used to change the usual approach to an activity and whether the learning achievements improved as a result of this. I also looked for evidence of the teachers' understanding of the capabilities of the technology they are using

The original definition of Pedagogical, Content Knowledge (PCK) relates to the knowledge of teaching approaches and a deep understanding of the content to be taught It requires the skill to adapt this to provide the best learning experiences for the students. Building on the students' prior experiences, knowledge and understanding are fundamental to this as it ensures that the learning experience is appropriate for their individual needs. Formative and

summative assessment processes are essential to identify issues and barriers to learning so that these can be addressed quickly and any difficulties overcome (Fisher, 2013).

In the early years context, Pedagogical Content Knowledge is teachers' understanding of the most appropriate approach for delivering content to children. The teacher requires a deep understanding of the children, gained through observation, assessment and sound relationships. The teacher needs to fully comprehend the theory underpinning the pedagogical approaches and be able to adapt these in order to support the children's individual needs. The criteria to discuss PCK for this study will be analysis of the observation, assessment and planning process, and the teaching approach used.

Technological Content Knowledge (TCK) is defined by Mishra and Koehler in Table 3 and focuses on the teachers understanding of how technology and content have a reciprocal relationship and how this can impact on both the content and the use of technology. In early years education, this translates into the way in which the teacher plans the content and is aware of how technology can change the approach and range of experiences. It is demonstrated through teachers' knowledge of the content to be taught and how the use of a digital resource supports children to access a deeper understanding.

The central intersection of Technological, Pedagogical and Content Knowledge is the most important element of the TPACK (also written by some authors as TPCK) framework. Koehler and Mishra (2005: 134) express that:

> Good teaching is not simply adding technology to the existing teaching and content domain. Rather, the introduction of technology causes the representation of new concepts and requires developing a sensitivity to the dynamic, transactional relationship between all three components suggested by the TPCK framework.

TPACK, therefore, is the understanding that develops from the engagement with all of the previous domains and intersections of the framework. In Table 3, Mishra and Koehler

express the importance of the teacher's understanding of the technology available to represent concepts in the most efficient manner. Furthermore, teachers need the skill to adapt pedagogical approaches to encourage children to engage with content as well as deep knowledge of the content. This allows for the development of creative approaches to support, consolidate, and extend children's learning. They emphasise the importance of understanding children's prior knowledge and using this to extend their learning

Teachers require an understanding of what technological resources are available and all the ways in which they can be used to support learning. Teachers need to apply their understanding to make appropriate use of the resources and also understand when it is not appropriate and other approaches would be more effective. The use of the technology is integral to the learning situation; it supports the pedagogical approach, engages the children, builds on their skills, interests and curiosity, and extends their learning. The content of the three intersections (TPK, PCK, and TPK), as discussed above, is the most important. The intersection of all three domains (Technological, Pedagogical and Content Knowledge) requires an understanding of all the criteria. When analysing the data for evidence of each of the four intersections as required in the original TPACK framework, there was much repetition and in the case of PCK, little that was relevant to the current study.

The intersection of all three domains forms the desired approach to the integration of technology in early years education and is therefore the crucial intersection. This understanding has led to the creation of a new framework, TPACK-EY, which will be presented in Section 4.8. Investigating each of the key components of TPACK in relation to early years teaching enabled the identification of key elements in the analysis of the data.

3.6 - Summary of Chapter 3

This chapter began by explaining the importance of establishing a clear understanding of how each of the TPACK domains and their intersections appear in early years provision. It clarified how understanding this enabled the data to be categorised into the relevant themes, which then provided clear evidence of the different domains and how the children's experiences were affected by them. This chapter also discussed the importance of digital technology in early years provision, as well as the three main domains of TPACK as they apply to early years practice. The chapter then explained how the intersections of these elements would appear in early years teaching (see Table 6). Finally, it clarified how the presence of these elements is indicated in the data from each case study in order to thoroughly analyse them.

Technological Knowledge Criteria	**Pedagogical Knowledge Criteria**	**Content Knowledge Criteria**	**Technological Pedagogical Knowledge Criteria**	**Technological Content Knowledge Criteria**	**Pedagogical Content Knowledge Criteria**	**Technological Pedagogical And Content Knowledge Criteria**
Personal Use of Technology	Classification and framing	Approach to EYFS	Teachers' attitudes towards technology in the early years	Planning for technology to enhance content	Teaching methods	Multiple interaction of all domains of the TPACK framework
Confidence with Technology	Active learning	Hidden Curriculum	Training to use technology	Using technology to vary content	Using the Observation Assessment and Planning cycle to deliver content to young children	Understand the best resource to develop a concept
Type and Use of Resources	Listening to the children's voice	Child Initiated or Adult Led	Planning and Practice			Build on children's understanding of technology
Understanding the Capabilities of Resources			Using technology to change learning experience			
Role Modelling						

Table 6: Table of indicative criteria of early years practice for each domain and intersection of the TPACK framework

Whether these elements are present or not will aid the discussion towards answering the research questions and arriving at a conclusion in Chapter 6.

As will be seen next in Chapter 4, defining the criteria for each domain and intersection, was essential in classifying the data to ensure it could be analysed with reference to the TPACK framework.

Chapter 4 - Methodology and Methods

4.1 - Introduction to Chapter 4

Chapter 1 outlined the context for this research, as well as considering its purpose and the questions it aimed to find answers to. In Chapter 2, I examined the literature regarding the development of early years pedagogy and the reasons why introducing new concepts of technology may not always be regarded positively. The main research question sought to discover how the Technological, Pedagogical and Content Knowledge (TPACK) of early years teachers in the use of technology improve learning experiences for young children. Chapter 3 deconstructed these elements and established what early years practices would constitute for each of them. This process enabled distinct criteria to be created, thus allowing me to clearly focus on pertinent evidence to find valid answers to the research questions. I was then able to design a research approach which would allow me to analyse the data in a systematic and robust way.

This chapter explains how I developed a multiple case study approach with four early years settings which enabled me to analyse data to answer the research questions in an effective manner. I aimed to describe and explore the phenomenon of the TPACK framework within a variety of early years settings, which would provide rich data and offer a variety of perspectives on a complex subject area.

I adopted a variety of methods to collect a range of data that would allow me to achieve an in-depth response to the research questions. In order to gain a clear picture of the use of technology and underpinning issues and strengths, various methods were adopted for data collection. Interviews (4.7.1) with the teachers gave a detailed view of their personal experiences and understanding. In addition, I had data from blog entries, which provided

the teachers with an opportunity to write a reflective account of their use of technology with the children. Using a variety of methods enabled me to view the use of technology in the settings from the teachers' perspective. Having the opportunity to contribute to the blog gave the teachers a chance to consider what they had said in interviews and add to it, but also to reflect on ideas that they thought of after we had spoken (Garza & Smith, 2015). There is always the possibility of socially desirable responses in interviews (Vésteinsdóttir et al., 2018) and adopting a case study approach provides the potential to triangulate the responses through analysing data collected through observation and documentary analysis as discussed below.

Observations (4.7.2), of the children and teachers engaged in the use of technology gave detail as to how the teachers used their understanding of the capabilities the resources possessed. Documentary evidence (4.7.3), such as records of children's development across the areas of the curriculum, known as learning journeys, illustrated the children's understanding and previous experiences of technology in the setting. The teachers' planning highlighted how technology was integrated into the curriculum.

Whilst case studies may be regarded as a controversial approach to research (Silverman, 2013; Thomas, 2015; Costley et al., 2010), they were ideal for my situation. Thomas (2015) explains that creating a case study enables you to look at the situation from many perspectives rather than the limited view many other methods afford. Foucault (cited in Rabinow & Rose, 2003: 249) called this a 'polyhedron of intelligibility' referring to the multiple dimensions investigated that create a three-dimensional picture of the cases being studied. My research questions demanded that a variety of perspectives be explored and analysed to find in-depth responses to them. As will be discussed in more detail later in this chapter, four settings were chosen, because, although they each taught the EYFS to 3-5-

year-olds, their individual characteristics were varied, allowing a broader view of practice. A single case study can provide rich in-depth data; however, by using four case studies the data is increased and findings are more robust. Using a multiple case study approach enables a testable theory with greater potential for generalisability (Eisenhardt & Graebner, 2007).

This chapter will also explain my role as a researcher, as well as my experience as an early years teacher and how it impacts on my ontological and epistemological stance for this research. It will explain how the four settings came to be selected for the case studies and briefly describe them. Conducting research involving children requires clear consideration and adherence to ethical requirements which will also be discussed.

4.2 - Designing the research

This study was designed to provide an in-depth view of 'real people in real situations' (Cohen et al., 2011: 289) which can be achieved through the case study approach. The use of technology to enhance children's learning experiences is a contemporary phenomenon, elements of which have been researched and discussed in Chapter 2.

I considered the variety of perspectives regarding case study approaches whilst making my decision to adopt this as my research methodology. As will be discussed in more detail later in this chapter, using a case study approach leads to a very specific study with a small number of participants, investigating their practice in depth was a positive way forward which would still enable me to respond to the questions I had set out in my initial proposal. Tetnowski (2015) describes how using a case study approach is particularly effective when multiple sources of evidence are utilised in order to achieve a clear understanding of the phenomena in a genuine context. It enables an analysis of the 'complexity of interaction'

(Tetnowski, 2015: 40) between the different elements of the phenomena being studied. This qualitative study was designed to analyse how early years teachers incorporated digital resources into their provision. A multiple case study methodology would be an effective approach in developing the analysis of the TPACK framework's wide variety of factors and their relationships and impact on the use of technology.

There seems to be a variety of perspectives when explaining what a case study approach is, Costley et al. (2010: 89) stated that it is 'not a methodology in itself: this is an approach that can draw on a variety of methods', Gray (2014) refers to it as a method. In this instance the multiple case studies are not simply a method but an overarching approach which defines the design, methods, and analysis employed. Thomas (2009) explained it as a focus rather than a method and while the study is focussed on the practice in these settings, it is for a wider discussion than simply their practice. Hyett et al. (2014: 1) examined case study approaches to discuss whether it could be considered a methodology or a method. They concluded that case studies as a methodology needed to 'provide a clear methodological description or justification relevant to case study…'. If this is not clear, the research becomes a 'case report method' (Hyett et al., 2014: 1) defined as such because of inconsistent methodological explanation and lack of clarity in the purpose and reasoning behind the use of the cases. It is necessary to ensure that there are clear explanations of the research paradigm, theoretical positioning, and methods used to acquire data provided so that study findings are both valuable and credible.

This piece of research has provided a clear paradigm and theoretical position, the methods are explained in detail and reasoning for the decisions made are explicit. It is important to note that in this study it is the practice across the cases that is important and that this is not a comparative case study. As such, Hyett et al.'s (2014) perspective is most appropriate as in

this piece of research, a case study methodology is utilised to investigate a variety of approaches to technology and findings are based on an analysis of these, rather than a 'case report method' which would have been more appropriate if practice were to be compared across the four settings.

This method of research may examine a single case or multiple cases; Yin (2009) explains how more than one case adds greater weight to the study, while Blaikie (2009) describes the use of case studies as ranging from descriptive - one case, to explanatory - multiple cases, as data can be compared and a localised generalisation of theory can be formulated. My intention for this research was to analyse practice across the four cases, not to compare them, but to consider how the components of the TPACK framework appear in differing environments, which would applicable across different contexts. The design of the presentation of findings was of particular importance to this research. Baxter and Jack (2008) suggest that there is no definitive approach to presenting the findings from a multiple case study, but suggest that the propositions of the study should be used as a guide. Yin (2013) also advocates returning to the initial propositions to ensure a focused analysis. In this study, the propositions arise from the domains and intersections of the TPACK framework and in order to present a full, in depth response to the research questions, the findings are presented as a cross-case analysis for each of these.

4.4 - The researcher

To rationalise my decisions in selecting the methodology and methods for this research, it is important to clarify my role as a researcher and my previous experience, which has influenced my ontological and epistemological stances. This will be explained in Section 4.5.

As explained in Chapter 1, my experience as an early years teacher and as a Senior Lecturer in Higher Education has nurtured a passion for ensuring that young children receive the best possible start in life. No matter what their family circumstances or social status, they should have the opportunity to learn through play, questioning and investigating without fear of failure. I personally view technology as a great resource which can be used to support, consolidate and extend children's learning and experiences. In my role as an early years teacher, I led practice in the use of technology to enhance children's learning from the beginning of the millennium, delivering in service training for the local authority, demonstrating the types of technologies available and particularly in how it could be implemented in order to improve children's knowledge, skills and understanding. The focus of this thesis is a result of my long-standing commitment to developing the use of Technology Enhanced Learning (TEL) and the fact that through my current role, I have opportunities to carry out observations in many settings which strengthened my belief that technology was not being used to its full potential.

The questions posed required insights into personal experiences, values and beliefs; Wallace and Atkins (2012: 20) explain that educational researchers have to accept the fact that educational research 'involves human beings and human beings are not predictable or static in the same way that inert materials or fixed numbers are'. Qualitative research designs enable this type of data to be collected and analysed in a robust way. Research into early years provision requires a flexibility and understanding that young children are often more unpredictable and active than adults. Experience as an early years teacher has given me a strong personal philosophy regarding active learning, which Woods (2017: 57) explains as the child's engagement, with activities leading to 'a transformation of ideas, materials and emerging skills'. My principal aim was to acquire data which would tell the story of the

teachers' understandings, experiences and beliefs, how they used technology in everyday situations, and how they integrated it into the children's play and active learning to support children's development in the curriculum subjects. As a qualitative researcher, my aim was to systematically analyse their stories to identify how key elements of practice linked to the TPACK framework and what effect these had on the children's learning experiences. Reflection is an accepted part of early years practice (Lindon & Trodd, 2016) and it was natural for me to adopt a reflective and holistic approach to the process, as Marshall and Rossman (2011) advocate. I aimed to enable the participating staff to engage with the process without feeling overly anxious. Gathering and using data was fundamentally crucial in my work and as suggested by Cohen et al. (2011), empowered and enabled me to use the data to develop my theory. Working closely with the participants enabled me to acquire a clear picture of the provision in each setting. There was a possibility that participants may have felt obliged to engage, as they had originally agreed to be part of the pilot study. They may not have wanted to express an honest opinion, as colleagues could feel annoyed or offended. This could have a very negative impact on the research process, so confidentiality and discretion were assured on an individual basis. This is discussed in detail in Section 4.9.

4.5 - Ontological and Epistemological Perspective

My perspective on the use of technology with young children has developed from my experience of teaching young children. I believe that early years teachers have their own perception of technology and interpret it in the way that aids them to engage with it in the classroom. Gray (2014: 19) considers that 'Ontology is the study of being, that is, the nature of existence and what constitutes reality'. It is important to examine the many perspectives that can be adopted regarding this. Jarvis (2012) emphasised the importance of clarifying

assumptions regarding social realities. My ontological approach derives from the belief that teachers' perspectives are constructed from their personal experiences and understandings of the everyday use of technology and that this influences their use of digital resources in the classroom. I will analyse the data to establish what everyday practice looks like to them. My experience and understanding will influence my interpretation when presenting the data. While this may be viewed as a form of bias, Roulston and Shelton (2015) articulated the importance of recognising that being subjective rather than objective is a form of bias which must be accepted in qualitative research. The previous section was written to ensure that readers are aware of my background and understand my experience and approach. As I have an interest in technology on a personal level and believe that while traditional approaches create a wealth of learning opportunities, technology is all around us. It is continually improving and providing new opportunities and it must not be ignored. I do not advocate that it should be used for everything, but if digital resources are able to enhance the children's experiences, supporting, consolidating and extending their learning, then they should be used.

I believe that there are many perspectives to the reality around us, not simply a single view, the participants' approach to technology depends upon their individual understandings and experiences which leads to a subjective knowledge of the affordances and issues it brings. While there may be similarities between experiences, each is unique to that individual.

A clear explanation of the concept of 'epistemology' is given by Cohen et al. (2011); they defined it as the means by which we acquire ontological knowledge. Gray (2014) clarified this further by suggesting that it is the basis by which we decide what is valid and reasonable. My epistemological approach appreciates that the nature of this inquiry is very personal to each of the teachers. They each have unique experiences, understandings and

support available, which will develop a detailed story of how technology is used in their settings.

4.6 - Participant selection

My professional role, as a Senior Lecturer in Early Years Education at a university, allowed me access to a wide range of settings, both those who offer placements for students and from students who owned, managed, or were part of an early years team. Initially it appeared there would be many I could engage with in this research. I needed to decide on an appropriate method of sampling, I firstly considered probability sampling. Gray (2014) stated that this is often the method of choice as it will give confidence in the results of the data as the sample is randomly selected from a large population and increases the probability that it provides a fair representation of the population. On examination, however, it could involve a great many settings. Newby (2010) explained the sampling frame as the total population that data could be drawn from. In terms of potential early years settings, this is a large, very diverse population across the country, all of whom will be utilising technology in a variety of ways. I reduced the sampling frame to the North West of England and then to settings who had engaged with my university as placement providers for students, as these were all quality assured. The university ensures that all settings have a Partnership Quality Officer, i.e. a teaching member of staff trained in this role. They will visit on a regular basis to speak to both staff and students and ensure that provision is suitable. This may involve consideration of Ofsted inspections, students' concerns, own observations, for example.

This resulted in 37 potential participants, including local authority primary schools, academies and private, voluntary and independent settings. Part of my role in the university

is as a Visiting Tutor, supporting trainees whilst on professional practice. This provided me with links to many of these early years settings, all of which were using technologies in one form or another to differing extents. I initially selected a purposeful sample of nurseries and reception classes. Purposeful because it is a criterion for this research that they have access to technology and random sampling would not ensure that (Miles & Huberman, 1994, cited in Cohen et al., 2011). I needed to ensure that the teachers selected would be willing to engage with the research and this was a factor in the selection process. I also wanted to ensure I had access to as broad a range of provision as possible. Finally, from each of the selected nurseries and classes, the teachers recommended a sample of four children to represent a variety of learning approaches, experiences and interests. The result was four case studies consisting of two schools – one reception class, one nursery class, and two private nurseries. This allowed me to engage with a variety of practices; as previously mentioned, the teachers had a variety of experience and qualifications. The settings themselves had different populations, as can be seen below (in Table 7), they also had diverse funding streams and the implications of this will be discussed during the analysis. The settings' managers and teachers were positive when approached and were interested in engaging with the research and developing their approach towards the use of technology in the EYFS. Table 7 provides an overview of the characteristics of the four case studies.

Case Study	*Reception*	*Charity*	*SEN*	*Private*
Setting details	Reception Class in Primary School Set in a rural village 95 children on role. 15 children in Reception class	Day Nursery run by a charity. Set in suburban area 36 children on role. 20 in class	Nursery/Reception class in Primary Special School Set in an urban area 53 children on role 10 in class	Private Day Nursery run by independent owners Set in suburban area 85 children on role. 35 in class
Teacher	Graduate with Qualified Teacher Status *Sally*	BTech qualification *Karen*	Graduate with Qualified Teacher Status *Janice*	Graduate *Chris*

Children	4-5years old	3-4 years old	3-5 years old	3-4 years old
	4 children - 2 girls and 2 boys *Child 1a,1b,1c,1d*	4 children – 3 girls and 1 boy *Child 2a,2b,2c,2d*	4 children – 2 girls and 2 boys *Child 3a,3b,3c,3d*	4 children 2 girls and 2 boys *Child 4a,4b,4c,4d*

Table 7: Characteristics of Case Studies in the research.

4.7 - Research methods

I needed to determine the participants' personal beliefs and experiences to begin to answer the first question. The information was personal and unique to each participant and interviews were used to allow flexibility and encourage considered responses (Cohen et al, 2011). The more practical details for the second research question were found through documentary scrutiny and observations. Finally, all of these methods helped to establish the participants' use and understanding of the different TPACK elements which contributed to the response to the third research question. This piece of research used the TPACK theoretical framework as a basis. The data was used to examine the impact of the different elements of TPACK on the participants' use of technology to support children's learning.

The questions asked in the interviews, followed by information the participants received regarding further information and observation criteria required, are in Appendix 3.

4.7.1 - Interviews

I formulated the initial interview questions with the TPACK framework as a foundation; the information gained enabled a clear analysis of the extent the three domains and four intersections of the framework were being addressed in practice. The questions were piloted with a trial setting and the responses were subsequently analysed, leading to minor changes which enabled participants to provide the relevant information. I had planned two interviews with each participant (Appendix 3); the initial one was designed to establish what practice was taking place and to clarify the participants' understanding and experience of technology both personally and professionally. The second interview was planned to

consider wider issues that can affect the teachers' approach to technology use. The first interviews took place in October 2015 and the second in May 2016.

4.7.1.1 – Approach to interviews

Interviews are an interactive process and rather than providing a focused answer to a question, often lead to a discussion which, while structured to some extent, may shape the investigation in unanticipated ways (Fontana & Prokos, 2007). Creating an interview format requires a great deal of planning; if a structured format is used, you are far more likely to receive consistent responses that can be easily thematised and analysed using preconceived coding systems (Fontana & Prokos, 2007). Whilst this approach would ensure the participant remains focused, the information acquired will be limited and can prevent them from sharing insights and experiences which may be useful. A structured format does eliminate any interviewer bias by using a technique Fontana and Prokos (2007: 20) referred to as 'interested listening'. This requires the interviewer to balance being approachable and responsive with being detached and objective, thereby encouraging participants to share their responses whilst keeping them focused and on topic. I needed a personal response to my questions; however, I also wished to avoid an unstructured approach. This requires a very different process and results in varied data from the participants. I am a confident speaker and prone to go off topic; using an unstructured interview approach may thus have resulted in more of a conversation and resulted in copious amounts of unnecessary data. I decided the most appropriate method would be a semi-structured interview, which Howitt and Cramer (2011: 58) refer to as a 'more conversational style of interviewing'. A semi-structured interview approach enabled me to give participants the opportunity to discuss the topic as they see it providing rich data for analysis. As mentioned earlier, I wanted to enable the participants to feel comfortable and able to do the majority of the talking, which

moves it away from being a conversation; however, the questions are designed to keep the topic focused and the interviewer can introduce new questions to encourage the participant to elaborate their response (Howitt & Cramer, 2011; Cohen et al., 2011). My ideal approach was that of an 'open dialogue between equals' (Kvale, cited in Brinkman et al., 2008: 242). Developing a good relationship with the participants to enable them to move beyond expressing what they believe the interviewer wants to hear towards a more exciting discussion of ideas was my ultimate goal. The interviews also gave me an understanding of what the participants thought was happening in practice enabling me to compare it with what appeared to be happening in the observations.

When engaging with an emotive subject such as using technology with young children, as will be seen later, there are many strong opinions and beliefs. I did not want to rely on using a non-personal data collection method, such as postal or email questionnaires, as it may have resulted in unwanted or overly negative responses or none at all (Callan & Reed, 2011). I had to consider what data I wanted to collect (May, 2002); I considered whether I needed exact, factual responses or more qualitative information which would include feelings, emotions and experiences. In this investigation, I required qualitative data which would enable me to examine the teachers' practical use of and planning for technology as well as their experiences and feelings around the concept. The interview schedule had to be designed so that it would elicit both of these aspects, yet remain uncomplicated (May, 2002). I considered the TPACK framework and the information I would need to support the analysis of practice, I also took into consideration the questions that I intended to ask and I constructed a very simple interview outline. The participants were offering me time in their teaching day which is very limited, so there was a need to keep the interview short and concise. I also wanted to avoid being too prescriptive, however, so the questions were

straightforward and open-ended. Cohen et al. (2011) explained the importance of sharing the outline of the interview with the participants, developing an honest relationship which will support a clear and frank discussion. The initial interview focused on the teachers' personal use of technology and how they used it in the classroom. The second interview discussed wider use of technology in the school, funding for digital resources, and changes since the first interview.

4.7.1.2 – Interview process

Each teacher was interviewed to establish their views on the use of technology in their classroom, their own personal skills using technology and how successful using technology in the setting was. The interview was qualitative and I led the interview as a conversation, in which the primary purpose was to encourage the participants to discuss how they engaged with technology to develop children's knowledge, skills, and understanding. I wanted the participants to feel comfortable and able to talk freely, so visited them in their own settings and allowed them to decide where the best place to conduct the interview would be. I also understood that there may be difficulties for participants to be released from their responsibilities. I explained that the interviews would last for 30-45 minutes, and if more information was needed I would continue the interview by telephone.

Prior to my first visit to the settings, I forwarded the questions I had designed for the semi-structured interview with guidance as to what I would ideally like to happen during the first visit. I did this via e mail and found the participants enthusiastic and happy to ask questions if unsure. These were mainly about logistics, such as the amount of time I needed with them for the interview and whether or not I wanted them to do anything specific, which I was able to quickly reply to. I established that I did not want to see anything specific, but that I was looking at how they used technology on a daily basis. This may have influenced the

teachers to use their digital resources in a less usual way and this was apparent in the findings, which are discussed in Chapter 5. I also requested time to observe the children as well as interviewing the teachers. In practice, these were always done before the interviews, however this was due to the teachers' requests.

4.7.1.3 – Extending the response process

As a supplement to the interview process, during the initial phase of the research I created a blog for the participants to engage with asynchronously so as to develop discussion and sharing of ideas. The teachers found it difficult to engage with this method of communication, citing lack of confidence, unsuitable technology (Karen, for example, only used her smartphone) and most commonly, lack of time as the reasons. Whilst that approach was not successful, they did make several reflective posts following the interviews demonstrating how the conversation had encouraged them to think further about their practice. This information proved very useful in the study; Bouwma-Gearhart and Bess (2012) believe that blogs are an excellent tool for research purposes and propose more extensive use for researchers to work and collaborate. As using blogs becomes more ubiquitous, they may offer an alternative to interviews and questionnaires for the collection of data. The teachers all contributed extra ideas to the blog, which were also used as part of the interview data.

4.7.1.4 – Interview data

There are issues when considering the analysis of interviews that need to be examined and addressed appropriately. When conducting interviews, clearly a record needs to be kept of the proceedings. Unless the interviewer is adept at shorthand and minute taking, keeping a full written record is likely to be unsuccessful as much information would be lost. It would seem more appropriate to make an audio recording of the interview; however, as Cohen et al. (2011) point out, much of the non-verbal communication will then be lost. There is also

the potential to use a video recording which would provide a record of both verbal and nonverbal communication but analysing so much data would prove to be excessively time consuming. As this research is being run with very limited time restrictions, audio recording has been the mode of choice. Full transcriptions were made of the recorded interviews. I had initially planned to use software to thematise my data. Once I had collected the data and began to examine it, I decided that as I had a clear framework with TPACK, Qualitative Content Analysis (QCA) (Schrier et al., 2013), appeared to be a more appropriate method. It requires the data to be sorted into pre-determined areas derived from TPACK-EY and with the variety of data the study had generated, this proved to be easier when performed manually. Further investigation of this approach identified a sub-category of this in the form of Direct Content Analysis (DCA) which is applicable when the framework may need adapting (Hsieh and Shannon, 2005), which proved to be the case in this study.

Performing themes manually enabled me to manage data, organise ideas, interrogate findings, visualise aspects of data, and use these processes to report on findings (Bazeley & Jackson, 2013). I created the criteria discussed in Chapter 3 and created tables for each of the domains and intersections. I was then able to populate these with relevant data from each of the data formats. This process was used to support the analysis of each of these topics, which were then examined as they occurred until data saturation was achieved. I ensured all themes were addressed (Saumure & Given, 2008) thus enabling a clear picture of all the data required to give valid responses to the research questions.

Following the meetings, the recordings were saved to a password-protected cloud storage area. The files were saved, named as the date they were recorded. The second interviews were conducted in the same manner, ensuring a consistent approach. While Interview 1 focused on personal experiences and considerations, Interview 2 encouraged discussion

about wider considerations such as parental support for technology and funding for digital resources.

4.7.2 - Observation

In order to acquire this information, observation was an important method of data collection. I needed to develop an overall picture of the practice, demands and expectations, gaining a first-hand experience of the subtle innuendoes and real-life experiences that occur in a setting. Observation allowed me the option of removing myself from participating in activities with the children and allowed me to record freely without becoming engaged in discussion (Stringer, 2013). Dawson (2009) also discussed direct observation, as used by psychologists where no interaction takes place between the observer and observed. I would then be able to record what the actual lived experience is like as opposed to obtaining second-hand experiences of those events from another's perspective (Cohen et al., 2011). This would enable me to use all my senses to understand behaviours and relationships (Marshall & Rossman, 2010), allowing different types of information to be recorded than would be in questionnaires or interviews. I realised that this approach would not always be appropriate for the research, however, as the curious nature of young children makes some of them want to engage with new adults and include them in their play. Observations can be conducted in a variety of ways and a more interactive approach would be participant observation, in which the observer is part of the activity and all of the relationships and behaviours involved in order to fully embrace the experience, which was much more appropriate. Cohen et al. (2011) and Rugg and Petre (2007) explain that this can be further divided depending on the degrees of interaction between the observer and the participants. In the multiple case study methodology I

adopted, observation was an essential means of acquiring data. I required the observations to be detailed and to demonstrate what was really happening in the setting (Appendix 4), relying less on prescriptive foci and more on recording the natural ebb and flow of an early years classroom (Stringer, 2013). Observation is a natural process we engage with constantly; an experienced observer can engage with this in a non-intrusive manner which does not make staff or children nervous and they are more likely to act in their usual way (Koshy et al., 2010). An advantage to this is the flexibility to vary what is being observed as well as creating an in-depth picture of what is occurring, enabling the observer to gather qualitative data which identifies reactions, expressions and other subtle indicators of what is actually occurring. On the other hand, there is also a risk of recording too much information, irrelevant information, or people changing the way they behave because they are being observed (ibid.).

I decided I would observe each of the 4 children for 20 minutes on each of the 2 visits and this would be during the routine activities in each setting. Observations were conducted with the children to record exactly how they were engaging with the technology, the way they interacted with each other and with the adults. Observations included, communication between the child and peers or adults, this included conversation or other methods of communication such as body language, facial expression and vocal tones (Appendix 4).

These were participant observations; I have a great deal of experience observing children and am aware that the conversations during the activities are often far more informative than the visual information recorded (Palaiologou, 2008). Observation of children has been a central approach in early years education from its very early development. Froebel viewed early years teachers as 'observers of children' (Reifel, 2011: 1), Montessori believed that the adult should be an 'unobtrusive observer' (Bradley et al., cited in Miller & Pound, 2010: 79)

as she believed adults often gave too much direction to children's play, altering their flow and learning from it. Other influential early years pedagogues such as Isaacs and Dewey supported this practice and wrote prolifically about it. They noted how understanding what a child knows and is confident with can enable the teacher to plan opportunities to move the child on to the next steps in their learning (Palaiologou, 2013). This approach continues to be used today in the Early Years Foundation Stage.

My observations recorded the children's use and understanding of the digital resources provided. Greig et al. (2007: 119) consider a variety of approaches to observing young children:

- predominant activity sampling: only the behaviour that best describes what has happened in the interval is sampled;
- unit sampling (or one-zero sampling): the behaviour is recorded only once if it occurs in a given time interval;
- instantaneous sampling: recording takes place at a predetermined moment at regular intervals;
- natural sampling: all relevant occurrences and their length are recorded for a given time interval.

The most suitable approach for this investigation was natural sampling as young children are very spontaneous and may all access technology in a different way. By adopting this approach to observation, I could see how the children used their understanding of the resources, alongside their imagination, to play with the chosen technological resources. The aim was to acquire an honest, clear picture of what actually occurred in a set period of time, which was arranged as 20 minutes. This was due to time limitations for the length of the sessions observed and to allow time for the teacher's interview during my visit. To record an accurate account of their experiences, you need to have a flexible approach; I conducted the observation for a given length of time and wrote what took place on a simple proforma (Appendix 4). This allowed me to record everything the child said and did, including

interactions with adults and other children, during the observation. The data from these observations allowed me to understand the children's actual experiences using digital resources in their learning and any support or challenges provided by adults or children. I was able to observe each child once during each of the two visits. I engaged with the children when they drew me into their conversation and play, but if they were engaged with their friends or other adults, I stood back and recorded their interactions and activity at a distance.

These observations were also highly relevant to analysing the links between the teachers' understanding of the elements of TPACK and their use of technology to move children's learning forward, which was relevant to answering the third research question.

4.7.3 - Documentary Evidence

In order to give additional perspectives, documentary evidence was also utilised; Bell (2010: 134) describes how documentary evidence must be analysed to establish that it is both 'genuine and authentic', that is to say that it has genuinely been written by the practitioner and it is authentic or accurate in what it says. There were several forms of data which were to be analysed. The children's learning journeys were used to establish the children's levels of understanding in a certain area of learning. These were excellent primary documentary evidence (Cohen et al., 2011). The teachers' planning was another form of documentary evidence and this enabled me to evaluate how the practitioners were planning for the technology, pedagogy and content through the use of the technology. Copies of the planning documents were kept with a detailed analysis of the three domains by myself to ensure a detailed overview of the planned experiences in the above areas early years practitioners regularly observe all the children to build up a detailed picture of their

progress, these are kept in records, often called ‘Learning Journeys'. The observations are evaluated alongside evidence of children’s work or photographs of the child engaged in an activity. The advantage of using these records is that they give a more complete picture of the child, their learning and experiences and enabled the interpretation of observations to be supported or questioned so that an accurate picture of each child is created at the start of the research investigation. The teachers' planning was also scrutinised to establish the pedagogical understanding of the use of the technology. Early years teachers use a variety of planning and whilst it may contain different amounts of detail, much of what is included is the same. Long-term planning is very general and will cover main events, such as celebrations, topics, visitors for the whole year; it provides a clear overview of what will be done, ensuring all areas of the EYFS are covered and enabling planning of important events in advance. Medium-term planning is more detailed and covers special resources required, trips, and an overview of a term, approximately six to eight weeks. Short-term planning is also more detailed and will include either daily or weekly activities, all resources, and often intended learning outcomes for the activity. Using documentary evidence to supplement observations and create a more robust collection of data will help to ensure validity of the research findings (Marshall & Rossman, 2010). These forms of documentary evidence are primary sources (Cohen et al., 2011).

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domains to ensure a detailed overview of the planned experiences in the above areas. Once the data collection process had been completed, the data gave a clear picture of the experiences of both children and practitioners.

4.8 - Data Analysis

As I began to code the data, the enormity of the TPACK framework became clear. While there are general descriptions of what practice each domain and intersection consists of, when this is put into an early years context, there is repetition, combining what has been discussed in two domains to create the criteria for an intersection. When considering Pedagogical and Content Knowledge, for instance, a long and in-depth discussion is desirable. In this study, however, it would have little impact upon the final responses to the research questions as there is no focus on technology use which is fundamental to this research study.

TPACK has been criticised for its complexity and size. Brantley Dias and Ertmer (2013: 104) comment:

> In general, TPACK takes the concept of technology integration and packages it as a framework that is much too big (i.e. one that acknowledges seven different knowledge types) while simultaneously making it too small by packaging it into so many pieces, they have become indistinguishable from each other…

Graham et al. (2011) discuss the difficulty they found in producing clear delineation between each of the domains and intersections. Voogt et al. (2012), in their review of the literature regarding the TPACK framework, concluded that the combination of skills and understanding for the TPACK intersection, made it a unique body of knowledge. Considering the complicated nature of the TPACK framework (Figure 7), the fuzzy boundaries between the domains and intersections and the importance of the central

TPACK intersection led to the design of a more focused framework for the early years (Figure 8).

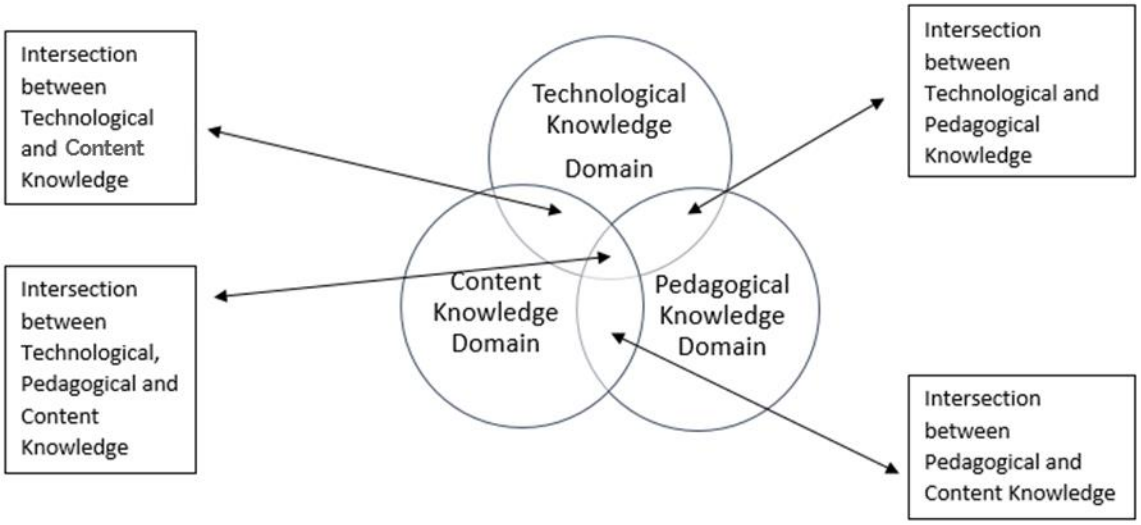

Figure 7: Diagram illustrating the domains and intersections of the TPACK framework

As I advanced through this theoretical analysis, it became clear that within the intersections, the criteria established for technology in the early years in particular did not provide a great deal of insight. Drummond and Sweeney (2017) highlight the poor boundaries between the domains and overlapping between the components of three domains and four intersections. This has proved a consistent difficulty with the use of the TPACK framework and more recent studies have focussed on the central intersection of all three domains (Voogt et al., 2012; Kabakci Yurdakel & Coklart, 2014), eliminating the intersections of two domains from their analysis. This supported my findings as particularly when considering Pedagogical and Content knowledge, the data contained no information about the use of technology and was not relevant to the research question. Evidence of Technological and Pedagogical Knowledge and Technological and Content Knowledge was identified, however, analysing these, revealed repetition of discussion regarding the data. The data for Technological,

Pedagogical and Content Knowledge provides evidence for the importance of this blended intersection, when creating a framework to represent this and to support understanding, rather than representing this as a small desirable outcome at the centre of the intersections and domains; it needs to be the aim for all practice and should be given equal importance to the three domains. Angeli and Valenides (2009) considered the central intersection of the three domains to be 'a body of knowledge separate from its constituent components' (Angeli & Valenides, 2009: 158).

TPACK -EY has been developed with this in mind. Considering Mishra and Koehler's original framework, this intersection appears to be, visually, less important, but in fact it represents the most desired form of practice and therefore should be represented as equal to the three domains. From this understanding, I created a new more appropriate framework, TPACK-EY (Figure 8). I concluded that the three domains were of critical importance to the research as teachers need to understand these in considerable depth. The deconstruction of the original TPACK framework in Chapter 3 highlighted that the combination of all three domains was the crucial factor in establishing the ideal practice for enhancing children's learning experiences.

The criteria established for TPK, PCK and TCK were also relevant to other areas and were therefore disseminated appropriately. An example of this is 'planning for technology to enhance content' which was a criterion for TCK, which was integrated into 'Child-initiated or adult-led' as part of the criteria for Content Knowledge.

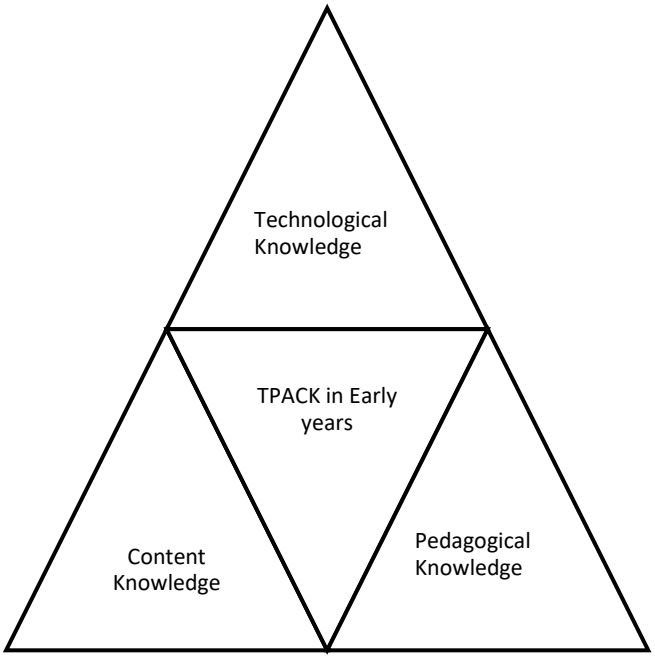

Figure 8: Diagram illustrating the domains and intersection of the TPACK-EY framework

This simplified framework together with the criteria for each of the four elements allowed the data to be classified and analysed in a more focused way.

Deciding the method of analysis of the data proved to be complicated. The initial plan had been to gather the information from the data and thematise the findings. Thomas (2015: 204) calls this the 'Constant Comparative method', the 'constant' being the action of going through the data repeatedly to compare each phrase to all the others to determine themes and establish concepts. As the research developed, however, I focused more upon the domains and intersections of TPACK and realised that I needed to consider these as my themes rather than develop new ones which may not be relevant to the research questions. Whilst the domains and intersections of TPACK are very broad, in Chapter 3 there is a clear breakdown of each one to define the characteristics as they may appear in early years practice and the characteristics that I looked for to demonstrate evidence of each element. Table 8 illustrates these for Technological Knowledge. As discussed previously, I adopted Hsieh and Shannon's (2005) focused analysis of Direct Content Analysis. They explain that

the theory being used is not complete or would benefit from further description. There was a possibility that new themes may emerge and rather than omit them, I planned to adapt the framework to incorporate them, which DCA would allow for. While the TPACK framework is designed to be applied to education in general, in this investigation it has been refined to specifically analyse practice in early years education, so Direct Content Analysis is the most appropriate approach. I deconstructed the elements of TPACK to relate them to early years education and identified key factors that map to practice, which indicate that participants are engaging with them. This was then used to develop the coding frame to identify the three domains and four intersections elements of the TPACK framework and the specific early years indicators for each. The criteria for these must be clear for DCA and they are explained in depth in Chapter 3 and listed in Table 6. Schreier (2013) also explains the flexibility of QCA and that a hierarchy of coding may develop with the main terms, developing sub-categories as the data is analysed. Figure 9 is based on Mayring's (2000) cycle of QCA and I have revised it to illustrate the DCA cycle used to adapt the TPACK framework to support teaching technology in the early years.

As required, the coding was redone to check the effectiveness of the framework after fourteen days (Schreier, 2013). I returned to the data and the criteria and reviewed the coding process. I found it to be effective, not requiring further modification.

Each case study generated a variety of data from the methods previously discussed. These data were analysed in terms of the categories and indicators described above and entered into the relevant table.

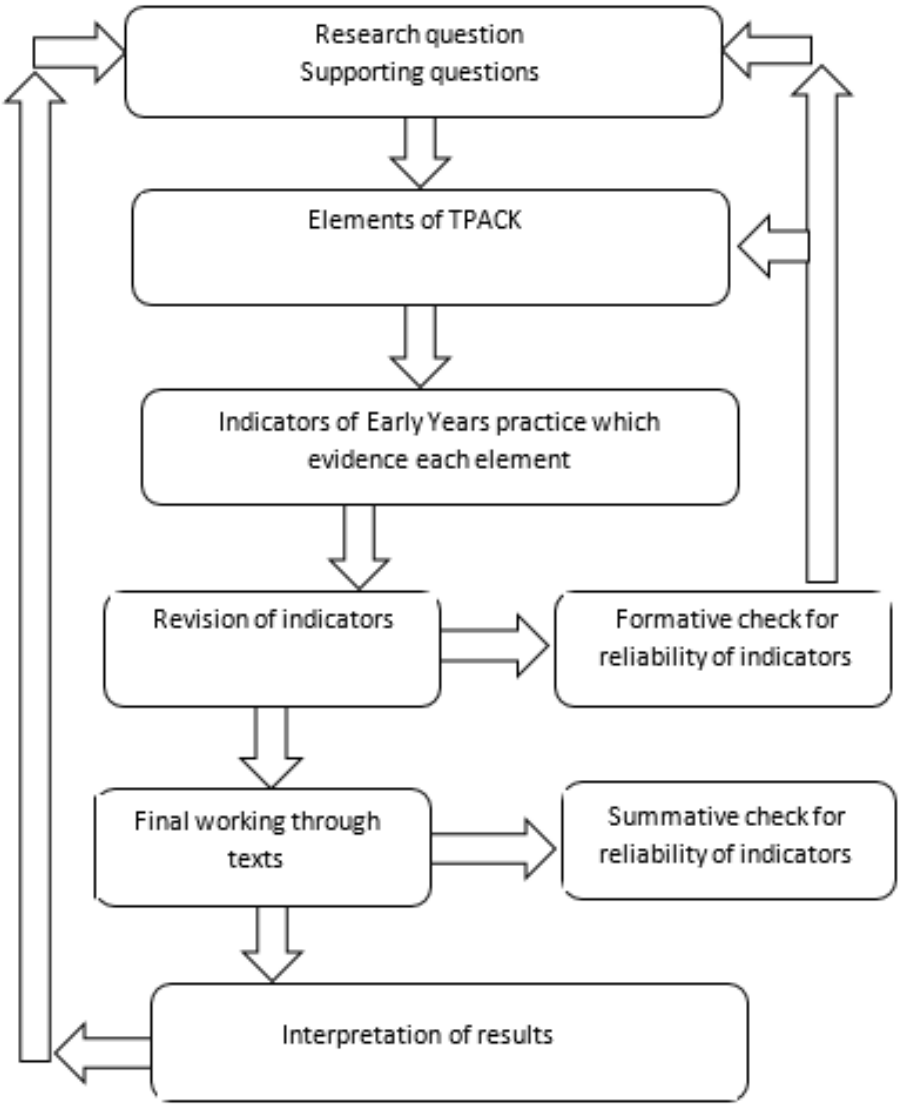

Figure 9: Direct Content Analysis Cycle for adaptation of TPACK to early years education, based on Mayring (2000).

Each case study generated a variety of data from the methods previously discussed. These data were analysed in terms of the categories and indicators described above and entered into the relevant table, see Table 8 for an example of the Technological Knowledge I designed for the classification of the data.

Setting	Reception	SEN	Private
Personal Use of Technology			
Confidence with Technology			
Type and Use of Resources			
Understanding the Capabilities of Resources			
Role Modelling			

Table 8: Technology table generated to classify data

Table 6 illustrates the criteria for each of the elements of TPACK as they relate to early years practice and these will be used in Chapter 5 to classify the data associated to each element and support discussion.

This approach enabled the data to be classified into the relevant areas linking to the elements of TPACK. A code was generated to identify the source of the information, as illustrated in Table 9.

I1	**Interview 1**
I2	Interview 2
CO	Child Observation
AO	Adult Observation
LTP	Long Term Plans
MTP	Medium Term Plans
STP	Short Term Plans
B	Blog
LJ	Learning Journey

Table 9: Codes for identification of source of data

Once the tables were completed, they provided a picture of how each of the case studies engaged with each of the elements of TPACK, which enabled a comprehensive discussion and comparison of these in Chapter 5. This report investigated how the TPACK framework appeared in early years practice and questioned how it could support developing early years

teachers' pedagogical approach towards cross-curricular integration of technology. Baxter and Jack (2008: 555) warn that there is:

> …a danger in the analysis phase is that each data source would be treated independently and the findings reported separately. This is not the purpose of a case study. Rather, the researcher must ensure that the data are converged in an attempt to understand the overall case, not the various parts of the case, or the contributing factors that influence the case.

Yin (2013: 186) stated:

> …there may be no separate chapters or sections devoted to individual cases. Rather, your entire report may consist of the cross-case analysis, whether purely descriptive or also covering explanatory topics. In such a report, each chapter or section would be devoted to a separate cross case issue, and the information from the individual cases would be dispersed throughout each chapter or section.

The data will therefore be presented as a cross case analysis of the settings with regard to each of the domains and intersections of the TPACK framework. This approach allows for consideration of the range of practice and its implications across the settings.

In any research study, the data, processes and interpretations must be transparent and trustworthy to ensure that researchers meet the needs of the audience. Silverman (2013) expresses how quantitative research methodology has a conventional structure whilst qualitative methodologies need to consider the variety of approaches available and how applicable they are to the research design being proposed. It was essential that as a qualitative researcher, I provide detailed evidence for the reader to be confident in the validity of the findings. To ensure validity (Cohen et al., 2011), I used combined levels of triangulation by analysing the interviews, the observations, the documentary evidence. Tetnowski (2015: 39) explains the advantage of a case study approach in providing a wide range of data 'which converges in a triangulating fashion'.

4.9 - Ethical Considerations

All research need to be planned to ensure that participants are protected and safe from harm. Rugg and Petre (2007: 107) explain that the main concept in an ethical approach to research is to have a 'Duty of care' to the participants. The British Education Research Association bases its guidelines on principles of respect for:

- The Person
- Knowledge
- Democratic Values
- The Quality of Educational Research
- Academic Freedom

(BERA, 2011: 4)

Involving children in research can be a very sensitive issue and researchers need to be aware of the particular needs of the children participating. This investigation examined the children's learning experiences through the use of technology; it is important to understand their experiences and perceptions of the technology which can only be achieved by listening to their many languages (Malaguzzi, 1993).

Informed consent was sought from all participants, two Participant Information sheets were designed, one for each of the teachers invited to participate and one for each of the parents of the children invited to participate. Consent forms were attached for signing if those invited were happy to participate. Contact details for myself and my supervisor were included in the invitation so that we could be contacted if there were any concerns or questions. These were designed using Lancaster University's template and were submitted to Lancaster University's Ethics Committee as part of the request for ethical approval. An important consideration was to ensure they were aware of their right to withdraw at any time. They were also given the opportunity to review their comments once transcribed and as they were being discussed in the analysis. Parental consent was gained for each of the

children involved to enable me to access their learning journeys and observe their children in the setting. They were given the same reassurances as the adult participants. There was a change to the research design during the early stages of the study and the teachers participating were part of the discussion to adopt an alternative approach, so were constantly informed of the changes in the study. From a practical perspective, the required data remained similar, the main difference in the research design was that they would not be required to contribute in as much depth. The children's contribution would not change at all. Following a discussion with my supervisor and consultation with the Programme Leader, the original ethical approval was deemed sufficient.

In practice, I told the children who were being observed what I was doing and answered their questions. I took care not to interfere with their play unless they involved me and listened to their responses to me to ensure that they were happy with my presence. Fortunately, they were comfortable with my presence and the only issue was physically keeping up with them when they were playing outside. One of the most important considerations is that of anonymity which is particularly vital when conducting small-scale research such as in a multiple case study of four settings, as due to the local nature of the investigation it can be easy to identify participants and their settings (Koshy et al., 2010). To address this, I ensured the setting and participant details were kept to basic, essential information only, no descriptions of children, teachers, or settings have been included to ensure that the possibility of identification is kept to an absolute minimum.

4.10 - Summary of Chapter 4

This chapter introduced my research design and discussed how my ontological and epistemological stances as a researcher influenced the decisions I made. It then discussed how the participants were selected.

Consideration of the research questions directed the data required and the research methods were chosen to meet these needs. The variety of methods used to collect data have been discussed in depth and the method of data analysis introduced. The data from the case studies were systematically analysed with reference to the elements of the TPACK framework which were then used to answer the research questions. Finally, it included a discussion of the ethical considerations and how they were addressed to ensure the study was conducted in an appropriate manner.

These considerations underpinned the collection of data, ensuring a robust, ethical process was followed. In Chapter 5, the data will be presented using the three domains and their intersections, as designed in TPACK–EY. The findings will be discussed for each domain as the chapter progresses. Finally, the conclusions from the study are presented in Chapter 6.

Chapter 5 – Findings and Discussion

5.1 – Introduction to Chapter 5

In this chapter I present the findings from the data and create a cross-case synthesis of the experiences, influences, practices and understanding with regards to Technological, Pedagogical and Content Knowledge. In Chapter 3, I deconstructed the three domains and four intersections as designed by Mishra and Koehler (2006) (Table 6), relating them to early years practice and creating observable criteria to identify their presence in four different settings. The three domains of TPACK are essential; however, the aim of this study is to identify, support and promote the central intersection of the three domains. The combination of Technological, Pedagogical and Content Knowledge enables the teacher to use digital resources to support, consolidate and extend children's learning in all areas of the curriculum as well as develop specific IT skills. This realisation led me to question the complexities of Mishra and Koehler's original TPACK framework and evaluate the importance of each domain and their intersections. I also considered the need for a simple, practical framework which would provide a framework for early years colleagues to assess their own practice and develop their provision. With these factors in mind, I created the TPACK-EY framework, which is explained in Chapter 4 (Figure 8), both to support the reader and to allow me to present my findings in a more structured and relevant way.

As explained in Chapter 4, I used a Direct Content Analysis (DCA) approach using the criteria developed in Chapter 3 to classify and analyse the data across the four case studies, thus providing an illustration of how technology in early years education is currently used across these varied settings.

The findings from the data provide evidence to support the responses to the Research Questions (RQ):

> RQ1. In what way does the range of experience and understanding of the use of technology held by early years teachers affect the provision for children in the setting?
>
> RQ2. How can the use of technology enhance the children's learning experience?
>
> RQ3. How does the early years teacher's understanding of available technologies, the need for sound underpinning pedagogy and appropriate content, support learning opportunities for young children to enable them to move confidently to the next steps in their learning?

The data collected in these case studies consisted of the learning journeys (records of progress) of the children participating in this research, interviews with key staff, observations of both children and staff engaging with technology, and the participants' planning documentation. Each data format provided varying amounts of information from each of the settings, as each teacher had access to different types and amounts of digital resources. They also had different beliefs and approaches around technology and this had an impact on their practice for each of the domains and their intersections with the TPACK-EY framework. Some sections of reported evidence may therefore rely more heavily on one source of data or one case study than others.

In Chapter 4, I explained how the data from all case studies were used to discuss the ways in which the domains and their intersections of TPACK-EY have been identified in practice. I also explained that the purpose of this research is not to compare the experiences and approaches of those involved, but to analyse the diversity in use of technology across the four case studies. Chapter 5 utilises the adapted version of TPACK, 'TPACK-EY', and is divided into sections addressing the criteria of each of the domains and their intersections.

For each of the domains and the intersection of all three, a table summarising the key findings from the data will be presented, followed by the presentation of the findings and an

analysis of each of the criteria associated with them (see Table 4). The chapter will conclude with implications and discussion regarding their relevance to the research questions. Chapter 4 (Table 7) provided an overview of the case studies and participants discussed in this chapter.

5.2 - Technological Knowledge

The first major element of the framework is Technological Knowledge (TK). From the analysis of the previous research regarding TK in Chapter 3, I established the criteria to analyse, which would assist in determining each teacher's technological knowledge (Table 10).

I scrutinised the data for evidence of the participants' personal experience of technology, as well as how confident they were in its use. The variety of technology, as well as its currency, available in the setting is also important. Of particular importance is participants' understanding of the attributes of the various resources. Evidence of participants' role modelling the use of technology in everyday situations will also be examined, as this adds value to the use of the resources as constructive tools to improve children's experiences. Table 10 explains the format of this section.

Technological Knowledge Criteria
5.2.1 - Personal Use of Technology
5.2.2 - Confidence with Technology
5.2.3 - Type and Use of Resources
5.2.4 - Understanding the Capabilities of Resources
5.2.5 - Role Modelling

Table 10: Technological Knowledge criteria

Evidence of TK in practice will enable me to discuss how the range of experience and understanding of the use of technology held by early years teachers affects the provision for children in the setting in Chapter 6.

5.2.1 - Personal use of technology

The first research question enquired whether the teachers' personal use of technology had any effect on their provision of technology for the children. The interview data provided most of the data for this section. The first question in the interviews (Appendix 3) asked whether the participants used technology in their personal lives and if so, how they used it, to help me understand the range of experiences and views of technology.

Interrogating the interview data showed that all participants expressed an understanding that technology helped them in their day-to-day personal life and enabled them to communicate with colleagues and friends. The interviews also highlighted a range of experiences and attitudes and began to reveal that these did have some impact on the participants' approach to the use of digital resources with the children. Sally (Reception) explained that she used technology for a variety of purposes:

> I do I use it for emails, word processing, planning as a teacher so it's all electronic, communicate with lots of people, internet banking. I use the internet quite a lot for searching for things, photo shopping, things that I want to know, everything is there isn't it? (Sally, Reception, Interview 1)

Not all the participants were as adept with their personal use of technology. Karen (Charity) explained that she was very reliant on her smartphone; she used it for social networking, shopping and to research for her job interview. Occasionally she read on a Kindle, but had avoided her laptop since finishing her studies two years earlier, saying:

> I did a college course a couple of years ago, so I've got a laptop for that under my bed getting rusty near enough. (Karen, Charity, Interview 1)

She considered her technology skills to be basic:

> I can do shopping and social media but that's about it, although PowerPoints and technology, bit more than that is a bit too much for me… (Karen, Charity, Interview 1)

She commented that this did cause her difficulties as she rarely used e mails personally, however, with her new role she was trying to remember to check them. As she only used her smartphone, she explained that she found it difficult to follow links to webpages and other resources. She felt her technological skills were limited as she only used the internet for shopping and social networking on her smartphone.

Janice (SEN) explained that she had an iPad and used it for Facebook and shopping. She said:

> Yeah, I do enjoy using it I wouldn't necessarily say I was very competent, we were talking about this before and I said I know how to do lots of things but I don't necessarily know the best way of doing them, I'm more self-taught. (Janice, SEN, Interview 1)

Interestingly, she did not consider that by teaching herself, she appeared to be demonstrating both competence and confidence.

The interview data from Chris (Private) found that while she used her iPhone for social networking, online banking and emails, she did not use the iPad she had access to or her PC which, for similar reasons to Karen (Charity), she has never used since finishing her degree course. A possible explanation for this is a lack of opportunity for development of technological skills, minimal access to technology, and difficulty using a laptop. These factors greatly influence personal emotions and attitudes. Sang et al. (2011) expressed how personal attitude influences teachers' uptake of technology in the classroom, emphasising that training and practice can support the development of positive attitudes towards technology. Furthermore, personal use of technology can be quite limited, either through

choice or opportunity; however, changes in circumstances can result in the need to develop skills previously thought unnecessary.

Considering the manner in which the participants from the four case studies approached technology in their personal life revealed a common link between the findings. The interview data showed that the participants had varied personal experiences of technology, it was generally used for speed and convenience for specific purposes, for example shopping, banking, emails and communication (social networking sites). None of the participants used it for enjoyment and two avoided it for all but essential purposes. Sally (Reception) said:

> Whereas my husband sits on it all evening and looks at it, while I don't want to do that really, once I finish my work I'll come off it unless I've got a specific reason for it. I'd only do it if I needed to really. (Sally, Reception, Interview 1)

These issues correspond to the findings by Ertmer et al. (2012) who found that despite technology becoming increasingly universal, personal attitudes, beliefs, and confidence continued to be an issue in its use in schools.

These findings may support the hypothesis that negative experiences from past use of technology seem to have led to an avoidance of using digital resources, which appears to have become a natural disposition (Mumtaz, 2000; Sang et al, 2011). Other research has suggested that a lack of personal use leads to lower confidence in the use of technology in teaching, as well as a reluctance to try (Blackwell et al. 2014, Karaca et al., 2013; Ertmer et al., 2012).

Personal use of technology is frequently linked to confidence in using it as a teaching resource (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Gialamas & Nikolopoulou, 2010). This section has examined the personal use of technology by the participants in each of the case studies; earlier in this section I examined their confidence with technology and

whether this had an effect on the way they used it in the classroom. These findings implied that training sessions should include support for personal use of technology, for both practical purposes and for fun; building teachers' confidence and understanding of the attraction children have towards technology and how to use this to encourage the children's interest and engagement.

After establishing the participant's personal use of technology, I examined the data to see if there was a relationship between this and their confidence in using technology in the classroom. The purpose of this is to examine the data from the interviews to establish which factors the participants felt affected their confidence in their personal use of technology. This further supported the response to the initial research question.

5.2.2 – Confidence with technology

The literature reviewed did not investigate the potential for bad experiences as major contributors to the lack of confidence in using technology. It did, however, refer to the lack of training available, which was clearly a major issue in these cases (Aubrey & Dahl, 2008; Plowman et al. 2010; Kennington & Meaton, 2010).

It would appear that the lack of engagement with technology began as a personal issue and developed into a professional one. This demonstrates the importance of giving young children the skills and understanding to use these resources confidently in order to prevent such issues occurring in the future. To bring about a change from this perspective, leaders need to give teachers new, positive experiences through professional development, which will change their opinions and enable them to accept and use technology to develop children's learning experiences (Kim et al., 2013).

Analysis of the interview responses highlighted the range of experiences and confidence in their own personal use of technology. In the interviews, all the participants played down any knowledge they had of technology, particularly Chris (Private) who when first asked to be part of the research said that she was not very good at it and that it had been highlighted as an area for development in the last Ofsted report. Technology use in the setting was observed to be well integrated, however, as they had a wide variety of technology resources available, some of which were available at all times. Possibly, Chris was considering her own personal experiences; there were more confident teachers in the setting who were developing their use of technology with the children. She did acknowledge that:

> It's easier to ask someone to show me how to do it, then instead of sitting down to do it, let them do it instead (Chris, Private, Interview 1).

The participants' perceptions of their own confidence in the use of technology varied between each case study. From the analysis of the interviews, Karen (Charity) and Chris (Private) explained that they were quite traumatised by the technological experiences they had had when engaging in a programme of study to such an extent that they would no longer use the PC or laptop involved.

> I used it [laptop]because I had to, but it was stressful as I had deadlines to meet and things went wrong. (Karen, Charity, Interview 1).

And:

> Since I finished studying, I don't go near that computer anymore! … I just have a phobia about that big computer upstairs, I walk in and think 'oh no' (Chris, Private, Interview 1).

Their issues were regarding losing files, internet connectivity, and the emotional impact of these experiences, which added to the stress they were already under when writing assignments with time constraints.

To expand on these thoughts, the teachers were asked to discuss their feelings regarding technology in the initial interviews. The interview data highlighted an overarching appreciation of the advantages it offered with day-to-day tasks such as shopping, banking, and social networking. Sally (Reception) commented that while she did like it, she did not want to use it all the time in her personal life and so avoided social networking. Karen (Charity) emphasised that she did not feel confident except with the activities mentioned earlier for which she could just use her phone. Confidence was also an issue raised by Janice (SEN) when asked about her skills and confidence:

> I would say moderate, there are things I'd like to do but don't know how to do, I'm certainly okay for most things I need. (Janice, SEN, Interview 1)

and Chris (Private):

> I tend to say to someone, just show me how to do that and instead of sitting down and doing it, it's easier just to get somebody to do it for you. (Chris, Private, Interview 1)

They were self-taught or had a little assistance from family and friends. These responses appear to indicate an appreciation of the value of technology in society. There were also strong concerns, however, regarding the potential for it to consume too much of their free time, for technological difficulties to occur, or that they would make mistakes. From this data, I ascertained that the participants did not feel confident in their own use of technology and I discovered that there were other issues that contributed to their use of digital resources. This was further confirmed by the issues regarding engaging with the initial active research approach. Only one participant, Sally, contributed to the blog without support; Karen, who only accessed the internet on a smartphone, found issues accessing e mails and then following the link to the blog:

> The only technology I really use is my phone. By the time I have received your email, half the time I had lost the link. When you did send, I would have a look again. It's

> because it is on my phone, it's the only technology I use. It was difficult on my phone to negotiate through it...The first time I went on I couldn't find the bit where people commented. Then I did, it was really interesting reading it all. (Karen, Charity, Interview 2)

Janice (SEN) explained that posting on the blog was difficult even with guidance, but that appeared to be the result of lack of time to look at it:

> Yes, I did. At the time I looked no one had actually written on it, so I sent you some things direct, but I don't know how you do the online chat, I think it's quite difficult. Although support was available, I think it was just time, because it couldn't be during the day, time after school was a big issue. (Janice, SEN, Interview 2)

Lack of confidence using technology was also cited as an issue in the interviews. In order to support the participants in contributing to the blog and maintain anonymity, I asked them to email their comments to me and I would post them. This improved engagement and three out of the four participants found time to do this twice.

Balanskat et al. (2006: 5) described three levels of barriers to the integration of technology, 'the teacher-level, school-level and system level'. These concerns and experiences are clearly teacher-level barriers, suggesting that with support and appropriate training they could be overcome (Pasnik & Llorente, 2013).

The teachers' responses during the interviews appeared open and frank. They spoke about their personal use of technology and how they were anxious about using it with the children. There is a need to value teachers' experience and knowledge of early years pedagogy when addressing the use of technology and any support should focus mainly on play and how the technology can be included to enhance the children's learning experiences (Nuttall et al., 2013).

It appeared that personal confidence in the use of technology did have an impact on how teachers used technology; Karen and Chris, from the Charity and Private settings respectively, avoided using the hardware that they related to stressful situations and only

using technology for certain purposes, such as email and shopping. This appears to demonstrate that there was a relationship between anxiety regarding technology and how they explained their approach to the use of digital resources in their teaching. While they both felt that there was a place for technology, it was sometimes limited by time allocated, supervision, and the amount of choice available to the children. Baylor and Richie (2002) propose that without adults' understanding of and self-confidence with technology, it would not be used in the setting. They continued to discuss how with support and training this situation could change. Chris (Private) proved, however, use of technology may not be adversely affected if one person lacks confidence, as she disclosed during her first interview, that she had colleagues who were more confident with the digital resources. This suggests that Chris used this as an opportunity to step back and not engage with technology. Dennis (2009) proposes that there may be a tendency to have an 'expert' in the setting to whom everyone passes issues, problems, and even teaching. This allows other staff to step back and possibly neglect developing their own skills or understanding. While Sally (Reception) and Janice (SEN) expressed a lack of confidence in their own use of technology during the interviews, the analysis of the interview data indicates that they were clearly using it effectively both personally and professionally for certain purposes, taking on leading roles regarding technology in their setting.

Lacking self-confidence in personal use of technology was highlighted by each of the participants in the interview data, which was in line with findings from previous research (Aubrey & Dahl, 2008; Ertmer & Ottenbreit-Leftwich, 2013; Tallvid, 2016). The review of the literature suggested that lack of personal confidence leads to lower engagement with the use of technology in teaching, as well as a reluctance to try (Blackwell et al., 2014; Karaca et al., 2013; Ertmer et al., 2012). This study recognised the potential of poor experiences as

major contributors to the lack of confidence in using technology, for example, the stress when work on the computer is lost Karen (Charity) and Janice (Private). Importantly, Inan and Lowther (2010) explained that one of the most influential factors affecting the integration of technology was the teachers' self confidence in its use. Considering the responses from the interviews, the lack of engagement with technology appeared to begin as a personal issue and developed into a professional one, which has been noted in other research (Inan & Lowther, 2010; Sang et al., 2011).

Scrutinising the participants' responses, it appears that teachers' levels of personal confidence are influential in their use of technology with young children. The effects of this may be less noticeable, however, if colleagues who are more confident can support practice. In two of the cases, lack of personal confidence resulted in the teacher interpreting their abilities modestly. Reflecting on practice following the first interviews, the only support they required was the opportunity to see and discuss the possibilities of digital resources available.

5.2.3 - Type and use of resources

The variety of digital resources in each case study varied (Table 11). The effects of this are considered in more detail below.

Reception	Charitable	SEN	Private
IWB	2 PCs	Sensory room	2 microscopes
1 laptop	Leap Frog pad	IWB	Digital scales
6 iPads	Digital camera	Remote control cars	Children's cameras
2 PCs	Android tablet (acquired mid -way through study)	Interactive garage	1 iPad
Recordable pegs		iPads	Walkie talkies
Beebots		Camera	Karaoke machines
Microphones		Communication aids	IWB
Microscope		Switches	
Talking tins		Toy microwave/ kettle	
		Musical instruments	
		PC	
		Sound buttons	

Table 11: Digital resources available in each setting

Personal experience and confidence with technology can affect enthusiasm and willingness to introduce technology into the classroom (Ertmer et al., 2012; Blackwell et al., 2013). The EYFS does not provide clear guidance and support for teachers. As discussed in Chapter 2, there is a culture, even at the highest level, of separating technology from play activities (Edwards, 2013). This serves to give the message to practitioners that it is an add-on, something extra that needs to be included. Edwards also highlights the way in which technology should be an integral part of children's play rather than 'extra resources' that may or may not fit into children's play. As can be seen from the interview responses, the type of technologies available were very varied from setting to setting, which led to the question of who decides what resources are purchased and how do they make those choices?

Morgan and Siraj-Blatchford (2013) recommend that technologies should be selected in order to maximise learning potential, develop creativity, communication, collaboration, and develop dialogue and sustained shared thinking. As can be seen from Table 11, which was formulated from interview responses and observations, the type of technologies available

varied from setting to setting. This led to the question, who decides what resources are purchased and how do they make those choices?

Chris (Private) mentioned that if the staff thought a technology would be useful:

> It is a group decision, if staff feel that we need new technology we will speak to [the owners]. We also fundraise twice a year in nursery, so we always have funds to purchase items. (Chris, Private, Interview 2)

Sally (Reception) explained that:

> It is the Computing Coordinator in our school, usually, the item is requested by need or requested by a colleague, i.e. Digimap for KS2 or more netbooks to complement the stock as some are no longer working. The request is passed to the head and if this has been budgeted for in the subject development plans they can be ordered. If it has not been budgeted for and the need is great, the head may OK it (if school has some money) or it may have to wait till the next year! (Sally, Reception, Interview 2)

The comments from the interviews above highlighted that access to funding for digital resources was not a straightforward process. During our first meeting Karen (Charity) discussed ways of increasing the amount of technology in the setting with me, for instance purchasing second-hand toys, which would be less demanding on the setting's budget. Karen explained in the second interview that she did investigate the possibility of acquiring further resources in this way with her manager, but unfortunately there was a strict policy of requesting funding and limitations as to where the budget can be spent. Experience has shown that this is not an unusual situation, even though much of the literature reviewed suggested that access to technology has improved (Hofer & Grandgenett, 2012; Eteokleous, 2008; Angeli & Valanides, 2005).

Interest in this research did encourage the manager to appreciate that more digital resources were needed. She requested funding from senior management, who agreed to the purchase of an Android tablet to enable Karen to develop her practice with technology.

Janice (SEN) explained that the Technology Coordinator generally budgets for technology throughout the school:

> For myself I generally tend to put it through on the early years budget, because technology is different during the early years isn't it? If there are specific things I want for my Foundation Stage I will put that in. (Janice, SEN, Interview 2)

Funding for resources varies over time and place; schools tend to have larger budgets, but the demands on these are great. As both Sally (Reception) and Karen (Charity) pointed out during the interviews, requests for resources are sent to the budget holder and whether the request is granted or not depends on that person's commitment to technology and/or the argument the teacher provides as to why it is needed.

If the participants wanted to acquire new technology, they had to place requests to managers and convince them that the purchase would be of value to the children. This raises a further issue; as Simon et al. (2013) note, it is not just early years teachers who need to understand the importance of technology in early years provision, but also the owners and managers who have control of the budgets. Karaca et al. (2013) deduced that without the support of senior management, neither access to digital resources and technological support nor associated training would be sufficient to provide high quality learning experiences for children.

While access to technology is an important factor in the integration of technology, it is not the sole issue. As Inan and Lowther (2010) emphasise, understanding how digital resources can support learning experiences is also necessary.

5.2.4 - Understanding the Capabilities of Resources

To provide an in-depth response to RQ1, the data was not only analysed to identify the digital resources available to the participants, but also to examine their understanding of

how their understanding of the capabilities of the digital resources at their disposal could be used to enhance the children's learning experience.

In establishing the participants' understanding of the capabilities of the digital resources they had access to, consideration of the variety of technologies available in each setting was essential as this would have a considerable effect on the quality and variety of the children's experiences (see Table 11). Blackwell et al. (2013) found a wide variation in the digital resources available depending on the type of setting and its location. This also proved true for the four case studies.

While there was disparity between the settings in terms of number and types of resources, it was important to consider how the digital resources available were utilised. The documentary evidence included planning for technology. With Karen (Charity), there was a particular focus on the skills required to use the equipment:

> Computer (CBeebies games): To complete simple games & gain some control over the mouse (Karen, Charity, weekly plan)

The planning from the other case studies focused on specific curriculum areas, which will be discussed in detail later in this chapter.

The data from observations and documentary scrutiny highlighted that while PCs were available in each of the settings, their use varied widely. In some instances, while the PCs were switched on during the observations, they were not always used to their full potential. While Karen (Charity) had two PCs, they were not switched on during either visit, although she did mention using them to answer children's questions:

> We have been looking a lot more stuff up on the computer, we use it for research. One of the girls brought a snake in, so we have been looking that up and worms. I was asked 'Why do worms live underground?'. I couldn't answer, so we went and looked. So, we use it for research and they do like to watch programmes and short clips. So mainly games and researching. (Karen, Charity, Interview 2).

Games were selected by adults, as they turned them on, but there was no introduction to them.

> Child 4b went to the PC, but there was nothing on the screen, he went to ask Chris how to make it work. Chris stood with him and explained how to switch it back on from sleep mode, the game was already loaded and she explained how to play it. Child 4b listened to her and followed her instructions, however, he tried to play the games by touching the screen and Chris had to explain the difference between using the PC and a tablet. She demonstrated how to use the mouse and he tried again. Chris stayed with him to explain the game and what to do. (Child 4b, Private, Observation 1)

In contrast, there was also observational data illustrating examples of the children using them confidently and having opportunities to make decisions as to which program they would use. Sally (Reception) had a laptop connected to the IWB:

> She asks Child 1d to help his friend with the activity; they decide to work on the laptop (which is connected to the IWB) and play a game the adult has put on there to develop sequencing skills. They talk about the story and start to move the pictures around on the IWB trying to put it in order. Child 1d initially tries to do it all, but Sally suggests that the other child might like a turn. Child 1d steps back and tells his friend where to move the picture to. They complete the sequence and are really pleased with themselves. (Sally, Reception, Observation 2)

As Mueller et al. (2008) discusses, even though teachers are becoming more familiar with the use of technology in their everyday lives, they may still feel insecure when trying to integrate it into the curriculum.

Sally (Reception) wrote in her blog post about the first activity I observed using the iPads. While the children completed the activity well, it was clear that this was not Sally's normal approach, as the children needed additional support to understand how to use the iPads and the app itself. She explained:

> [I] had decided to use the iPads to support the development of literacy. The children were just learning about rhyming in phonics so I had found a super, free app to support and reinforce this. The children quickly got the hang of what to do and with some support sometimes did what they were supposed to do and matched up the

> rhyming words and pictures by listening and looking. One child who was quite bright got a bit bored with it! (Sally, Reception, Blog post)

When visiting Chris' (Private) setting for the first time, it appeared that the members of staff in the rooms were aware that I had come to observe technology, as they had put all the available digital resources out for the children, both indoors and outdoors. Perryman (2009: 622) refers to this as 'fabricating the stage'. 'Fabrication' (Clapham, 2015: 613) of this type is reported to be frequently seen during Ofsted inspections and while the intention is to show the very best and impress, it could also hide the everyday good practice that should be celebrated.

During my initial visit to Karen (Charity), she had also taken the time to use technology during my first visit. The room had a Leap Frog Pad, a game to encourage children to write letters or numbers. Karen sat with the children to support and direct them to engage with it. As we were speaking, I asked about resources and was informed there was one camera which was mainly used by staff.

> Karen took a picture of Child 2a, then showed it to her on the display screen at the back of the camera. She asked Child 2a if she would like to take a picture of her (Karen). She explained how to take a picture and Child 2a successfully took a picture. (Karen, Charity, Observation 1)

Interpreting the observational data illustrated that children using the camera was not usual practice; however, Karen was enthusiastic about developing this approach. This was also characteristic of fabrication in this visit; there was, from both the discussion and observation elements, indications that Karen was unfamiliar with the resources and not confident in using them to develop the children's understanding. Her enthusiasm when she did see the opportunity demonstrated, however, that it was a lack of training in this area that was the issue. Once she saw the potential, she expressed that she wanted to engage with it further.

Janice's (SEN) setting had more technological resources than the other case studies. They used more specialised equipment with their children due to their severe and profound learning difficulties. During my visits, I was able to see a variety of both assistive and educational technology options. I observed Janice using it with the children. Technology supports the children's learning through both improving accessibility, enabling them to engage with activities they would not have access to without the digital resource and its capabilities to provide stimulus and extension (Williams, 2005). The sensory room is used on a regular basis, as one of the participant children (Child 3a), finds it difficult to engage with the regular activities; however, technology allows her the opportunity to communicate and interact in a way that would be more difficult without:

> Child 3a lies on the floor looking at the lights also on the floor. The teacher changes the colour, first to blue, then red then yellow, Child 3a smiles. the teacher gives the child lots of encouragement to move to the control panel. Child 3a sits up and looks at the panel as the colours change on it, the teacher helps her press a button, the colour changes and she smiles again. The teacher moves her again but she moves herself back to the panel and starts to show an interest in the buttons. She pushes them with her head, changing the light to blue, but does not seem aware that pushing the button caused this effect. She tried to push the buttons with her hands but was unable to due to her lack of strength, the teacher helped her to press hard enough to make the lights change (Child 3a, SEN, Observation 2)

Janice (SEN) expressed her understanding of how she could use technology to include different learning approaches in her planning. She used a combination of approaches due to the specific needs of each child; they each had an IEP to ensure that their particular learning needs were being approached in a very specific way. They also had more flexible weekly plans for covering curriculum content, which allowed the teacher to plan activities related to the EYFS and adopt a more child-led, play-based approach. Medium term plans used the development statements to highlight areas of the EYFS that need to be addressed, which underpinned the focus of the weekly plans.

As Cook (2011) explained, technology is flexible and accommodates individual needs and styles of learning. Janice (SEN) used video on the IWB a great deal as that incorporates action, visual cues, and sound, engaging kinaesthetic, visual, and auditory learners. There was a high adult-to-child ratio in this setting, as all the children have a Statement of Special Educational Needs, which leads to some additional funding. This enabled Child 3a, for example, to have maximum support to enable her to engage with the resources.

During the first visit to Sally (Reception), the children needed quite a lot of support. Analysing the data from the observations highlighted that the children had varying experience of the tablets and were confused about the expectations of them.

> Child 1c did not see the similarity in the words, Sally explained the appearance of the words, that they had similar letters at the end. She then demonstrated this with the game and asked them to listen closely to hear if they sounded the same. (Child 1c, Reception, Observation 1)

Child 1b was also engaged with the activity:

> She is matching the pictures that rhyme. Sally explained the written words and how they look alike, she continues to play confidently. Sally suggests a new game and demonstrates it to her. Child 1b is able to identify the pictures and match the sounds confidently. If she is unsure she presses the picture and the word is spoken, which then makes it easy for her. (Child 1b, Reception, Observation 1)

Tallvid (2016) explained how technology needs to be integrated into the curriculum as a regular feature to enhance and extend learning experiences. As we progressed through the interview following the activity, Sally reflected on her approach:

> [I] had decided to use the iPads to support the development of literacy. The children were just learning about rhyming in phonics so I had found a super, free app to support and reinforce this. The children quickly got the hang of what to do and with some support sometimes did what they were supposed to do and matched up the rhyming words and pictures by listening and looking. One child who was quite bright got a bit bored with it! (Sally, Reception, Interview 1)

When I visited the second time the children were given independent access to the iPads, they were given a task to complete. From the observations, it appeared they had used the app before because they were confident using its features. Previous experience enabled them to have control over the activity, which was writing a story, adding characters, backgrounds, voices, and even their own photograph.

This is an example of something that became apparent during the research; often the participants did not consider technology to support and enhance specific subjects. Sally highlighted this in her blog post, explaining:

> After discussion with Jacqui, I suddenly had the realisation that I do use technology in a more natural way that engages the children more. Instead of using the app to practice skills which is ok sometimes, I could have got the microphones out and got the children to say the rhyming words in to it and play it back! Or used the talking tins, to maybe sort them in to; if the words recorded on them rhyme or not! (Sally, Reception, Blog Post 2)

This suggests that often it is just a stimulus or a little time to consider technology that can make all the difference as to how it is used.

During the planning for my first visit, Chris (Private) explained that as a setting they did not have many resources and were 'not good with technology'. Yet when I observed their practice, they had an array of digital resources (Table 11). Chris said she had not realised that all of these resources were classed as technology and was pleased that they were actually providing a range of technological experiences for the children. This reinforces the discussion regarding the need for support and training for early years teachers, who may not fully comprehend what 'technology' actually means at a basic level.

Karen (Charity) had limited access to technology, as discussed earlier. After my first visit and our conversations regarding technology, she began to use the internet with the children to discover information about topics. She explained in her blog post:

> I have also continued to show the children that the internet can answer questions for example a child asked me the other day why do worms live underground so we looked it up on the internet. (Karen, Charity, Blog Post 1)

Having considered how she used technology during the interview, Karen had then realised she could build on her current practice and give the children more in-depth experiences through the use of the internet.

Another aspect to TK is understanding the multiple uses of technology. Janice (SEN) developed this by taking a group of children for a 'sound walk' in a nearby town. Child 3b's Learning Journey illustrated the trip through annotated photographs. The child had identified what was making a noise and the learning journey commented on how he had looked for other practical technologies in the local environment. The children had identified pelican crossings and a cashier's till as sources of sound.

Both Janice (SEN) and Chris (Private) encouraged children to use the photocopier to make copies of their work to take home. An entry in Child 4a's Learning Journey demonstrated this:

> It is a hedgehog, I need to copy it in the office! – She was very excited when the copy came out. (Child 4a, Private, Learning Journey)

Early years teachers are trained to adopt a social constructivist model of teaching (Veale, 2012). The child is central to everything that is planned; they are observed to establish individual needs, which enables the teacher to plan appropriate activities to develop their knowledge, skills and understanding (Petko, 2012). This process may not translate into their practice using technology in the classroom, however, where a more didactic approach is

frequently adopted (Petko, 2012; Hermans et al., 2008). Lack of confidence and lack of appropriate training in the use of digital resources may be the reason for this (Hermans et al., 2008). During the observations, staff were focusing on the children using the digital resources and explaining to me what technology they had and that the children could use any digital resources in continuous provision whenever they wanted. Perryman (2009) highlighted this behaviour in her research and referred to it as 'playing the game' (ibid: 623). Similarly, de Wolf and Janssens (2007: 382) defined it as 'intended strategic behaviour'. The staff were positive and enthusiastic and resources were all visible and accessible to the children for the purpose of the visitor. In contrast, on the second visit, which was planned shortly before the date, fewer resources were available and adults were focusing on other aspects of learning. This is to be expected, but leads me to question what practice is usually available and with what support, as clearly special events took place for my benefit. The interview and observation data appear to indicate that these issues contribute to a lack of role modelling of technology in everyday situations. Role modelling would support the children to develop a broader understanding of the wide range of capabilities of digital resources.

5.2.5 - Role modelling

Role modelling is an important criterion for TK, as seeing how technology is used in real life situations helps children to understand that these resources are tools with a purpose rather than just for games (Ertmer & Ottenbreit-Leftwich, 2013). Teachers do have a responsibility to be positive role models of good behaviour, attitudes, and approaches to learning (Wilford, 2007) and this is accepted practice. The recent introduction of technology in the classroom needs to be included in this. There are criticisms of its use with young children,

however. Considering a teacher's powerful influence on children, role modelling positive, constructive ways of using the right digital resource for the job is likely to be highly effective.

The settings varied in their approach to this; Sally (Reception), explained that she used the PC for research when children asked questions and she often used an app on her smartphone as a timer. From Karen's (Charity) interview data, she did not role model the use of technology other than to research questions the children asked. Unfortunately, there was also a logistical issue, as the setting did not have many resources to use and the photocopier and printer were too far away from the room to access easily. Karen did take photographs of the children and during the first interview, Karen explained:

> …we've only really got the one camera that we share, so it's hard for them to have a camera out all the time, but we do try we just said we're gonna start bringing in a child's point of view so a camera would be good to be used with that… But that's again supervised more than just it's a camera, we've got toy ones that used to be real cameras but they got broken, that they can pretend with but not actually use. (Karen, Charity, Interview 1)

By the second visit they had acquired a tablet and during the observations, Karen role modelled its use to take photographs and encouraged the children to take their own photographs under close adult supervision.

The observations recorded how both Janice (SEN) and Chris (Private), used PCs connected to the IWB to research answers to the children's questions; they also used the photocopier and printer and encouraged the children to operate them. The learning journey observation of the sound walk in SEN was also a role modelling opportunity, with the children using the pedestrian crossing, buying items from the shop, and seeing first-hand how the cashier's till worked.

There are criticisms of the use of technology with young children (Healy, 2001; Gurney-Reid, 2013; Bosely, 2012; Sigman, 2012), but an alternative perspective considers how the teacher's powerful influence on children and their ability to role model positive and constructive ways of using the appropriate digital resource for the job could be highly effective. The literature reviewed does not consider role modelling with technology, but as Marsh et al. (2005) and McPake et al. (2005) asserted that children mimic what they see adults do, so it is important to role model good practice. As discussed in Chapter 2, it is important that children have continuous exposure to technology in much the same way they do pencils and paper. When they observe adults using technology as a tool to assist in tasks, they learn that digital resources can used creatively for a purpose and develop experiences, rather than a mere novelty only used for special occasions (Chen & Chang, 2006).

5.3 - Pedagogical Knowledge

Pedagogical Knowledge (PK) is the second main domain of the TPACK framework considering the overall pedagogical approach in the case studies. PK is included to demonstrate the overall ethos of the setting and underpin the response to the third research question. Establishing the participants' approach to early years pedagogy is crucial to develop understanding of how technology can be used to enhance it further. While this domain covers a broad range of issues, for the purpose of this investigation, the use of technology is the focus. The criteria defined in Chapter 3 are addressed as illustrated in Table 12:

Pedagogical Knowledge Criteria
5.3.1 – Classification and Framing

5.3.2 – Active Learning
5.3.3 – Listening to the Children's Voice

Table 12: : Pedagogical Knowledge Criteria

Chapter 3 introduced Bernstein's (2000) classification and framing of pedagogy. The teachers' pedagogical approach towards teaching in the early years would be expected to have weak classification and weak framing (Bernstein, 2000), this allows for a cross curricular approach and the child leading the majority of the activities. This framing and classification of subject matter was most clearly observed through the analysis of the planning. Each of the settings had a very different approach to planning, varying in complexity and detail. The data were analysed for evidence of the teachers' use of the classification of subjects; was there a weak frame or a strong one, where did the power lie, with the acquirer or transmitter? Did the child have a say in their learning and how was this shown? Analysis of PK will also discuss the participants' attitudes and beliefs towards active learning and listening to the children's voice. Their principles on early years education will be included, as well as evidence of this in practice. An examination of the planning process and the specificity to the early years curriculum and the encouragement of active and independent learning will help to explain the early years teachers' pedagogical approaches.

5.3.1 – Classification and framing

Establishing the teachers' classification and framing for the sessions assists in determining their understanding of how they enhance the teaching of content and enable young children to develop as autonomous learners, as discussed in Chapter 3. This section analyses both observations and planning to gain an insight into non-technology-based activities and will

develop the discussion regarding the importance of child-initiated activities and promotion of independent learning. These aspects will contribute to the response to RQ3.

For Sally (Reception), planning was quite formal, particularly regarding phonics and mathematics teaching, while still ensuring that aspects of play were incorporated. Each of these areas had separate plans in addition to the main planning. These sessions were planned for each day and included whole group activities, adult-led activities and independent activities which were more child led but with a specific aim, which was introduced in the group activity and determined by the resources. There were planned learning outcomes and planned assessment opportunities.

Analysing the planning indicated that in the two school settings, for some areas of learning there was very strong classification and framing. Sally (Reception) planned phonics and mathematics specifically, for example, leading to a much more formalised experience for the children (see Tables 13 & 14).

	Monday
Revisit/Review	Recall n/m/g/o/c/k/ck/e/u/r/h/,b, f, ff using powerpoint
Teach	Remember 'f, ff' action and formation Children form letters on boards
Practise	Play phoneme frame words: Fat, huff, puff, fin
Apply	Read captions together. Model blending words to read. George write a sentence It can huff and puff
Assessment	Give the sound when shown any phase 2 letter Find any phase 2 letter from a display when given the sound Be able to orally blend and segment CVC words

Table 13: Example of planning for phonics session in Reception

Day	Whole Group	Adult Directed Activity	Resources	Independent	Plenary
Monday Missing numbers	**Learning Outcome**: To continue to understand time of day, what happens in the morning, afternoon and evening	Children to continue working on ordering	Pictures to order	Computer, putting events in order, differentiate,	Discuss with the children some of the things they

Children to count, clap to miss a number Children to say which number it is	**Learning Assessment**: Remember times of day, children say events that happen morning, afternoon and evening. Remember computer programme http://www.iboard.co.uk/iwb/my-day-sequence-109	pictures of events of the day, discussion		sequence cards, own choice	do at the weekend, is it different from a school day?

Table 14: Example of planning for one-hour mathematics lesson (Reception)

The power here is in the hands of the 'transmitter', in this case the teacher. It could be argued that this helps young children to be 'school ready'. 'School readiness' is a term that appears in a number of government documents, seemingly meaning something different in each one, however no clear definition has ever been provided (Whitbread & Bingham, 2011). Sally (Reception) demonstrated in her blog posts and interviews her passion for early years practice:

> I think early years education should be the stage where the children have the chance to continue to develop their personalities, find out what they like and they ways they prefer to do things. You are only four and five once and it is a precious time where ideals are developing. Children should be given opportunities to develop themselves, begin to develop skills and techniques that will stand them in good stead for the rest of their lives…
>
> Children in the Early Years are full of awe and wonder, are fresh, ready and willing to learn, eager to find out about the world and how things work. They are so impressionable and deserve a high-quality learning experience. It is the teacher's job to find out what the children are interested in and plan enjoyable engaging experiences for these little people to allow them to get one step nearer to developing the skills and techniques they will need in their life. (Sally, Reception, Blog Post 2)

While being restricted in what and to some extent how she taught mathematics and phonics, Sally kept her sessions short and then developed the content through her use of play. This can clearly be seen in both her planning and observations. Planning included, for example, using play dough to form letters, while during the observations, she provided other games on tablets and PCs to give the children a chance to consolidate what they had

learnt during the lesson. The prescriptive nature of Systematic Synthetic Phonics programmes, with their strong classification system, means that the power is with the teacher; children have little say in what happens. By using play activities to support this learning, Sally (Reception) kept this to a minimum.

There are no recommendations in the EYFS for any specific planning format to be used. Each setting adopts a style that is suitable for their practice. Karen (Charity) had adopted a less formal approach to planning, dividing the plans into the EYFS Areas of Learning. The setting had a weekly plan proforma, which they used for each room (Table 15). This may not be as detailed as Sally's (Reception)or Janice's (SEN) plans, but it allows for more flexibility and the opportunity to follow the children's interests, adapting resources, teacher input, and content throughout the week.

PSED - Settling new children into the room, looking at our promises and others'feelings, own independence within the routine, talk about crossing the road and how to keep safe for when the garden is closed and we have to cross the road	Communication and Language - Circle time songs, stories, animal sounds game - listening and attention	Physical Development- Name writing - developing tripod grasp and beginning to recognise own name, music and movement - experimenting with different ways of moving, pedaling bikes to develop gross motor skills, hand eye coordination using computer and mouse to click on screen
Literacy- Recognising beginning letter of their name and sounding it out, self registration - collecting names as they arrive to help recognise their names and the letters in them	Planning	Mathematics - playing games to recognise numbers 0-1, shape snap game - to begin to recognise shapes
Understanding the World - Talk about the weather - what do we need to wear, is it hot cold or warm? Computer (CBeebies games) To complete simple games & gain some control over the mouse	Expressive Arts and Design - Junk modelling, beginning to construct, Painting with forks,begin to realise tools can be used for a purpose	

Table 15: Example of weekly planning (Charity)

Table 15 illustrates how Karen (Charity) provided a general framework of the EYFS targets to focus on whilst allowing a flexible approach. This is desirable in the EYFS, enabling children to follow their interests and adults to support them (Brodie, 2013b). This allows for weak classification, so children's play will cross several subjects, and weak framing as the children will select the form activities will take.

Janice (SEN) had a variety of plans, from IEPs to weekly plans to medium term plans for each area. This could have led to a complicated process, but she also used her understanding of how young children learn to adapt potentially limiting processes to ensure flexibility and opportunities to learn through play (Thornton & Underwood, 2012). Weekly planning (Table 16) in this setting calls for adults to demonstrate activities to support children to see the opportunities that are available. In order to develop fine motor skills, the children are given a printing activity, which involves them using a pincer grip to pick up the print materials. They enjoyed doing this, as they were printing bear footprints and creating a picture with others, rather than practicing these tasks as a separate activity with their LSA. Often, the social learning aspect is omitted for children with SEN in favour of supporting them to achieve targets; however, learning to work alongside others and then in partnership is equally important for settings aspiring to provide a fully inclusive environment (Thornton & Underwood, 2012).

Group Focus for Each Session	Learning Intentions	Activities
Communication Language and Literacy	Give visual attention to IWB and props Match props to pictures Re tell story with adult support	Group – Introduce story 'Peace at last' using powerpoint and props to develop children's understanding https://www.youtube.com/watch?v=9U9y35kWBvM Individual- Act out story with adult support using props and pictures

	Enjoy experience of this story	Children to work individually or in pairs first matching props to pictures then re telling the story following the sequence on the powerpoint Staff to record photographically and through annotation of children's responses.
Creative Focus	Show interest in images of bears Print purposefully, showing awareness that their actions are making the prints Count their prints Name the colours	Group – Look at images of bears walking and of their paw prints Individual – Create paw prints using pre prepared sponge prints
PSED	Imitate imaginative play with bear and props Talk about what they are doing	Group – Look in a bag and find teddy bears, brushes, cups, spoons, bowls, toys etc. Demonstrate how we can care for the bears Individual – Role play with bears/toys will be set up and children encouraged t use equipment appropriately. Staff record children's responses as a basis for future sessions
Physical	Be confident to handle dough Experiment with different ways of making marks in it	Press shapes and toy animals into play dough to make paw prints
Mathematical Focus	Sort toy bears with a marked difference in size Respond to/use language 'bigger' and 'smaller' Sort daddy and baby compare bears	Group – Look at big and small toy teddy bears- sort into sets by size and use appropriate language. Start off with those with a marked difference in size Individual – Sort bears by size, for children that find this easier extend to sorting daddy and baby compare bears
Group Focus for Each Session	Learning Intentions	Activities
Understanding the World	Visit Give visual attention to image of giant panda on IWB Relate these images to toy pandas Identify animal as a panda	Listening walk with teddy bears to see what they can hear Giant panda – recap name and watch clip of them playing then make a picture https://www.youtube.com/watch?v=sGF6b0iNfa https://www.pinterest.com/pin/535083999452472710/

	Apply shapes purposefully and know that they have made a panda	
PSED/Physical		Shares PE Outdoors - pedalling
Technology	Control a vehicle using remote control	Range of remote control vehicles for children to explore Use- robots and rugged racer cars
Physical	For children to be physical in a safe environment	Session of no more than 4 children in soft play room

Table 16: Example of weekly plan (SEN)

The unique needs of the children Janice teaches require a structured approach (Table 16). The children may be unable to make choices independently, thus she has to adopt strong classification and framing. Each child has specific targets dependent on their abilities, so Janice plans and supports the child to achieve these. She also ensures that in so far as possible, there are also opportunities for free choice and engaging with resources that interest them. This highlights her commitment to weaker framing and classification in terms of early years principles.

Adult Focus within Continuous Provision – Enabling Environments – Everyday activities			
Support at snack time Support toileting			
Role Play Add beds and bowls to house corner	**Book Area** Add books about bears opposite and number	**Sand**	**Water** Add small, middle & large jugs & spoons to water. Add numbers 1,2,3
Creativity Can children draw 3 bears or create their own story using props?	**Construction and Small World** Builder's tray – Add 3 bears, goldilocks, 3 beds, 3 chairs Add words and numbers	**Indoor Physical Play**	**ICT** Use photocopier & camera
Going Out and About	**Outdoor Area** 3 bears house in the lodge	**Exploring Area/ Heuristic play** Explore oats, oaty play dough	**Mark Making** Snowman – matching

		Tray in the garden, explore textures	Numbers – Draw circles talk about shape size and number
Unique Child	**Activity- Positive Relationships/ Enabling Environments**	**Differentiation**	**Assessment/ Characteristics of Effective Learning**
CL – Single channelled attention Listens to others 1:1 and in small groups Listens to stories with increasing recall Extension – EAD Introduces storyline or narrative into their play	Children listen to Goldilocks and the Three Bears story Use props, puppets, repetitions and signs. Focus on 1,2,3 and big, middle and small Will children create their own stories using props, bears, beds, chairs, porridge?	Use props, puppets, repetitions and signs. Small groups, minimise distractions Provide props and materials in small world play	Active Learning Being involved and concentrating Playing and Exploring

Table 17: Example of weekly plan (Private)

Table 17 is an example of Chris's (Private) planning. She created a focus for each of the areas of continuous provision which link to the EYFS for the week. Adopting this approach gives colleagues a learning objective while allowing the children freedom to choose when and how they approach this. This provides a slightly stronger classification and framing than Karen's planning, but still promotes child-initiated learning.

Current government policy to increase early years provision in schools is designed to increase the number of fully qualified teachers to introduce more formal teaching to young children (Brodie, 2013a). Not being part of a school, therefore, means they can be much more flexible in their planning and have weaker classification. Activities and opportunities provided are cross curricular and allow for greater creativity, imagination and exploration. This puts the power more into the 'acquirer's' hands, in this case the children; they have the freedom to access learning in the way that is most interesting and appropriate for them individually. Through the use of play-based activities, they are able to ensure this 'power'

lies with the children, thus giving them an opportunity to make decisions and follow their preferences. This gives the teachers the time to observe and assess what they are able to do confidently, where there might be areas needing further support, and listening to the children's voice to plan the next steps in their learning following their interests, questions, and experiences. Investigating the use of a play-based curriculum more closely enabled discussion regarding how active learning was incorporated into the curriculum.

5.3.2 – Active learning

Reflecting upon the discussions in Chapters 2 and 3, active learning is a fundamental element of early years teaching; it is one of the Characteristics of Effective Learning explained in the Development Matters document as 'being involved and concentrating, keeping trying, enjoying achieving what they set out to do' (Moylett et al., 2012: 5). In a later article Moylett explains that these definitions are designed to incorporate the development of persistence and resilience. She discusses the concept of 'enjoyment' as being different from 'fun', which is often considered the main focus of play, in this instance meaning an internalised feeling of achievement (Moylett, 2014).

Analysis of the observations revealed the importance of this as part of each teacher's pedagogical approach. Understanding the case studies' approaches to active learning will support responses to both the first and third research questions. The analysis will add to the discussion regarding the active nature of early years provision and how teachers' interpretation of this may affect their use of digital resources.

During the visits to the settings, the majority of the activities I observed with the children participating in the study had a technological focus. I was able to ascertain through observation and analysis of the documentary evidence, however, that there were a variety

of other activities available. These illustrated a variety of pedagogies practiced within the settings. In the Reception class, there were opportunities for the children to engage with a darkened tent and torches independently to investigate light and dark, reading stories of their own choice, and mark making. Providing new resources encourages children to engage, experiment and learn independently. Early years pedagogy promotes independent, active learning (Moylett, 2014). There was evidence of this in the planning, with opportunities for the children to play with malleable materials, for example making string telephones and several activities which involved children using their senses (see Table 18). There was also evidence of a more structured approach being found in primary classrooms.

Monday	**Assembly**	**Phonics**	Complete Funny Bones work Write names/Letters Funny Bones play dough mats	To develop a sense of time, learn about different part of the day Sequence events of the day	Introduce senses What are these? Talk about what senses are, focus on sight and hearing Get lightbox out	**PSED** Likes and dislikes, favourite foods, smell, sound, Good listening, how to do this, helping hands
Tuesday			PE	Complete work on time	Senses box play Make string telephones	Play out with senses resources Bikes/Scooters
Wednesday			Senses poem Introduce touchy, feely box, use vocabulary, record Begin to write own senses poem	Number order	Remember senses, what are these? Talk about what these are Senses, work, play Smell/touch/hearing	Play out with senses resources

Thursday			Activities Senses poetry	Missing Numbers 10/20	Focus on sight and hearing Get light box out	RE: Sense of belonging What groups do we belong to? Activities to reinforce this belonging together
Friday			Spellings Complete activities from week and guided reading	Counting songs Numbers 10/20 Number order	Food to help you have strong bones – healthy choices	Green time Story

Table 18: Example of daily planning in Reception

In the charity-run setting, during my second visit, the children had access to cooking activities with a member of staff, painting, construction, and role play, while the participating children were engaged in the observations. The children went outside at set times; they had a garden area where they grew vegetables and could play with the outdoor resources (see Table 15). Early years philosophy views the child as part of the environment and promotes a flexible curriculum which gives them opportunity to engage with the world around them, developing an understanding and appreciation of the natural environment and their responsibility to nurture and care for it (Brown, 2012). The children are able to choose which activities they engage in. Bruce (2012) explains the Frobelian philosophy of giving young children the opportunity to develop resilience through decision making, discussion, and investigation. The adults' role is to support and observe them, assessing what stage of learning each child is at and planning how they can provide new experiences to enable them to achieve their full potential. Without the downwards pressure of school leaders, the setting can give children a true play-based curriculum.

The SEN setting had a high adult to child ratio due to their specific needs. They were engaged in physical activities specifically designed for the individual child, mark making, small world play (garage and toy cars), and they had a play time outdoors with access to a slide, bicycles, and space to run (Table 16). Early years approaches are all embracing, they begin with each child being unique and the expertise of the early years teachers ensures that they understand each child's current level of development. This means that no matter what they child's needs are, they will be addressed in a way which supports them. Moreover, their progress is not compared to others, but to their individual targets; what the child can do is the important factor, not what they cannot (Brodie, 2013b).

The private setting operated continuous provision, with free flow between the indoor and outdoor environments. All of the children were encouraged to access all areas of the setting during the session. Continuous provision provides a wide range of resources and activities which truly allow the children to develop an independent approach to their learning (Bryce-Clegg, 2015). Adult support was available to develop sustained shared thinking, enabling the children to reflect on what they have achieved and consider how they can move on to the next steps in their learning (Purdon, 2016). Adult-led activities were available and the children could choose to engage with these.

Hayes (2012) explains how successive government interventions have progressively reduced the breadth of the compulsory curriculum, explaining it as 'increasing essential knowledge' (ibid, 2012: 16). While the reception class must adhere to the EYFS framework, it is also part of a primary school which focuses on the National Curriculum. The need for 'school readiness' thus led to a more structured approach in reception to prepare children for the next stage of their education, entering Key Stage 1 of the National Curriculum (Fisher, 2011). Reception class teachers have had a very difficult role since the introduction of a separate

early years curriculum. They are expected to follow a play-based curriculum by the government, but in order to achieve better results in Standard Assessment Tests (SATs) at the end of Key Stage 1 and 2, school leaders push them to introduce more formalised learning so that the children's performance will improve and the school will have better results to improve their position in government league tables. As Fisher (2011) highlights, there is no justifiable reason for this complete change in approach at the age of five. Children do not change the way they learn and find it very difficult to adapt to this didactic style of teaching (Tassoni, 2012). Research into child development has identified a change in children's way of learning at the age of seven and in many countries formal schooling does not start until then, as in Scandinavian countries. Finland, for example, demonstrates that a play-based curriculum until seven years of age and formal schooling thereafter leads to their children achieving far better than those in other western countries by the age of 15 years in languages, mathematics, and science, according to the Programme for International Student Assessment (OECD, 2018).

5.5.3 – Listening to the children's voice

As discussed in Chapter 3, listening to children's thoughts and opinions is an important aspect of early years pedagogy and this was evident throughout the settings. The EYFS theme of the 'unique child' requires a high level of knowledge and understanding of each child's experience and interests. This can only be acquired through listening to their thoughts, ideas, and opinions, understanding whichever method of communication they are able to use. Evidence of this demonstrates the importance of the children's thoughts and experiences within the setting and will contribute to the responses for RQs 2 and 3. As the observations all involved technology, it was not possible to comment on this when digital

resources were not involved; however, the observations highlighted the variety of methods the participants used to hear what the children wanted and respond to these views. Listening to children's thoughts and opinions is an important aspect of early years pedagogy (Clark & Moss, 2011; Rinaldi, 2006).

Listening to children requires more than giving time to hear their words. This was best illustrated in Janice's (SEN) setting. Many of the children had limited communication skills, so body language was an important indicator of what the children wished to communicate:

> Child 3c is clapping and dancing to a dinosaur counting game, when it finishes he touches the screen to start the next verse… (Child 3c, SEN, Observation 2).

The child's behaviour, dancing and clapping to the song, showed he was enjoying the activity; touching the screen to make it continue demonstrated his desire to carry on with the activity. This particular programme required the child to touch a specific part of the screen to move the game forward, which Child 3c had not understood, so the adult supported him to do this. Observing the child's reactions enabled Janice to understand that he was happy and enthusiastic about the activity. She was also able to assess what he was able to do and how to support him to extend his learning.

In the reception class, Sally had the laptop connected to the IWB and a game loaded for children to choose to play:

> Child 1d is playing on the IWB. He knows how to navigate through the programme and quickly gets to the game he wants…his friend is with him but Child 1d is in control and he follows the instructions; however, his attention turns to the laptop and he decides to play on that… (Child 1d, Reception, Observation 2).

Sally observed this change of interest and in order to extend the play, suggested that Child 1d helped his friend to play the game:

> Child 1d points to what he thinks his friend should do and encourages him to move the cursor. They discuss the sequence of the story and he helps his friend to put the pictures in the correct order. (Child 1d, Reception, Observation 2).

By using her observations and understanding what the children were doing and how to use their interests and abilities to develop each other's confidence with the laptop and sequencing skills, Sally demonstrated the effectiveness of listening to the child's voice in developing learning opportunities.

Palaiologou (2014) explains how the United Nations Convention on the Rights of the Child (1989) considered children as individuals with a voice which must be listened to. There was evidence from the observational data that the children's voice was important in each of the case studies. The examples quoted highlight the clearest evidence for this. Children learn best when they have a purpose and freedom to investigate through play (Basquill et al., 2011). Hohti and Karlsson (2014) found that in adult-led activities, the children's voice was considered irrelevant, as the adult had all the information. They explain that the teacher needs to provide time and space to allow the children to share their views and that these experiences are much more interactive, positive and enjoyable.

5.4 – Content Knowledge

This section examines what is meant by Content Knowledge (CK). To provide an in-depth response to all of the research questions, CK must be explained in terms of early years teaching. The EYFS explains the content to be taught to the children; there is also a requirement to teach Systematic Synthetic Phonics from Reception onwards (DfE, 2017) which had an impact on Sally's approach to the content taught. Planning for learning is required to ensure that children are provided with varied opportunities for learning. Something that is frequently overlooked are the things children learn that are not planned

for. The data will thus be examined for evidence of the 'hidden curriculum'. As discussed in Chapter 3, this unplanned content has the potential to either enhance or detract from learning experiences. Evidence to demonstrate that the resources available are being used to develop the children's understanding of the content to be taught will also be sought. CK will also consider the way the resources are being used; if they are mainly controlled by the adult, used by the children under adult supervision, or independently by the children. Table 19 illustrates the criteria for this domain established in Chapter 3:

Content Knowledge Criteria
5.3.1 – The Approach to the EYFS
5.3.2 – The Hidden Curriculum
5.3.3 – Child Initiated or Adult Led

Table 19: Content Knowledge Criteria

Understanding these key points will enhance the understanding of the importance of the content taught to young children, how that content is decided, and the importance of the content to the children's learning experience.

5.4.1 – Approach to the EYFS

The EYFS is the framework which all early years teachers must adhere to. As previously discussed, there are seven areas of the curriculum and in each there are descriptors of what children should be able to achieve within each of the six age ranges (Birth to 11 months, 8 – 20 months, 16-26 months, 22-36 months, 30 – 50 months and 40 – 60 months). This gives the teacher targets for the children to achieve and supports the teacher in deciding the range of activities the children need to be successful. Understanding the curriculum content will help establish what content must be taught and supports the discussion regarding RQs 2 and 3.

In the reception class, examination of the planning found evidence of the areas of the curriculum to be taught, particularly for phonics and mathematics, which have separate plans. Using phonics as part of the method to teach reading is a long-established tradition (Watts & Gardner, 2013) and in 2006, the Rose Report recommended that synthetic phonics should be introduced as part of the curriculum. 2008 saw the publication of the Williams' 'Review of Mathematics Teaching in Early Years Settings and Primary Schools', which emphasised the importance of developing basic mathematical skills in the EYFS. The content of Sally's (Reception) individual plans was very clear and precise and demonstrated her understanding of the requirements to teach in these in a more structured way. There were separate weekly plans covering phonics, mathematics, and all other areas of the curriculum. There were also clear sections for whole group activities, adult led activities and independent learning opportunities. The remaining areas of the curriculum were less prescribed and had more scope for creativity, however.

The planning included activities to develop children's understanding of their senses. A lightbox was utilised, as can be seen in Image 2.

Image 2: Child playing with a light box.

The light box allows children to experiment with colours, light and shadow to develop their understanding of their sense of sight. Activities can include mixing colours using coloured pieces as shown in the image above or using acetates to paint on so the light shows through. Using creative activities such as the light box and making telephones from paper cups and string encouraged the children to engage and learn new concepts whilst having fun (Edgington, 2007). There were a wide variety of resources used to enhance the activities, from creative resources which allowed the children to make their own telephones, to malleable materials such as play dough and mats that encouraged children to identify and mould body parts using the children's book *Funny Bones* (Ahlberg & Ahlberg, 1999) as inspiration.

In the charity-run setting, planning was much less formal. As a PVI setting, they followed the EYFS completely. Karen planned in far less detail (Table 15) than Sally (Tables 13; 14; 18) was required to; however, this allows for the much more flexible approach which is promoted in the EYFS. Karen discussed how a child brought a snake skin in from home to show the group and this stimulated new unplanned activities, using technology to research snakes and how they shed their skin (see 5.2.4). Research has shown that understanding the individual child is central to early years education (Sylva et al. 2004) and in order to ensure all children's needs are met, a flexible approach to planning is required (Bruce, 2012). Planning in the private setting addressed the seven areas of learning and as this is a play-based curriculum, the planning focused on specific development statements as defined in the non-statutory guidance for the EYFS (Moylett et al., 2012). Analysis of Karen's planning (Table 15) showed opportunities to develop children's learning in each area of the curriculum through play-based activities. This is a much less structured approach which allows for early years teachers to follow the children's interests and lines of thought. It acknowledges the children

as competent learners who will construct their own understanding of the world when given the freedom and support to do so (Fisher, 2013). Children learn in different ways at different times and follow their interests; it is necessary to be able to change your strategies to engage their interest and follow their lead.

Janice (SEN) used a combination of approaches to the EYFS. As a Primary Special School, the children each have specific needs. They each have an IEP, which ensures that their particular learning needs are being met in a unique way to enable them to access the broader curriculum. Analysis of the plans (Table 16) revealed a clear focus on the EYFS and the relevant curriculum content. This allowed the teacher to plan activities related to the EYFS and adopt a more child-led, play-based approach. In this scenario, differentiation and flexibility are even more essential as the needs of the children are extremely diverse (Fisher, 2013).

Medium term plans use the development statements to highlight areas of the EYFS that need to be addressed and this underpins the focus of the weekly plans.

EYFS Medium Term Planning		
Personal, Social, Emotional Development **30-50 months** **Is more outgoing towards unfamiliar people and more confident in social situations**	**Communication and Language** 30-50 months Listens to others 1:1 and in small groups when the conversation interests them	**Physical Development** 30 – 50 months Moves freely with pleasure and confidence, crawling, running, jumping etc.
Literacy **30 – 50 months** **Enjoys rhyming and rhythmic activities**	**Focus** **Making Relationships**	**Mathematics** 30 – 50 months Use some number names and language spontaneously
Understanding the World **30 – 50 months** **Knows how to operate simple equipment**		**Expressive Arts and Design** 30 – 50 months Developing references for form of expression
Area of Provision **Books**	**Enhancements- Enabling Environments** Family, home life	**Planning and Resources** Variety of books, songs

EYFS Medium Term Planning		
Outdoors **Role Play**	Restock vegetable patch Home from home	Seeds, tools etc. Photos – own pictures, photo frames, display on cabinet, battery lamp, t.v. fishbowl
Areas of Learning and Development	**Focused Activities- Positive Relationships/Enabling Environments**	**Planning and Resourcing**
EAD	Developing preferences for forms of expression making face plate pictures	Plates, variety of media materials, mirrors
PSE	Family Tree – encourage children to bring in photos from home and draw family members for tree	Posters, labels, pens, paper, books, photos, staff photos
CL	Small groups to encourage expressing own interests, likes and dislikes. Building relationships adult/child, child/child	Letter home for mystery reader Use puppets, items from home
PD	Promote Movement with control encouraging listening and responding	Use activity board with signs and visual clues Net for crawling
Maths	Encourage recognition of own name using labels, clapping activities, self selections, own songs from visual clues Promote number games-language through songs and games	Sing simple songs, books and musical instruments, make song basket Use number sacks and visual clues, make number game adding machine
UTW	Support and encourage children to know how to	

EYFS Medium Term Planning		
	operate camera, tablet, cd player Harvest, make bread - pumpkin	Tablet, cd player and camera available with support – create book

Table 20: Example of medium term planning from Setting 4 (Private)

Chris taught in a large PVI setting and used continuous provision to enable children to access all areas of the curriculum freely. Chris planned enhancements to certain areas to extend the children's learning (Table 20). Development Matters (Moylett et al., 2012) was central to the planning to ensure that all children can access these areas at the level appropriate for them. Staff in the setting are given areas to focus on and they can support, consolidate, and extend children's learning experiences as they feel necessary from their observation and assessment of the children.

Roberts-Holmes & Bradbury (2016) discussed the impact of government-prescribed testing for early years children on teachers and how the results of these can affect the whole school. Bradbury (2013) found that head teachers in her research regarded the Early Years Foundation Stage Profile (EYFSP) as the Statutory Assessment Tests (SATs) of the early years. This meant that there was a pressure to do well, which in turn led to a focus on the specific skills that would be tested.

5.4.2 - The hidden curriculum

The 'hidden curriculum', as discussed in Chapter 3, may teach positive messages regarding content, but also negative perspectives. Cooper & Brna (2002) explain that the hidden curriculum has an impact on children's self-esteem. Zorec & Došlar (2016: 112) found that 'traditions and stereotypical beliefs of adults who fall within the subjective theories of preschool professional workers are important sources of hidden curriculum.' Considering

this in relation to technology, as discussed in Chapter 2, a belief in the active learning approach underlies many early years teachers' choice to avoid technology. A lack of self confidence in their own use of technology and a belief that technology is about children playing games can prevent them from giving children independent access to digital resources. Edwards (2015) discuss how the term 'hidden curriculum' implies an association with knowledge; however, it can also relate to relationships and the use of resources such as technology. Will this affect the children's approach to digital resources? The findings regarding this will contribute to Research Question 1.

Sally (Reception) designed an adult led activity in which six iPads were each used by a pair of children to play a rhyming game:

> The adult took the iPads and children into a separate room from the rest of the class and switched them on and handed them out. She then told them which app to select, the aim of the game and set them off on the task, circulating around them directing and supporting them… (Child 1a, Reception, Observation 1).

As previously highlighted, Sally realised that this approach had not been successful. She had designed a very specific activity because she knew I was observing. The children did not enjoy the activity because they had no control, were not even allowed to switch on the iPads and had no choice in how to use the app. These are negative experiences which do not give the children confidence or enthusiasm to engage with the content in depth. Cotton et al. (2013) emphasise that the information received through the hidden curriculum does not have to be negative, however. In contrast, during the second visit, Sally had changed her approach and the children using the iPads were working independently in the classroom. They asked each other or adults for help when it was needed. The app they used involved taking photographs, creating their own story, recording their narration, and finally sharing it with the rest of the class. The hidden message here was very positive; it showed confidence

and trust in the children to work independently on the iPads and valued what they had done through the sharing of stories at the end of the lesson. The difference between the two experiences here is a misunderstanding of purpose, which Sally saw and addressed, giving the children a much more positive message to learn from.

During both visits to Karen's (Charity) setting, from the interviews and observations, there were restrictions placed on the children. They were always supervised when using technology so that they would not damage it. There were limited resources, such as a camera and a tablet (visit 2), these were only used by adults or on occasions by the children if they asked, with the adult next to them. This gives the children the message that they cannot be trusted to use the resources. Technology was not used by the adults to complete any tasks, so the children did not see it being used as a tool. Their own experience did not appear to be considered, so even if they were confident with the digital resources due to home activities, this was not built on in the setting. Chris had a wide variety of digital resources and these were freely available to the children. Children were confident enough to use the photocopier and the staff positively encouraged them to do so. This provided a very positive message to the children and demonstrated Chris' confidence in this. In contrast, however, the use of the iPad was viewed very differently. It was rarely turned on and mainly used for researching information by an adult.

> Going back to a little boy two years ago, we discovered on one of the computers that you could get an app, which he had at home, the little boy didn't interact very much, he would sit in the book corner, playing the game, part of coming to nursery is to interact, to learn to share, to take turns, sadly if given the opportunity some children will just do that, but they are doing that at home anyway, so it's a tough one, to know whether you want that child to be sitting in a corner doing that, whilst he has other opportunities (Chris, Private, Interview 2).

This appears to illustrate a limit to Chris' confidence with the technology. The digital resources she felt confident with and understood the purpose of were freely available. The

iPad was new, however; she herself had limited experience of how it could be used in the setting. This had led to limitations on its use, which could influence the message children will receive regarding its use, i.e. they are trusted with some resources but not others (Newberry et al., 2013). The children's home experiences are not considered in full; the experience quoted above states that the child was quiet and did not play well. Rather than stopping the child from playing the game that he was confident with, his skills could have been celebrated by using the computer for practical purposes, extending this to the camera or tablet to take photographs and videos, creating pictures and documents, and many other possibilities. This would send a much more positive message to the child and move them away from their experience of solely game playing.

Self-esteem is an important factor in a young child's engagement with activities and hidden messages from the teacher can have a great influence on their learning. It is important, therefore, that the teacher is aware of this, as it is just as easy to pass on a negative message as a positive one (Cooper & Brna, 2002).

This section has examined examples of the hidden curriculum observed during the visits to the four settings involved in this study. It has highlighted issues regarding the purpose of using technology, confidence using it, and the potential to build or reduce children's self confidence in its use, which will contribute to the discussion in response to RQ 1.

5.4.3 – Child-initiated or adult-led activities

The content children learn depends on the amount of control the adult has over the learning opportunity. If the adult plans detailed content and the children are supported and directed as to what to do, the content is very specific and focused. This is sometimes necessary when introducing new ideas and resources to enable the children to fully

understand how to use them. When the children are allowed to take control of the situation and follow their own interests, however, their learning becomes much more varied. Through experimenting and investigating, children make sense of their world (Fisher, 2013). Allowing children to be in control requires the teacher to be confident in their own understanding. This section will support the responses to RQs 1 and 3.

Sally explained how she had changed her approach in her second interview:

> I think my thoughts have changed a bit since I talked to you and the things you have said have influenced the way I think about it. I am trying to incorporate it more in every day. Instead of it being a one-off thing, having it available, continuous provision, we have it out as much as we can. They have a lot to learn, if they start early they well develop those skills… Technology is a tool not a substitute! (Sally, Reception, Interview 2)

Originally, she had viewed technology as a specific teacher-led activity, but discussing her approach and reflecting upon her practice, she made digital resources freely available and encouraged the children to use them as tools to aid learning across the curriculum.

Karen (Charity) had limited digital resources and believed that the children needed adult direction to use them. This was evident through observations:

> Karen called Child 2a over to her to ask if she would like to play on the Leap Frog game, Child 2a came over and sat on Karen's knee, listening and watching her demonstrate how to use it. She pressed the initial letter of her name and the screen showed small lights in the shape of the letter. She then had to trace over the lights with her finger… (Child 2a, Charity, Observation 1).

She also worried that allowing them to initiate play with them would cause damage to the resources:

> They like to press buttons, and they don't know what buttons they're pressing so they could break the computers by pressing a couple of buttons and turning it to Spanish or something.
>
> We do let them on the games, we put the games on for them but then again, they need a lot of help with the mats and everything. The leapfrog we tend to get out and supervise again because they'll start arguing over it and running on it and painting on it, it just gets broken again (Karen, Charity, Interview 1).

Adult direction was also observed with Chris in the private setting:

> Child 4b asked for help with the PC which did not appear to be switched on. Chris sat with Child 4b and explained that the computer had gone into 'sleep mode' because no one had played on it for a while. She told him to shake the mouse, he did so and it came back on. He then tried to start the game by touching the screen, Chris asked if he had a tablet to play with at home and he said yes. She explained that there was a difference and that he needed to use the mouse. Chris asked him what game he would like and he told her, she explained what he needed to do to start it. Once the game had loaded Chris asked Child 4b what he thought he needed to do, it was a hospital game and he pointed to the patient and said, 'he needs a plaster'. Chris asked if he could find a plaster on the screen and he immediately clicked on it. She asked if he knew the other items on the page and encouraged him to discuss the ones he knew (injection and bandage). (Child 4b, Private, Observation 1).

This type of activity illustrates how using technology can become burdensome and regarded as unnecessary in an early years setting. Early years pedagogy promotes independent learning through play (Sylva et al. 2008; Bruce, 2012), this very focused adult-led activity did not appear to follow this philosophy.

Janice (SEN) also frequently adopted an adult-led approach, which was necessary to engage the children and maintain their focus:

> The toys are always available, the sound buttons are always available, the touch screen computer is always available, but the smart board isn't always available, because sometimes like you saw this morning sometimes if I put that on everybody stops what they're doing and just goes to look at that. The iPad also isn't always available, the iPad I tend to find if I have the iPad out in class, a lot of them flock to it and try to take it off each other, so with the iPad they tend to take it into a separate room with an adult so they can focus on something. (Janice, SEN, Interview 1).

There were examples of child-initiated play in three out of the four studies, in the reception class the initial observation was of a very adult-led and directed activity developing an understanding of rhymes using an app on the iPad. In the second interview, however, this was Sally's response to being asked if the children's technology skills had developed since my first visit:

> Yes, it has. They have free choice, they can go on laptops, some children go on loads, others don't really, they engage a bit more with the iPads, but I think the ones that really didn't want to engage with it are getting used to it now, I am aware of that

> now, so sort of encourage them to have a little turn, some children will stay on it all day and get really good on it and can find their way around. Most of them can find their way around and choose their own programme on those, on the board.... we use that quite a bit as well, so they are getting good at that. (Sally, Reception, Interview 2).

Chris (Private) highlighted that she felt there needed to be a balance between adult-led and child-initiated activities:

> Yes, I think the provision areas, they can access them anyway and certainly the things you bring in like the microphones/microscopes? Things like that, some things have to be done as a structured activity, with an adult leading it, for safety reasons, because of the little pieces of glass and things, so I think we need the fine balance of things that children can just access with things that you actually bring in as a focus for them. (Chris, Private, Interview 2)

Chris did have a variety of digital resources available for children to access freely, both indoors and out. Child 4d, for example, was playing outside and picked up the walkie talkies, she gave one to her friend:

> She holds the handset while sitting on a toy zebra and talks into the handset. Chris explains how to press the button before she talks but Child 4d runs off. She hides behind a tree and Chris brings her friend to her and explains how to use it again. Child 4d makes noises into the handset and they all laugh. She then begins to sing into it, but still does not use the buttons, she runs around holding the handset and speaking into it… (Child 4d, Private, Observation 1).

This observation highlights the child's interest in the resource and her understanding that it can be used to communicate with another person. Hiding while speaking into it appears to suggest that she would like to use this more interactively and direct her friend to her hiding place, however, lack of experience in operating this proved to be a barrier. This could be easily addressed through adult role modelling and more frequent use of the walkie talkies. There is a need for a balance between adult led and child-initiated activities; often a more didactic approach is required to introduce new concepts and resources. As Robson (2016) found, however, child-initiated activities provide more in-depth experiences. Children know what they want to achieve and use problem solving approaches to find a solution. Robson also found that the children were more likely to work together in this than if the teacher

gave them an activity to complete. Kinos et al. (2016) discuss the appreciation of children as agents of their own learning as fundamental to early years practice and suggest that the adult's role is to respond to the children's ideas and scaffold their learning. The data revealed a variety of approaches, some changing depending on the type of digital resource. The EYFS ran throughout the planning and practice in all the settings and this can be seen in the observations previously discussed and the planning in Tables 13, 14 and 18. Sally (Reception) was the only setting required to teach Systematic Synthetic Phonics and did so in a creative, playful way to engage the children and encourage them to practice each day's learning. There was also evidence of the deconstruction of skills, as Chris (Private) explained the use of the walkie talkies step by step. There was evidence that the hidden curriculum being presented to the children varied depending on the teachers' experience, confidence, and understanding of the digital resources available. This resulted in a variety of messages being given to the children and is an area that needs to be considered in more depth as part of a proactive approach to technology. There were indications of innovative use of the digital resources to enhance the children's learning experiences.

5.5 – Technological, Pedagogical And Content Knowledge

As established in Chapters, 3, 4 and 5, Technological, Pedagogical And Content Knowledge (TPACK) is the successful combination of elements from all three domains in such a way that the technology is used because it will extend and enhance the content that is to be taught. Furthermore, the pedagogical approach is adapted to match children's understanding and interests (Harris & Hoffer, 2011; Glowatz & O'Brien, 2015).

The data were analysed for examples of this combination in the case studies to contribute to the discussion in response to the third research question.

> When technology integration is working well, effective teaching represents a 'dynamic equilibrium' between the content, pedagogy and technology, such that a change in any one of the factors has to be compensated by changes in the other two
> (Mishra & Koehler, 2009: 17)

This level of knowledge allows teachers to combine the elements of the TPACK framework and select appropriate digital technologies to enhance the content they wish to teach. Teachers thus naturally adapt their pedagogical approach and these learning activities become highly effective (Hoffer & Grandgenett, 2012). The discussion regarding TPACK in Chapter 3 identified that to create such highly effective activities, teachers needed to understand how the domains and intersection of TPACK can be adapted and applied to support the teaching of all curriculum areas. In order to achieve this, the teachers need to understand the range and capabilities of digital resources at their disposal. Finally, understanding and building on the children's experience was highlighted as an important factor in the successful use of technology in the early years.

Table 21 illustrates the criteria for this domain as established in Chapter 3:

Technological, Pedagogical And Content Knowledge Criteria
5.5.1 - Multiple interaction of all domains of the TPACK framework
5.5.2 – Understanding of the best digital resource for the activity
5.3.3 – Build on the children's understanding of technology

Table 21: Technological, Pedagogical and Content Knowledge Criteria

5.5.1 - Multiple interaction of all domains of the TPACK framework

Boschman et al. (2015) incorporated workshops in their research regarding TPACK and commented how the discussions during these led to better understanding and ideas. Interestingly, all of the participants had developed their approach to technology following the first interview. Having discussed technology and how they employed digital resources, the participants considered how they could use it more constructively. This concurs with

Boschman et al. (2015) who suggested that discussion supported the teachers to realise their own understanding and use this to develop their use of the digital resources in their planning. The interview was deliberately designed to adopt a conversational approach to encourage discussion, as well as provide information. Sally (Reception) demonstrated how she used the multiple interaction of all the TPACK domains to enhance children's understanding of 'the body'.

Following the first interview, Sally (Reception) spoke of her plan to introduce the theme of 'Our Bodies' in one of her blog posts:

> We are naturally going to have the microscope out, we are learning body part names so will make a diagram, have the recordable pegs to clip to the certain body part and observe the children being engaged and excited about their learning!!! (Sally, Reception, Blog post 1)

From this comment, Sally was considering the content that she needed to teach, names of body parts. She reflected on the attributes of the different technological resources she had at her disposal and because the children would be drawing their bodies and labelling the parts, she concluded that the recordable pegs could be clipped to the body parts and the children could record the names of the parts and identify them. Her pedagogical approach on active learning; the children (the acquirers of knowledge) would have control and she as the transmitter (deliverer of knowledge) would be there to guide them. There would be opportunity to adapt the activity to the needs of individual children; Sally could record parts of the body and children find them, the children could do this themselves; the part of the body labelled could be basic or more complex.

In her second interview she reflected on how it had worked:

> I began by recording the names of the different body part on each peg and attaching them to the large picture of a body I use. The children press the pegs and hear the body names, they are also labelled so it helps them to read the words. Then I took them off and the children had to listen to the words and then peg them to the

> correct body part. After that, I erased my voice and the children recorded themselves saying a body part then attached it to the correct place. They really enjoyed it and became very confident using them. (Sally, Reception, interview 2)

This meets the requirements of the EYFS, it develops children's understanding that technology can be used for a purpose and most importantly, the children will enjoy the activity and thus engage and extend their understanding. This suggests that the discussion during the first interview encouraged Sally to consider all the components of TPACK and enabled her to build on her existing knowledge and promote an active learning experience for the children (Glowatz & O'Brien, 2015). TPACK is not simply a combination of technological, pedagogical and content knowledge, but an understanding of how they can interact and adapt to ensure children's unique needs are met (Koehler et al., 2013). In this activity, Sally began by scaffolding the children's learning using a very structured, teacher-led approach, but she then adapted it and allowed the children to develop their own learning. This ensured a seamless integration of technology (Drummond & Sweeney, 2017) into the activity, which engaged the children in taking an active approach to their own learning.

5.5.2 – Understanding of the best digital resource for the activity

Early years education requires a flexible approach, as young children change their focus and interests very quickly (Fisher, 2013). Early years teachers adopt a flexible approach by being open to change and while planning is required, as Woods (2013) suggests, teachers should not plan for learning objectives but for possibilities. With this child-led approach, understanding the best resource for developing a concept is particularly important. It requires the teacher to appreciate the resources available, their potential uses, and the

practicality of incorporating them into an activity. This understanding is of particular importance when considering the use of digital resources.

An example of an opportunistic approach can be seen in Case Study 4. It was an activity that was not seen in the planning, but from Chris's interview, it shows innovative use of the IWB:

> When I went in the room the other day it was fantastic. There were 25 children in there. We have one little boy who has additional support and he was engaged in this activity as well. It was so quiet, you could hear a pin drop. The children had brought ice in from home and they were recording the ice crackling. They were all stood around listening, something they couldn't have done without the white board. (Chris, Private, Interview 2)

In this instance, Chris had thought about the attributes of the technology available and chosen the IWB as most suitable. Despite this not being the usual use of the IWB, it was adapted for a different purpose. Other technologies were not as suitable as nothing else was wired to the speakers, so would not have been as effective or engage as many listeners. The children were able to hear sounds they would not normally hear and this was an active experience which sparked their curiosity and developed their understanding.

Janice (SEN) was able to see the value of technology to support the children in her class. As they had SEN, communication and engagement were both important issues and technology provided solutions.

> Janice introduces a nursery rhyme programme on the IWB, she asks Child 3c which rhyme she would like, Child 3b shouts 'trains' and Child 3c chooses the train rhyme. When it ends, Janice says it is her turn and she goes to press the arrow to start the next verse. Janice picks up her PECS book and encourages her to choose her own rhyme. She chooses '5 Little Ducks and then says '5 Little Ducks'; Janice asks her to press start and she does. (Child 3c, Observation 2).

In this instance, Janice understood that Child 3c would have difficulty engaging in this activity if she were just to sing the nursery rhymes. By using the IWB, there are audio-visual stimuli and the opportunity for Child 3c to control the activity. The programme used incorporated illustrations of the nursery rhymes available; by pressing the picture, the

programme moved to an animated version of the nursery rhyme for children to sing along to. Janice also explained:

> I use different programmes to help all the children engage, for instance one has a 'Next' button that they have to press to move to the next screen, but another moves on no matter where they press. Some of the children do not understand the concept of the 'Next' button and if they are taking part, I would use the second programme to develop their understanding of controlling the screen. (Janice, SEN, Interview 2)

Koehler and Mishra (2009) commented that teachers need to take opportunities to experiment with technology and consider new approaches to teaching. Abbitt (2011) explains that technological knowledge alone is not sufficient to develop appropriate use of resources and Anderson et al. (2013) build on this, suggesting that it takes time and confidence to move away from the expected uses of digital resources to the pedagogical adaptation of their capabilities for an educational purpose. The evidence suggested that both Chris and Janice demonstrated their ability to do this and it proved successful.

5.5.3 – Build on the children's understanding of technology

RQ 3 enquires about the relationship between pedagogical approaches, the content being taught, and the use of technology to enhance learning experiences. Benson and Ward (2013) emphasise that TPACK is greater than the sum of its parts. Building on the pedagogical contribution to this, I looked for evidence that demonstrated the teachers' understanding of what the children could already do and their use of technology to further extend the children's knowledge.

In Sally's (Reception) planned activity, using the iPad and the Puppet Pals app (section 5.4.2), is a good example of how she used her observations of the children's capabilities on the tablet in the activity from my first visit.

> The children were just learning about rhyming in phonics so I had found a super free app to support and reinforce this. The children quickly got the hang of what to do and with some support sometimes did what they were supposed to do and matched up the rhyming words and pictures by listening and looking. One child who was quite bright got a bit bored with it!! The app did reinforce rhyme and made the children think. (Sally, Reception, Blog post 1).

When Sally reflected on the initial adult-directed activity with me, she realised that it was not appropriate. One of the children became bored as it was too easy, while from my observations it was clear that others struggled with it:

> Child 1b listened to Sally's instructions, but did not follow them. He pressed on the pictures and accidentally got some right. Sally explained again and encouraged him to listen to the words, he let Child 1a have a turn and watched. He tried again, but pressed the pictures randomly, Sally demonstrated how to play the game and supported him to listen to the words. He then identified a rhyme and pressed the correct pictures. (Child 1b, Observation 1).

She built on this observation to extend their story-telling skills as well as their technological abilities for the activity I observed during my second visit.

> Child 1c had an iPad and opened the 'Puppet Pals' app. He said, 'I am having a wicked witch' and laughed. He chose a background for his story and then walked away with the tablet. He talked to another child engaged in the same activity and showed her what he had done. He returned to the table and sat quietly picking his characters and talking through the story to himself. He left the table again and entered a tent. He returned after 15minutes to play his story to me. He laughed and explained 'I started once upon a time…' He explained he had made a spell and recited alongside his narration as his 'witch' was saying it. He smiled proudly as his story ended. (Child 1c, Reception, Observation 2)

I discussed this with Sally in her second interview and she was surprised that Child 1c had engaged so well with the activity, commenting that:

> I had not expected that as, when he is engaging with traditional story writing activities, he does not show a lot of interest and would never have created such detail. (Sally, Reception, Interview 2).

Building on these observations before my second visit, she had provided the children with more experiences using the iPads and more autonomy in their use. Rather than one set game to practice a skill, she had used an app which enabled differentiation by outcome. The

children were able to create a story as complex or simple as they were able to, then share their stories with each other. Following the activity, Sally encouraged the children to share their stories with the class, giving her opportunity to assess what they had achieved and for the children to comment on the stories, considering what was good or could be better, developing a peer review approach.

Through evaluating the initial activity, observing and assessing the children's skills using the tablets, responses to the app, and approach to the activity; Sally was able to develop a more constructive approach. Using the observation, assessment and planning cycle enabled Sally to gauge the level of each child's understanding and plan opportunities to extend this (Stevens, 2014). Sally also encouraged the children to practice using the apps in a less formal way, which allowed a more creative approach. This activity highlights how effective technology can be when the teacher combines their knowledge of the content to be taught with their understanding of the technology available and consideration of the best method of teaching for the child (Blackwell et al., 2016).

5.6 - Summary of Chapter 5

Having examined the TPACK framework in detail in Chapter 3 and created criteria for practice in each of the areas as it would look in early years settings, I then adapted the framework to TPACK-EY. This chapter reported the findings from the variety of methods of data collection, which produced a picture of the technological provision across the four case studies. I have classified the evidence found into each of the TPACK-EY elements and discussed the practice indicative of each.

Using evidence from interviews, observations, and documents enabled me to analyse how personal experience, confidence and training influenced planning and provision for the

children. I have linked this to relevant research and identified common issues and those of a more individual nature.

From the DCA, important findings from the data drew attention to the reliance on first-hand experiences and traditional approaches which do not require technology. There are concerns raised regarding the reliability of technology, which appear to be the result of a lack of experience and confidence in the use of technology, both personally and professionally. This restricts the imaginative use of the digital resources at the participants' disposal. Children's individual experiences and understanding is accepted as the starting point for planning experiences, yet the data implies that regarding technology, it is either assumed or not considered, leading to very prescribed use with adult support. This may give the children the hidden message that they cannot be trusted with the digital resources.

Across the case studies, the data revealed a range of priorities which affected the use of technology; the need for school readiness emerged in the Reception class, the team in the Charity setting were prioritising the creation of a new outdoor area for the children, in the SEN class there was a strong focus on technology to enable children to access learning, and in the Private setting there was access to some digital resources through continuous provision, but not the iPad. This overview briefly highlights the differences in the technological experiences with which the children in each of the case studies were able to engage.

All the participants had engaged with different early years professional programmes and confirmed that none had covered the use of technology as a learning resource. They also highlighted that Local Authority training did not include any support for the pedagogical use of technology either. Without such support, they were restricted in adopting a creative

approach, not having the opportunity to engage with the art of the possible regarding the potential of technology.

Using the TPACK framework for this purpose illustrated the complexity and frequent duplication caused by using seven categories. TPACK has been criticised for its size and lack of definition (Archamboult & Barnett, 2010) and this became increasingly obvious through this research. To analyse the type of use of technology in the four case studies, the seven domains and intersections needed to be defined in terms of early years practice (Chapter 3). The importance of each of the domains and intersections were evaluated and a new framework, TPACK–EY, was created to enable clear, concise analysis of the data.

The variety of practice and the influence of the teachers' experience and training have shown themselves to be important factors in the teachers' approach to technology with young children. Lack of training in the pedagogical use of technology led to more tokenistic uses to meet the requirements of the EYFS or support accessibility. However, through discussion during the interviews and Blog posts, the participants were able to reflect on the digital resources available and consider other ways of using them to enhance the children's learning experiences. This appears to imply that the participants personal experiences with technology can have an impact on their practice if it is viewed as a supportive tool and time is given to consider its potential.

Availability of resources is also a contributor, but perhaps the most striking finding is that the training that the teachers had accessed was focussed on a specific resource and that simply discussing the potential of this gave the participants time and opportunities to think creatively and consider more flexible uses of technology. In order to raise the focus of technology and enable early years teachers to assess their own abilities in its pedagogical application, a self-assessment tool was created based on the TPACK-EY model (Appendix 5).

Considering technology through TPACK-EY emphasises its use as a tool to support learning and not a replacement for the play they hold so dear.

Chapter 6 considers these findings and discusses six key conclusions drawn from the study.

Chapter 6 - A Pedagogical Approach to Technology in Early Years Education

6.1 – Introduction to Chapter 6

This research study is based on my conviction of the potential of technology to be used in order to enhance pre-school children's learning experiences. Chapter 1 introduced the background to the research study and explained the development of early years pedagogy, as well as the importance of a play-based curriculum that has an emphasis on the Characteristics of Effective Learning - active learning, playing and exploring, creating and thinking critically (Moylett et al., 2012). It also introduced the principal research question: How does the Technological, Pedagogical and Content Knowledge (TPACK) of early years teachers influence their use of technology for the purpose of enhancing learning experiences for young children?

The review of the literature in Chapter 2 considered how the use of technology is becoming essential to both adults and children and how it is important to realise that the developments made over the last 25 years have created technologies that pervade almost every area of society. Smartphones are a good example. Fundamentally, the children who participated in this study will grow up to be adults in a digital world we can only imagine. As Gibbons (2006) and Hopkins et al. (2013) suggest that when current pre-school children reach adulthood, technological competency will be essential for the majority of professions. Providing a strong foundation of digital literacy in the early years is essential in order to ensure that children learn how to use technology as a tool to enhance their first-hand learning experiences rather than as a substitute for them (Marsh, 2017; Gibbons, 2006).

A further perspective from the literature reviewed was the emphasis on the importance of giving children a strong foundation to build the skills they will require in the future. It raised

concerns regarding early years teachers' attitudes and practice in this area, however. It is imperative that children have high-quality experiences with adults who are confident in the use of digital resources.

Examining the TPACK framework as discussed in Chapter 3 enabled me to consider the ways in which technology could be incorporated into the early years curriculum. Questioning this encouraged me to develop an in-depth multiple case study in order to explore and recognise the components of practice that the data had revealed. From this, I was able create a version of TPACK that focused on early years practice in the form of TPACK-EY.

In Chapter 4, I discussed the journey taken in order to reach the eventual research design. This included the use of Direct Content Analysis, which utilised the original TPACK framework and allowed for its adaptation to TPACK-EY as a result of the process. I introduced TPACK-EY, a framework I designed to specifically address the incorporation of technology into the early years curriculum.

This chapter explains the importance of the findings from the analysis of data, discussed in Chapter 5. I will begin by using these as a basis for the response to each of the research questions and by then explaining the salient themes which have arisen from this process. My original contribution to knowledge in this area will be discussed and highlighted, with consideration of the implications for policy and practice. I will then suggest potential areas for future research.

This process has thus enabled me to offer the following six key conclusions from the study, all of which are equally important in enhancing children's learning experiences through the use of technology. However, they are presented in the order of importance in developing a positive approach to using technology to enhance and extend children's learning experiences:

1. Personal experience, understandings and attitudes have an impact on the use of technology in early years education

Chapter 2 revealed criticism of the use of technology in education, with research finding the use of technology had made little or no impact on the children's learning experiences. The empirical findings in this study contribute to the existing body of research (Christia et al., 2012; Warschauer & Ames,2010; Trucano, 2005) by suggesting that, rather than the resources not having an impact on the children's learning, it is the experience, understanding and attitudes teachers have towards technology that have the initial effect on its use.

As discussed previously, two of the participants explained stress and worry over using the computer/laptop for their assignments during their professional programme. It can thus be assumed that they did not receive support in the most common use of technology during a taught programme. As one of these participants was a mature student, she confirmed that she had not received any IT lessons during her time at school. This could have been anticipated and support could have been arranged. The second participant had engaged with technology at school; however, this was not sufficient to develop her skills and confidence in this area. It is a common belief that younger people have grown up with technology and are therefore adept at using it (Prensky, 2005); however, findings from the current study do not support this.

Outcomes from this research study demonstrated the wide variety of personal experiences the teachers had. There appeared to be more of a reliance on smart devices than PCs or laptops, which suggests that mobile technology is becoming the preferred means of use even with those who profess a distrust of technology. Negative, stressful experiences had caused a fear of using technology for Karen (Charity) and Chris (Private) and this had led to

avoidance. Analysis of the interview data revealed that they had both experienced a lack of support during academic programmes. The effect of this was a personal mistrust of technology. This had, in turn, found its way into their professional approach when it came to using it with the children.

2. There is a lack of training opportunities to develop their understanding of and confidence with technology for early years teachers

Previous research has regularly highlighted the need for training in the use of technology for all teachers, including those in early years (Marsh et al., 2005; Hermans et al., 2008; Aubrey & Dahl, 2008). The findings from this study are consistent with these. This raises the question of why the lack of available training continues to be an issue.

The results of this study indicate that, while the four teachers each studied different early years programmes, none of them had included the pedagogical use of technology which Brun and Hinostroza (2011) discussed. The participants who did engage with digital resources had to teach themselves how to do it. Those in school settings had engaged with some training for specific resources around their functions and requirements. This was done by the companies who were marketing the resources, but the pedagogical applications were not covered. While local authorities were able to fund training for Safeguarding and Child Protection training, money was not, however, available for training in other areas. This then leaves the matter of developing teachers' skills to personal funding for courses. This was not an option taken by any of the participants of this study. They were teaching themselves as necessary, which does not lead to the best experiences for young children.

The present study provides additional evidence of the theory that there is an issue which remains regarding the provision of training in the pedagogical use of technology for early

years teachers, not only as continuing professional development, but also in professional programmes.

3. Teachers' ability to enhance learning opportunities through the use of technology is influenced by the inequality of funding and training opportunities across the sector

The EYFS framework underpins all early years' provision. One of its original purposes was to ensure that all young children had equal opportunities to learn across the curriculum. Equal access is therefore an essential consideration for any study which relates to early years practice. As discussed in the literature review, the wide range of digital resources available is rapidly expanding; examining what is available reveals the potential for exciting new learning experiences which allow children to engage with previously inaccessible content. Examples of this include apps which turn a tablet into a microscope, for instance, which allows children to quickly see things in more detail and take photographs of them. There are also recordable devices that encourage children to engage in activities more independently and to a higher level than they have previously achieved. Good quality digital resources can be expensive, however, and funding can be an issue. As discussed in Chapter 2, equality of opportunity is required by the EYFS. The data highlighted that in the case of technology, this was not apparent.

This research has highlighted another issue worthy of concern when approaching the resources and experiences the children had access to across the settings. The findings revealed that, across the four case studies, the amount and type of digital resources varied widely. This in itself could lead to an inequality in the children's experience, with some having the opportunity to engage with a variety of digital experiences while others not having those experiences at all. It is also necessary to consider that, while settings may have a range of technology available, it may not be used and remain in a cupboard (Kennington &

Meaton, 2009). While it is clear that it is important to have access to resources, the quality of experiences also needs to be considered. The data indicated that there were resources which were considered suitable for children to have free access to while others were viewed as needing supervision. This depended on the views of the teacher and was another factor in determining the digital experiences provided for the children.

These findings revealed how some digital resources were simple, inexpensive and robust. These included, for instance, children's cameras and walkie talkies. These are often seen available in continuous provision environment within the settings, and the children access them freely often with little or no adult support. When more apparently expensive resources are available, for instance, tablets, then concern is raised that the children may break it, even when protective covers are used. The teachers often ensured that the children were fully supervised when using tablets and insisted on providing apps for a specific purpose. Tablets are currently available at a very low price and may be less expensive than apparently simpler digital resources, such as children's cameras or headphones. The perception remains, however, that the children require full supervision. This view could be influenced by negative media stories about the use of tablets by young children (Bosely, 2012; Harding, 2015). The interview, for instance, revealed that both Karen and Chris had been influenced in this way. A clear example of this was the difference between Chris' enthusiasm for children choosing to use digital resources and her view that the iPad was not included in that and needed close adult supervision.

Awareness of the demand by policy makers and OfSTED Inspectors for the need to include technology in provision often leads to tokenistic gestures. Depending on the skills and values of the inspectors, this may be sufficient. This requirement appears to have led to an interesting approach, whereby there is a 'fabrication' (Clapham, 2015:1) of events designed

to impress. This was apparent in two of the first visits to the case studies, where there was a clear focus on technology which was not usual or necessarily successful. This highlights the need for regular engagement with such devices. While the aim may be to impress the visitor, it may have the opposite effect. The acquisition of digital resources does not always depend on the teacher's understanding, particularly in PVI settings. If owners and managers (who may not have any early years' experience) have negative attitudes or no understanding of the need for digital resources, they may give priority to other areas in need of development. This was seen in the charity setting, as limited funding was available and other areas of the curriculum were given a greater priority. In other settings, this may be reversed and digital resources may be available, but teachers do not use them. It can thus be suggested that while there are many digital resources available, personal experiences and understanding of their potential can have a major effect on how they are used.

The study highlighted the importance of technology in supporting children with SEN (Hayes et al., 2010). As this research demonstrates, both assistive technology and educational technology resources were being used to support the children's learning. Technology was considered a great enabler in order to support children with learning difficulties. Janice (SEN) explained how children communicated better and accessed learning that would have been impossible before the advent of technology, reinforcing the importance of technology in order to support equal opportunities to access learning.

With frequent criticisms of the use of technology with young children in the media and debate regarding the effectiveness of technology in the classroom, which was previously discussed in Chapter 2, this study argues that rather than the technology being the issue, it is the way it is employed that gives cause for concern. Demands on teachers' time, as well as

their commitment to the use of technology, impact both the investigation and trial of new digital resources. If there is an existing lack of confidence with technology, the already limited time available may well be allotted to other activities which teachers feel are of more importance. The empirical evidence appears to indicate that, while some children have access to a wide range of technology which is planned for and used to enhance learning experiences, others receive limited access, with little planning, which is of less benefit to their learning. The wider implications of these findings suggest that young children are not receiving an equitable experience of technology across early years settings. Given the increasing importance of technology in the 21st century in all aspects of society, the findings suggest that this issue needs to be addressed with some urgency.

4. If children observe technology used in a positive constructive way, they will learn to use it similarly

Generally young children spend the majority of their time with one or both of their parents and, as such, their earliest technological experiences will be with their parents (Palaiologou, 2016). With regards to technological experiences, several pieces of research highlighted that the majority of children were growing up in contact with some forms of technology (Palaiologou, 2016; Plowman & McPake,2013; Price & Price, 2010). This could be a smartphone, increasingly a tablet device, a laptop or a PC. What the children learn about how to use these resources depends on their parents. These experiences may include playing games to keep them quiet or set times where they can use them for entertainment. Some parents may allow educational apps to be accessed, while others will ban the children from using screen technology to safeguard their children from what they are concerned about. Parents have the right to choose how they approach the use of technology, but often this leads to the media hype regarding the bad influence of technology, such as spending

long periods playing games as discussed in Chapter 2. If digital resources are planned activities across the curriculum, when they have the capability of enhancing the content, making content more accessible or encouraging different approaches to learning, the children then develop an awareness of the potential for discovery and creativity, rather than only game playing. The findings in Chapter 5 revealed how early years teachers are beginning to role model the use of technology as a tool to support practical tasks such as photocopying, timing activities, research purposes and to record children's work for example.

Working with parents and using their knowledge of their child to support observation, assessment and planning is expected in the EYFS. In this study, however, this was not applied to children's technological skills. In some instances, it was assumed that they all had access to iPads while in others it was not considered. To build on what the child can do, it is important to understand their experiences, which is the professional approach taken for other areas of the curriculum.

Parent partnership is an important factor in the EYFS and settings encourage parents to support their children's learning and development. When parents do not understand the approach, the early years teachers often deliver information sessions or provide information leaflets for support. Given the concerns found in the literature review regarding young children's use of technology, discussed in Chapter 2, provision of such support with technology would begin to address this issue. Adopting such an approach would not prioritise technology but it would also encourage its use in order to support other areas of the curriculum, thereby enhancing parents' understanding of the curriculum and encouraging them to engage with their child's education while promoting the positive use of technology at home and in the setting. While support for parents' use of technology with

their children was included in Interview 2, none of the settings engaged with this in any way. This highlights an important opportunity to improve children's use of technology that is being missed.

In an early years setting, teachers have ideal opportunities to role model the use of technology in a positive and productive way. The research highlighted examples of how smartphones could be used as timers, pictures could be photocopied, PCs could be used to research information on the internet and iPads could be used to record observations. This could be extended further, depending on the digital resources available. The analysis of the data has shown that while adults role modelling the use of digital resources is important, it needs to be followed up with opportunities for the children to engage with them as well.

5. The TPACK framework requires adaptation to reflect the early years context

The findings of this study aligned with the findings from Kopcha et al. (2014) and Brantley Dias and Ertmer (2013). The authors postulated that TPACK in its entirety was far too large to cover in great depth. Analysis of teachers' discussions regarding technology by the three domains and four intersections, which due to their nature intersect with each other, resulted in repetition and at times, confusion. Very little was found in the literature to define how TPACK appeared in early years practice. Deconstructing the Technological, Pedagogical and Content Knowledge framework and establishing how the domains and intersections appear in early years practice in Chapter 3, allowed for deep analysis of learning experiences. As I performed the task, one in which I attempted to create specific early years definitions, it was often difficult to be precise. The intersection of Pedagogical and Content Knowledge (PCK) is an example of this. In theory, it could cover any amount or type of content and a vast array of teaching approaches that are not pertinent to the

current study. As TPACK focuses on the use of technology, PCK is useful when considering non-technological approaches. It also requires clear limits to what is considered in these approaches. Once the three domains were clarified in terms of early years practice, I was able to establish how working with this knowledge and combining the defined criteria could produce exciting, purposeful activities which would enhance the children's learning experiences. A model emerged from this process, which if this research is to be taken further to support early years teachers, will be far more practical. The TPACK-EY framework which is suggested in Figure 8, with the characteristics of each domain in Table 6, will support self-evaluation and positive approaches to the use of technology in early years education (Appendix 5).

Technology, pedagogy and content are essential elements; however, the intersections between each pair are not. They are useful for categorising practice and identifying where an element is missing. The data presented in Chapter 5 highlighted that the most important aspect is the consideration of the three domains and the way in which their use may collectively develop a sound learning experience. The use of iPads and the 'Puppet Pals' app to develop independent creative writing, as well as the use of the IWB speakers to add the dimension of sound to the ice melting activity are examples of this. For the purpose of enhancing early years teachers' approaches to technology in the classroom, the simplified framework designed to support this study is recommended (Figure 8).

This is the first study to clarify the domains and intersections of the TPACK framework with respect to early years practice. It does so by creating the new framework of TPACK-EY, which is designed to support early years teachers in enhancing their use of technology with young children.

Table 22 illustrates the original TPACK framework (Koehler & Mishra, 2006) and the TPACK-EY (2018) designed through this study. TPACK-EY has built on the definitions by Koehler & Mishra. This was done by using this information and applying it to early years pedagogical theory to then create definitions that are more relevant to early years teachers and can be applied to practice to support self-assessment (Appendix 5), which in turn created a framework for future training needs.

Domain or Intersection	Mishra & Koehler (2006) Descriptors	TPACK-EY (2018) Descriptors
Technological Knowledge	The skills required to operate particular technologies, this includes knowledge of operating systems and computer hardware, and the ability to use standard sets of software tools such as word processors, spreadsheets, browsers, and e-mail. TK includes knowledge of how to install and remove peripheral devices, install and remove software programs, and create and archive documents. The ability to learn and adapt to new technologies	• Personal use of technology - Uses technology in personal life; has skills to use it for a purpose and can see the positive contribution it makes to day to day tasks • Confidence with technology – Uses different software and hardware for a variety of purposes and is confident to experiment with new ideas to achieve better effects. • Type and use of resources – Understands what digital resources are available and what they have access to; aware of funding issues which impact on new purchases. • Understanding the capabilities of resources- Knowledge of what the digital resources can do, how they may be adapted and the different purposes they can be used for • Role modelling – Using technology as a tool in the classroom, demonstrating the purpose and advantages of digital resources to children so they are viewed as a tool as well as for enjoyment
Pedagogical Knowledge	A deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses,	• Classification and framing – Understanding of the variety of pedagogical approaches used in teaching, how external pressures

	among other things, overall educational purposes, values, and aims. This is a generic form of knowledge that is involved in all issues of student learning, classroom management, lesson plan development and implementation. It includes knowledge about techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating student understanding. A teacher with deep pedagogical knowledge understands how students construct knowledge, acquire skills, and develop habits of mind and positive dispositions toward learning. As such, pedagogical knowledge requires an understanding of cognitive, social, and developmental theories of learning and how they apply to students in their classroom.	can affect the classification and framing of these. Using this understanding to ensure that the strong classification and framing required in certain subjects is kept to a minimum and not transferred to other curriculum areas. • Active learning – Ability to use deep understanding of the way young children learn to ensure activities incorporate first hand experiences, opportunities to problem solve and have a cross curricular, play based approach • Listening to the child's voice – The skill to observe the many ways children communicate and use their thoughts, feelings and interests to plan and teach to their strengths and interests
Content Knowledge	The actual subject matter that is to be learned or taught. teachers must know and understand the subjects that they teach, including knowledge of central facts, concepts, theories, and procedures within a given field; knowledge of explanatory frameworks that organize and connect ideas; and knowledge of the rules of evidence and proof (Shulman, 1986). Teachers must also understand the nature of knowledge and inquiry in different fields	• Approach to the EYFS - A deep understanding of the cross curricular nature of the EYFS; the skill to plan and teach through play, using what the child can do as the starting point for planning. • The hidden curriculum – Understanding that young children do not learn only that which is planned, but also that which they are not intended to see. The teacher must understand the impact of unplanned messages and present a positive experience across the curriculum • Child initiated or adult led experiences – The skill to understand when children need direct teaching, the scaffolding to begin to experiment and the opportunities to become independent and make their own choices and decisions

Technological, Pedagogical And Content Knowledge	An emergent form of knowledge that goes beyond all three components (content, pedagogy, and technology). This knowledge is different from knowledge of a disciplinary or technology expert and also from the general pedagogical knowledge shared by teachers across disciplines. TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones.	• Multiple interaction of all domains of the TPACK-EY framework - The skill to use their in depth understanding of the three domains above in combination. This creates new approaches which consider the content to be taught, the capabilities of the technology available to change the content positively and the adaptation of the pedagogical approach to give children a positive, challenging learning experience • Understand the best resource to develop a concept – The confidence and skill to use digital resources in innovative ways to support, consolidate and extend children's learning experiences • Build on children's understanding of technology – The understanding that children have access to many digital resources outside school and while these may be recreational, they are still developing skills that can be adapted and used to develop their educational experiences. Understanding that they as a teacher can use their partnership with parents to support the parents in using technology constructively with their children.

Table 22: Comparison between TPACK (Koehler & Mishra, 2006) and TPACK-EY (2018)

6. The combination of Technological, Pedagogical and Content Knowledge has a positive impact on the children's engagement and learning

Chapter 2 discussed concerns raised in the literature reviewed. These were regarding technology use with young children. An important element of this study was the deconstruction of the TPACK framework (Chapter 3). This was done by relating each element to early years practice and clarifying the types of activity that illustrate each of the domains and intersections. The findings presented in Chapter 5 highlighted the variety of

experiences the children had opportunity to engage with, such as using cameras to take pictures of items and events they were interested in, as well as using tablets to create their own stories. The data also revealed, however, the relatively small number of technological activities that were planned to change or enhance the content to be taught. An example of this was the use of iPads to practice phonics. This drew attention to the fact that, while each setting had access to technology, its use was often not planned for. Opportunities to develop the combination of technological, pedagogical and content knowledge were, as such, limited.

Understanding the capabilities of the digital resources the teachers have at their disposal is essential. There were examples of how participants reflected on this and realised the potential to use specific resources in a new way. One example was from the Reception class, where Sally reflected on her use of iPads with the children and from this went on to plan a much more interactive session. Adopting a reflective approach changed the dynamic of the learning, increased the children's engagement, and encouraged collaborative working. By planning the technology that would develop the content to be taught, teachers were able to adapt the content they were teaching, as they could now investigate a wider range of content and add more depth to the learning experiences. Finally, their teaching altered and instead of the lesson being very adult-led, the children were able to have control of their own learning, experiment with new ideas, and with both peer and adult support, achieve their full potential. An example of this was identified when Child 1b was producing a story on the iPad. He created a full story which he narrated confidently, even making up a spell for the witch to use. Sally was surprised at his level of engagement and skill through his use of technology, as previously his story telling using traditional methods had not demonstrated such ability and understanding. This is a clear example of how the use of

technology can enhance children's learning experiences; by encouraging interest and enthusiasm, as well as by enabling children to exceed expectations.

The instances of the combination of technological, pedagogical and content knowledge were few., They arose from discussion regarding the potential of digital resources and in one case, on the spur of the moment. When they did occur, however, they clearly produced a memorable experience for the children. Examples of this were when Chris (Private) commented how a whole class were engrossed in listening to the sound of the ice cracking, a very rare event in a nursery class. Sally (Reception), too, was surprised at Child 1b's level of understanding, as it was far greater than she had previously assessed. These examples illustrate how important TPACK-EY is in engaging and challenging children to participate in new experiences and in extending their understanding. As discussed in Chapter 5, having an awareness of the possibilities which are offered by technology should inform the teachers' plans for learning. There needs to be consideration of the resources needed, to how they can be used to change or enhance the content and how the pedagogical approach can be adapted to enhance the children's learning experiences.

This study has illustrated how combining the teachers' knowledge of pedagogy and content, with an awareness and understanding of the capabilities of the technology at their disposal, supports more extensive learning opportunities for the children.

6.2 - Contribution of the research

This present study has built upon the limited but growing number of research studies that discuss the use of technology with young children at both a national and international level (Marsh et al., 2017; Palaiologou, 2016; Blackwell et al. 2016). All of those concerned with early years identify some of the issues raised in this research. While Blackwell et al. (2016)

employed the TPACK framework, they focused on the use of tablets and considered practice at the micro and macro level, however. This, thus, is the first study carried out in order to identify how the domains and intersections of TPACK appear in early years practice. Other comparable studies have preferred to use the original version in their discussion and match their findings to existing definitions. Deconstructing the domains and intersections enabled me to identify the components of each and I was able to analyse in turn how they could be combined to provide learning experiences that give the children broader and deeper understanding of the content being taught. This research has analysed how the inter-relationship of these elements can influence the quality of young children's learning experiences through the use of a variety of digital resources. The findings of this study suggest that early years teachers would quickly adopt technology with support and appropriate training in order to be able to support and enhance young children's learning across all areas. This study also highlighted the importance of the hidden curriculum and of role modelling the use of digital resources. This has not been investigated in previous research which looked into the use of technology with young children. Technology has a great influence on young children, who naturally learn through imitation. If children use technology, particularly screen technologies, for playing games and never see it used as purposefully, they will not understand its potential. Early years teachers are in an excellent position to challenge this and encourage children to view it not as a toy, but a tool. Importantly, teachers should be able to offer parents support so that they can understand this, as well as provide ideas and activities that parents and children can engage with at home.

This work contributes to existing findings by demonstrating the range of experiences and understanding early years teachers can have through a multiple case study approach, and

how it impacts upon their engagement with technology as a learning tool. Alongside this, it has highlighted that even though technology is present in all walks of life, it cannot be assumed that all teachers are confident in its use as a learning tool. A further consideration is that, in PVI settings, managers and budget holders who may not have a teaching role, also need to understand the importance of acquiring digital resources to support the children's learning. These findings highlight the potential inequality in access and use of technology across early years settings.

A unique feature of this research is the use of a multiple case study approach, which enabled me to investigate the use of technology in four varied early years settings. This extended the range of data, allowing for a broader view of current practice than a single case would allow when conducting research in a variety of early years provision. The research has scrutinised the data collected in the form of interviews, observations, documentary evidence and a thorough review of the literature. After identifying the characteristics of the domains and intersections of TPACK as they apply to early years practice, these were used as themes in the Direct Content Analysis, which was implemented to classify the data. Implementing this process enabled the study to provide a clear link between the theoretical perspectives and the practice in settings.

The revised TPACK approach clarifies the components of effective use of technology in the early years. It will be used to develop training for those studying on degree programmes in early years at the university I am based at. A series of sessions have been designed using the TPACK-EY framework to explain the importance of using technological resources in order to support children's learning experiences across the curriculum. Evidence of its success has been observed when visiting trainees on placement, as they are role modelling the use of technology in their teaching. An example of this was a trainee using an iPad to take

photographs of children's work as they were progressing and then displaying it on the IWB for the class. They encouraged the children to share what they were doing and how, which then gave the children positive reinforcement that they were doing well and the rest of the class ideas as to how to progress.

6.3 - Implications for policy and practice

The information gathered in response to the three supporting questions has enabled me to thoroughly investigate the original inquiry the research was designed to address. The review of literature highlighted a major gap in the research, which was the lack of investigation into the pedagogical approaches early years teachers adopt when using technology. This was then addressed in this study through the analysis of interviews, observations and planning. The concept of technology being used as play, as considered by Yelland (1999), Whaller (2006), Marsh et al. (2016) and Bird and Edwards (2015), has focused either on children in their home environment and/or using the technology independently in their play. Marsh et al. (2017) discussed the need to develop a pedagogical approach to the use of technology in their White Paper 'Developing Digital Literacy in Early Years Settings: Professional Development Needs for Practitioners'. This study provides empirical evidence of the underpinning issues that may create barriers to early years teachers' use of technology in the classroom. The study identified that there is a lack of training opportunities for staff to develop an understanding of the variety of digital resources, their potential to enhance children's learning experiences and their ability to develop skills in which can use technology across the curriculum in order to enhance and vary content. Finally, this research builds on the concept of digital play, recommending that early years teachers get support in understanding this and incorporating it into the play-based curriculum they teach.

From these findings, I recommend that policy makers engaged with all early years programmes and staff development make technology a higher priority. All curriculum areas are important, but as the findings from this study demonstrate, technology can be used to enhance teaching and extend children's learning experiences. It should, as such, not be considered as separate from other subjects. Investing time, resources and training in technology will benefit all subjects being taught. The self-assessment questionnaire (Appendix 5) is designed to highlight areas of strengths and those which need development. Identifying good practice can provide an opportunity for colleagues to deliver training to each other at little cost, while allowing practice across the provision to improve. A further recommendation is that all programmes training early years teachers and practitioners provide opportunities for students to engage in the use of technology and to develop an understanding of TPACK-EY. I have begun to teach sessions to both undergraduate and postgraduate students on how to use the TPACK-EY framework. This has been successful; as a visiting tutor, I see students using technology as part of their teaching, using iPads to take photographs of children's work in progress and mirroring them to the IWB and letting the child explain what they are doing to the class to help others progress, for example.

I have planned training events for partnership settings to support staff development, which has allowed teachers to access new digital resources such as QR Codes, augmented reality and Virtual Reality. We discuss ways of using these and many other resources in order to develop children's learning experiences across the curriculum. The Technology Self-Assessment tool (Appendix 5) has proved useful and discussing TPACK-EY has encouraged in depth discussion, which receives excellent feedback. I am currently involved in a new early years degree programme and am writing a module dedicated to technology in the early years which will be based on TPACK-EY.

Examining the data revealed that there were few examples of teachers linking the content they wished to teach to the technology available. Often the pedagogical approach used to create an engaging purposeful activity was not considered in advance. The instances that were found tended to be incidental. What is important to note is that, when these activities were implemented, there was a profound effect on the children. When TPACK-EY is used, it can provide exciting opportunities for children and teachers to explore new ways of learning.

6.4- Suggestions for further research

Conducting this research has enabled me to understand the many dimensions of requirements for successful integration of digital resources in an early years classroom. Much of the previous research discussed here has highlighted the lack of training available to support teachers in the use of technology in the classroom (Aubrey & Dahl, 2008; Plowman et al., 2010c; Kennington & Meaton, 2009; Blackwell et al., 2016). Future research to investigate practice prior to and following training regarding the TPACK–EY framework to establish the impact on provision would prove beneficial for training providers.

Due to a change in the research methodology, the opportunity to measure the impact of effective use of technology, pedagogy and content on children's learning was limited to participants' perceptions. Future research could look at this in greater detail in order to assess how effective technology can be when teachers understand the link between the three domains of technology, pedagogy and content. The content of this training is essential to the change in practice. Research into the most effective approach will also be of interest (Brantley Dias & Ertmer, 2013). Often, training is delivered as a one-off event and it is easily forgotten, so follow-up activities and support may be more successful (Hur et al., 2016).

The original TPACK framework, whilst clarifying important elements of effective teaching using technology, lacks a place for the child's voice. In TPACK-EY, the revised version, I have proposed that it is included as part of the pedagogical element. Further research into the influence this has in the classroom and in how the teacher adapts their approach because of this could have a positive effect on the impact of the use of technology to enhance learning experiences.

References

Abbitt, J.T. (2011). Measuring Technological Pedagogical Content Knowledge in Preservice Teacher Education: A Review of Current Methods and Instruments. *Journal of Research on Technology in Education*, vol. 43, no. 4, pp. 281.

Abbott, C., Lachs, V. & Williams, L. (2010). Fool's gold or hidden treasure: are computers stifling creativity? *Journal of Education Policy*, 16(5), pp. 479-487.

Adams, P. (2011). ICT and pedagogy: opportunities missed? *Education 3-13*, 39(1), pp. 21-33.

Ahlberg, J. & Ahlberg, A. (1999). *Funnybones*. London: Puffin.

Allen, S.F. & Whalley, M.E. (2010). *Supporting Pedagogy and Practice in Early Years Settings.* Learning Matters: Exeter.

Allvin, R.E. (2014). Technology in the Early Childhood Classroom. *Young Children*, 69(4), pp. 62.

American Academy of Pediatrics (2016). *Media and Children Communication Toolkit.* https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/pages/media-and-children.aspx [Accessed 14/01/17].

Anderson, A., Barham, N., Northcote, M. (2013). Using the TPACK framework to unite disciplines in online learning. *Australasian Journal of Educational Technology*, 29 (4).

Angeli, C., & Valanides, N. (2005). A socio-technical analysis of the factors affecting the integration of ICT in primary and secondary education. In L. T. W. Hin & R. Subramaniam (Eds.), *Literacy in technology at the K-12 level: Issues and challenges* (pp. 123–131). Heshey, PA: Idea Group, Inc. Education, Education Media International, Routledge.

Änggård, E., Barn- och ungdomsvetenskapliga institutionen, Stockholms universitet & Samhällsvetenskapliga fakulteten (2015). Digital cameras: agents in research with children. *Children's Geographies*, 13(1), pp. 1-13.

Archambault, L.M. & Barnett, J.H. (2010). Revisiting technological pedagogical content knowledge: Exploring the TPACK framework. *Computers & Education*, 55(4), pp. 1656-1662.

Aubrey, C, & Dahl, S. (2008). *A Review of the Evidence on the Use of ICT in the Early Years Foundation Stage*. BECTA: Coventry.

Balanskat, A., Blamire, R., & Kefala, S. (2006). The ICT impact report—a review of studies of ICT impact on schools in Europe. http://unpan1.un.org/intradoc/groups/public/documents/unpan/unpan037334.pdf [Accessed 29th August 2017].

Barron, B., Cayton-Hodges, G., Bofferding, L., Copple, C., Darling-Hammond, L. and Levine, M.H. (2011): Take a giant step. The Joan Ganz Cooney Center at Sesame Workshop. http://www.joanganzcooneycenter.org/upload_kits/jgcc_takeagiantstep.pdf [Accessed 25/01/17]

Basquill,J., Beattie,L., Ryan, J. (2011). *The EYPS Handbook*. Pearson: London.

Baylor, A.L. & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers & Education*, vol. 39, no. 4, pp. 395-414.

Baxter, P. & Jack, S. (2008). Qualitative case study methodology: study design and implementation for novice researchers, *The Qualitative Report*, vol. 13, no. 4, pp. 544.

Beckley, P. (2013). *The new Early Years Foundation Stage: changes, challenges and reflections*. Open University Press: Maidenhead.

Bell, J. (2010). *Doing Your Research Research: A Guide for First-Time Researchers in Education, Health and Social Science*. 5th edn. McGraw-Hill Open University Press, Maidenhead, Berkshire; New York.

Benson, S.N.K. & Ward, C.L. (2013). Teaching with Technology: Using Tpack to Understand Teaching Expertise in Online Higher Education*. Journal of Educational Computing Research*, vol. 48, no. 2, pp. 153-172.

BERA (2011). *Ethical Guidelines for Educational Research*. BERA: London.

Bernstein, B. (2000). *Pedagogy, symbolic control and identity*. Rev. ed. Rowman & Littlefield: Lanham, MD.

Bird, J. & Edwards, S. (2015). Children learning to use technologies through play: A Digital Play Framework: Children learning to use technologies through play. *British Journal of Educational Technology*, 46(6), pp. 1149-1160.

Bishop, J.C. & Curtis, M. (2001). *Play today in the primary school playground: life, learning and creativity*. Open University Press: Buckingham.

Blackwell, C.K., Lauricella, A.R. & Wartella, E. (2016). The influence of TPACK contextual factors on early childhood educators' tablet computer use. *Computers & Education*, 98, pp. 57-69.

Blackwell, C.K., Lauricella, A.R. & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education*, 77, pp. 82-90.

Blackwell, C.K., Lauricella, A.R., Wartella, E., Robb, M. and Schomburg, R. (2013). Adoption and use of technology in early education: The interplay of extrinsic barriers and teacher attitudes. *Computers & Education*, 69, pp.310-319.

Blaikie, N.W.H. (2009). *Designing social research: the logic of anticipation*. 2nd edn. Polity: Cambridge.

Boschman, F.B., McKenney, S.E. & Voogt, J.M. 2015, Exploring teachers' use of TPACK in design talk: The collaborative design of technology-rich early literacy activities, *Computers & Education*, vol. 82, pp. 250-262.

Bosely, S. (2012). Ban Under 3s Watching Television. *The Guardian.* Available at https://www.theguardian.com/society/2012/oct/09/ban-under-threes-watching-television [Accessed 21/01/17].

Bouwma-Gearhart, J.L. & Bess, J.L. (2012). The Transformative Potential of Blogs for Research in Higher Education. *The Journal of Higher Education*, 83(2), pp. 239-275.

Bowers, J. & Stephens, B. (2011). Using technology to explore mathematical relationships: A framework for orienting mathematics courses for prospective teachers. *Journal of Mathematics Teacher Education*, 14, 285–304.

Bradley, M., Isaacs, B., Livingstone, L., Nasser, D., True, A.M. & Dillane, M. (2010). Maria Montessori in the United Kingdom: 100 years on in Miller, L. & Pound, L. (2010). *Theories and Approaches to Learning in the Early Years*. SAGE: London.

Bransford, J.D. (2000). *How people learn: brain, mind, experience, and school*. National Academy Press, Washington, D.C: Hadleigh.

Brantley-Dias, L. & Ertmer, P.A. (2013). Goldilocks and TPACK: Is the Construct 'Just Right? *Journal of Research on Technology in Education*, 46(2), pp. 103.

Brinkmann, S., Emholdt, C. and Kraft, G. (2008). A Qualitative Stance. 1st ed. Aarhus University Press: Santa Barbara.

Brodie, K. (2013a). Schoolification of the early years. *Early Years Educator*, 14(12), pp. 7-7.

Brodie, K. (2013b). *Observation, assessment and planning in the early years: bringing it all together*. Open University Press: Maidenhead.

Brooker, L. & Siraj-Blatchford, J. 2002, "'Click on Miaow!': How Children of Three and Four Years Experience the Nursery Computer", *Contemporary Issues in Early Childhood*, vol. 3, no. 2, pp. 251-273.

Brooker, L., Rogers, S., Ellis, D., Hallett, E. and Roberts-Holmes, G. (2010). *Practitioners' Experiences of the Early Years Foundation Stage*. DfE: Runcorn.

Brown, A. American Council on Communications and Media (2011). Media use by children younger than 2 years. *Pediatrics*, 128(5), pp. 1040-1045.

Bruce, T. (2001) *Learning through Play: Babies, Toddlers and the Foundation Years.* London: Hodder and Stoughton.

Bruce, T. (2012). *Early childhood practice: Froebel today.* SAGE: London.

Brueck, J.S. and Lenhart, L.A. (2015). E-Books and TPACK. *The Reading Teacher,* 68(5), pp. 373-376.

Brun, M., & Hinostroza, J. E. (2011). Research on ICT integration for enhancing quality in teacher education: Nationwide policy or global challenge? In E. Eisenschmidt, & E. Löfström (Eds.), *Developing quality cultures in teacher education: Expanding horizons in relation to quality assurance* (pp. 99-118). Tallinn: OÜ Vali Press.

Bryce-Clegg, A. (2015). *Continuous provision: the skills*. Featherstone Education: London.

Buckingham, D. (2007). *Beyond Technology: Children's Learning In The Age Of Digital Culture*. Malden, Ma: Polity.

Burger, K. (2010). How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds, *Early Childhood Research Quarterly*, vol. 25, no. 2, pp. 140-165.

Callan, S., & Reed, M. (2011). *Work-Based Research in the Early Years*. London: Sage.

Campbell, A. & Scotellaro, G. (2009). Learning with technology for pre-service early childhood teachers. *Australasian Journal of Early Childhood*, 34(2), pp. 11-18.

Carr, D. & Landon, J. (1999). Teachers and Schools as Agencies of Values Education: reflections on teachers' perceptions Part Two: the hidden curriculum. *Journal of Beliefs & Values*, 20(1), pp. 21-29.

Chen, J. Q., & Chang, C. (2006). Using computer in early childhood classrooms: Teachers' attitudes, skills, and practices. *Journal of Early Childhood Research*, 4, 169–188.

Children and Youth in History: Paleolithic Finger Flutings (Cave Drawing). [Online] Item #413, http://chnm.gmu.edu/cyh/primary-sources/413 [accessed August 29th 2017].

Clapham, A. (2015). Post-fabrication and putting on a show: examining the impact of short notice inspections. *British Educational Research Journal*, 41(4), pp. 613-628.

Clark, A., Moss, P. & National Children's Bureau (2011). *Listening to Young Children: The Mosaic Approach*. 2nd edn. London: National Children's Bureau.

Clark, C. (2011). ICT is everywhere. *Child Care*, 8(5), pp. 22-23.

Cohen, L., Manion, L. & Morrison, K. (2011). *Research Methods in Education*. 7th edn. Routledge: New York; London.

Cook, R.E. (2011). *Adapting early childhood curricula for children with special needs*. 8th edn. Merrill: Upper Saddle River, N.J; London.

Cooney, J. (2011). *Pre Historic Pre School.* [Online] University of Cambridge. Available at: http://www.cam.ac.uk/research/news/prehistoric-pre-school [Accessed 22/01/17].

Cooper, B. & Brna, P. (2002). Hidden curriculum, hidden feelings; emotions, relationships and learning with ICT and the whole child. *Paper presented at BERA 2002*: UK.

Cooper, D.E. (2001). Plato 427- 347. In Palmer, J., Bresler, L. and Cooper, D.E. (2001). *Fifty Major Thinkers on Education: From Confucius to Dewey.* London: Routledge.

Costley, C., Elliott, G. and Gibbs, P. (2010). *Doing Work Based Research. Approaches to Enquiry for Insider-Researchers*. London: Sage.

Cotton, D., Winter, J. & Bailey, I. (2013). Researching the hidden curriculum: intentional and unintended messages, *Journal of Geography in Higher Education*, vol. 37, no. 2, pp. 192-203.

Couse, L. J. & Chen, D. W. (2010). A tablet computer for young children? Exploring its viability for early childhood education. *Journal of Research on Technology in Education*, 43(1), 75-98.

Cox S. & Graham C.R. (2009). Diagramming TPACK in practice: using and elaborated model of the TPACK framework to analyze and depict teacher knowledge. *TechTrends* 53, 60–69.

Craft, A. (2012). Childhood in a Digital Age: Creative Challenges For Educational Futures. *London Review of Education*, 10(2), Pp. 173-190.

Cristia, J. P., Ibarrarán, P., Cueto, S., Santiago, A., & Severín, E. (2012). Technology and child development: evidence from the One Laptop per Child program. *Working Paper IDB-WP-304.* Washington, DC: Inter-American Development Bank.

Dawson, C. (2009). *Introduction to Research Methods* 4E. [online]. How to Books. Available from: http://www.myilibrary.com?ID=224510 [Accessed 29th August 2017].

DCSF (Department for Children, Schools and Families) (2008). *Every Child a Talker guidance for consultants*. Annesley, Notts: DCSF Publications.

de Wolf, I.F. & Janssens, F.J.G. (2007). Effects and side effects of inspections and accountability in education: an overview of empirical studies. *Oxford Review of Education*, vol. 33, no. 3, pp. 379-396.

Dennis, S. (2009). ICT for Practitioners: One 'Star' is not enough. In H. Price (Ed.), *The Really Useful Book of ICT in the Early Years* (pp. 4-24). London: Routledge.

Department for Education, (2012). *Nutbrown review- FOUNDATIONS OF QUALITY*. London: Crown.

Department for Education, (2017). *Statutory Framework for the Early Years Foundation Stage.* Runcorn: Department for Education.

Department of Education and Science (DES), (1967). *Children and Their Primary Schools*. London: HMSO.

Doering, A., Scharber, C., Miller, C., & Veletsianos, G. (2009). GeoThentic: Designing and assessing with Technological Pedagogical Content Knowledge. (G. L. Bull & L. Bell, Eds.) *Contemporary Issues in Technology and Teacher Education*, 9(3), 316-336.

Donnelly, J.E. and Lambourne, K. (2011). Classroom-based physical activity, cognition, and academic achievement. *Preventive medicine*, 52, pp. S36-S42.

Drummond, A. & Sweeney, T. (2017). Can an objective measure of technological pedagogical content knowledge (TPACK) supplement existing TPACK measures?: TPACK-deep and objective TPACK, *British Journal of Educational Technology*, vol. 48, no. 4, pp. 928-939.
Eagle, S. (2012). Learning in the early years: Social interactions around picture books, puzzles and digital technologies. *Computers & Education,* 59(1), pp. 38-49.

Edgington, M. (2007). Early years in crisis? Reflecting on the past ten years, hoping for the future. *Early Years Educator*, 9(4),22–24.

Edwards, R., (2015). Software and the hidden curriculum in digital education. *Pedagogy, Culture & Society*, 23(2), pp. 265-15.

Edwards, S., Nolan, A., Henderson, M., Mantilla, A., Plowman, L. & Skouteris, H. (2018). Young children's everyday concepts of the internet: A platform for cyber-safety education in the early years: Young children's everyday concepts about the internet. *British Journal of Educational Technology*, vol. 49, no. 1, pp. 45-55.

Edwards, S. (2013). Digital play in the early years: a contextual response to the problem of integrating technologies and play-based pedagogies in the early childhood curriculum. *European Early Childhood Education Research Journal*, 21(2), pp. 199-212.

Eisenhardt, K.M. & Graebner, M.E. (2007), Theory Building from Cases: Opportunities and Challenges. The Academy of Management Journal, vol. 50, no. 1, pp. 25-32.

Ertmer, P.A. & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers & Education*, 64, pp. 175-182.

Ertmer, P.A., Ottenbreit-Leftwich, A.T., Sadik, O., Sendurur, E. & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, 59(2), pp. 423-435.

Ertmer, P.A. & Ottenbreit-Leftwich, A.T. (2010), Teacher Technology Change: How Knowledge, Confidence, Beliefs, and Culture Intersect, Journal of Research on Technology in Education, vol. 42, no. 3, pp. 255.

Ertmer, P.A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development,* 47(4), pp 47–61.

Eteokleous, N. (2008). Evaluating computer technology integration in a centralized school system. *Computers & Education*, vol. 51, no. 2, pp. 669-686.

Falloon, G. (2013). Young Students Using I pads: App Design And Content Influences On Their Learning Pathways. *Computers & Education*, 68(0), Pp. 505-521.

Feasey, R. & Still, M. (2006). Science and ICT in Hayes, M., Whitebread, D. (2006). *ICT in the early years*. Maidenhead: Open University Press.

Fisher, J. (2010). Moving on to key stage 1: improving transition from the early years foundation stage. Open University Press, Maidenhead, England.

Fisher, J. (2011). Building on the Early Years Foundation Stage: developing good practice for transition into Key Stage 1. *Early Years*, 31(1), pp. 31-42.

Fisher, J. (2013). *Starting from the Child: Teaching and Learning from 4 – 8*. 4th edn. Maidenhead: McGraw Hill Education.

Foley, A. & Ferri, B.A. (2012). Technology for people, not disabilities: ensuring access and inclusion. *Journal of Research in Special Educational Needs*, 12(4), pp. 192-200.

Fontana, A., Prokos, A.H. (2007). *The interview: from formal to postmodern*. Walnut Creek, Calif: Left Coast Press.

Foucault, M. (2003). 'Questions of method', in P. Rabinow & N. Rose (eds.), The essential Foucault: selections from essential works of Foucault, 1954–1984. London and New York: *The New Press*: 246–258.

Fröbel, F. and Herford, W. (1916). *The student's Froebel*. London: Sir Isaac Pitman & Sons.

Garza, R. & Smith, S.F. (2015). Pre-service teachers' blog reflections: Illuminating their growth and development. *Cogent Education*, 2(1).

Gialamas, V. And Nikolopoulou, K. (2010). In-Service and Pre-Service Early Childhood Teachers' Views And Intentions About ICT Use In Early Childhood Settings: A Comparative Study. *Computers & Education*, 55(1), Pp. 333-341.

Gibbons, A.N. (2006). The politics of technology in early childhood in Aotearoa/New Zealand: fitting early childhood educators in the ICT grid. *Australian Journal of Early Childhood*, 31(4), pp. 7-14.

Glowatz, M. & O'Brien, O. (2015). An Exploration of the Technological, Pedagogical and Content Knowledge (TPACK) Framework: Utilising a Social Networking Site in Irish Higher Education. *Irish Journal of Academic Practice*, 4(1).

Graham, C.R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, vol. 57, no. 3, pp. 1953-1960.

Gray, D.E. (2014). *Doing Research in the Real World*. 3rd edn. Los Angeles: Sage.

Greig, A., Taylor, J. and MacKay, T. (2007). *Doing Research With Children*. 2nd edn. Los Angeles: Sage.

Gurney Reid, J. (2013). *How Young is Too Young for Technology?* The Telegraph [Online] http://www.telegraph.co.uk/education/10488240/How-young-is-too-young-for-technology.html [accessed 19/10/15].

Gutnick, A., M. Robb, L. Takeuchi, and J. Kottler. (2011). *Always Connected: The New Digital Media Habits of Young Children*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Hakim, C. (2000). *Research Design: Successful Designs for Social and Economic Research*. 2nd edn. London: Routledge.

Hallström, J., Elvstrand, H. and Hellberg, K. (2015). Gender and technology in free play in Swedish early childhood education. *International Journal of Technology and Design Education,* 25(2), pp. 137-149.

Hamilton, B. (2015*). Integrating technology in the classroom: tools to meet the needs of every student*, First edn. Eugene, Oregon: International Society for Technology in Education,.

Harding, E. (2015). *iPads leave young pupils too weak to grip pencils: Leading headteachers says lack of activity means four and five-year-olds are not strong enough.* DailyMail [Online] http://www.dailymail.co.uk/health/article-3345305/iPads-leave-young-pupils-weak-grip-pencils-Leading-headteachers-says-lack-activity-means-four-five-year-olds-not-strong-enough.html#ixzz3tcoemDqH [Accessed 21/01/17].

Harris, J.B. & Hofer, M.J. (2011). Technological Pedagogical Content Knowledge (TPACK) in Action: A Descriptive Study of Secondary Teachers' Curriculum-Based, Technology-Related Instructional Planning. *Journal of Research on Technology in Education*, 43(3), pp. 211.

Harreveld, B. (2016). *Constructing methodology for qualitative research: researching education and social practices*. Palgrave Macmillan, London, [England].

Hayes, D. (2012). *Foundations of primary teaching*. 5th edn. London: Routledge.

Hayes, G.R., Hirano, S., Marcu, G., Monibi, M., Nguyen, D.H. & Yeganyan, M. (2010). Interactive visual supports for children with autism. *Personal and Ubiquitous Computing*, 14(7), pp. 663-680.

Hayes, M., & Whitebread, D. (2006). *ICT in the early years*. Maidenhead: Open University Press.

Healy, J.M. (2001). Failure to Connect: How Computers Affect Our Children's Minds: For Better or Worse. *Phi Delta Kappan,* 81(5), pp. 1; 1-11; 11.

Hedman, J. And Gimpel, G. (2010). The Adoption Of Hyped Technologies: A Qualitative Study. *Information Technology and Management*, 11(4), Pp. 161-175.

Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education*, 51, pp. 1499-1509.

Higgins, S., Xiao, Z., & Katsipataki, M. (2012). The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation London: EEF. [Online] https://v1.educationendowmentfoundation.org.uk/uploads/pdf/The_Impact_of_Digital_Technologies_on_Learning_FULL_REPORT_(2012).pdf [Accessed 21/01/17].

Hobbs, R. (2010). *Digital and Media Literacy: A Plan of Action*. Washington, DC: The Aspen Institute, John S. and James L. Knight Foundation.

Hofer, M. & Grandgenett, N. (2012). TPACK Development in Teacher Education. *Journal of Research on Technology in Education,* 45(1), pp. 83-106.

Hohti, R. & Karlsson, L. (2014). Lollipop stories: Listening to children's voices in the classroom and narrative ethnographical research. Childhood, vol. 21, no. 4, pp. 548.

Hopkins, L., Brookes, F. & Green, J. (2013). Books, bytes and brains: the implications of new knowledge for children's early literacy learning. *Australasian Journal of Early Childhood*, 38(1), pp. 23-28.

House of Lords Select Committee (2015). *Childcare Bill[HL] Government Amendments*. [Online] http://www.publications.parliament.uk/pa/ld201516/ldselect/lddelreg/37/37.pdf [Accessed 20/10/15].

Howitt, D. & Cramer, D. (2011). *Introduction to research methods in psychology*. 3rd edn. Harlow: Prentice Hall.

Hsieh, H. & Shannon, S.E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, 15(9), pp. 1277-1288.

Hughes, B. & Melville, S. (2002). *A playworker's taxonomy of play types*. 2nd edn. London: Playlink.

Hur, J.W., Shannon, D. & Wolf, S. (2016). An Investigation of Relationships Between Internal and External Factors Affecting Technology Integration in Classrooms. *Journal of Digital Learning in Teacher Education*, 32(3), pp. 105.

Hutchin, V. (2013). *Effective practice in the EYFS: an essential guide*. Maidenhead: Open University Press.

Hutt, C. (1979). Typology of Play. In Kernon, M. (2007). *Play as a context for Early Learning and Development*. Dublin: National Council for Curriculum and Assessment, p.18.

Hyett, N., Kenny, A., & Dickson-Swift, V. (2014). Methodology or method? A critical review of qualitative case study reports. *International Journal of Qualitative Studies on Health and Well-Being*, vol. 9, no. 10, pp. 3402.

Ifenthaler, D. & Schweinbenz, V. (2013). The acceptance of Tablet-PCs in classroom instruction: The teachers' perspectives. *Computers in Human Behavior*, 29(3), pp. 525-534.

Inan, F.A. & Lowther, D.L. (2010), Factors affecting technology integration in K-12 classrooms: a path model. *Educational Technology Research and Development*, vol. 58, no. 2, pp. 137-154.

International Standards for Teaching Technology (2017). ISTE Releases New Standards For Educators To Maximize Learning For All Students Using Technology. *Tech & Learning*, [Online], vol. 38, no. 1, pp. 10.

Isaacs, S. (1999). *Social development in young children.* Florence, KY: Routledge.

Jarvis, P. (2012). *Research in the early years: a step-by-step guide*. Harlow: Pearson.

Judge, S., Puckett, K. And Bell, S.M. (2006). Closing The Digital Divide: Update From The Early Childhood Longitudinal Study. *The Journal of Educational Research*, 100(1), Pp. 52-60.

Kabakci Yurdakul, I. & Coklar, A.N. (2014). Modeling preservice teachers' TPACK competencies based on ICT usage: Modeling preservice teachers' TPACK compentencies. *Journal of Computer Assisted Learning*, vol. 30, no. 4, pp. 363-376.

Karaca, F., Can, G. and Yildirim, S. (2013). A path model for technology integration into elementary school settings in Turkey. *Computers & Education,* 68, pp. 353-365.

Kennington, L., & Meaton, J. (2009). Integrating ICT into the early years curriculum. In H. Price (Ed.), *The Really Useful Book of ICT in the Early Years* (pp. 4-24). London: Routledge.

Kerckaert, S., Vanderlinde, R. & van Braak, J. (2015). The role of ICT in early childhood education: Scale development and research on ICT use and influencing factors. *European Early Childhood Education Research Journal*, 23(2), pp. 183-199.

Kim, C., Kim, M.K., Lee, C., Spector, J.M. & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, vol. 29, pp. 76-85.

Kinos, J., Robertson, L., Barbour, N. & Pukk, M. (2016). Child-Initiated Pedagogies. Childhood Education, pp. 345.

Koehler, M., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. Journal of Educational Computing Research, 32(2), 131–152.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60-70.

Kopcha, T.J., Ottenbreit-Leftwich, A., Jung, J. & Baser, D. (2014). Examining the TPACK framework through the convergent and discriminant validity of two measure. *Computers & Education*, 78, pp. 87.

Koshy, E., Koshy, V. and Waterman, H. (2010). *Action Research in Healthcare*. London: Sage.

Kritt, D., & Winegar, L. (2010). Technological determinism and human agency. In D. Kritt and L. Winegar (Eds.), *Education and technology: Critical perspectives, possible futures* (pp. 3-30). Lanham, MD: Lexington Books.

Lee, S.Y. (2006). A journey to a close, secure, and synchronous relationship: Infant-caregiver relationship development in a childcare context, *Journal of Early Childhood Research*, 4(2), pp. 133-151.

Lepičnik-Vodopivec, J. And Samec, P. (2012). Advantages And Disadvantages Of Information-Communication Technology Usage For Four-Year-Old Children, And The Concequences Of Its Usage For The Childrens' Development. *International Journal Of Humanities And Social Science* 2(3), pp. 54-58.

Levy, R. (2008). 'Third spaces' are interesting places: Applying 'third space theory' to nursery-aged children's constructions of themselves as readers, *Journal of Early Childhood Literacy*, vol. 8, no. 1, pp. 43-66.

Lile Diamond, L. 2018, "Problem Solving in the Early Years", Intervention in School and Clinic, vol. 53, no. 4, pp. 220-223.

Lindahl, M.G. & Folkesson, A. (2012). ICT in preschool: friend or foe? The significance of norms in a changing practice. *International Journal of Early Years Education*, 20(4), pp. 422-436.

Lindon, J. & Trodd, L. (2016). *Reflective Practice and Early Years Professionalism*, 3rd edn. Hodder Education, London.

Livingstone, I. and Hope, A. (2011). *Next Gen. Transforming the UK into the world's leading talent hub for the video games and visual effects industries*. [online] Available at: https://www.nesta.org.uk/sites/default/files/next_gen_wv.pdf [Accessed 21/01/17].

Locke, J. (1752). *Some thoughts concerning education*. By John Locke, Esq;. The twelfth edition. London, M,DCC,LII. [1752]. Eighteenth Century Collections Online. Gale. http://find.galegroup.com.ezproxy.lancs.ac.uk/ecco/infomark.do?&source=gale&prodId=ECCO&userGroupName=unilanc&tabID=T001&docId=CW116231538&type=multipage&contentSet=ECCOArticles&version=1.0&docLevel=FASCIMILE [Accessed August 29th 2017]

Lyons, C.D. & Tredwell, C.T. (2015). Steps to Implementing Technology in Inclusive Early Childhood Programs. *Computers in the Schools*32(2), pp. 152-166.

Maddux, C. D., & Cummings, R. (2004). Fad, fashion and the weak role of theory and research in information technology in education. *Journal of Technology and Teacher Education*, 12(4), 511–533.

Malaguzzi, L. (1993). No way. The hundred is there. In C. Edwards, L. Gandini, & G. Forman (Eds.), *The hundred languages of children: The Reggio Emilia approach to early childhood education*. (p. vi). Norwood, NJ: Ablex Publishing.

Manches, A. & Plowman, L. (2017). Computing education in children's early years: A call for debate, *British Journal of Educational Technology*, vol. 48, no. 1, pp. 191-201.

Manning-Morton, J. (2014). *Exploring well-being in the early years*. Open University Press: Maidenhead.

Marsh, J., G. Brooks, J. Hughes, L. Richie, S. Roberts, and K. Wright. (2005). *Digital Beginnings: Young Children's Use of Popular Culture, Media and New Technologies*. Sheffield: University of Sheffield, Literacy Research Centre.

Marsh, J., Plowman, L., Yamada-Rice, D., Bishop, J. & Scott, F. (2016). Digital play: a new classification. *Early Years,* 36(3), pp. 242-253.

Marsh, J., Kontovourki, S. Tafa, E. and Salomaa, S. (2017). Developing Digital Literacy in Early Years Settings: Professional Development Needs for Practitioners. A White Paper for COST Action IS1410. [Accessed: http://digilitey.eu]

Marshall, C. & Rossman, G.B. (2010). *Designing Qualitative Research*, 5th edn. SAGE: London.

May, T. (2002). *Qualitative Research in Action*, abridg ed. London: Sage.

Mayring, Philipp (2000). Qualitative content analysis in Flick, U., Kardoff, E.V. & Steinke, I. 2004, *A companion to qualitative research*, SAGE: London.

McGivern, R.F., Rodriguez, A., Hilliard, V.R., Fielding, B., Anderson, J., Shapiro, L.P. and Reilly, J.S. (2007). Improving preliteracy and pre-math skills of Head Start children with classroom computer games. *Early Childhood Services: An Interdisciplinary Journal of Effectiveness*, 1, pp.71-81.

McInnes, K., Howard, J., Miles, G. & Crowley, K. (2011). Differences in practitioners' understanding of play and how this influences pedagogy and children's perceptions of play. *Early Years*, vol. 31, no. 2, pp. 121.

McKenney, S. & Voogt, J. (2010). Technology and young children: How 4–7 year olds perceive their own use of computers. *Computers in Human Behavior*, vol. 26, no. 4, pp. 656-664.

McPake, J., C. Stephen, L. Plowman, D. Sime, and S. Downey. (2005). *Already at a Disadvantage? ICT in the Home and Children's Preparation for Primary School*. Coventry: Becta.

McPake, J., Stephen, C., Plowman, L. (2007). *Entering E-Society: Full Research Report*. ESRC End of Award Report, RES-341-25-0034. Swindon: ESRC.

McPake, J., Plowman L. & Stephen C. (2013). Preschool children creating and communicating with digital technologies at home. *British Journal of Educational Technology* 44(3,) pp.421-431.

Miller, L. & Cameron, C. (2013). *International perspectives in the early years*. Los Angeles: Sage.

Miller, L. & Pound, L. (2010). *Theories and Approaches to Learning in the Early Years*. London: Sage.

Ministry of Education (2004). *The Role and Potential of ICT in Early Childhood Education: A Review of New Zealand and International Literature*. Wellington: New Zealand Council for Educational Research.

Ministry of Social Affairs and Health. (2004). *National Curriculum Guidelines on Early Childhood Education and Care in Finland.* Helsinki: Ministry of Social Affairs and Health.

Mintz, J., Gyîori, M., Aagaard, M. (2012) *Touching the future technology for autism?: lessons from the HANDS research*. IOS Press: Amsterdam; Washington, DC

Mishra, P. & Koehler, M. (2009). Too cool for school? No way! Using the TPACK framework: you can have your hot tools and teach with them, too. *Learning & Leading with Technology*, 36(7), pp. 14.

Mishra, P. & Koehler, M.J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record,* 108(6), pp. 1017–1054.

Mitra, S. (2012). *The Hole in the Wall Research and the Power of Self-Organized Learning.* [Blog] Edutopia https://www.edutopia.org/blog/self-organized-learning-sugata-mitra [Accessed 29/12/16].

Montessori, M. (1912). *The Montessori method: scientific pedagogy as applied to child education in "The Children's Houses"* with additions and revisions by the author, London: Heinemann.

Morgan, A. & Siraj-Blatchford, J. (2013). *Using ICT in the early years: parents and practitioners in partnership*. Revis and updat edn. London: Practical Pre-School Books.

Moyles, J.R., S. Adams, A. Musgrove. (2001). *SPEEL study of pedagogical effectiveness in early learning*. London: Department of Education and Skills.

Moylett, H. (ed.) (2014) *Characteristics of Effective Early Learning: helping young children become learners for life*. Maidenhead: Open University Press.

Moylett, H., Stewart, N. & British Association for Early Childhood Education (2012). *Development matters in the Early Years Foundation State (EYFS)*. London: British Association for Early Childhood Education.

Mueller, J., Wood, E., Willoughby, T., Ross, C. & Specht, J. (2008). "Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration", *Computers & Education*, vol. 51, no. 4, pp. 1523-1537.

Mumtaz, S. (2000). Factors Affecting Teachers' Use of Information And Communications Technology: A Review Of The Literature. *Journal of Information Technology For Teacher Education*, 9(3), Pp. 319-342.

Newberry, M, Gallant, A, & Riley, P (eds) (2013). Advances in Research on Teaching , Volume 18 : Emotion in Schools : Understanding How the Hidden Curriculum Influences Relationships, *Leadership, Teaching, and Learning*, Emerald Insight, Bradford, GBR. Available from: ProQuest ebrary. [13 March 2016].

Newby, P. (2010). *Research Methods for Education*. Harlow: Longman.

Nuttall J., Edwards A., Lee S.W.F., Mantilla A., Wood E. (2013). The implications of young children's digital consumerist play for changing the kindergarten curriculum. *Kul'turno-istoricheskaya psikhologiya [Cultural-Historical Psychology]*. 2, pp. 54–63.

O'Hagan, T. (2001). Jean Jacques Rousseau 1712 – 1778. In Palmer, J., Bresler, L. and Cooper, D.E. (2001). *Fifty Major Thinkers on Education: From Confucius to Dewey.* London: Routledge.

OECD (Organisation for Economic Co-operation and Development) (2018). *PISA 2015, Results in Focus.* [Online] https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf [Accessed 27/08/18]

Oelkers, J. (2001). Rudolph Steiner 1861 – 1925. In Palmer, J., Bresler, L. and Cooper, D.E. (2001). *Fifty Major Thinkers on Education: From Confucius to Dewey.* London: Routledge.

Office for Standards in Education, Children's Services and Skills (OfSTED) (2013). *ICT in schools: 2008 to 2011*.[Online] https://www.gov.uk/government/publications/ict-in-schools-2008-to-2011 [Accessed 13/01/17].

Office for Standards in Education, Children's Services and Skills (OfSTED) (2015). *Are You Ready*? [Online]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/418819/Are_you_ready_Good_practice_in_school_readiness.pdf [Accessed 13/01.17].

Pace, M. (2014). *I Love Forest School.* London: Featherstone Education.

Paciga, K. A., Lisy, J. G., & Teale, W. H. (2013). Better start before kindergarten: Computer technology, interactive media and the education of preschoolers. *Asia-Pacific Journal of Research in Early Childhood Education*, 7, 85–104.

Palaiologou, I. (2008). *Childhood Observation*. Exeter: Learning Matters.

Palaiologou, I. (2013). *The Early Years Foundation Stage: Theory and Practice*, 2nd edn. London: Sage.

Palaiologou, I. (2014). 'Do we hear what children want to say?' Ethical praxis when choosing research tools with children under five. Early Child Development and Care, vol. 184, no. 5, pp. 689-705.

Palaiologou, I. (2016). Children under five and digital technologies: implications for early years pedagogy. *European Early Childhood Education Research Journal*, Vol 24, No1. Pp 5-24.

Papert, S. (1987). *A critique of technocentrism in thinking about the school of the future*. [Online] http://www.papert.org/articles/ACritiqueofTechnocentrism.html [Accessed 21/01/17].

Papert, S. (2003). What Are You Talking About?: A Dialogue with Seymour Papert. *Convergence: The International Journal of Research into New Media Technologies*, 9, (2), pp. 10-12.

Paredes, M.F., James, D., Gil-Perotin, S., Kim, H. et al. (2016). 'Extensive migration of young neurons into the infant human frontal lobe.' Science 354, 6308, pp.7073.

Parkinson, S. (2015). *Inclusive Educational Policy in Ireland – An Illusory Quest?* In O'Donnell, A. & Birch, S. 2015. The inclusion delusion?: reflections on democracy, ethos and education, Bern, Switzerland: Peter Lang.

Pasnik, S. (2007). *iPod in Education: The Potential for Teaching and Learning.* New York: Education Development Center; Menlo Park, CA: SRI International. [Online] http://cct.edc.org/publications/ipod-education-potential-teaching-and-learning [Accessed 21/01/17].

Pasnik, S. & Llorente, C. (2013). *Preschool teachers can use a PBS KIDS transmedia curriculum supplement to support young children's mathematics learning: Results of a randomized controlled trial. A report to the CPB-PBS Ready to Learn initiative.* Education Development Center: SRI International: Waltham, MA: Menlo Park.

Passey, D. (2013). *Inclusive technology enhanced learning: overcoming cognitive, physical, emotional, and geographic challenges*. London: Routledge.

Perry, B.D. (2002). Childhood Experience and the Expression of Genetic Potential: What Childhood Neglect Tells Us About Nature and Nurture. *Brain and Mind*, vol. 3, no. 1, pp. 79-100.

Perryman, J. (2009). Inspection and the fabrication of professional and performative processes, *Journal of Education Policy*, vol. 24, no. 5, pp. 611-631.

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool' model and integrating teachers' constructivist orientations. *Computers & Education*, 58(4), pp. 1351-1359.

Piaget, J., & Inhelder, B. (1956). *The Child's Conception of Space*. London: Routledge & Kegan Paul.

Piper, B., Zuilkowski, S.S., Kwayumba, D. & Strigel, C. (2016). Does technology improve reading outcomes? Comparing the effectiveness and cost-effectiveness of ICT interventions for early grade reading in Kenya. *International Journal of Educational Development*, 49, pp. 204-214.

Plowman, L. Stephen C., McPake, J. (2010a). Supporting young children's learning with technology at home and in preschool. *Research Papers in Education,* 25(1), pp. 93-113.

Plowman, L., Camp, J. & Stephen, C. (2010b). The Technologisation of Childhood? Young Children and Technology in the Home. *Children & Society*, 24(1), pp. 63-74.

Plowman, L., Stephen, C., McPake, J. (2010c). *Growing up with technology: young children learning in a digital world*. Routledge: London.

Plowman, L. & McPake, J. (2013). Seven Myths About Young Children and Technology. *Childhood Education*, 89(1), pp. 27-33.

Plowman, L. (2015). Researching Young Children's Everyday Uses of Technology in the Family Home. *Interacting with Computers*, 27(1), pp. 36-46.

Porayska-Pomsta, K., Frauenberger, C., Pain, H., Rajendran, G., Smith, T., Menzies, R., Foster, M.E., Alcorn, A., Wass, S., Bernadini, S., Avramides, K., Keay-Bright, W., Chen, J., Waller, A., Guldberg, K., Good, J. & Lemon, O. (2011). Developing technology for autism: an interdisciplinary approach. *Personal and Ubiquitous Computing*, 16(2), pp. 117-127.

Pound, L. (2011). *Influencing early childhood education: key figures, philosophies and ideas*. Maidenhead: McGraw-Hill/Open University Press.

Prensky, M. (2005). *Do They Really Think Differently?* http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.pdf [Accessed: 23/06/17]

Price, A. and Price, B. (2009). Role modelling practice with students on clinical placements. *Nursing Standard* (through 2013), 24(11), pp. 51-6;

Purdon, A. (2016). Sustained shared thinking in an early childhood setting: an exploration of practitioners' perspectives. *Education* 3-13, 44(3), pp. 1-14.

Rabinow, P. and Rose, N.S. (2003). '*Introduction', in The Essential Foucault: Selections from Essential Works of Foucault, 1954–1984*. New York: New Press.

Reifel, S. (2011). Observation and Early Childhood Teaching: Evolving Fundamentals. *Young Children*, 66(2), pp. 62-65.

Resnick, M. (2002). Rethinking Learning in Digital age. In The Global Information Technology report 2001-2002, Readiness for the Networked World, edited by G. S. Kirkman, P. K. Corneliuous, J. Sachs, and K. Schwab, 32–37. Oxford: Oxford University Press.

Riley, J. (2007). *Learning in the early years 3-7*. 2nd edn. SAGE Publications, Los Angeles.

Rinaldi C. (2006). *In Dialogue With Reggio Emilia*. London: Routledge.

Roberts-Holmes, G. & Bradbury, A. (2016). The datafication of early years education and its impact upon pedagogy, *Improving Schools*, vol. 19, no. 2, pp. 119-128.

Roberts-Holmes, G. (2015). The 'datafication' of early years pedagogy: 'if the teaching is good, the data should be good and if there's bad teaching, there is bad data. *Journal of Education Policy*, vol. 30, no. 3, pp. 302-315.

Robson, S. (2016). Self-regulation, metacognition and child- and adult-initiated activity: does it matter who initiates the task? *Early Child Development and Care*, vol. 186, no. 5, pp. 764-784.

Roland Martin, J. (2001). Maria Montessori 1870 – 1952. In Palmer, J., Bresler, L. and Cooper, D.E. (2001). *Fifty Major Thinkers on Education: From Confucius to Dewey.* London: Routledge.

Roskos, K. & Hanbali, O. M. (2000). *Creating Connections, Building Constructions Language, Literacy, and Play in Early Childhood. An invited commentary* Reading Online. Available at http://readingonline.org [Accessed 06/09/15].

Roulston, K. & Shelton, S.A. (2015). Reconceptualizing Bias in Teaching Qualitative Research Methods. *Qualitative Inquiry*, 21(4), pp. 332-342.

Rowe, C.J. (2001). Socrates 469 – 399 BCE. In Palmer, J., Bresler, L. and Cooper, D.E. (2001). *Fifty Major Thinkers on Education: From Confucius to Dewey.* London: Routledge.

Rugg, G. & Petre, M. (2007). *A gentle guide to research methods*. Maidenhead: Open University Press.

Saine, P. (2012). iPods, iPads, and the SMARTBoard: Transforming literacy instruction and student learning. *New England Reading Association Journal*, 47(2), p.74.

Sang, G., Valcke, M., van Braak, J., Tondeur, J. & Zhu, C. (2011). "Predicting ICT integration into classroom teaching in Chinese primary schools: exploring the complex interplay of

teacher-related variables", *Journal of Computer Assisted Learning*, vol. 27, no. 2, pp. 160-172.

Sarathy, V. (2018). Real World Problem-Solving. *Frontiers in human neuroscience*, vol. 12, pp. 261.

Sargent, M. (2009). Fostering sustained shared thinking. *Early Years Educator*, 11(6), pp. 44-50.

Saumure, K., & Given, L. M. (2008). Rigor in qualitative research. In L. M. Given (Ed.), *The Sage encyclopedia of qualitative research methods* (Vol. 2, pp. 795-796). Thousand Oaks, CA: Sage.

Savin-Baden, M. (2015). Rethinking Learning in an Age of Digital Fluency. London: Taylor and Francis

School Curriculum Assessment Authority (SCAA) (1996*). Nursery education: Desirable outcomes for children's learning on entering compulsory education*. London: SCAA and Department for Education and Employment.

Schreier, M. Qualitative Content Analysis in Willig, C. & Stainton Rogers, W. (2013). *The SAGE handbook of qualitative research in psychology*, Los Angeles, [California]: Sage.

Serriere, S.C. (2010). Carpet-Time Democracy: Digital Photography And Social Consciousness In The Early Childhood Classroom. *The Social Studies*, 101(2), Pp. 60-68.

Sherwood, S. A. S. & Reifel, S. (2010). The Multiple Meanings of Play: Exploring Preservice Teachers Beliefs About a Central Element of Early Childhood Education*. Journal of Early Childhood Teacher Education,* 31, pp. 322–343.

Shifflet, R., Toledo, C. and Mattoon, C. (2012). Touch tablet surprises: A preschool teacher's story. *Young Children*, 67(3), pp.36.

Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, 15(2), pp.4-14.

Sigman, A. (2012). Time for a view on screen time. *Archives of disease in childhood*, 97(11), pp. 935.

Silverman, D. (2013). *Doing Qualitative Research*, 4th edn. Los Angeles: Sage.

Sime, D. And Priestley, M. (2005). Student Teachers' First Reflections On Information And Communications Technology And Classroom Learning: Implications For Initial Teacher Education. *Journal Of Computer Assisted Learning*, 21(2), Pp. 130-142.

Simon, F., Nemeth, K., & McManis, D. (2013). Technology in ECE classrooms: Results of a new survey and implications for the field. *Exchange*, 35(5), pp. 68–75.

Siraj-Blatchford, I., K. Sylva, S. Muttock, R. Gilden, and D. Bell. (2002). *Researching Effective Pedagogy in the Early Years (REPEY).* DfES Research Report 365. London: HMSO, Queen's Printer.

Siraj-Blatchford, I., Siraj-Blatchford, J. & British Association for Early Childhood Education (2006). *A guide to developing the ICT curriculum for early childhood education*. Stoke-on-Trent: Trentham.

Siraj-Blatchford, I., Taggart, B., Sylva, K., Sammons, P. & Melhuish, E. (2008). Towards the transformation of practice in early childhood education: the effective provision of pre-school education (EPPE) research. *Cambridge Journal of Education*, 38(1), pp. 23-36.

Siraj-Blatchford, J. & Siraj-Blatchford, I. (2004). *IBM KidSmart Early Learning Programme European Evaluation*. IBM White Paper, London, IBM. [Online] http://www-05.ibm.com/dk/ibm/ibmgives/pdf/KidsmartEvalueringsrapport.pdf [Accessed 21/01/17].

Siraj-Blatchford, J. & Whitebread, D. (2003). *Supporting Information and Communications Technology in the Early Years*. Buckingham: Open University Press.

Siraj-Blatchford, J. (2010). Playful learning with ICT. *Early Years Educator*, 12(6), pp. 26-28.

Siraj Blatchford J. (2014). *ECERS-ICT* (Revised). [Online] http://www.327matters.org/Download.htm [Accessed 14/01/17].

Skolverket: Swedish National Agency for Education (2010*). Curriculum for the preschool*. [Online] https://malmo.se/download/18.29c3b78a132728ecb52800034181/1383645293487/pdf2687.pdf [Accessed 21/01/17].

Smith, C.R. (2002). Click on Me! An Example of How a Toddler Used Technology in Play. *Journal of Early Childhood Literacy,* 2(1), pp. 5-20.

Stephen, C. (2012). Looking for Theory in Preschool Education. *Studies in Philosophy and Education*, 31(3), pp. 227-238.

Stevens, J., (2014) . Observing, Assessing and Planning For How Young Children Are Learning in Moylett, H. 2014, Characteristics of effective early learning: helping young children become learners for life, Open University Press, Maidenhead, Berkshire, England.

Stringer, E.T. (2013). *Action research*, Fourth edn. Los Angeles, California: Sage.

Swaminathan, S. And Wright, J. (2003). Educational Technology In The Early And Primary Years. In Isenberg, J.P. & Jalongo, L. R. (2003) *Major Trends And Issues In Early Childhood Education: Challenges, Controversies And Insights*, Pp. 136-149.

Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., Taggart, B. (2004). *The Effective Provision of Pre-School Education (EPPE) Research: Final Report*. London: DfES/Institute of Education, University of London.

Taggart, G. (2015). Sustaining care: cultivating mindful practice in early years professional development. *Early Years,* 35(4), pp. 381-393.

Tallvid, M. (2016). Understanding teachers' reluctance to the pedagogical use of ICT in the 1:1 classroom. *Education and Information Technologies*, vol. 21, no. 3, pp. 503-519.

Tassoni, P. (2012). *Penny Tassoni's practical EYFS handbook*. 2nd edn. Oxford: Pearson Education.

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. Computers & Education, vol. 57, no. 4, pp. 2432-2440.

Tetnowski, J. (2015). Qualitative Case Study Research Design. *Perspectives on Fluency and Fluency Disorders*, vol. 25, no. 1, pp. 39.

Thomas, G. (2009). *How to do a research research: a guide for students in education and applied social sciences*. 1st edn. Thousand Oakes, Calif: Sage.

Thomas, G. (2015). *How to do your case study: a guide for students and researchers*, 2nd ed. Los Angeles, [Calif.]; London: Sage.

Thornton, C. & Underwood, K. (2013). Conceptualisations of disability and inclusion: perspectives of educators of young children, *Early Years*, 33(1), pp. 59.

Tröhler, D. (2001). Jean Heinrich Pestalozzi 1746 – 1827. In Palmer, J., Bresler, L. and Cooper, D.E. (2001). *Fifty Major Thinkers on Education: From Confucius to Dewey.*: London: Sage.

Trucano, M. (2005). *Knowledge Maps: ICTs in Education - What do we know about the effective uses of information and communication technologies in education in developing countries?* infoDev/World Bank: Washington.

United Nations (1989). *UN Convention on the Rights of the Child.* Geneva: United Nations.

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: toward a unified view. *MIS Quarterly*, 27(3), 425–478.

Vésteinsdóttir, V., Steingrimsdottir, E.D., Joinson, A., Reips, U. & Thorsdottir, F. (2018). Social Desirability in Spouse Ratings. *Psychological Reports*, pp. 3329411876781.

Voogt, J.M., Fisser, P., Pareja Roblin, N.N., Tondeur, J. & Braak, J. (2013). Technological Pedagogical Content Knowledge - a review of the literature. *Journal of computer assisted learning*, 29(2), pp. 109-121.

Vu, J.A., Han, M. & Buell, M. J. (2015). The effects of in-service training on teachers' beliefs and practices in children's play, *European Early Childhood Education Research Journal*, 23(4), pp. 444-460.

Wallace, S. & Atkins, L. (2012). *Qualitative research in education*. London: Sage.

Waller, T. (2005). An introduction to early childhood: a multidisciplinary approach. 2nd ed. Thousand Oaks, Calif; London: Sage.

Waller, T., Sandseter, E.B.H., Wyver, S., Ärlemalm-Hagsér, E. & Maynard, T. (2010). The dynamics of early childhood spaces: opportunities for outdoor play? *European Early Childhood Education Research Journal*, 18(4), pp. 437-443.

Walsh, G., Sproule, L., McGuinness, C. and Trew, K. (2011). Playful structure: a novel image of early years pedagogy for primary school classrooms. *Early Years,* 31(2), pp. 107-119.

Warschauer, M. & Ames, M. (2010). Can One Laptop Per Child Save The World's Poor? *Journal of International Affairs*, vol. 64, no. 1, pp. 33-51.

Watts, Z. & Gardner, P. (2013). Is systematic synthetic phonics enough? Examining the benefit of intensive teaching of high frequency words (HFW) in a year one class. *Education 3-13*, vol. 41, no. 1, pp. 100-109.

Wheeler, S. (2011). *Making Smart Decisions on Technology*. [Online] https://www.plymouth.ac.uk/news/making-smart-decisions-on-technology [Accessed 21/01/17].

Whitebread, D., & Bingham, S. (2011). *School readiness: A critical review of perspectives and evidence.* (Occasional Paper No: 2). Severn Stoke, United Kingdom: Training, Advancement and Co-operation in Teaching Young Children. Retrieved from http://tactyc.org.uk/occasional-paper/occasional-paper2.pdf.

Wilford, S. (2007). *Modeling Appropriate Behaviors: Helping Teachers Recognize Their Position as Role Models for Children*. London: Scholastic, Inc.

Williams, P. (2005). Using information and communication technology with special educational needs students. *Aslib Proceedings*, 57(6), pp. 539 – 553.

Wohlwend, K.E. (2015). One Screen, Many Fingers: Young Children's Collaborative Literacy Play With Digital Puppetry Apps and Touchscreen Technologies. *Theory Into Practice,* 54(2), pp. 154-162.

Woods, A. (2015). *The characteristics of effective learning: creating and capturing the possibilities in the early years*. Routledge: Abingdon, Oxon; New York.

Woods, A. (2017). *Child-initiated play and learning: planning for possibilities in the early years*. Second edn. Routledge, London.

Yelland, N. (1999). Technology as Play. *Early Childhood Education Journal*, 26(4), pp. 217-220.

Yin, R.K. (2009). Case study research. 4th ed. Thousand Oaks, Calif.: Sage Publications.

Yin, R.K. (2013). *Case Study Research: Design and Methods*. 5th edn. Los Angeles, California: Sage.

Zevenbergen, R. & Logan, H. (2008). Computer use by preschool children: rethinking practice as digital natives come to preschool. *Australian Journal of Early Childhood*, 33(1), pp. 37-44.

Zorec, M.B. & Došler, A.J. 2016, Rethinking the hidden curriculum: daily routine in Slovene preschools, *European Early Childhood Education Research Journal*, vol. 24, no. 1, pp. 103-114.

Appendix 1

Examples of Early Years Digital Resources

Appendix 2

Hughes and Melville: A Playworker's Taxonomy of Play Types

- Symbolic Play – play which allows control, gradual exploration and increased understanding without the risk of being out of one's depth.
- Rough and Tumble Play – close encounter play which is less to do with fighting and more to do with touching, tickling, gauging relative strength. Discovering physical flexibility and the exhilaration of display.
- Socio-dramatic Play – the enactment of real and potential experiences of an intense personal, social, domestic or interpersonal nature.
- Social Play – play during which the rules and criteria for social engagement and interaction can be revealed, explored and amended.
- Creative Play – play which allows a new response, the transformation of information, awareness of new connections, with an element of surprise.
- Communication Play – play using words, nuances or gestures for example, mime, jokes, play acting, mickey taking, singing, debate, poetry.
- Dramatic Play – play which dramatizes events in which the child is not a direct participator.
- Deep Play – play which allows the child to encounter risky or even potentially life threatening experiences, to develop survival skills and conquer fear.
- Exploratory Play – play to access factual information consisting of manipulative behaviours such as handling, throwing, banging or mouthing objects.
- Fantasy Play – play which rearranges the world in the child's way, a way which is unlikely to occur.
- Imaginative Play – play where the conventional rules, which govern the physical world, do not apply.
- Locomotor Play – movement in any or every direction for its own sake.
- Mastery Play – control of the physical and affective ingredients of the environments.
- Object Play – play which uses infinite and interesting sequences of hand-eye manipulations and movements.
- Role Play – play exploring ways of being, although not normally of an intense personal, social, domestic or interpersonal nature.
- Recapitulative Play – play that allows the child to explore ancestry, history, rituals, stories, rhymes, fire and darkness. Enables children to access play of earlier human evolutionary stages.

Devised by Bob Hughes, published in full in 'A playworker's Taxonomy of Play Types' (PLAYLINK, second edition 2002).

Hutt: Taxonomy of Play

PLAY					
EPISTEMIC BEHAVIOUR		GAMES WITH RULES	LUDIC BEHAVIOUR		
Problem solving		Co-operative	Symbolic		
Exploration		Games of chance	Representative object	Immaterial fantasy	
		Games of skill	Fantasy object	Fantasy person roles	
Productive		Competitive	Repetitive	Innovative	Perserverative
Materials	Acquisition of skills				

Taxonomy of Play, Hutt (1979) in Kernon (2007: 18).

Bishop and Curtis: Classification of Play Traditions

High verbal content		General verbal play: jeers, epithets	
		Narratives	
		Jokes, riddles	
		Entertainment rhymes	
		Counting out	
	Singing games	Song and dance	
		Clapping rhymes	
		Skipping rhymes	
		Ball-bouncing rhymes	
High imaginative content	Role enactment		
	Acting games	Set plot and characters	
		Set plot, characters and dialogue	
High physical content	Games without playthings	Individual	
		Group	High-power It
			Low-power It
			No It
		Team	
	Games with playthings	Individual	Balls
			Ropes
			Stones
			Miscellaneous
		Group	Balls
			Ropes
			Stones
			Miscellaneous
		Team	Balls
			Ropes
			Stones
			Miscellaneous
	Making things		
	Collecting things		

Bishop and Curtis Classification of Play Traditions (2001: 14)

Appendix 3

Interview 1

Interview Questions –

1. Do you use technology often in your personal life?
2. What do you use and do you like using it?
3. How would you describe your technology skills?
4. What training have you received?
5. What technological resources do you have access to?
6. Are there any restrictions placed on the children using technology? If so what are they and what is the reasoning behind them?
7. What place does technology have in an early years classroom/setting?
8. How can technology be used to develop session content?
9. How can technology be used to enhance the delivery of the activity?
10. How often do you use technology in the classroom?
11. How do you plan for its use?
12. What apps have you used?
13. What area of learning are you planning to develop through the use of tablet technology?

Copy of planning for sessions
Copy of each child's assessment record for selected area of focus
Observations (Teaching) –

1. Techniques used with tablets
2. Explanation and support for children
3. Area of learning and focus

Observations (Learning)

1. Level of understanding in selected area of learning
2. Target in same area
3. Experience using technology

Interview 2

1. Do you have a website?

2. Do you have any input?

3. Is the website just for information, or are there any interactive parts of it?

4. How are the parents involved with technology, are they involved with the website at all or is it just for them to access?

5. Do you text them, email or anything like that?

6. Have you ever run any training classes to help parents with technology?

7. Is there any funding available to develop your technological provision

8. Is there any funding for training for staff or is there training available for staff ?

9. Do you have internet access?

10. Is technology used by adults whilst the children are present? So sort of role modelling the use of technology in everyday practice or in everyday life?

11. So it I just a routine thing, if children took a photo or created a picture , they would know know what to do with it, how to print it off?

12. How important do you think developing technology is, has it changed since the last time?

13. Do you use the technology strand of understanding the world in the eyfs to support your planning?

14. Do you think there should be a strand in the EYFS?

15. How is the use of technology developed in the school since you have been here?

16. Has technology developed the children's skills since September and how do you feel its helped?

17. Do you think it is helping any of the curriculum areas

18. Do you find they are more confident?

Appendix 4

Child Observation Proforma

Name: Child 3A

Date:
03/06/2015

Time:
PM

Duration:
20 minutes

Curriculum Focus:
UTW/ PSED

Technology:
Sensory Room

Observation:

The teacher smiles at Child 3a and tells her they are going to see the lights, Child 3a smiles at the sound of the teacher's voice. The teacher puts her into her pushchair and takes her through to the Sensory Room. Child 3a makes some noises and waves her hands, she appears happy to be here. The teacher takes her out of the pushchair.Child 3a lies on the floor looking at the lights also on the floor. The teacher changes the colour, first to blue, then red then yellow, Child 3a smiles. The teacher gives the child lots of encouragement to move to the control panel. Child 3a sits up and looks at the panel as the colours change on it, the teacher helps her press a button, the colour changes and she smiles again. The teacher moves her again but she moves herself back to the panel and starts to show an interest in the buttons. She pushes them with her head, changing the light to blue, but does not seem aware that pushing the button caused this effect. She tried to push the buttons with her hands but was unable to due to her lack of strength, the teacher helped her to press hard enough to make the lights change.Child 3a slides back to lying on the floor, she touches the lights and gurgles and laughs. She continues to lie on the floor smiling, sucking her fingers, but shows no further interest in the lights or buttons. The teacher tells her it is time to go back to the classroom and puts her back in the pushchair. Child 3a sits quietly while the teacher fastens the harness and then begins to pull on it as she returns to the classroom.

Key Highlights:

Variety of communication – vocal tones, facial expression, body language
Noticed change in the colour of the lights, changed facial expression and tried to touch the light
Did not link pressing the button with change in colour of light
Good relationship with teacher, trusted her and was happy and comfortable

Appendix 5

Technology Self-Assessment Tool

Name:					
	1 – Highly experienced and confident; 4 – No experience				
Personal Use *How do you use technology in your everyday life?*					
Technology	1. You feel confident using technology	1	2	3	4
	2. You know all the technology available and use it regularly	1	2	3	4
	3. You research new technology and follow the funding process to acquire new digital resources	1	2	3	4
	4. You use technology in the classroom as a tool to help in everyday activities. (Timer, printer etc)	1	2	3	4
Pedagogy	5. You always use a cross curricular approach in your planning	1	2	3	4
	6. You plan a play-based curriculum using the Characteristics of Effective Learning to design your activities	1	2	3	4
	7. You use a variety of approaches to listen to the children's voices	1	2	3	4

	and use this to inform individualised planning				
Content	1. You use the EYFS as the framework for your planning and assess what the child can do in order to extend their knowledge skills and understanding	1	2	3	4
	2. You understand the hidden curriculum	1	2	3	4
	3. You plan a variety of adult led and child-initiated activities for all areas of learning	1	2	3	4
Use of technology to teach young children	1. You have experience of using technology in an educational setting	1	2	3	4
	2. You use observations and assessments to plan appropriate use of technology to further develop children's learning	1	2	3	4
	3. You understand the capabilities of digital resources and use them in a variety of ways to enhance the content you are teaching the children	1	2	3	4
	4. You use children's individual knowledge skills and understanding of technology to plan for next steps	1	2	3	4