Teachers' Perceptions and Practices in relation to the Integration of Digital Technologies in Kindergartens in China: An Interpretive Multi-method Study

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Abstract

The present study aimed to provide insights into the integration of digital technologies in the kindergartens of China from the perspectives of teachers, with a specific focus on teachers' perceptions, pedagogical practices and the multiple contextual factors behind them. Given the focus of the study on the particular context of China, this study did not intend to be representative. The sociocultural ideas developed by Vygotsky were adopted to provide the theoretical bases for this study, whilst the TPACK model (Mishra & Koehler, 2006) and its context framework (Porras-Hernandez & Salinas-Amescua, 2013) were employed to conceptualise some of the research findings. In order to empirically address the research questions regarding participants' perceptions, practices and their relationships with contexts, this study employed the two-phase interpretive qualitative research design, which included individual interviews of fourteen kindergarten teachers and five case studies with kindergarten teachers and their classrooms in China. In specific, I adopted the case study to deeply understand participating teachers' pedagogical approaches when integrating digital technologies. The data were generated from individual interviews, classroom observations and document reviews, and then were analysed through the thematic approach and multimodal approach. In particular, both inductive and deductive approach were applied to analyse the data in a reflexive way.

This thesis made several empirical and theoretical contributions to the existent knowledge base. Firstly, the findings indicated that the participating teachers tended to foster a greater use of digital technologies for consumption purposes, rather than for creative functions. Secondly, the pedagogical practices of teachers in the present study were interconnected with their understandings of digital technologies and pedagogical beliefs. Thirdly, it was found that teachers' perceptions and practices were shaped by multiple and interrelated contextual factors, among which the meso-level kindergarten context played a more important role than micro- and macro-level forces. Lastly, the thesis theoretically adapted the context framework for TPACK developed by Porras-Hernandez and Salinas-Amescua (2013) to a networked framework, providing the basis for researchers to study more complex interrelationships between contextual systems in the future.

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Chapter 1. Introduction

This thesis presents a doctoral study focused on kindergarten teachers' integration of digital technologies in China. The study sought to understand participating teachers' decision-making in relation to the pedagogical use of digital technologies in kindergartens, so the interpretive qualitative research design was employed to investigate teachers' attitudes, perceptions, and practices. Specifically, I adopted the case study to deeply explore their pedagogical approaches of integrating digital technologies. The findings of this study extend previous knowledge about teachers' perceptions and pedagogical practices of using digital technologies and have important implications for effectively integrating digital technologies into kindergartens. This chapter introduces the study, firstly by explaining some relevant context. Following this contextualisation, I introduce the focus of the study in more depth, including its three central research questions. The chapter ends with an overview of the contents of the whole thesis and some definitions of central terms. Firstly, then, I begin by outlining some relevant context in terms of digital technologies and their use by young children as well as the early childhood education (ECE) sector in China.

1.1 Context

1.1.1 Digital Technologies and Young Children

The growth in popularity of new technologies and digital devices increased the Internet usage of very young children and brought fundamental changes to their lives. In China, an increasing number of empirical studies provided some details about Chinese young children's experiences with digital technologies (Huang, 2019; Fan, 2016; Gou & Dezuanni, 2018). Many surveys reported that more than 85% of families owned at least one smartphone and at least 76% of researched children used digital devices regularly (Wang et al., 2018; Yan & Yue, 2019). Furthermore, Gou and Dezuanni (2018) described that the average screen time of Chinese young children was 63 minutes per weekday and 88 minutes per weekend (including the television, early educational tablet, tablet, computer, smartphone, music player, e-reader, game console time) after investigating 1,171 children aged three to seven in six provinces of China. While in 2021 Li et al. (2021) reported that the average screen time of 1750 five to six years olds in Shenzhen of China was 115 minutes per day. Li et al. (2021) explained the possible two reasons for the increased screen time: Firstly, the COVID-19 pandemic made the virtual learning an alternative for in-person learning. Secondly, the five to six years olds were facing the school readiness, so they tended to do more distance learning than young children.

Furthermore, Chinese children were frequently involved in online activities, such as watching cartoons, playing games, learning, communicating with others and online shopping (Fan, 2017; Wang et al., 2018; Liu, 2016). In particular, online learning was increasingly accepted by Chinese children and parents. China Internet Network Information Center (CNNIC) (2019) reported that the number of active users in the field of children's (aged 0-18) online education has reached 59.126 million. Also, Li et al. (2021) revealed that early years children spent more screen time on educational activities than in entertainment activities. Similarly, research conducted by Gou and Dezuanni (2018) found that parents valued educational apps more than any other types of apps. This might have been due to Chinese tradition, which attaches great importance to children's academic performance, along with the huge profit that many commercial companies identified within the early education market (Gou & Dezuanni, 2018).

Reports of other countries showed a similar trend. Data from the Common Sense Media studies (Rideout, 2014 & 2017) indicated that there was a dramatic increase (from 38% to 72%) in young children's mobile device use in the United States. Also, the EU Kids Online study showed that the percentage of children aged three to four years accessing the Internet in Sweden, Belgium and the Netherlands was nearly 70% (Holloway et al., 2013). These children have been described as 'digitods' (Holloway et al., 2015) or the touch-screen generation (Rosin, 2013). However, it should be acknowledged that not every child born today is digitod and there are range of reasons for this. For example, some children still cannot access to digital technologies and develop digital skills due to the disadvantaged socioeconomic backgrounds or parental values and preferences (Holloway et al., 2015).

In recent years, mobile devices, such as tablets and smartphones, have been increasingly used by preschool children for diverse educational and entertainment activities, encompassing watching videos on YouTube (Marsh et al., 2017), playing games (Neumann, 2014a), searching for information using Google, communicating via Skype or Facetime, and creative activities such as taking photographs, drawing, story making (Marsh et al., 2015) and coding (Scott, 2022). In particular, it was argued that the COVID-19 pandemic encouraged children's engagements with digital technologies (Cowan et al., 2021). The Play Observatory (2021) reported children's various digital play during the pandemic, such as online gaming, video calling, digital media creating. Additionally, young children spent considerable time on these activities. It was reported that the average duration of tablet usage by children from infancy to five years old was 79 min/day in the UK (Marsh et al., 2015), whilst Organisation for Economic Cooperation and Development (OECD) (2020) reported that 42% of 5-year-old children in the US, England and Estonia used digital devices every day and 83% were using at least once a week.

However, it continued to be a controversial issue among researchers, educators, policymakers, and parents worldwide (Blackwell et al., 2013). Some researchers showed their concerns about excessive screen time, passivity, low activity levels and negative developmental impacts of digital play (Nathanson et al., 2013; Vandewater et al., 2005; Greenfield, 2014; Christakis & Zimmerman, 2007). Despite this, Plowman and McPake (2013) argued that no evidence from parents could be found to prove that the adoption of digital technology by children had harmful impacts on their health, behaviour or learning. Similarly, Bell et al. (2015) argued that no evidence from neuroscience studies supported the arguments forwarded with regard to the dangers of technology use on children's brains. Instead, they contended that the digital technology itself should not be blamed for potential negative effects and that the displacement of other activities seemed to be the cause (Bell et al., 2015). Many scholars argued that engaging with digital technologies could benefit young children's communicative skills (McPake et al., 2013; Bell et al., 2015), art and drawing skills (Price et al., 2015), play and creativity (Marsh et al., 2018) and their competences with digital technology (Plowman et al., 2012). According to Plowman et al. (2012, p.6), learning of this type, supported by interactions with technologies, could be classified into four categories: 'acquiring operational skills, extending knowledge and understanding of the world, developing dispositions to learn, and understanding the role of technology in everyday life'.

The potential of digital technologies to act as a significant teaching tool in early education settings was progressively recognised by many researchers and educators globally. Chen and Tu (2018) argued that the incorporation of Internet-enabled devices in preschool activities was positively associated with the development of students' learning abilities and cognitive skills. Similarly, the research of Papadakis et al. (2018) presented that the adoption of ICT enhanced children's engagement, motivation, persistence, curiosity, and attention. Specifically, children's numeracy (Papadakis et al., 2018), language and literacy (Hsin et al., 2014) development were found to benefit from ICT use in preschool. More detailed considerations can be located in Section 2.1.1. Accordingly, many countries (e.g. Australia, UK, Sweden and Denmark) acknowledged the important role of digital technology in children's development, thereby developing some educational policies and projects to encourage the integration of ICT into the early childhood education sector (Plumb et al., 2013). It was reported that almost half of Swedish municipalities issued projects to equip schools and preschools with digital tablets (Petersen, 2015). In addition, Singapore made and implemented an ICT Master Plan for Education in 1997, and the Republic of Korea invested massively in the Smart Education Initiative relating to enhancing children's digital skills from 2009 (Hooft Graafland, 2018). Furthermore, some countries tried to integrate digital technologies into the school curriculum (Ilomäki et al., 2016; Hooft Graafland, 2018). For example, in Norway, all students had to be tested nationally for their digital literacy, which was defined in the curriculum reform as a central skill for the future (Sefton-Green et al., 2009). In addition to investing in ICT and supporting the integration of technologies into the curriculum, several countries also concentrated closely on teachers' relevant knowledge, including preschool teachers' ability to apply ICT. In the US, Norway, China and Australia, using digital tools was defined as a criterion for being a preschool teacher (Du et al., 2019; Ilomäki et al., 2016). Also, a position statement listing 16 principles for directing teachers' use of digital media was released by the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Centre (Ernest et al., 2014). In brief, digital literacy was increasingly integrated into international educational systems.

Some empirical studies, however, showed that the digital technology was underused in ECE classrooms (Wartella et al., 2013). Even when in use, it was found that the digital technology was usually applied in a traditional and dogmatic way instead of in a creative and student-centred way (Ertmer & Ottenbreit-Leftwich, 2013; Vidal-Hall et al., 2020). This lack and ineffective integration of technology could be related to ECE practitioners. Research demonstrated that it was difficult for many ECE teachers to learn and apply digital technologies in their pedagogical practices (Cviko, et al., 2015) and they had restricted competence and confidence in integrating them into their classroom (Ertmer et al., 2012). In addition, teachers' attitudes towards young children's early digital engagement, which could be influenced by their previous experiences (Plowman et al., 2012) and public concerns (Teichert, 2017), also had an impact on their actual practices with technology (Ertmer et al., 2012; Blackwell et al., 2014). Thus, it was argued that understanding early years practitioners' perspectives was essential to achieving the potential benefits of digital technologies for children's development. The Sections 2.1.2, 2.1.3 and 2.1.4 in Literature Review provided more detailed discussion on the use of digital technologies in early years settings.

In the last decade, a significant improvement in the application of Information and Communication Technology (ICT) was made in China. In mainland China, an education reform document issued by the Council of State suggested accelerating the integration of digital technologies within school and university sectors (Fan, 2016). In 2011, the Ministry of Education of China (MoE, 2011a) announced the *Professional Standards of Kindergarten Teachers (Trial),* which required kindergarten teachers to be equipped with the necessary knowledge on new technologies. Afterwards, the *Education Digitisation 2.0 Action Plan* (MoE, 2018) pointed out that both the environment and application level of ICTs in nationwide universities and schools should be enhanced during this period. This included but was not limited to digital equipment, online teaching resources, professional software and teachers' digital competencies. From the perspective of practice, the Ministry of Education implemented a professional project to promote the ICT application abilities of national school teachers, including preschool teachers, which established a standardised system for assessing teachers' ability to use information technology in teaching (Dong, 2018a). However, compared with school education and higher education, early childhood education’s technology integration received less attention from policymakers and researchers (Kang et al., 2013). This was because preschool education was excluded from the basic education schema in China and a huge number of kindergartens were private, not public (Leung, 2003). Without the consistent support and regulation from the government, these kindergartens could not develop digital technology integration at the same pace (Kang, 2014).

As a result, some existing studies revealed that the integration level and utilisation frequency of digital devices by Chinese early years teachers were relatively low (see Section 2.1.3). In addition, most practices demonstrated superficial rather than effective integration (Dong & Newman, 2016; Liu et al., 2014; Liu et al., 2016), such as the passive use of the interactive whiteboard (IWB) (Kang, 2014). In contrast with the extensive findings on the benefits of digital technology integration for children’s development, the problem of underuse and passive use of digital technologies in China highlighted the lack of research on teachers’ perceptions and pedagogy. Therefore, researchers called for more empirical studies on digital technology integration by kindergarten teachers in China (e.g. Dong, 2014; Yang, 2021).

1.1.2 Early Childhood Education (ECE) in China

In mainland China, ECE was non-compulsory and consisted of nurseries and kindergartens, accommodating children from zero to six years old. Nurseries primarily provided care services for children from zero to three, whilst kindergartens served children between the ages of three and six. By 2023, there were 289,200 kindergartens in China and 46.28 million children in kindergartens (MoE, 2023). Based on the funding status, there were two categories of kindergartens in China: public kindergartens that were funded by governments and private kindergartens that were owned privately. Moreover, more recently, a new category was proposed. This was in reference to the inclusive (not-for-profit, ‘Puhui’ in Mandarin) kindergartens, which aimed to enrol as many children as possible in kindergarten education. Thus, the charging fees in these kindergartens were uniformly controlled by the government and were lower than fees charged by for-profit kindergartens. All publicly owned kindergartens and the majority of private ones were not-for-profit, whilst the rest were privately owned premium kindergartens in which parents were charged high fees. There were 245,700 not-for-profit kindergartens across the nation, covering approximately 84.96% of all kindergartens in China (MoE, 2023). Within the kindergarten, children were distributed into different class levels according to their age. Generally, children aged three to four were in lower classes; four- and five-year-olds were in middle classes; and five- and six-year-olds were in upper classes. The teacher-child ratio was required to be no less than 1:9 in each class, with three or four teachers for 20-35 children (MoE, 2001). However, in practice, the class size was larger, and the teacher-child ratio was lower than required (Yang, 2021). Especially in rural areas, kindergartens were reported to be short of teachers and infrastructures due to economic and social factors (Dong, 2014). Furthermore, the statistics showed that 97.79% of kindergarten teachers were female and 72.42% did not hold a bachelor's degree (MoE, 2020). These characteristics were believed to potentially influence the teaching and learning practices in kindergartens (Yang, 2021).

The ideas behind ECE curriculum and pedagogy in China were complicated. Many scholars believed that the educational ideology of ECE in China was greatly influenced by Chinese traditional culture that was rooted in Confucianism (e.g. Chan & Rao, 2011; Naftali, 2010; Yang & Li, 2019b). The Confucian perspectives attached high values to knowledge, unity, collectivism, conformity and social order (Li & Chen, 2017; Cheung, 2017), which profoundly affected the beliefs and expectations of parents and educators towards ECE, thereby shaping the whole educational ideology.

According to the arguments of many researchers (Li & Chen, 2017; Liu & Feng, 2005), the impacts of Chinese traditional culture on ECE ideology could be categorised into the following four aspects. Firstly, influenced by Confucian values, many Chinese parents expressed an emphasis on academic achievement and favoured academic-oriented programmes (Wong & Rao 2015; Yuen and Grieshaber 2009; Chen, 2005; Li et al., 2019). In particular, the previous one-child policy (though currently abolished) was believed to be a driving force behind parents' emphasis on academic achievement. This was because the single child in the family unit usually had to 'bear the entire weight of their parents' and grandparents' hopes, expectations and aspirations' (Naftali, 2010, p591; see also Croll, 1996). In addition to parents, some teachers also reported their traditional conception of teaching and learning (Ng & Rao, 2008). Therefore, in Chinese society, the prescribed subject-based curriculum and pedagogy were highly valued. Secondly, it was indicated that Chinese people tended to value drilling and memorising rather than understanding and creativity (Li et al., 2012). Therefore, in Chinese kindergartens, classical reading and recitation, recalling songs and delivering long speeches were the normal activities for young children (Li, 2006). It was stated that even in Hong Kong, where east meets west, rote memorisation and drill and practice had long been employed as the learning method in ECE (Ng & Rao, 2008). Furthermore, many scholars contended that Confucianism focused on desirable child behaviour by stressing discipline rather than individual freedom (Li & Chen, 2017; Rao et al., 2010; Li et al., 2016). It was argued that Chinese ECE ideology tended to instil adult standards in young children in order to train them to be civilised citizens who could contribute to creating a harmonious society (Naftali, 2010). Lastly, due to the high value placed on unity and collectivism, the group-oriented and extrinsically motivated activities, as opposed to individual-oriented and intrinsically motivated activities, were preferred in kindergartens (Liu & Feng, 2005; Tobin, 2005).

However, the economic, political and social transformations undergone by China were constantly changing and updating people’s beliefs and thereby educational ideology. Earlier in the 1950s, when the ‘new China’ was founded, the Soviet Union’s Model of education was espoused, which greatly influenced the Chinese ECE ideology (Tobin et al., 2009). Scholars illustrated that the Soviet communist culture placed emphasis on planning and unity, which is consistent with Chinese traditional culture (Wang & Spodek, 2000). As a result, at that time, the ECE pedagogy in China focused on lesson planning and teacher-centred instruction with prescribed subject content and learning goals (Zhu & Wang, 2014). However, this model was later rejected as it was regarded as ineffective for achieving China’s national goals (Fees et al., 2014).

Furthermore, researchers pointed out the 1980s as a significant period of Chinese ECE reform when the ‘Open Door’ policy was carried out in China (Li & Chen, 2017; Zhu & Zhang, 2008). The ‘Open Door’ policy, though initiated for economic reform, greatly modified traditional education ideas by introducing western culture into China

(Zhu, 2015). Educational philosophies, such as the ideas of Dewey, Vygotsky, Bronfenbrenner and Piaget, were introduced in mainland China for both researchers and educators in ECE (Zhu & Zhang, 2008). Similarly, various ECE models, such as the Montessori pedagogy (Italy), Reggio Emilia approach (Italy), the Project approach (US) and Developmentally Appropriate Practice (DAP) (US), were also introduced to China and affected the development of Chinese ECE (Li et al., 2012; Liu & Feng, 2005). Li et al. (2011) summarised the features of western pedagogies as a child-centred approach, child-initiated and process-oriented activities, inquiry-based playful learning, small group learning, integrated teaching and so forth. Moreover, in contrast to Chinese tradition and communist culture, the ideas derived from western culture tended to promote young children's individuality, autonomy and cognitive development through ECE (Zhu & Zhang, 2008). However, it was argued that these western ideas could not be taken for granted as the dominant ECE discourse in China without considering the social and cultural differences (Li, 2007). Thus, according to Yang and Li (2019), despite the cultural clash between Chinese traditional culture, communist culture and western culture, all of three could still be interwoven and interconnected to form a 'Chinese hybrid culture of ECE' (Wang & Spodek, 2000), thereby shaping the beliefs of parents and practitioners, as well as inspiring ECE reforms in China. The mixture of these ideas influenced early years teachers' pedagogical practices (see detailed discussion in Section 2.2.5), which could further affect their digital technology integration into curriculum and pedagogy.

As indicated previously, despite the increased emphasis on the use of digital technologies in education by the Chinese government, less attention was paid to the ECE sector. Two key documents of ECE in China, *A Guide to Learning and Development for Children Aged 3-6 Years* (MoE, 2012) and *Guidelines for Kindergarten Education (Trial)* (MoE, 2001), did not explicitly include the connection between digital technology use and ECE practices. Furthermore, there were no policies or guidelines specific to digital technology integration in ECE and ECE teachers' professional development related to digital competencies. However, along with the implementation of *Education Digitisation* nationwide, as well as the increasing discussion on young children's engagement with digital technologies globally, it was inevitable for kindergartens in China to be involved in the trend. Accordingly, with these environmental factors in mind, how kindergartens and kindergarten teachers responded to and participated in the digital technology integration needed to be investigated in depth.

1.2 Area of Study, Research Questions and Importance

Since young children's access to digital technologies increased, the benefits of using digital technologies for children's play, learning and development were recognised and their potential as an educational tool was generally acknowledged by researchers, educators and policymakers (Fesakis, 2011; Hsin, Li & Tsai, 2014; Marsh et al., 2018). As a result, the debate evolved from the appropriateness of digital technologies in an ECE context towards how digital technologies could be used pedagogically to achieve children's educational potential (Yang, 2021). The important role of early years practitioners in facilitating effective digital technology integration was highlighted, and researchers called for more investigations on practitioners' perspectives (Mertala, 2019). The existing western-centric studies provided some insights into teachers' beliefs, knowledge and general approaches to integrating digital technologies into kindergarten activities (e.g. Furman et al., 2019; Morgan, 2010; Bird, 2017). Moreover, the research established that kindergarten teachers' use of digital technologies was situated within specific contexts (Blackwell et al., 2013; Oldridge, 2010). Thus, more empirical studies on teachers' perspectives within different sociocultural contexts were needed.

As earlier discussed in detail, the social and cultural contexts in China are distinct from western contexts, which adds a layer of complexity to ECE values and ideas within China. The combined ideology of ECE shaped the diverse pedagogical practices in kindergartens. Therefore, it was valuable to study how digital technologies were integrated into such diversified pedagogical practices. Furthermore, whilst the reform of education digitisation in China was underway, little consideration was given to the ECE sector despite its involvement due to its status as a non-compulsory education (e.g. there were no specific guidelines). In light of this particular situation, understanding how kindergartens and kindergarten teachers made decisions on digital technology integration and how their decisions were shaped by multiple contextual factors could be necessary for further policy-making. However, the research on the integration of digital technologies into early years education in China only began in recent years. Moreover, most merely focused on teachers' use of digital technology but did not involve its integration into curriculum and pedagogy, which might not have provided a holistic picture of digital technology integration in kindergartens.

Consequently, this study aimed to explore kindergarten teachers' perspectives on pedagogically integrating digital technologies into ECE in China, including the pedagogical use of both teachers and children. Particularly, how teachers perceived and practised digital technology integration, along with how multiple contextual factors influenced their perspectives, were investigated in depth.

Three research questions were developed:

1. What are participating teachers' attitudes and perceptions in relation to the integration of digital technologies into kindergartens in China?
2. How do these teachers integrate digital technologies within their pedagogical practice?
3. How do a range of contextual factors shape these teachers' perceptions and practices in relation to digital technology integration?

Answering the above research questions through an interpretive and qualitative lens, this study makes multiple contributions to knowledge. Firstly, the empirical contributions (see detailed discussion in Section 7.1) address the noted gaps in existing literature (discussed in Chapter 2). By focusing on kindergarten teachers' perspectives, in particular their perceptions and practices, this thesis contributes to identifying and reducing the barriers for an effective digital technology integration, which ensures that young children are exposed to technologies in an appropriate manner. In addition, by providing rich and in-depth descriptions and analysis of technology use in Chinese kindergartens, this study presents a view of the integration of digital technologies into early years settings within a different sociocultural context from the mainstream research contexts. This adds to the knowledge base regarding the interplay among perceptions, practices and contexts. More importantly, this study not only focuses on teachers' use of digital technologies as teaching tools in kindergartens, but also examines children's use of digital technologies as learning tools in classrooms. In particular, teachers' instructional strategies during children's technology use have been explored in greater depth from the perspectives of 'guided interaction' (Plowman & Stephen, 2007). This zoom-in approach deepens the understanding of how digital technologies were used as both learning and teaching tools by participants, providing comprehensive descriptions and interpretations of technology integration. Furthermore, the comprehensive examination of contexts closes a gap in previous literature, which lacks interpretations of how contextual factors work together to shape digital technology integration in kindergartens. This extends the knowledge of how kindergarten teachers make decisions on technology use, thereby providing implications for stakeholders for facilitating effective technology integration. Moreover, by modifying Porras-Hernandez and Salinas-Amescua's (2013) framework of context for TPACK, the theoretical contribution (see Section 7.2) allows researchers to visualise interactions among contextual elements and between different context levels. Additionally, it lays the groundwork for further study into more complex interrelationships between systems in the future.

1.3 Overview of Thesis Structure

This thesis consists of six chapters. Chapter 1 constructs the foundations on which this study is grounded by introducing the research context and clarifying the research problems, objectives and questions. In Chapter 2, literature relevant to the integration of digital technologies into ECE is reviewed. In particular, the literature review consists of reviews of studies discussing digital technology integration in ECE settings, the context of ECE pedagogy and the specific digital pedagogies. The theoretical frameworks are also reviewed in this chapter. Chapter 3 provides a comprehensive account of the methodology. It begins with an outline of the research design and the rationale for the methodological approach. The descriptions and explanations of two research phases follow, presenting the research settings and participants, data collection and data analysis. Methodological issues including ethics, research quality and my reflections on the researcher role and the COVID-19 pandemic are addressed. Chapter 4, 5 and 6 presents the analysis and findings drawn from the two research phases, answering the research questions around participating teachers' perceptions, practices and contextual factors. Chapter 7 interprets and discusses the overall findings. Finally, Chapter 8 concludes by summarising the key findings, presenting limitations and recommendations. The references and appendices are attached at the end.

1.4 Definitions of Relevant Terms and Acronyms used in the Thesis

Digital Technologies: Digital technologies have been understood in different ways, both through history and in different contexts. In the present thesis, however, digital technologies are understood in line with the definitions of Johnston and Highfield (2017) and Fleer (2017). The former defined digital technologies as 'anything that can create, store or process data' (Johnston & Highfield, 2017, p.58), while the latter categorised them into digital toys (e.g. robotics), tangibles (e.g. computers, smartphones, tablets, the interactive whiteboards) and less tangible forms (e.g. the Internet, software, apps) (Fleer, 2017). I will use the term digital technologies/digital technology throughout the thesis when referring to my research. As some of the previous literature used Technology/Technologies or Information and Communication Technologies (ICT) to mean similar things, I will apply the terms originally used by the authors when referring to the respective literature.

Early Childhood Education: This is generally perceived to be the educational programme and services for children aged eight years old and under (UNESCO, 2007). However, in China, early childhood education refers to caring and educational services for children aged six and under (Dong, 2014). Specifically, nurseries provide services for children from birth to three years old, while kindergartens or preschools are for children aged three to six (National Education Committee, 1996). In the present thesis, the acronym of it - ECE is applied.

Pedagogy: There are different definitions of the term 'pedagogy', however in this study, I adopted the definition of Siraj-Blatchford (2008) who defined pedagogy in early childhood education as a set of instructional methods and techniques designed to enhance learning and to facilitate children's acquisition of knowledge, skills as well as learning dispositions. This is achieved through the interactions between teacher and children (Siraj-Blatchford, 2008).

Digital Pedagogy: In this thesis, the digital pedagogy is understood based on the definition of Fleer (2017) who used the term 'digital pedagogy' to describe the pedagogical approaches employed by teachers to use digital technologies for children's play, learning and development.

TPACK: This is an abbreviation developed by Mishra and Koehler (2006) to refer to Technological Pedagogical Content Knowledge. In particular, it emphasises the interrelations of the three knowledge domains: pedagogy, technology and content. An in-depth discussion of TPACK can be found in Section 2.4.2.

IWB: It is an acronym for the Interactive Whiteboard.

NAEYC: This is an acronym for the Nation Association for the Education of Young Children.

DAP: Developmentally Appropriate Practice was developed and defined by NAEYC (2009, 2020) as the approaches taken by teachers to facilitate children's appropriate development and learning through a play-based and engaged way.

MoE: It is the acronym of the Ministry of Education of China.

1.5 Summary

This chapter has introduced the reader to the study by clarifying the relevant context, research focus, the overview of the whole thesis and finally some definitions of central terms. Next, I present my literature review.

Chapter 2. Literature Review

This study aimed to explore early years teachers' digital technology integration within classrooms in China. Accordingly, this chapter contains a review of literature on digital technology usage in ECE settings both internationally and in China. Moreover, the development of research questions and the literature review were iterative, and they interplayed with each other. The final research questions were as presented in section 1.2, and four aspects of literature particularly relevant to the research questions are reviewed in this chapter. Firstly, the research on digital technology integration in ECE settings is reviewed. The reviewed literature particularly emphasises four themes here: the debate on digital technology integration; teachers' attitudes and views; teachers' practices and pedagogical beliefs, along with barriers to digital technology integration. This section contributes to the identification of gaps. Secondly, the context of ECE pedagogy is introduced by clarifying the range of ECE pedagogies worldwide, the elements of effective pedagogy and the pedagogy reform in China. Thirdly, I focus in depth on studies investigating digital pedagogy, discussing the various approaches to integrating digital technologies into pedagogies. Finally, I explore relevant literature in line with two core frameworks that are used in this study. In the end of the chapter, I summarise key findings and highlight the contributions of the study to the body of literature on digital technology integration in ECE.

The literature was searched online in four steps. Firstly, I defined the scope, search keywords and inclusion criteria. I used multiple databases to access the literature, which included Google Scholar, ERIC (Education Resources Information Centre), Scopus, ProQuest, and CNKI (China National Knowledge Infrastructure). Then sets of keywords were developed based on the research questions: early years education/ early childhood education/ preschool/ kindergarten, technology/ digital technology/ ICT integration, teachers' perspectives/beliefs/ practices. These terms were combined for the initial literature search. Meanwhile, the inclusion criteria I used to narrow the search were as follows: full-text, peer-reviewed sources. Then, I searched for and collected a number of literature in the above databases by combining keywords and inclusion criteria. Secondly, the suitability of each article for inclusion was further examined based on the title, abstract and full-text review. Thirdly, during the process of reviewing the initial group of literature, extra publications were added and reviewed in the light of bibliography of existing literature. Fourthly, after the relevant themes emerged, the new sets of search keywords were developed, such as ‘ECE pedagogy in China’, ‘Play-based pedagogy’, ‘Digital pedagogy in kindergartens’, ‘TPACK’. Then the second and third steps were repeated to search for and review the relevant literature. It was a complex process.

Next, I present the findings from literature review.

2.1 Digital Technology Integration Within Early Childhood Education Settings

2.1.1 The Debate on Integration of Digital Technologies

Many scholars agree that the integration of digital technologies into ECE could be beneficial to young children’s learning and development. It was concluded that children’s academic performance and learning outcomes could be improved by integrating ICT into the teaching and learning process (Fesakis, 2011) and that this could also benefit children with learning disabilities (Toki, 2012). In particular, the academic outcomes concentrated on subjects such as mathematics (Zuo & Jia, 2010; Nikiforidou & Pange, 2010), language and literacy (Neumann, 2018), art (Sakr, 2017); Guan et al., 2007; Guo, 2011) and music (Zhu, 2011; Panagiotakoua & Pange, 2010). For example, a control experiment, conducted by Schacter et al. (2016), showed that the adoption of tablets with discipline-specific apps increased children’s mathematics outcomes in a kindergarten. This was determined by pre-testing and post-testing children’s number sense knowledge using a number sense assessment developed for this study. Also, Fenty & Anderson (2016) introduced digital narratives to three kindergarten classrooms that allowed students to make meaning through images, audio and music. They found that young children could better demonstrate their understanding of content than before, thereby implying that their language and literacy skills had improved. Some researchers indicate that ICT increases children’s academic performance through enhancing children’s engagement in classroom activities (Fenty & Anderson, 2016), thus increasing their learning motivation and promoting independent learning (Moore & Adair, 2015). In addition to learning outcomes, some studies suggest that digital technologies could also support children's social development through enhancing their cooperation and communication with their peers (Infante et al., 2010; Hsin et al., 2014). For example, Lim (2012) observed preschoolers' social behaviour in the computer area of a classroom and argued that, within that area, young children engaged in learning through actively interacting with each other. Moreover, Marsh et al. (2018) connected children's use of apps to their development of play and creativity.

However, many researchers (Clarke et al., 2015; Philip & Garcia, 2013; Jong, 2016; Fu, 2013; Vernadakis et al. 2005) argue that it is the form of pedagogical use of technology, not the technology itself, that matters for young children's development. For example, in quasi-experimental research conducted by Furman et al. (2019), there was no obvious difference in the science learning outcomes of preschool children between the tablet-improved groups and those with traditional materials, although the learning outcomes of children in both groups were enhanced. The authors commented that the well-designed inquiry-based teaching sequence utilised in both groups could provide more benefits for learning outcomes than the potential advantage of tablet integration in this study, indicating that the pedagogy was far more vital than the materials used. In line with this, another study, conducted by Shamir et al. (2008), showed that the children who were instructed to read e-books in pairs made greater progress in reading competences than those who read alone. This is consistent with previous arguments that a peer-assisted learning context could improve the academic performance of school-age children (Crook, 1998; Topping & Ehly, 1998). Therefore, these studies, collectively, appear to suggest that pedagogical approach is broadly more important than the presence or absence of digital technologies for children's learning.

Meanwhile, the appropriateness of digital technologies for young children is still being debated amongst professional institutions (Teichert, 2017). For instance, NAEYC (2012) proposed the possible negative impacts of screen time, low activity levels, passive use of technologies and digital play. Furthermore, some scholars claimed that using digital devices could hinder young children's social and emotional development (e.g. Cordes & Miller, 2000). They argued that young children's social skills are developed through personal interaction and that the use of digital technologies might impede this kind of interaction. However, such a direct cause-and-effect relationship between technology use and adverse results is critiqued by some researchers (e.g. Blum-Ross & Livingstone, 2018). They contend that the negative outcomes are not caused by the technology but are the results of problematic approaches to its use. This could be evidenced by Mertala's (2017) study, in which the early years practitioners tended to encourage children to use digital technology on an individual and independent basis, rather than intentionally allowing them to use it in pairs or in small groups. Thus, children's interactions and collaborations around technologies might not be promoted. Similarly, Sakr and Scollan (2019) argue that the turn-taking use of the IWB in the observed classroom limits the collaborative engagement of children. Moreover, Bell et al. (2015) also support this criticism, illustrating that it is not the digital technology but the displacement of other activities that has an effect on children's development, such as the lack of physical and academic activities associated with technology use.

Therefore, it could be inferred that both the positive and negative effects on children associated with digital technology use are not only the direct results of digital technologies but are also produced by the different approaches to use. As the above examples highlight, the use of digital technology could both hinder and facilitate children's social development. As a result, the focus in academic research has evolved from whether digital technology should be used to how to integrate technologies in an effective way (Yang, 2021). Accordingly, the important role of adults (teachers) in guiding children's digital technology use is underlined. To investigate the technology integration in kindergartens, this study centres the early years teacher as the focal subject, exploring their relevant decisions on digital technology use. In the subsequent parts of this section, the existing research on teachers' perspectives will be reviewed, including studies exploring teachers' attitudes, beliefs, practices and perceived barriers.

2.1.2 Teachers' Attitudes and Views about Digital Technology Integration in Early Childhood Education Settings

According to many scholars, teachers' attitudes and perceptions could affect their classroom practices, such as how to balance the technological and non-technological activities in classrooms (Suzette, 2014), and thus influence children's learning (Nikolopoulou & Gialamas, 2015). By reviewing previous studies, it is found that many teachers hold a positive attitude towards the presence of digital technologies in classrooms in some countries (Dong, 2018; Furman et al., 2019; Mertala, 2017; Nikolopoulou & Gialamas, 2015). For example, a Finnish study showed that 80% of the preschool teachers studied felt positive about technology integration with children (Mertala, 2017). Similarly, Morgan's (2010) research exploring teachers' views on using IWB with children aged three to seven years old reported that all of the participating teachers valued the use of the IWB. It is also indicated that younger teachers with fewer years of teaching experience would be more likely to understand the significance of digital technology use in kindergartens, as they experience the use of digital technologies during their education (Ahmad et al., 2014; Joshi et al., 2010). However, this claim is critiqued by some researchers as their research results show a different conclusion, which will be discussed in detail in section 2.1.4. By reviewing the empirical studies on early years teachers' perceptions of digital technology integration, it is found that teachers' positive perceptions could be categorised by two features: they acknowledge the important role of digital technologies in children's learning and development (Morgan, 2010; Ahmad et al., 2014; Dong, 2018; Suzette, 2014); and they have the disposition to integrate ICT into formal curriculum (Beschorner & Hutchison, 2013; Dong & Newman, 2016; Aubrey & Dahl, 2014).

In terms of the first aspect, teachers in Suzette's (2014), Ramsey's (2018) and Ahmad et al.'s (2014) studies shared the opinion that digital technology could be used to enhance the academic skills young children needed for school readiness, such as reading readiness and numeracy, which were given more weight by teachers. In particular, the ability of IWB to support interactive experiences for children's learning was valued by teachers in Morgan's (2010) research, whilst the mobility and easy-to-touch attribution of tablets were valued by teachers in relation to the 'mobile laboratory' and 'science booklet' (Furman et al., 2019). Furthermore, in addition to the knowledge construction and academic performance improvement, teachers in some studies recognise the affordance of digital technologies to facilitate the development of children's learning dispositions. For example, teachers in Mertala's (2017) study emphasised the exploratory spirit developed through digital technology use by children, whilst the technology was prized for promoting children's problem-solving ability in Ahmad et al.'s (2014) research. In addition, teachers also believed that integrating technologies into classrooms could equip young children with operational skills in 21st-century technologies to prepare them for the future (Macdonald, 2017). On the whole, teachers' perceptions of the affordances of digital technologies are consistent with the researcher's academic conceptualisation of how 'learning' is supported by interactions with technologies. This encompasses four areas: 'acquiring operational skills, extending knowledge and understanding of the world, developing dispositions to learn, and understanding the role of technology in everyday life' (Plowman et al., 2012, p.6).

In terms of kindergarten teachers' dispositions toward digital technology, Beschorner and Hutchison (2013) found that most teachers in their study were willing to expand their understanding and actively integrate technology into their pedagogies, even though they were not previously familiar with or confident about its use. This conclusion is supported by Aubrey and Dahl (2014). In addition to the perceived benefits for young children's learning, some teachers also claim that digital technology could be an effective tool for their class preparation and knowledge transmission (Liu et al., 2014; Mertala, 2017). As an example, teachers in the research of Suzette (2014) mentioned that they could use online images, rather than pictures drawn and coloured by themselves, to teach children with concepts, which could increase their productivity by reducing the time spent preparing and providing visual enhancements for children.

However, some teachers express their practical concerns. For example, teachers interviewed by Suzette (2014) shared their concerns about how the large class size could affect class management when integrating digital devices, along with the limited resources that children can have access to. Another concern is that the novelty of the device could sometimes override the learning activity itself (Furman et al., 2019). For example, teachers mentioned that children were more excited about using the tablets than observing and recording the things they were learning (Furman et al., 2019). Similarly, teachers in Ihmeideh's (2010) study reported their concerns about the passive learning experiences of children through merely watching, listening and following instructions from tablets. Moreover, some teachers showed inadequate confidence in using digital technology as a tool for teaching (Blackwell et al., 2014; Fenty & Anderson, 2014).

Although sparse, researchers in China also conduct relevant empirical research to investigate teachers' attitudes and views towards technology integration in recent years. The main finding of the research is similar to that of western-centric studies; namely, that most teachers hold a positive attitude toward digital technology use. In these studies, however, teachers' perceptions about the potentials of digital technologies are not identical to those of teachers reviewed above. For example, in a recent study of Yang and Gunn (2020), teachers focus more on the role technologies could play in attracting children's interests, thereby increasing their engagement in activities, rather than valuing the interactions between children and digital technologies for children's development. Similarly, teachers interviewed by Dong and Mertala (2019) are more likely to recognise technology as a teaching tool that facilitates their own work, such as making classroom teaching more efficient. At the same time, some teachers in their study express concerns that the use of digital technology could limit children's direct learning experiences.

The above studies indicate that the perceptions of teachers surrounding digital technology use in early childhood education settings are diverse and complex. Furthermore, it is claimed that teachers' attitudes could change as their beliefs about digital technologies changed (Dwyer et al., 1991). Oldridge (2010) interprets this complexity of perceptions to be contextually shaped. In particular, Dong and Mertala (2020) recently situate the participating teachers' perceived affordances of digital technologies within Chinese traditions, which emphasise the pedagogies of lecture and demonstration and valued subject learning. These findings from the literature review inspired me to investigate the sociocultural contexts of digital technology use.

Next, studies investigating early years teachers' practices are reviewed.

2.1.3 Teachers' Practices and Beliefs about Pedagogical Use of Digital Technologies

Despite the positive attitudes held by most preschool teachers, the integration level and utilisation frequency of digital devices in their practices are reported to be relatively low, and most of their practices are considered to be surface-level rather than effective integration (Dong & Newman, 2016; Liu et al., 2014; Kerckaert et al., 2015). For example, the engagement and fun factor of the IWB are highly valued by teachers to promote active learning, but in their practical teaching activities, such features are explored in a limited way (Morgan, 2010). Similarly, as reviewed earlier, both researchers and some in-service teachers acknowledge the great potential of the tablet to facilitate children's subject learning, social development, play or creativity, whilst some teachers either only have children using them in rainy day sessions or restrict children's use (Bird, 2017). This might have been because most practitioners are not informed well about the research trends of digital technology use in early childhood education. They also may not have an in-depth understanding about the pedagogical potential of digital technologies, despite the rich and valid research in support of technology integration into the curriculum (Dong & Newman, 2016). Additionally, researchers provide other possible explanations for the perception-practice gap of teachers, including inadequate equipment, parental concerns and different views of other stakeholders (e.g. principals) (Dong, 2014; Voss, 2008). Aside from the above external factors and teachers' limited understanding, Chen (2008) also identifies the 'teachers' conflicting beliefs' as the third factor for interpreting the mismatch between teachers' reported perceptions and practices, which will be discussed later.

Past research has highlighted two typical kinds of practices of digital technology utilisation by teachers. Firstly, according to Liu et al. (2014) and Liu (2007), digital technologies are usually used by teachers to search for and deliver online teaching resources, such as images, videos and texts for teaching preparation, rather than to organise and plan teaching activities. For example, in Suzette's (2014) study, participating teachers mentioned the replacement of hand-drawn pictures by online visuals. In these practices, it is the teacher, not children, who operates and controls the digital devices, which is believed to possibly limit children's hands-on experiences (Yang, 2021). Secondly, as mentioned in teachers' perceptions, many teachers adopt technologies as a tool to encourage young children to learn without considering children's interests (Drew & Baji, 2004). For example, Mertala (2017) reported that when teachers instructed young children to play digital learning games, these young children were not informed about the purposes of these activities. Instead, they were regarded as passive learners who were enticed into learning. Similarly, in Ludgate's (2019) research, teachers did not listen to children and make informed decisions but instead made rules for children's technology use which could constrain children's engagement. This could indicate that despite the opportunities children have to use digital technologies in kindergartens, they are still passively controlled and supervised by teachers. Accordingly, researchers suggest that teachers should give children opportunities to freely and autonomously explore the devices and engage in digital activities, which could enable children to have creative and productive lives (e.g. Edwards et al., 2017; Yelland, 2018).

The introduction of new technologies into traditional teaching practices shows teachers' problematic pedagogical beliefs about technology integration, such as their emphasis on teacher-centred and teacher-dominated learning (Mertala, 2017). In the first case, the digital technology plays the role of medium for knowledge transition and learning task presentation (Mertala, 2017; Ramírez et al., 2015), which indicates that the teachers 'lacked pedagogical understanding of the desirability of, and process for, integrating technologies into teaching and learning' (Dong & Newman, 2016, p.233). Their practices position children as passive recipients but themselves as agents (Suzette, 2014), which is in conflict with the student-centred pedagogical principle (Mertala, 2017). In the second case, teachers' narrow and surface view that young children's inclination towards technology could be used to motivate and engage them, without considering pedagogical issues or children's interests, limits the way in which they integrate technology into their teaching activities (Dong & Newman, 2016). However, the technology-related pedagogical beliefs of teachers are often in conflict and are not necessarily consistent with their general pedagogical beliefs. The research conducted by Mertala (2017) supports this argument. Within this research, teachers valued children's social-emotional skills, active roles and their interactions with peers in general pedagogical practices but emphasised the learning of academic skills and individual exercises with technology use in an instructive way. The author explained that teachers' technology-related beliefs were not based on general pedagogical beliefs but shaped by their perceptions about the affordances of technology or guidance from others (Mertala, 2017). This highlights the important role of both internal and external factors in influencing teachers' beliefs about the integration of digital technologies.

In partial contradiction to these practices, some studies indicate that certain pedagogical practices with digital technology have changed the roles of teachers and preschoolers. Kjällander and Moinian (2014) showed in their study that, through children actively engaging in digital tablet activities by playing and redesigning, the children's roles transformed from consumers into positive producers. In line with this, Skinner and Hagood (2008) reported that the introduction of digital narratives allowed a young English language learner to become a good meaning-maker by creating a story about his favourite cartoon character, Spiderman. However, because most of these studies involve researcher intervention and the educators are guided to practise technology use, so these practices can be seen to represent the potentials of digital technology use rather than typical technology use in everyday ECE environments.

Meanwhile, the rapid updates to the application of digital technologies in teaching and learning bring about great challenges to Chinese kindergarten teachers, which align with the situation of teachers in western countries. According to Kang (2014), the IWB is the most common digital teaching device in Chinese kindergartens, promoting interactions between teachers and students in the class. However, research indicates that this kind of interactivity is limited and not utilised to the full extent in the actual practices (Kang, 2014). Moreover, the IWB is usually used with the presentation software, PowerPoint, which is adopted by most Chinese preschool teachers (Liu et al., 2016). However, studies suggest that some teachers misuse PowerPoint by not blending diverse media, overuse irrelevant content or interact rarely with students (Liu et al., 2016). In addition to the previously mentioned problematic pedagogical beliefs held by teachers, the lack of competencies and skills in technology adoption may also have been a significant factor affecting effective technology integration amongst Chinese preschool teachers (Du et al., 2019; Wang & Zhu, 2014). Therefore, it is suggested that both the conceptual understanding and the practical skills of ICT integration are significant for kindergarten teachers to use ICT in classrooms effectively and appropriately, indicating the need for changes to teacher training content.

To conclude, the effective integration of digital technologies in kindergartens appears to be at an early stage globally, and there is an inconsistency between teachers' practices and positive attitudes. Scholars provide possible interpretations which involve both internal and external factors, such as teachers' personal understanding of the potentials of technology, guidance from others, parental concerns and so on. Therefore, in the next section, studies discussing influential factors or barriers to digital technology integration are reviewed.

2.1.4 Barriers to Digital Technology Integration in Early Childhood Education Settings

Previous studies have identified many barriers to digital technology use in ECE. For example, according to European Commission (2006), insufficient equipment and underqualified teachers pose some of the most significant challenges to effective technology usage. Also, Bingimlas (2009) summarises several obstacles to implementing digital technologies for teaching and learning, such as teachers' limited skills and negative attitudes towards digital technology, shortage of facilities and internet access along with the poor condition of the physical environment. In addition, technology illiterate parents, lack of guidelines, lack of time and insufficient and poor-quality resources are also identified by other studies as barriers that could impede the implementation of technologies in classrooms (Leung, 2003; Liu & Chen, 2019).

Many studies categorise these barriers into first-order and second-order barriers for teachers, a categorisation proposed by Ertmer (1999). First-order barriers refer to the factors extrinsic to teachers, including inadequate equipment, resources, time and training within teachers' workplaces. Second-order barriers are regarded as internal factors, such as teachers' beliefs and attitudes (Plumb & Kautz, 2015a). For example, the survey of Blackwell et al. (2013) showed that the first-order barriers, such as programme type and student SES, affected teachers' access to digital technologies. In contrast, the second-order barriers, including teachers' beliefs, influenced whether and to what extent they used technologies. However, in these studies, specific issues are not investigated by researchers, such as how and why the barriers could affect teachers' practices with technology integration, as well as the possible changes and relationships amongst these factors. Accordingly, Plumb and Kautz (2015a; 2015b) use a tri-perspective framework to categorise these barriers to use digital technologies in early years settings. The tri-perspective framework was proposed by Slappendel (1996) to classify the literature about institutional innovation, encompassing individualist, structuralist and interactive process perspectives (Plumb & Kautz, 2015a). The interactive process took the interaction between these barriers over time into consideration, which was not involved in the previous categorisation. Thus, in this section, the tri-perspective framework is adapted to present these barriers.

Individualist. The individualist perspective focuses on individual actions and internal traits, regarding people themselves as the source of change, which is similar to the 'second-order' categorisation mentioned previously (Plumb & Kautz, 2015b). Accordingly, the issues discussed in the previous sections surrounding teachers' perceptions, attitudes and pedagogical beliefs about digital technologies could be grouped within the 'individualist' realm. Through reviewing relevant literature, the following identified barriers are categorised into this domain:

Teachers' negative attitudes and beliefs. As previously illustrated, although many teachers valued the positive effects that the technology could bring to young children's learning, teachers in some studies still expressed their concerns about the negative impacts of digital technologies on children (e.g. Ihmeideh, 2010). According to Plumb and Kautz (2015a), teachers' concerns focus on children's social and cognitive developments, encompassing hindered socialisation, fostered individualism and technology addiction. Furthermore, the concerns about children's visual health are also raised by some teachers in Asian countries (Chen et al., 2018; Dong & Newman, 2016). These concerns make educators unsure about whether to use digital technologies in early years settings (Joshi et al., 2010). It has been argued that teachers' beliefs and attitudes towards technology could be influenced by factors such as their previous experience with ICT, years of teaching and training (Nikolopoulou & Gialamas, 2015; Petrogiannis, 2010).

Lack of knowledge and skills. Through discussing teachers' pedagogical practices, it becomes evident that many teachers do not have the adequate conceptual understanding or practical skills for integrating digital technologies into the curriculum. This could be supported by other empirical studies (e.g. Wood et al., 2008; Parette et al., 2013; Ihmeideh, 2010). In particular, they lack the necessary knowledge and skills to use digital technologies appropriately and pedagogically in the subjects they teach, which is conceptualised as the Technological Pedagogical and Centent Knowledge (TPACK) (Koehler et al., 2014). This is believed to be a factor that prevents them from using digital technologies (Wood et al., 2008).

Educator's lack of confidence. Nikolopoulou and Gialamas (2015) and Blackwell et al. (2014) shared the view that teachers' confidence with technology could significantly influence their use of ICT in preschool classrooms. However, teachers in many studies expressed their insecurities about technology integration (Blackwell et al., 2014; Fenty & Anderson, 2014; Furman et al., 2019).

Lack of time. Plumb and Kautz (2015b) also identify the time constraints of teachers as a barrier to technology integration. Several studies report that the normal routines of teachers are busy and overloaded, not only with pedagogical work but also the responsibility of caring for the children (Yang, 2021; Li, 2006). Thus, teachers do not have time to learn about technologies, search for digital resources and prepare for activities that integrate digital technology (Plumb & Kautz, 2015a).

Structuralist. In terms of the structuralist perspective, any barriers identified that are associated with the organisational characteristics and elements of the environment surrounding a kindergarten could be grouped into this domain (Plumb & Kautz, 2015a). Therefore, limiting physical conditions such as ***lack of ICT devices and resources, lack of funding, lack of appropriate educational software, technical problems*** *and* ***classroom and physical environment constraints*** *belong in this category* (Plumb & Kautz, 2015a). In particular, because teachers require physical devices in order to integrate digital technologies into their practices, the issues caused by a lack of access to digital equipment are frequently reported by studies (e.g. Liu & Pange, 2014; Nikolopoulou & Gialamas, 2013). In addition to these factors, external limitations that could influence teachers' knowledge, skills and confidence, such as ***lack of training, support and guidelines****, are* also regarded as barriers to teachers' integration of technologies (Blackwell et al., 2013; Johnston, 2017). Of note, scholars suggest that only focusing on the quantity of 'soft' support is not enough and that the quality or content of the support should also be emphasised. (Fenty & Anderson, 2014). For example, teachers in some studies called for concrete, clear and evidence-based guidelines for integrating technologies in ECE (Liu & Pange, 2014; Ljung-Djärf, 2008). Moreover, the type of kindergarten could also make a difference (Blackwell et al., 2013). Similarly, Plumb and Kautz (2015a) argue that the ***different types of kindergartens, such as profit/not-for-profit, public/private, government-funded/non-government-funded,*** could lead to certain barriers to digital technology integration.

Interactive process. It is suggested that ICT integration is a continuous and dynamic process of change, where individualist and structuralist barriers influence and interact with each other (Plumb & Kautz, 2015a). The relationships between these identified barriers are close and complex. For example, the survey of Blackwell et al. (2014) indicated that support and technology policies could influence teachers' confidence about using technology for teaching and learning, thereby affecting their attitudes. Furthermore, Plumb and Kautz (2015a) provided some examples about the relationships within these barriers. Funding could be associated with digital equipment, training and support. Moreover, a lack of time could lead to a lack of training, which could contribute to teachers' limited knowledge and skills, ultimately resulting in inadequate confidence. Thus, it could be important not only to learn about what the barriers were, but also to understand how they interacted over time to influence the integration process.

Barriers perceived by Chinese educators. Khan et al. (2012) argue that the level of digital technology integration into education in developed countries is higher than that in developing countries. This may have been because the introduction of digital technologies into the educational system started later in developing countries (Pelgrum & Law 2003). With this in mind, it could be assumed that the barriers teachers believed were affecting technology integration might vary from one country to another, not only due to the various contexts but also because of the different stages of technology introduction in education (Liu & Pange, 2014). However, in China, very little attention has been paid to the study of technology introduction and integration in early childhood education, with even less regarding barriers the preschool teachers encountered.

Liu and Pange (2014) surveyed 46 preschool teachers in mainland China to learn about the barriers of technology use to their teaching practices. They found that the main barriers perceived by these teachers fell into the first-order (structuralist) category, including lack of infrastructures and software, as well as insufficient pedagogical models. However, this finding could be limited by the fixed variable selection in its questionnaire, which did not involve some barriers that were identified in other literature, such as teachers' negative beliefs and teachers' confidence. Furthermore, the small sample size for the survey could also have caused limitations for the study. In addition to this, another study conducted by Dong (2018) also identifies some barriers to incorporating technologies into teaching for Chinese preschool teachers. Participating teachers perceived that a lack of time, insufficient relevant knowledge and skills, excessive workload and lack of curriculum guidance and training could be obstacles to their practice. Also, it was indicated that the teachers' traditional pedagogical beliefs emphasising teachers' expert and authoritative roles, as well as valuing order and control, affected their effective technology integration. The limitation of this study is that only four participants from two urban early years settings in Shanghai were interviewed. Therefore, it did not extend to other settings and other regions, where the findings could vary significantly.

Moreover, there are still some issues that required critical consideration. Firstly, certain identified barriers are perceived by researchers or kindergarten teachers but might not have been experienced by teachers in reality (Plumb, 2017). For instance, the relationship between the teacher's age (years of teaching) and technology integration is criticised. Whilst Joshi et al. (2010) believed that younger teachers with less teaching experience could have more positive attitudes towards technology use, the survey of Blackwell et al. (2014) showed that teachers with more teaching experience used technologies more frequently. Meanwhile, Plumb (2017) argued that no evidence supported the teacher's age to be a barrier to technology use in her study. Furthermore, possible barriers such as online safety and privacy related to new technologies were not identified by previous literature (Plumb & Kautz, 2015a). More importantly, the barriers identified in many studies are seen as challenges that prevented teachers from integrating digital technology, specifically in terms of whether or to what extent they did so. As detailed in previous sections, however, using digital technologies in kindergartens is not the central focus; instead, how to integrate them in an effective way is a more essential topic. Thus, exploring the contextual factors behind how teachers perceived technology and its integration within pedagogical practices could provide a more comprehensive picture of technology integration in kindergartens than merely focusing on barriers to integration.

By reviewing the empirical studies that investigated contextual factors through various approaches, it is found that these factors cover the elements discussed in barrier-related research but also span beyond them. For example, the cultural traditions and influences of colleagues are identified as contextual factors for understanding teachers' digital perceptions and practices (Yang, 2021; Dong, 2014), which are rarely given a space in barrier discussions. Additionally, it is found that the contextual elements identified by different studies overlap but are not identical and there may be conflict between the findings. For example, many researchers concluded that training was a facilitator for teachers' technology integration (e.g. Johnston, 2017), but Blackwell et al. (2016) found that the approach to tablet use of teachers with more training was no different from that applied by those with less training. This disparity might be related to the research context, design and characteristics of participants. Most notably, it indicates that teacher's technology integration is not the result of a sole influential factor but is shaped by the collaborative influences of various contexts. Therefore, it is not adequate to simply identify these factors; instead, how these factors work and co-work to influence teachers' digital technology use needs to be explored in more depth. This prompts me to investigate the influential factors behind teachers' perceptions and practices, inspiring the research design for the present study. As a result, I not only identify the factors but also interpret how these factors influence teachers' perspectives, taking into account the influence of individual factor, the interplay between different factors and the comparative advantage of certain factors.

This section provides the debates on digital technology integration in early years settings from the perspectives of both academic researchers and early years practitioners, identifying some important issues surrounding this topic and also gaps in the current studies. These findings contribute to the development of the study's research objectives and research questions regarding teachers' pedagogical use of digital technologies. Next, in order to delve into the 'pedagogical' perspective of teachers' digital technology use, the discussions around ECE pedagogy, in particular the digital pedagogy in ECE, are provided.

2.2 Early Childhood Education Curriculum and Pedagogy

Globally, interest in early childhood education has risen. There has been increased recognition of the vital role that it plays for children's individual development and the improvement of their mental functions, cognition and emotional and social abilities, along with economic growth in society (Farquhar & White,2014; Walsh et al., 2010; Brierley, 1994; Schweinhart & Weikart, 1997). Therefore, concerns about the most appropriate pedagogical approaches in ECE required to ensure the holistic development of young children have arisen among parents, educators, researchers and policymakers (Walsh, 2000).

Pedagogy in ECE is defined as a set of instructional methods and techniques designed to enhance learning and provide opportunities for the acquisition of knowledge, skills, attitudes and learning dispositions. This is generally achieved through the interactive process between the teacher and learner within a particular social and material context (Siraj-Blatchford, 2008). Typically, pedagogy could not be separated from the curriculum. There is not a common definition of curriculum and sometimes the uses of the terms 'pedagogy' and 'curriculum' are vague and indistinguishable (Siraj-Blatchford, 2008). According to Bennett (2005), the general sense of curriculum refers to a series of instructional activities planned and carried out by teachers to inculcate predefined knowledge and skills. This seems inappropriate in the case of early childhood education due to the overemphasis on content and the inapplicable methods for young children. Conversely, in the ECE curriculum document of New Zealand, Te Whäriki (Ministry of Education, 1996, p.10), the curriculum is defined as 'the sum total of the experiences, activities and events, whether direct or indirect, which occur within an environment designed to foster children's learning and development,' which might be appropriate in the early childhood context. However, some of the learning and development that occur is unexpected and not the intentional purpose of the adults' design (Sirgj-Blatchford, 2008).

Given the diverse beliefs underlying pedagogy and curriculum in the early years, there are different models of early childhood education. For example, Walsh (2000) divided the current pedagogic approaches into the categories of play-based pedagogy and formal approaches. The play-based pedagogy places the child at the centre of curriculum and pedagogy by using developmentally appropriate practices, particularly through play, to foster children's development. In contrast, formal approaches place the emphasis on subject content and aim to teach young children basic skills, such as writing, reading and numeracy. In the same vein, Bennett (2005) also simplified the models into two categories: social pedagogy and the school-readiness approach. Similar to play-based pedagogy, the social pedagogical tradition emphasises children's holistic development, and suggests learning together through play and educator scaffolding with broad orientations. The school-readiness approach, however, focuses on the knowledge and skills useful for school readiness, with predefined learning goals and outcomes.

Irrespective of the terminology used, the approaches above are 'ideal types'. In practice, some settings may have remained uncertain about these approaches and used a blend of more than two methods (Siraj-Blatchford, 2008). Therefore, many researchers are still working to identify the best appropriate pedagogical or curricular approach for young children. In the following section, the arguments commenting on the diverse pedagogical approaches in ECE and justifying 'effective' pedagogy will be presented.

2.2.1 Discussions about Different Pedagogical Approaches

The above introduction reveals that the pedagogy in early years education is traditionally categorised into formal approach and play-based approach (Walsh, 2000; Bennett, 2005). However, beyond such dichotomy, some scholars put forward the concept of integrated pedagogy (e.g. Wood, 2007a&b; Walsh et al., 2010; Langford, 2010). In the next, these three types of pedagogy that are commonly discussed in the literature will be reviewed.

Formal approaches. In traditional ECE systems, the direct instruction model, or school-readiness programme, is more favoured by practitioners, as it is mostly teacher-directed and academic-oriented (Bennett, 2010). Under the guidance of this kind of pedagogy, the acquisition of subject knowledge, such as literacy and numeracy, is focused and delivered by teachers in a standardised way to children who are regarded as already formed (Bennett, 2010). In addition, the curriculum content, learning goals and outcomes are prescribed and are not altered according to the interests and needs of each individual child (Bennett, 2010). Some studies conducted in the US found that this academic-oriented approach was beneficial to the disadvantaged by ensuring greater academic achievement and achievement motivation (Bennett, 2010). Thus, this approach is employed in many settings across the world. For example, in Lam Dong in Vietnam, some settings still used the didactic and teacher-directed teaching strategies to focus on the acquisition of memorised knowledge (Thao & Boyd, 2014). However, some scholars in the US tried to ascertain if the benefit of an academic-oriented approach still worked for children from middle-class families, but they failed to extract the generalisability and suggested that increased anxiety and reduced creativity resulted from the approach (Walsh et al., 2010). Furthermore, it is argued that it is inappropriate to base the pedagogy on 'race' or class since this indicated a deficit understanding of 'poor' children's families (Smith, 2015, cited in Bradbury, 2017). Moreover, many researchers agree that the advantage of the direct instruction model may exist initially but would wash out after a short time (Marcon, 2002; Siraj-Blatchford et al., 2002). In the long term, the academic-oriented and school-oriented methods incur less intellectual benefit and lower future achievement for children than play-based and child-directed approaches (Pinkerton, 1990). They could also lead to growing stress and anxiety (Walsh et al., 2010).

Child-centred Pedagogy. Conversely, in western traditions, child-centred and play-based approaches are the most favoured and accepted. There is not a consensus on the common meaning of the term 'child-centred', and Chung and Walsh (2000) identified over 40 interpretations of it when reviewing contemporary literature in early childhood education. However, they did reveal three dimensions of child-centredness: the child is at the centre of his/her world; the child is the centre of schooling; and children should direct their activities. The play-based approach refers to facilitating children's learning through play. This is described by scholars and educators using terms such as voluntary, freely chosen, symbolic, intrinsically motivating, pleasurable and process-oriented (Shipley, 2008). It is stated that play had 'motor, spatial, cognitive, emotional, social and moral values' in children's development (Palaiologou, 2016, p.306). In particular, Vygotskians studied dramatic play and indicated that dramatic play could facilitate the development of higher mental functions, such as self-regulation skills (Bodrova & Leong, 2010). Due to this, it is argued that it should be preserved and nurtured as a central activity for preschool children (Elias & Berk, 2002; Elkonin, 2005). Thus, such a child-centred and play-based pedagogies include the following beliefs: children are viewed as the agent of their own learning who could develop naturally through free and independent exploration; the role of the teacher is as the facilitator, arranger and observer on the side; and the learning begins with the interests and needs of children and occurs through play, relationships and teachers' scaffolding at the appropriate moment (Bennett, 2010; Tang, 2006; Langford, 2010; Bodrova & Leong, 2008).

Many researchers have studied the outcomes of child-centred and play-based pedagogies and concluded that they had a positive impact on both children's social and emotional development, as well as cognitive development (Devries, Reese-Learned & Morgan, 1991; Marcon, 1992; Schweinhart & Weikart,1997). For example, the research conducted in Portugal by Nabuco and Sylva (1995) showed that children in informal settings possessed a higher degree of social acceptance. Similarly, Schweinhart and Weikart (1997) conducted a longitudinal study for over 20 years to investigate the impacts of different early childhood education models on children's outcomes. They found that the child-centred graduates were less likely to suffer emotional problems and were involved in fewer felony arrests than children from teacher-directed programmes. In terms of academic achievement, the Competent Children Project in New Zealand showed that play-based learning had long-term effects on children's mathematics and literacy development, which is supported by Marcon (2002) and Stipek et al. (1998). Similarly, studies also illustrate that dramatic play could facilitate children's acquisition of more advanced literacy skills (Weisberg et al., 2013; Bergen & Mauer, 2000).

Adding to this, a body of studies focusing on the education process and internal elements of ECE settings also agree on the argument that the play-based pedagogy is superior to the formally structured approach (Walsh et al., 2010). For instance, Walsh's (2000) study comparing the quality of learning experiences of children aged between four and five in formal and play-based settings revealed that the more play-based approach provided a higher quality learning experience for young children in terms of quality. This was based on 'motivation, concentration, confidence, independence, physical well-being, multiple skill acquisition, higher-order thinking skills, social interaction and respect' (Walsh et al., 2010, p.13). In summary, deduced from these studies, the child-centred and play-based pedagogies are more beneficial for the development of children than the formal and structured approaches.

However, these forms of pedagogy are challenged in light of contemporary sociocultural views. According to the literature, the concept of child-centredness is contested for the following two reasons. Firstly, child-centred pedagogy is criticised as a decontextualised construct due to its over-generalised assumptions about development (Cannella, 1997). For example, many feminist critics argued that child-centredness could reproduce gender bias (Cannella, 1997; Walkerdine, 1990). Gender bias not only lies in the power relations of the centred male child and facilitating female preschool teacher but is also strengthened by the central position of the child as a 'pioneer, explorer, constructor and developer of independence' (Langford, 2010, p.116), which is a stereotypical masculine figure constraining both boys and girls (Cannella, 1997). In addition to the gender bias, Langford (2010) also pointed to its failure to recognise the influence of context like culture, race and social class, arguing that this pedagogy might not be appropriate for all the children. The second critique focuses on the limited role of teachers as a facilitator and passive observer. The child-centred approach requires teachers to employ a non-intervention approach by leaving children free to explore and being present to respond to children's needs. This leads to a lack of co-working or shared thinking, which is highly valued by sociocultural perspectives (Singer, 1996). In particular, in play-oriented activities, the active teachers could provide a significantly positive impact on children's development of play (Hakkarainen & Bredikyte, 2010). As suggested by previous studies, teachers should be emotionally involved in play, such as taking on a character in the imaginary play activity (Fleer, 2015). In addition to the absence of co-working between teachers and children, it is demonstrated that the focus on the individual child limits the teacher's ability to support peer interactions, which are also valued by sociocultural theories (Singer, 1996).

Consistent with child-centredness, the centrality of play is also contested by some researchers. Wood (2007a) argues that not all play-based experiences would result in increased learning potential, which is supported by Sylva et al. (2004) and Walsh et al. (2010). In addition, Wood (2007b) also indicates that play is not the only way in which children learn. Moreover, empirical studies reveal that, in spite of the ideal conceptualisation, play in practice is problematic (Langford, 2010). Specifically, Bennett et al. (1997) reports the limited forms of play offered by early years settings. Secondly, in the same vein as child-centredness, problematic practices also originate from the underdeveloped role of teachers (Stephen, 2010). The play-based pedagogy is believed to be heavily reliant on teachers' personal dispositions and capabilities (Bloch & Popkewitz, 2000). However, research shows that most early years teachers lack the abilities to foster learning through play (Burman, 1994). The review of Pyle et al. (2017) also points to a series of practical barriers to employing play-based pedagogy reported by in-service teachers, including a lack of professional training, a lack of resources, high student to teacher ratios and pressure from parents.

Furthermore, as the emphasis on the academic achievement of children by governments and parents across the world increase, some scholars criticise the child-centred and play-based approaches for neglecting the importance of subject knowledge. Hedges and Cullen (2005) explained that in such approaches, spontaneous interactions that arose from and responded to children's interests and inquiries formed the majority of children's experience, within which subject knowledge was under-emphasised. Although the subject-based approach is regarded as a contravention to the ways children developed and learnt by some researchers (Hedges & Cullen, 2016), academic outcomes are still desired (Wylie et al, 2004). In addition, many scholars hold the belief that academic knowledge is important for children's development and learning as it is valued by society, which is consistent with the sociocultural views (Hedges & Cullen, 2005). Consequently, the lack of subject knowledge in the curriculum might limit children's inquiry-based cognitive learning. Therefore, this requires early years teachers to possess sufficient subject content knowledge. Furthermore, research shows that the teachers with more subject knowledge are more confident in their teaching (Hedges & Cullen, 2005).

Despite these arguments, the increasing focus on subject content knowledge does not conflict with the child-centred philosophy and play-based approach in early childhood education. This is especially true when the content is relevant to children's interests as the content knowledge could be integrated into play-based learning. Thus, many scholars (e.g. Wood, 2007a & 2007b) suggest balancing the extent of play and subject learning, teacher initiation and individualisation to achieve better social and cognitive outcomes for children.

Integrated Pedagogy. The concept of integrated pedagogy is put forward by some scholars (e.g. Wood, 2007a&b; Walsh et al., 2010; Siraj-Blatchford et al, 2002), which is similar to the definition of democratic pedagogy proposed by Langford (2010). This pedagogy avoids the traditional dichotomies, such as those between a play-based and subject-based curriculum, as well as child-centred and teacher-centred pedagogical approaches, involving all of them in teaching activities (Wood, 2007a; Walsh et al., 2010). Some interpretations suggest that both children and teachers are at the centre of the curriculum and pedagogy, meaning that the question of who initiates the activities might be no longer significant (Langford, 2010). Children could still freely choose from a range of activities, which might include both pure playful activities and more structured work related to their specific interested learning areas. Due to this, they could develop holistically in terms of social, well-being, cognitive and dispositional outcomes (Walsh et al., 2010). In light of the integrated pedagogy, teacher-children interaction is highly emphasised. Scholars highlight that the teacher should progress from the role of the passive observer in play and the instructor in learning to act as a knowledgeable participant in playful activities by closely attending to children's choices, activities, skills, dispositions and competences (Wood, 2007a; Dahlberg et al, 2007). Consistent with sociocultural perspectives, 'sustained shared thinking' and the co-construction of knowledge are valued in integrated pedagogy. This pedagogy has been increasingly accepted and applied by researchers and educators. For example, Bennett (2005) reported that several OECD countries were moving towards a more integrated approach in early childhood education, trying to pursue academic achievement in the areas of literacy and numeracy through play-based activities. As a result, this imposes a higher requirement for teachers' abilities to balance play, through which children show their creativity and benefit from social and emotional development, and the structured work that provide appropriate challenges for children to make progress in their cognitive skills (Walsh et al., 2010).

In particular, the Developmentally Appropriate Practice (DAP) guidelines proposed by NAEYC places more emphasis on the integrated pedagogical approach (Walsh et al., 2010). They suggest that school activities should be matched to children's abilities and interests to serve as foundations for their learning (Willingham, 2008; NAEYC, 2009). In a DAP environment, the child is the driver of activities whilst the teacher is the supporter and guide, promoting the responsibility, self-reliance and self-regulation of the children (Sanders & Farago, 2018). In addition, the teacher is required to set challenging but achievable goals for children (Sanders & Farago, 2018).

Some empirical studies assessed the effects of DAP (e.g. Marcon, 1992; Stipek et al., 1995; Hirsh-Pasek, et al., 1990). According to Van Horn et al. (2005), who critically reviewed empirical studies examining impacts of DAP, the effects could be discussed in terms of two aspects: academic and cognitive outcomes or psychosocial outcomes. The findings of the research on the impacts of DAP on children's academic and cognitive outcomes are mixed. For example, Stipek et al. (1998) found that children in a DAP environment performed better in numeracy and literacy than children in more formal classrooms. Another study by Stipek et al. (1995) found that children in more formal environments demonstrated greater progress in reading than children in DAP environments. With regard to the psychosocial outcomes, most studies reveal positive results. For example, several studies indicated that children in a DAP environment tended to have less academic stress than those in more subject-based classrooms (Hart et al., 1998). Furthermore, it is also reported that DAP curriculum could contribute to children's increased creativity (Hirsh-Pasek et al., 1990). However, these empirical studies focusing on impacts of DAP are criticised by Van Horn et al. (2005), not only due to the inconsistent results across these research, but also because of some methodological shortcomings, such as the small sample size, problematic analytic methods and inadequate outcome measures.

Moreover, DAP has faced ongoing criticism from several perspectives since its initial publication (Sanders & Farago, 2018). Firstly, it is critiqued for its false assumptions that children's cognitive development occurs based on stable stages and that the developmental state consistently influences all children's tasks (Willingham, 2008). Willingham (2008) argue that children's development is a continuous process that does not follow fixed stages. Additionally, the way that children perform cognitive tasks is not stable but varies depending on the individual child, the task and even the day. Specifically, children might perform differently in different tasks and, even when completing the same task on different days, the methods they use could also differ (Willingham, 2008). Thus, it is suggested that although children develop in a certain sequence (but not stages), teachers could not definitively recognise the development position of a specific child and adjust instructions according to the child's inferred abilities (Willingham, 2008).

Furthermore, DAP is critiqued for its failure to address contextual and cultural diversities (Walsh et al., 2010; NAEYC, 2009; Sanders & Farago, 2018). Many researchers argue that DAP is based on westernised notions that emphasise autonomy, individualism, independence and cognitive knowledge but ignored other alternative ways of learning (Lubeck, 1998; Cannella, 1997). In line with this, a study conducted by Brown and Lan (2015) showed that teachers in non-western contexts reported expectations and practices that were in conflict with DAP principles. For example, in China, the Confucian tradition places great value on discipline and collectivism, which is undesirable in DAP practices (Lee & Tseng, 2008). Additionally, Sanders and Farago (2018) demonstrate that the discouragement of academic learning by DAP could conflict with the beliefs of teachers and parents in countries like China and India, as well as those from low SES communities. Furthermore, with regard to the alternative ways of learning, Langford (2010) gave an example of the collaborative nature of knowledge construction that was not taken into account in DAP notions. Overall, the assumption that all children develop in the same way regardless of social and cultural differences is problematic (Lee & Tseng, 2008; Lubeck, 1994).

However, the discussion around these critical perspectives on DAP does not mean that it should be abandoned. In the later revised version, improvements are made by recognising the social and cultural differences among children, although the generalisation still exists to some extent. Thus, ongoing research would be necessary to provide further examination and more improvements would be needed.

2.2.2 Effective Pedagogy

Informed by the discussions surrounding different pedagogical approaches, many studies have tried to identify the characteristics of effective pedagogy in early childhood education through providing empirical evidence, such as the Five Standards for Effective Pedagogy developed by Center for Research on Education, Diversity, and Excellence (CREDE) (Rivera et al., 2002), the project of Researching Effective Pedagogy in the Early Years (REPEY) by Siraj-Blatchford et al. (2002), and the Study of Pedagogical Effectiveness in Early Learning (SPEEL) by Moyles et al. (2002). Moreover, some other researchers drew conclusions about the effective pedagogy upon literature review, like Bennett (2005), Walsh et al. (2010), Farquhar (2003), and Bertram and Pascal (2002). In particular, although the Five Standards for Effective Pedagogy (Rivera et al., 2002) was derived from the studies of effective pedagogy for at-risk students, it was still regarded as a general guideline for pedagogy across grades, subjects and cultural groups, not just focused on early years children. By reviewing these studies and findings, it could be concluded that despite the slight differences among these frameworks regarding features of effective early childhood education provision, there was some consensus between them. The most commonly discussed characteristics of effective pedagogical practices in early childhood education are discussed below.

Productive interactions. The studies point out that in effective early years practices, teachers usually interact closely with children to foster sustained shared thinking (Siraj-Blatchford et al., 2002; Farquhar, 2003). Stephen (2010) generalised these kinds of interactions as proximal guided interactions, including actions such as teachers' demonstrating, enjoying, instructing, providing feedback and supporting. Effective teachers also use a series of pedagogical techniques, such as modelling, questioning, explaining and scaffolding at an appropriate time, to deepen the conversations (Walsh et al., 2010). Throughout the in-depth conversations and shared thinking processes, not only could teachers learn about children's experiences and previous knowledge, but children could also be inspired to think deeply, thereby solving problems, developing concepts, making meanings and so on (Sylva et al., 2007). In addition, effective teachers usually interact sensitively with children, which strengthens the emotional connections between teachers and young children. This extends beyond head-to-head and hands-to-hands interactions to heart-to-heart communications, which could benefit children's social and emotional development, as well as their cognitive development in later schooling (Hamre & Pianta, 2007; Walsh et al., 2010). Furthermore, interactions with diverse peers are also encouraged by effective practitioners, which is believed to facilitate children's cognitive and social outcomes (Farquhar, 2003).

Structure-diversified activities. Many findings support the inclusion of playful activities and more structured instructive activities as a feature of effective pedagogical practices, which is consistent with the principles of the integrated approach. It is stated that the integration of instruction and play allow children to develop an understanding of learning and to progress from a play motivation to a learning motivation without interfering with their freedom of choice (Walsh et al., 2010; Bennett, 2005; Siraj-Blatchford et al, 2002). In addition, drawing on the SPEEL project, Moyles et al. (2002) highlighted the need to balance individual, small group and large group learning opportunities, suggesting that teachers use their knowledge of the children to allocate them to various groups according to particular learning goals.

Goal-diversified activities. In summary, based on these studies, both the social development and cognitive development of children are given equal importance in early childhood education. For example, one of the key statements of the SPEEL framework is that effective teachers teach and model language and communication skills, playful behaviours, thinking skills, collaborative working, positive attitudes and social expectations (Moyles et al., 2002). In the same vein, Farquhar (2003) argued that the emphasis on knowledge, skills, dispositions and feelings could best serve children's development in the long term, further suggesting that effective teachers could confidently use their content knowledge to support children's learning. Particularly, Hedges and Cullen (2012) categorise the outcomes of early years learning into three theoretical constructs: funds of knowledge, dispositions and working theories. This represents a more comprehensive picture of children's learning outcomes.

Careful planning and managing. The research highlights that, in addition to face-to-face interactions with children, effective practitioners are actively and skillfully involved in planning, structuring and informing children's activities and experiences (Farquhar, 2003; Walsh et al., 2010; Rivera et al., 2002; Bertram & Pascal, 2002). Stephen (2010) identified these types of interactions as distal guided interactions, including actions such as providing resources, planning and monitoring, which were seen as vital for supporting children's learning. For example, in the planning and structuring process, effective teachers incorporate a wide range of experiences, materials and equipment to accommodate children's various prior experiences, maturation rates, styles of learning, needs and interests (NAEYC, 1996). During activities, teachers need to observe and record children's experiences, along with documenting their outcomes and progress (Bertram & Pascal, 2002; Moyles et al., 2002).

Connecting with parents and communities. Finally, the partnership with family and larger communities is also viewed as an essential part of effective pedagogical practices (Siraj-Blatchford et al, 2002; Bennett, 2005; Bertram & Pascal, 2002; Walsh et al., 2010). It is found that a positive school/home relationship could benefit children's learning and development, as involving parents in the early childhood education settings could develop their pedagogical capacity and foster their understanding of the purpose and process of early years education (Walsh et al., 2010).

Ultimately, these elements, drawn from multiple discussions on effective pedagogy, could give an indication of the most essential ideas by stakeholders in the early years education sector. Although the findings are not exhaustive, they could still inspire the discussion on teachers' pedagogical strategies when integrating digital technologies. In order to situate the research within China, the curriculum and pedagogy in Chinese ECE should also be reviewed, which may tell a different story from the above western-based findings.

2.2.3 Curriculum and Pedagogy in Chinese Early Childhood Education

As illustrated in the Introduction Chapter, the traditional Chinese culture, rooted in

Confucianism and communist ideology, have historically shaped the ECE curriculum and pedagogy to be subject-based and discipline-oriented. Meanwhile, the influence of international educational philosophies, such as ideas of Dewey, Vygotsky, Bronfenbrenner, Piaget, and Bruner, has more recently shifted the ECE ideology in mainland China (Zhu & Zhang, 2008). In particular, the play-based curriculum, child-centred pedagogy and DAP affected the development of Chinese ECE (Liu & Feng, 2005). Li et al. (2011) summarised the features of western pedagogies to be a child-centred approach, integrated curricula, inquiry-based playful learning, child-initiated and process-oriented activities, small group learning and so forth.

In addition to the western ideas of ECE, various curricular and pedagogical models were also introduced to China and attracted the interests of Chinese scholars and educators (Zhu & Zhang, 2008). These include concepts such as the Montessori approach, Reggio Emilia approach, the Project approach and DAP (Li et al., 2012; Liu & Feng, 2005). According to Yang and Li (2019), these models are the representations of western educational theories and ideas and are guided by their practices. For example, the Reggio Emilia approach places children's 'relationship' with peers, parents, teachers, the community and the environment at the centre (Yang & Li, 2019; Yelland & Wai Man Vivienne, 2018), which reflects the sociocultural perspective of Vygotsky. In addition, the High/Scope curriculum, Montessori approach and DAP support play-based education, whilst they still maintain focus on school readiness by involving literacy and numeracy activities (Yelland & Wai Man Vivienne, 2018). Furthermore, most models are based on a 'child-centred' approach. For instance, in the Montessori programme, children are given the freedom to choose how to learn, and the learning materials were also child-centred (Yang & Li, 2019b). Similarly, in the Project Approach, the 'project' is intended to be initiated by children and driven by their individual interests (Helm & Katz, 2016).

Distinct from Chinese tradition and communist culture, the ideas derived from western culture tend to promote young children's individuality, autonomy and cognitive development through ECE (Zhu & Zhang, 2008). In light of progressive western ideas, models and practices, the central government of mainland China issued several policies to conduct ECE reforms from the 1980s. Some researchers have reviewed the ECE reforms in China (e.g. Liu & Feng, 2005; Zhu & Zhang, 2008) and they identified three essential documents during the process.

The first document is *Regulations on Kindergarten Education Practice (Trial Version)* (MoE, 1989), which is regarded as a revolution of ideas in ECE (Liu & Feng, 2005). It is illustrated that this document successfully promoted the five major progressive ideas: 1) 'respecting children', 2) 'active learning', 3) 'teaching for individual learning needs', 4) 'play-based teaching and learning', and 5) 'teaching and learning through daily life in kindergartens' (Liu & Feng, 2005, p.94). However, it is reported that kindergarten practitioners could not embrace these notions fully as there are conflicts between these scientific ideas about children and deep-rooted cultural traditions (Wang & Mao, 1996). Additionally, this document is criticised as that the practical guidance on how to implement these notions is not provided (Zhu & Zhang). Furthermore, the second policy document the *Guidelines for Kindergarten Education (Trial)* (MoE, 2001) was issued, which supplemented the 1989 document and deepened the ECE reform in China (Yang & Li, 2019). For bridging the idea-reality gap, this document identifies a balance between the two (Li et al., 2012). Furthermore, it also clarifies the ECE curriculum into five learning areas, Health, Language, Society, Science and Art, which are different from the six learning domains defined previously (Literature, Maths, Society, Science, Character and Physical Education) (Li et al., 2011). More importantly, the document advocates for specific requirements and content in each domain, as well as sound principles for teaching and learning as solutions to the gap (Li & Rao, 2005).

Researchers comment on these two documents as significant and influential as they attempt to transform the subject-based curriculum into an experience-based approach (Liu & Feng, 2005). For example, Li and Rao (2005) point out that the early teaching of Chinese reading and writing skills and testing are prohibited in kindergartens. In addition, the role of teachers is expected to change from the instructor of knowledge to the facilitator of children's activities, transforming the teacher-directed teaching towards child-initiated experiences (Li et al., 2011). Secondly, the reform emphasises the importance of play and formalises the ideas related to play in order to 'protect children's rights to play' (Liu & Feng, 2005, p.96).

Another key document is the A Guide to *Learning and Development for Children*

Aged 3–6 Years (MoE, 2012). Retaining the core values of the reform, this guideline proposes four principles for early childhood education: 1) to emphasise on the holistic development of children, 2) to respect children's individual differences, 3) to pay attention to learning processes, and 4) to value children's approaches to learning. Aside from the principles, it also sets age-appropriate objectives under the five learning areas. Notably, the guideline requires the practitioners to promote children's learning dispositions, such as curiosity, initiative, attention-focusing, persistence, imagination and creativity.

However, it is argued that there is still a policy-practice gap in Chinese kindergartens (Li et al., 2011). Researchers interpret that there are contradictions between the predominant understanding of ECE as subject learning and the scientific ideas about children (Li, 2013). Moreover, these western ideas could not be taken for granted as the dominant ECE discourse in China without considering the social and cultural differences (Li, 2007). Thus, according to Yang and Li (2019), despite the culture collision among Chinese traditional culture, communist culture and western culture (see detailed discussion in Section 1.1.2), all three could still be interwoven and interconnected to form a hybrid of ECE cultures (Wang & Spodek, 2000). This would shape the beliefs of parents and practitioners, as well as inspiring ECE transformations in China.

Teachers' beliefs about ECE curriculum and pedagogy. In order to understand the policy-practice gap, it is important to study the beliefs and perspectives of early childhood education practitioners, as their beliefs about curricular and pedagogical approaches, the children and ECE could affect their classroom practices (Cheung et al., 2017). Scholars indicate that the traditional pedagogical beliefs and contemporary ideas about ECE co-exist amongst Chinese kindergarten teachers (Rao et al., 2010). Many studies report that the majority of the Chinese kindergarten teachers that they investigated support the notions derived from western cultures (Li et al, 2011; Hu, 2011; Hu et al., 2017). For instance, in Li et al.'s (2011) research amongst 20 kindergarten teachers in Shenzhen, China, half of the teachers report favouring a child-initiated approach and 45% support a balance of a teacher-directed and child-initiated approach, which is consistent with the argument of Yang and Li (2019b). Furthermore, the pre-service teachers in Hong Kong surveyed by Cheng et al.

(2017) also express their preference for a child-centred approach. Along with child-centredness, teachers generally value children's social development and communication competencies over their academic performances (Cheng, Ling & Leung, 2017). In addition, free play, personalised learning, the diverse orientation of the curriculum, various forms of activities and small-group instruction are perceived as valuable in ECE teaching by many teachers (Yang & Li, 2019a; Fees et al., 2014; Zhu & Zhou, 2005).

However, not all teachers in China believe in the modern western ideology. After careful consideration about the appropriateness of the imported approaches, some teachers argue that the traditional teaching approaches could not be abandoned due to the cultural conditions (Yang & Li, 2019b). Furthermore, some teachers in the study of Rao et al. (2011) still hold teacher-directed beliefs. In the same vein, according to Li et al. (2011), most teachers (70%) that they surveyed believe that teaching some subject knowledge, such as Chinese literacy, is appropriate in kindergartens to benefit children's school readiness. Additionally, many Chinese parents also share similar viewpoints, emphasising the value of children's academic education (Zhu & Zhou, 2005; Hu & Li, 2012).

Consequently, although most of the Chinese teachers show acceptance towards the advanced educational ideology from western countries and have some knowledge of these approaches (Hu, 2011), many researchers argue that there is still a substantial belief-practice gap after investigating ECE practitioners' beliefs and practices (Li et al., 2011; Cheung, 2017; Rao et al., 2010; Zhu & Zhou, 2005).

Challenges to practising western approaches. According to the above discussion, there are policy-practice and belief-practice gaps in the curriculum and pedagogy reforms of Chinese early childhood education (Li et al., 2012; Li et al., 2011). Some researchers indicate that the practical challenges limit the success of practising the reformed ideas and imported approaches, discussing the influencing factors (Li, 2002; Liu & Feng, 2005). For example, through studying teachers' practising a borrowed curriculum in Hong Kong kindergartens, Li et al. (2012) identify six barriers to successfully putting progressive ideas into practice. These include the low teacher-student ratio, unqualified teachers, limited resources, parental expectations for academic learning and achievement, the utilitarian and elite education system, as well as the sociocultural environment. Along with Li (2002), Liu & Feng (2005) and Li et al. (2012) also suggest that the lack of relevant experience and necessary training constrain teachers' ability to change the traditional teaching practices. Tan (2017) support the idea that parents' high demand for their children's academic achievement contribute to this attribution. Furthermore, teachers in Chen et al.'s (2017) research report some other considerations when implementing the borrowed approaches, such as time limitations and curriculum demands.

Pedagogical Practices. The above difficulties indicate that, in China, no high-quality pedagogical approach could be fully borrowed from western cultures (Li, 2007). Accordingly, the Chinese educational authority allows and encourages kindergartens and practitioners to decide the curricular and pedagogical approaches freely, achieving democracy and decentralisation in early childhood education (Li, 2007). Yang and Li (2009a) demonstrate that this could promote teachers' initiation and profession. Meanwhile, Chinese ECE practitioners are endeavouring to innovate the curriculum and pedagogy (Yang & Li, 2009a). Therefore, research found that there are diverse pedagogical practices conducted by Chinese ECE teachers (Zhu & Zhang, 2008). For example, Cheung (2017) identified three approaches that different teachers used in creativity-fostering practices, including the product-focused method, hands-off method and teacher-guided method.

Similar to the teacher employing the product-focused method, which generate passive learning (Cheung, 2017), a certain number of teachers in China are reported to continue using traditional teaching approaches (Li et al., 2012). For example, observations from a study conducted in 14 kindergartens in Beijing found that the teacher-directed group activities occupied most of the children's day at kindergarten, whilst there was little time provided by the teachers for children's free play (Pan et al., 2010). Additionally, there was a lack of emphasis on children's individual needs and interests by the teachers (Pan et al., 2010). In the same vein, Li et al. (2011) reported that the teachers in their study conducted teacher-directed teaching, assigned homework for children, taught Chinese literacy skills and some even tested children.

In addition to these traditional instructional practices, most teachers innovate the curricular and pedagogical approaches by integrating several ECE models, encompassing both imported ones and local ones into their teaching (Yang & Li, 2019a). As Hu et al. (2015) argue Chinese kindergarten teachers are frequently observed delivering teacher-directed whole-class lessons along with more play-based and child-centred practices. For example, Liu (2011) conducted a survey focusing on children's kindergarten activities in 11 provinces of China and found that 46% of kindergarten children's time was spent on whole-class activities and 19% was spent freely exploring their areas of interest. Li et al. (2012) also indicated that despite the learning corners created by teachers for children's free learning, children's choices and interactions with materials were still limited by teachers. This could suggest that although integrated approaches were adopted by teachers, their methods of integration varied, such as the level of emphasis placed on academic learning and the specific models borrowed from foreign countries (Yang & Li, 2019a).

There are many examples of Chinese ECE teachers developing and adopting integrated approaches. Firstly, the Integrated Theme-based Curriculum in Shanghai is a representation of localised progressive ECE curricular approaches (Zhu & Zhang, 2008). Li (2004) also develops the Story Approach to Integrated Learning (SAIL) based on the integrated theme-based curriculum, which aims to achieve a balance of teacher-directedness and child-centredness. Furthermore, according to Yang and Li (2019a), the Anji Play, developed from Anji County in China and focused on the functions of self-determined play and expression for children's learning, is another example of localised ECE approach.

Through case studies, Yang and Li (2019a) identified three characteristics of these localised and integrated early childhood curricular and pedagogical approaches. These are the integration of imported and local models and approaches, play-based learning and the balance between teacher-directedness and child-centredness. Firstly, it is demonstrated that the Chinese ECE curriculum and pedagogy tend to be integrated and balanced with various approaches (Yang & Li, 2019a). For example, in an investigation into a kindergarten in Shenzhen, both Reggio Emilia and the Project Approach are borrowed by the teachers to conduct thematic inquiry activities and the Montessori method is used to supplement them. Also, another participating kindergarten in Shenzhen integrate five models, including the Montessori Method, Reggio Emilia, the Project Approach, the Spectrum Approach and the High/Scope curriculum (Yang & Li, 2019a). It is reported that teachers are apt to learn the strengths of imported models as well as to customise and revise them to fit for Chinese conditions (Yang & Li, 2019a). Secondly, it is noted that Chinese teachers' preference to balance teacher-directed and child-centred activities in their practices resulted from the tension between teacher-directness and child-centredness in their minds (Yang & Li, 2019a). Furthermore, this kind of balance is also related to the balance between freedom and discipline and between play and academic learning (Yang & Li, 2019b). Thirdly, Yang and Li's (2019a) case studies found that Chinese teachers placed importance on play from two different orientations: valuing 'eduplay' more than free play or valuing free play more than 'eduplay'. In particular, Chinese teachers tend to regard play as a method of learning, inspiring children to learn through play and providing them with materials with certain purposes, although they also acknowledge the value of free play for young children (Yang & Li, 2019a). This could be supported by Wu and Rao (2011) who reported that the teachers in their study usually associated children's play with pre-academic learning. Furthermore, the study also stated that the teachers struggled to achieve individualised learning in a collectivist environment, which could be supported by Fees et al. (2014).

Through reviewing the statements and arguments about Chinese ECE pedagogical approaches, the complex picture of what Chinese ECE values and how early years practitioners perceive and implement ECE is clearly presented. It provides a foundation for understanding teachers' perceptions and practices of digital technology use, as well as every pedagogical decision they made.

Furthermore, discussing pedagogy in isolation could not give a full picture as the introduction of digital technologies produced new opportunities and challenges for ECE pedagogy. In the next section, I review the ideas regarding the technology-integrated pedagogy in ECE.

2.3 Existing Knowledge about Digital Pedagogies

In this section, I present ideas like play and learning as well as consumption and creativity that are relevant to digital pedagogies in early years education. However, these ideas are complicated and cannot be simply dichotomous. As far as play and learning are concerned, the boundary between them could be quite vague in early years practices. For example, Pramling Samuelsson and Johansson (2006) argue that play and learning are inseparable and they are associated with children's experience in the world. In the same vein, both consumptive and creative practices of children are believed to have a place in early years education. Also, they are usually connected with each other, and it is difficult to define the boundary between them.

2.3.1 Introduction: Conceptualisation of Digital Pedagogies

Today, young children have been increasingly engaging with digital activities that are believed to provide new potential for their learning and development. Nevertheless, attitudes towards integrating digital technologies with early childhood pedagogy and curricula have continued to differ. On the one hand, according to Edwards (2013), many curriculum documents do not mention technologies at all, such as the DAP guidelines (NAEYC, 2009). Although some other international documents, such as those in England (Department for Education, 2012), New Zealand (Ministry of Education, 1996) and Sweden (Skolverket: Swedish National Agency for Education, 2010), identify digital technologies as resourceful materials for fostering children's communication and creativity development, they still keep the mention of digital technologies separate from the discussions of pedagogies, especially play-based pedagogies. On the other hand, environments with high digital mediation inspire many researchers to discuss the role of digital technologies in early childhood education (e.g. Lemon, 2019; Marsh et al., 2019; Saçkes et al., 2011), which provides insights into children's experiences and teacher perspectives (Fleer, 2017). Based on these discussions, recommended digital technologies for inclusion and approaches to integrating them into the early years curriculum have been emerging.

Some scholars argue for a broader definition of digital technology that extends beyond the narrow use of screen media in the early years context (Arnott, 2017). This is because the limited conceptualisation of digital technology, especially the sole focus on screen-based media, could restrict the possibilities of a wealth of digital resources in supporting children's play and learning (Arnott et al., 2017). For example, Fleer (2017) summarises three types of digital technology, encompassing digital toys (e.g. robotics), tangibles (e.g. computers and tablets) and less tangible forms (e.g. the Internet and apps). In the same vein, Johnston and Highfield (2017) conceptualise technology as 'anything that can create, store or process data' (p. 58). They also propose the inclusion of devices related to outdoor experiences, such as a GPS, compass, microscope or camera/video. Therefore, in this thesis, the broader definition of technology from Johnson and Highfield (2017) is employed to reflect on its pedagogical affordances.

Furthermore, many scholars explore the pedagogical approaches taken by teachers incorporating digital technologies into early years classrooms, such as multiliteracies (Yelland, 2018), infused technological practice (O'Mara & Laidlaw, 2011), digital pop-ups (Fleer, 2018) and so forth. In particular, Fleer (2017) uses the term 'digital pedagogy' to name a series of common characteristics of teachers' different pedagogical practices relating to the use of digital technologies for play, learning and development. These include 'technological intersubjectivity, distributed technologies, technologically framed narratives, prior experiences, infused in the technologies, virtual placeholders and digital pivots' (p. 124). In this chapter, the concept of 'digital pedagogy' is extended to refer to the emerging pedagogical approaches taken by teachers to integrate digital technologies into kindergarten activities.

According to the range of literature discussing teachers' pedagogical approaches, two main ideas emerge to conceptualise *digital pedagogy*. Firstly, researchers agree that digital technologies are complementary to non-digital resources, rather than a substitute for them (Lowrie & Larkin, 2020; Yelland, 2018). Arnott (2016) explains that a digital device is but one tool amongst the range of tools for pedagogically supporting children's play and development, much like blocks, toys and other objects. Thus, it is argued that digital tools could not be over-focused on and relied on in early years pedagogy and curriculum. Instead, they should be integrated as an everyday tool or resource to pedagogically facilitate children's experiences (Rivera et al., 2002; Johnson & Highfield, 2017). Similarly, Yelland (2018) indicates that early learning ecology should focus more on multimodal learning but not on the digital itself. It could be argued that access to both digital and non-digital resources could contribute to children’s development in many ways, such as improving literacy development (Kontovourki & Tafa, 2019), STEM learning (Fleer, 2018; Bird, 2017), and ‘21st-century skills,’ including creativity, possibility thinking, and social ability (Trilling & Fadel, 2009, p.1).

Secondly, according to Rivera et al. (2002), when digital technology is used as a tool for assisting teaching, the pedagogy could change to some extent, but the fundamental principles of pedagogy should remain fixed. This provides a context for many scholars’ agreement that digital practices could not be separated from the general and existing pedagogical practices in kindergartens (Wood et al., 2019; Fleer, 2020). This idea is obvious in emerging research revealing the blurring boundaries between digital and non-digital activities (McPake et al., 2012; McKee & Heydon, 2015). Furthermore, the literature indicate that these digital practices are an amplification of traditional practices, which extends the general play and learning experiences of children and expands the goals of early years settings (Fleer, 2020). As a result, these practices could be viewed as digitally enhanced pedagogical practices.

However, this does not mean that simply adding the digital technologies into the existing programme is sufficient, since, as argued in previous sections, it is not the tool itself but the methods for using the tool that matters. Hence, it would require careful consideration of the pedagogies of incorporating digital resources with learning activities to extend original practices in early years settings (Wood et al., 2019; Yelland, 2018). The rest of this section examines how digital technologies could pedagogically facilitate the original practices and expand children’s play, learning and development.

2.3.2 Digital Technologies and Play

As discussed in the previous section 2.2, play is viewed as a developmentally appropriate activity in early years education across various contexts (Wood et al., 2019). Many scholars point out that play activities not only allow children to reproduce what they experienced, but also encourage them to create their own understandings of the world (Siraj-Blatchford, 2007; Wood, 2009; Vygotsky, 2004). Consequently, although the term ‘play’ is difficult to define due to its complexity

(Magnusson & Pramling, 2018), it is typically associated with leisure, autonomy, imagination and children's previous experience and interests (Aldhaferri et al., 2016). In particular, play is increasingly emphasised as a key element for fostering learning and development regarding knowledge, skills, dispositions and attitudes (Waller, 2010; Wood et al., 2019). For example, Olusoga and Keen (2018) point out the role of play in exercising children's divergent thinking, problem-solving and creativity. In addition to the formally educative functions, however, play is considered to serve a range of other essential ones (Scott, 2021), such as contributing to children's 'freedom to explore, invent, create and discover' (Wood, 2014, p.145), and to the development of emotion and wellbeing (Olusoga & Keen, 2018). Moreover, there is a dominant belief in play pedagogy that everyday concepts children acquire through play could become the foundation for scientific concepts in other curriculum areas (Wood, 2009; Fleer, 2014). The conceptualisation of educational play is developed accordingly through theoretical and empirical discussions within European and American contexts (Wood, 2014). Despite the prevalence of educational play, child-initiated free play that serves no specific educational goals is still valued and encouraged by many educators (Nikolopoulou & Gialamas, 2015). Within such free play, children have opportunities to choose and control activities based on their own goals, which are not necessarily aligned with those of adults. Despite this, what is involved in this type of play could still be educational for the children and promote children's agency, power and self-actualisation (Fleer, 2010). Consequently, researchers advocate to expand the understanding of the play-pedagogy interface and to integrate different play-pedagogy modes (child-initiated play, adult-guided play, the technicist version of educational play) according to local contexts and cultures (Wood, 2014), not to focus on curriculum goals driven by policy discourses. However, it is argued that highlighting the values of play for achieving specific learning outcomes could help preserve play's position in many education systems (Jay & Kanus, 2018, cited in Scott, 2021; Wood, 2014).

Recently, it is suggested that digital technologies are changing the nature of children's play by providing different modes of playing than those in the non-digital world (Marsh & Bishop, 2014). Although there is a prevailing belief that play should refer to first-hand experiences in the real world (Beetham & Sharpe, 2007; Palaiologou, 2016) and debate continues around whether digital devices should be integrated into play-based pedagogy (Lindahl & Folkesson 2012), many researchers theoretically and empirically explore new ways in which digital technologies contribute to children's play and result in learning (Edwards, 2011; Bergen et al., 2010; Plowman et al., 2012; Cowan et al., 2021).

Due to this, recent discussion about digital play may help teachers to understand children's play and play-based learning in the early years (Bird & Edwards, 2015). However, Lowrie and Larkin (2020) argue that the use of the term 'digital play' might put much focus on the 'digital' rather than the 'play,' thereby restricting the possibilities of more holistic play. Similarly, Burke and Marsh (2013) suggest considering the broader context for play which could be interrelated with digital technologies. Also, as discussed in the conceptualisation of digital pedagogy, digital play is not an alternative to traditional forms of play and could not be separated from non-digital activities. As a result, Jayemanne et al. (2016) propose the concept of postdigital play, emphasising the interrelationship between digital and non-digital activities. Similarly, the concept of converged play, outlined by Edwards (2015), could better explain the complexity of children's play with technologies.

Converged play is a form of play that incorporates digital technologies, popular culture and children's traditional play (Nuttall et al., 2015; Edwards, 2015), which is a common experience for children and increasingly recognised in early years education. According to Wood et al. (2019), there are two types of converged play. One is 'from on-screen to off-screen' play, which means that children use digital technologies or popular-culture characteristics in traditional play. For example, in Edwards et al.'s (2020) study, a teacher recounted that a child viewed *Star Wars* on YouTube and then drew and built a Storm Trooper with blocks. The other form of converged play is 'from off-screen to on-screen' play, in which traditional activities are practised through digital technologies, such as using drawing apps on tablets or computers (Wood et al., 2019). Furthermore, Edwards et al. (2020) also identify three characteristics of converged play. Besides 'traditional-digital,' converged play is also labelled as 'multimodal' and 'global-local.' From the pedagogical perspective, 'multimodal' means not only the diverse modes of communication between the teacher and children during play, but also involves 'using digital technologies, media, and popular culture as a material resource and/or a semiotic reference point for learning' (Edwards et al., 2020, p. 648). In addition, 'global-local' refers to children's personalised meaning making from globalised popular culture, such as *Star Wars* in the previous example. Thus, the concept of converged play could imply that early years pedagogy should engage traditional-digital, multi-modal and global-local activities in play-based learning. However, it should be noted that a converged activity does not necessarily include all of the three characteristics (Edwards et al., 2020).

According to Edwards and Bird (2017), Lowrie and Larkin (2020), digital technologies could be integrated into two broad forms of play, ludic (imaginative play) and epistemic (exploratory play), the notions of which were proposed by Hutt et al. (1989). Hutt et al's (1989) categorisation of play as ludic play, epistemic play and games of rules is quite a broad classification of play and there are still many different types within each category (Marsh et al., 2016). For instance, Edwards and Bird (2017) propose the Digital Play Framework, which connects certain behaviours to ludic and epistemic play. For example, it relates exploration, problem solving and skill acquisition to epistemic and attributes symbolic and innovation to ludic. Nevertheless, this Digital Play Framework focuses on children's learning to use technologies through play and is expected to help teachers observe and assess. For this reason, it is not a suitable framework to discuss the support of digital technologies for play. Moreover, Marsh et al. (2016) adapt and revise a more detailed framework of play from Hughes (2002), which identifies 16 play types in a digital context. However, this framework is designed for a project concentrated on children's play with tablets and apps (Marsh et al., 2016), but does not take children's diverse activities with a wide range of digital technologies into consideration. Thus, the overarching notions of imaginative (ludic) play and exploratory (epistemic) play could still be useful for shedding light on the various practices of integrating digital technologies into children's play. In the next section, I will discuss how digital technologies could be used to support the two broad play types.

Imaginative play. Imaginative play is seen as a significant facilitator for the creative process, and thereby children's creativity, through its use of fantasy and symbolism (Arnott et al., 2017). In imaginative play, digital technologies could be used as props, just like other non-digital tools. For example, Arnott et al. (2017) described a case in which several children used an electronic till along with real money and plastic credit cards to pretend to run a bank. In this play session, one child controlled the till as a banker, whilst the others took turns visiting the banker and withdrawing money. Similarly, in Bird's (2017) research, the play space was designed to look like a hospital wherein two children role-played as a doctor and a mother. They pretended to use the phone to make calls and the 'doctor' used the computer to type notes. In particular, the phone and the computer were non-working technologies that simulated technologies. These activities usually take place during children's free play and the teachers assume the role of setting up imaginative play spaces and scaffolding children within scenarios (Bird, 2017).

In addition, digital technologies could also be applied to create a virtual world that is closely associated with the physical world, supporting children's imaginative play. One example was presented by O'Mara and Laidlaw (2011), who illustrated a tea party game between a five-year-old girl and her three-year-old brother. In this virtual imaginative play, the physical teddy bears were invited. At the same time, the movements of objects within the play seamlessly shifted from the iPad app to the physical world, such as the cups of tea that were served in the app extending into the real tea in the plastic tea set. This play blurs the boundaries between virtual and physical, with all of the objects entering into the realm of imagination (O'Mara & Laidlaw, 2011). Although the environment of this case is a home rather than an early years setting, it still has implications for practitioners who might wish to construct a digital context for children. In the same vein, some other digital games engaging children with virtual avatars could also afford opportunities for them to explore in imaginative ways (Edwards, 2013), such as Barbie Girls (Carrington & Hodgetts, 2010) and Club Penguin (Marsh, 2011). According to Carrington and Hodgetts (2011) and Marsh (2011), the play in these situations usually includes constructing, dressing, planning events and sometimes earning virtual money and purchasing for the avatar.

Exploratory play. Aside from imaginative play, exploratory play is also considered as an open-ended play to develop children's independence and autonomy (Johnson & Highfield, 2017). This form of play allows children to explore and play freely in natural environments, such as forests, gardens, beaches, mountains and riversides (Waller, 2010). Despite the false bias regarding technology as an indoor experience

(Palaiologou, 2016), the expanded definition of technology in previous conceptualisation allows for the blending of technology and outdoor exploratory play.

According to Lowrie and Larkin (2020), digital technologies could be utilised as a tool to support and extend children's explorations and investigations, such as the use of the digital camera to photograph objects for later patterning work. A rich example is given by Johnson and Highfield (2017), describing a group of teachers and children between three and four years old exploring roots in the garden. The children had no idea about what the objects (roots) found in the garden were called and the teachers did not intend to tell them. Instead, they encouraged the children to explore by themselves through looking at the samples under the microscope, looking for answers in reference books and the Internet. Within this methodology, the truth about nature was not directly presented to children as an object to learn about. In place of this, the emphasis was centred on children's wonder, hypothesis testing and extending the process in which the technologies (microscope and the Internet) were used as supporting and complementary tools to traditional resources (reference books) (Johnson & Highfield, 2017). Another example of integrating digital technologies into outdoor exploratory play is from the study of Waller (2010). In this case, based on an investigation in a country park, a three-year-old boy was encouraged by the researcher to film his favourite places with the digital camera, and he independently explored the functions of the camera. During the play process, the boy was offered the opportunity to assume a central role in revealing his own interests by freely choosing the filming locations.

In addition to these approaches, digital technologies could also function as a recording and documenting tool. Furthermore, it can be used as an instrument to develop children's narratives whether in imaginative play, exploratory or any other forms of play, which will be discussed in detail in the later section related to children's literacy skills development.

To summarise these cases, the findings suggest that when integrating digital technologies into children's play, teachers can focus on either constructing digital contexts for play or offering multiple play opportunities to children (e.g. through inquiry, dramatic play, storytelling, etc.), whilst involving children as experts and maintaining their autonomy in the play. These practices are linked to child-centred pedagogies, representing the two different meanings of child-centredness. Firstly, children construct their socio-cultural understandings of the world through engaging in technology-mediated imaginative play. Secondly, they explore nature through an inquiry-based process with the assistance of technologies.

2.3.3 Digital Technologies and Learning

The introduction of digital technologies also reconceptualises children's learning. Many scholars and educators realise that digital technologies could shape the ways children learn (Laidlaw & Wong, 2016; Beschorner & Hutchison, 2013; Flewitt et al., 2015). When connecting children's digital experiences with specific curriculum goals, the notions of 'consumption' and 'creation' could be used to distinguish the different experiences, which is proposed by Armstrong et al. (2015). In line with this, children could be both consumers and producers of digital artefacts. Correspondingly, two are introduced to classify teachers' technology use in early years education, namely, instructive approaches and constructive approaches. Initially, the ideas of 'instructive' and 'constructive' are presented to classify the different forms of educational applications (Goodwin, 2012, cited in Tavernier & Hu, 2020). In this categorisation, instructive apps are closed-ended for users to consume and practise predetermined content, whereas constructive apps are open-ended and flexible allowing for the creation of digital content. Thus, in this section, these ideas are borrowed along with ideas of 'consumption' and 'creation' to categorise diverse digital pedagogies and practices in early years settings. However, as noted earlier, both consumptive and creative practices of children had a place in kindergartens, and sometimes the boundary between them was difficult to define.

Instructive approaches. In the first realm, teachers usually employ digital technologies in more instructive ways to help children acquire foundational skills, such as vocabulary knowledge, phonetic skills and number identification (Mowafi & Abumuhfouz, 2021). Within this approach, children's play revolves around closed and 'drill and practice' activities with technologies, based on planned outcomes and predetermined learning content (Tavernier & Hu, 2020). For example, Gillen and Kucirkova (2018) described an episode in which the teacher directed a group of young boys to the sandpit, where she had buried some small metal numbers and letters in advance. The boys holding digital metal detectors became excited when they found these metal magnets with letters and numbers. This activity offered an opportunity for the children to achieve the traditional learning goals of identifying letters and numbers. Also, in Silverman and Hines's (2009) study, teachers used videos to present vocabulary and reinforce the memorisation of vocabulary for children between four and eight years old. According to Burnett (2010), who identifies three forms of technology integration into early literacy pedagogy, the technologies were used as a deliverer of texts in such practices. Additionally, the use of interactive whiteboards, electronic books and some learn-to-read apps are also referenced as the carriers of texts in early literacy learning (Kyriakou & Higgins, 2016; Radesky et al., 2015). Furthermore, the other group of practices would focus more on stimulating interactions around the digital texts encompassing teacher-children, children-children and children-technology interactions, thereby promoting the acquisition of particular literacy skills. For example, Yelland (2018) introduced the apps Alpha Tots and Monkey Lunch Box for teachers to use, which enabled children to engage in visual, audio and linguistic learning experiences and encouraged their conversations with teachers about letters, sounds and words.

The findings concerning the impacts of these practices are mixed. However, it is argued that there is no indication that children engage in these types of activities perform worse than those learning literacy concepts and skills through traditional teaching methods (Burnett, 2010). Moreover, some digital practices, especially those that encourage conversations and interactions, could expand children's literacy experiences and help them make sociocultural connections (Burnett, 2010; Yelland, 2018). Despite the positive possibilities of close-ended digital activities, children might quickly find them boring (O'Mara & Laidlaw, 2011). Furthermore, these activities are also criticised as disregarding children's interests, agency and autonomy, which are significant elements of early years pedagogical practices (Kearney et al., 2012).

Constructive Approaches. Conversely, in the second realm, children are allowed to engage in child-directed activities and create something in more constructive ways (e.g. through open-ended production applications), whilst teachers scaffold them in the activities. For example, the children in Couse and Chen's (2010) research used a drawing app to draw self-portraits, whilst Arnott et al. (2017) gave an example of children using props, puppets and a digital camera to create an unscripted story. It is stated that this kind of experience could provide the authenticity, collaboration, personalisation and socialisation that are valued in current early years pedagogy (Tavernier & Hu, 2020; Rivera et al., 2002). Therefore, one essential affordance of digital technology is its potential to act as a powerful medium for facilitating meaning making and documenting (Green, 2012). Employed in this way, digital technologies constructively assist children to create multimodal texts. Accordingly, a pedagogy of multiliteracies emerges. The concept of multiliteracies is first proposed by the New London Group (2006) as a manifesto to raise the significance of multiple modes of meaning making. Later, the concept is widely accepted and expanded for the new curriculum and pedagogy in early literacy learning (Serafini & Gee, 2017). It is interpreted that digital technologies allow communication and meaning-making to be multimodal, combining printed texts, digital images, audio and gestures, which also associate them with socio-cultural contexts (Edwards et al., 2020; Kontovourki & Tafa, 2019). Furthermore, according to Hesterman (2013), the principles of multiliteracies consistently include these ideas, namely, the expanded definition of literacy, the use of technology to support meaning-making and the involvement of sociocultural knowledge, which makes multiliteracies an effective pedagogy to integrate digital technologies into early literacy learning. Because they employ the pedagogy of multiliteracies, some constructive apps such as MyCreate, SeeSaw, MadPad, Sock Puppets and Play School Art Maker could be introduced by teachers for children to create multimodal representations (photos, videos, drawings, text, voice recordings) (Fleer, 2020; Tavernier & Hu, 2020). Depending on children's interests or investigation topics, the final creation might include but not be limited to e-books, animations and plays (Yelland, 2018; Undheim & Jernes, 2020).

By reviewing the literature studying early years teachers' practices of implementing multiliteracies, the representation of content could be separated into two categories. In the first category, the digital storytelling of a certain topic is selected by teachers or children themselves from popular culture. The second category contains the digital narratives and documentation of children's experiences. Next, the two kinds of implementations will be discussed in detail.

Digital storytelling. Many researchers have described examples of digital storytelling introduced by early years teachers in the classroom (e.g. Fleer, 2017; O'Mara & Laidlaw, 2011; Arnott et al., 2017). By reviewing these examples, it could be summarised that the general process of digital storytelling includes selecting a topic, doing research, writing a script, creating images, making sounds and finally combining them into interesting storytelling (Robin, 2008; Undheim & Jernes, 2020). However, it should be noted that not every digital storytelling activity includes all of these steps and some cases might involve additional steps. For example, O'Mara and Laidlaw (2011) presented a case wherein seven-year-old children chose a book written by their favourite authors, took photos of the illustrations and video-recorded their readings of the text and comments using a smartphone, creating the digital multimodal texts with the 'StoryKit' app.

Furthermore, the literature indicate that fairy tales are frequently selected topics. For example, Fleer (2017) reported that a teacher selected and introduced the fairy tale of 'Goldilocks and the Three Bears' to children for creating an animation in free play time. The children in this case read the story, role-played with props and created an animation of the story with an iPad. Then, during group time, the children and the teacher also worked together to retell this story by creating a musical soundtrack with musical instruments and making a voiceover. It is suggested that through deep engagement with this activity, the children's agency is promoted. Similarly, Fleer (2020) presented another teacher's pedagogical practices when implementing digitally enhanced activities. In this case, they used iPads and the MyCreate app to make an animation of the fairy tale called 'The Three Billy Goats Gruff.' Aside from explaining the general steps, the teacher guided the children to make props by themselves, such as bridges made of scrap wood for role-playing, through which the children developed their conceptual knowledge of engineering (Fleer, 2020). In these two examples, the teachers play a crucial role in children's digital storytelling as they prepare the activities, physically and conceptually scaffold and co-work with children during the process, along with actively guiding the discussions after creation. It is pointed out that a high level of intersubjectivity between children and teachers is evident in their practices (Fleer, 2017). Meanwhile, the intersubjectivity between children and technology is also facilitated as teachers prioritise children's participation and process (Fleer, 2017; Undheim & Jernes, 2020). Through reviewing such practices, it could be surmised that the teachers give the children control over the creation process and only scaffold the children when needed. In addition, by implementing the activities in group time, the collaboration among children is strengthened.

In addition to fairy tales, global popular culture is also a popular topic for digital storytelling. For instance, Hesterman (2011) described that a group of boys aged five to seven in a Reggio Emilia school in Australia used the popular culture franchise *Star Wars* to inspire a movie. They wrote the movie script, created props to look like spaceships, conducted research on light, shadow, special effects and even nonfiction related to planet science and so forth, before finally creating a real movie. As Hesterman (2011) commented, the children in this case transferred their knowledge from the popular culture franchise *Star Wars* to make a movie sequel. This practice highlights the importance of using children's interests as the basis of multimodal meaning making. Furthermore, this process proves to be effective at supporting children's skills in problem-solving and conducting research (Kontovourki & Tafa, 2019; Kupiainen et al., 2019).

Documenting Experiences. The second pedagogical approach in multiliteracies is allowing children to use digital technologies to narrate and document their experiences, such as learning processes, particular events or everyday routines (Lowrie & Larkin, 2020). Accordingly, these kinds of digital narratives are not limited to literacy lessons. In fact, this approach could be implemented around any activities or lessons, such as drawing, maths and science. During the process, children engage with activities such as taking images (still and moving), writing down comments representing their own ideas and observations, which could also be expressed through their oral narratives (Lukie et al., 2015).

To offer an example, Fleer (2017) described how a teacher and her children digitally narrated and documented their experiences of growing beans. Through making such an animation, children were allowed to output their own understandings of bean growth. Another example is from Knauf's (2016) study, in which children used the SeeSaw app to document the maths lesson. They took a photo of what they had drawn or built and then added a written or spoken comment to it. In these practices, the digital technologies (e.g. digital cameras) provide opportunities for children to be capable meaning-makers of their lived experiences (Lemon, 2019), enabling them to create and control their own multimodal texts based on their interests and lives (O'Mara & Laidlaw, 2011). The child-centredness is also reflected in allowing the individual child to decide which information to present and how to present it, even freely selecting tools in some classes (Tavernier & Hu, 2020). Hence, two effects of this pedagogical approach are apparent. Firstly, using digital technologies to narrate children's lived experiences supports their meaning making and authentic application of language, thereby nurturing their understanding of the world (Lemon, 2015; O'Mara & Laidlaw, 2011). Secondly, this approach allows children's voices to be heard, improving their enjoyment, confidence and sense of self (Lemon, 2019; Yelland, 2018; Gillen & Kucirkova, 2018).

Along with children's digital narratives, many researchers also present teachers' practices of using digital technologies to record and document children's learning and play experiences (Johnson & Highfield, 2017). For instance, Yelland (2018) used Book Creator to make e-books documenting children's activities, including 'photographs, videos, text, oral recordings, electronic and paint/crayon illustrations and information (maps) derived from the Internet' (p.854). Similarly, Johnson and Highfield (2017) reported that a teacher video recorded the children's planting experience in the garden, including digging, planting and watering, and used the video along with photographs and children's drawings to create a documentary of this experience. When watching the documentary, the children not only discussed their own actions but also commented on what their peers did during the process. According to Yelland (2018), the documentation of learning is a vital part of early years education as it makes the learning visible and emphasises the process of development instead of the product. In terms of the children, they could revisit their experiences and understand the activities from the perspectives of others, thereby generating further insights and extending their understanding of lived experiences (Johnson & Highfield, 2017; Lemon, 2019). It also contributes to children's self-evaluation (Lemon, 2019). For teachers, this kind of documentation enables them to repeat observations and continually reflect on their practice in order to provide more explicit scaffolding for children (Yelland, 2018). Another important impact of multimodal documentation is its contributions to connecting early years settings with parents and encouraging more detailed discussions about children's development (Knauf, 2016; Rivera et al., 2002; Fleer, 2017). It could be found that some teachers tend to share the children's experiences in the early years settings on online platforms, such as Twitter, Facebook, Seesaw and Kidblog, for parents to view. For example, the teacher in Knauf's (2016) research blogged about children's experiences of making animal sounds that introduced phonics to children. It is argued that these digitally enhanced actions made the home/school connection bidirectional (Knauf, 2016). On the one hand, after learning about children's school activities through the multimodal documentation, parents could respond to or initiate conversations. On the other hand, digital technologies could also offer a way for teachers to understand children's home activities. For instance, the teacher in Gillen and Kucirkova's (2018) study invited children and parents to post their holiday activities on blogs in order to strengthen the connections. Moreover, Knauf (2016) reported that a sick child at home used Twitter to communicate with the class. Meanwhile, Knauf (2016) argues that sharing children's activities through online media needs to be careful and intentional in terms of the selection of the activity, wording and communication channel. However, this does not suggest the need to refrain from presenting children's experiences on online platforms. Moreover, its benefits with regard to enabling a rich communication between school and family, as well as enhancing children's development, is still acknowledged.

2.3.4 Cross-Cutting Discussions in Research about Digital Pedagogies

Creativity. The above pedagogical practices and approaches to technology integration are believed to augment young children's creativity, which is valued by many early years curriculum frameworks as one of the '21st-century skills' (Craft, 2010; Lucas, 2016). However, the concept of creativity is complex and has no universally accepted definition (Prentice, 2000). Lucas (2016) proposes a Five-Dimensional Model of Creativity that is a relatively comprehensive conceptualisation of creativity. Thus, in this section, the model will be used as a framework to discuss the connections between digitally enhanced pedagogical practices and creativity.

In the Five-Dimensional Model (Lucas, 2016, p.282), the five core creative habits were inquisitive (‘questioning, exploring and challenging assumptions’), imaginative (‘playing with possibilities, making connections and using intuition’), persistent (‘sticking with difficulty, daring to be different, tolerating uncertainty’), collaborative (‘product sharing, feedback giving and receiving, cooperating’) and disciplined (‘developing skills, reflecting critically, crafting and improving’).

By reviewing the practices, it is found that they could support children’s different creativity habits to different extents.

Inquisitive children not only raise questions, but also try to explore the answers to questions and be critical about any assumptions. In the previous example of the ‘roots exploration’ (Johnson & Highfield, 2017), the children did not know what the ‘roots’ were, and the teacher encouraged them to use the microscope for exploration. After they discovered that the answer was ‘roots,’ they were also encouraged to discuss the possible species to which the roots belonged. Finally, they used books and internet searches to test their hypotheses. Therefore, throughout the process of ‘questioning-exploring-testing,’ children’s creativity was developed (Johnson & Highfield, 2017).

Imagination is another key element of creativity, which requires children to make connections and propose possibilities. For example, in Kumpulainen et al.’s (2020) project using an AR application, MyAR Julle, children aged seven to nine years old were invited to take a photo of the AR character, Julle, in nature and then create a digital story around Julle and nature. In this experience, children made relations between Julle and nature by positioning Julle in, on or beside different plants, objects or humans. They also developed interesting and varied storylines around themselves, their peers, Julle and nature. In particular, some children also imagined the feelings of Julle, such as happy or uncomfortable, and even the seasonal changes in nature were also involved in their stories. The imagination and fantasy of children were effectively promoted and reflected in the use of the MyAR Julle application. Similarly, when Sakr et al. (2016) introduced digital art making into a kindergarten class, the children were observed to use collective motifs and metaphors to gain understanding, which was an imaginative and innovative approach to digital resources.

Furthermore, persistent habits are related to children's problem solving. For example, in the *Star Wars* project (Hesterman, 2011), in order to make a movie, the children engaged with a range of activities, some of which might have been difficult for them, such as experimenting with light and shadow and studying nonfiction texts. However, they remained open to any uncertainty and continually crafted during the process, such as introducing new special effects and redesigning scripts. In this case, the children did not give up when encountering difficulties. Instead, they solved them with confidence, demonstrating their persistence.

The dispositions of collaboration and communication have been mentioned in several practices, especially those related to playful experiences. For instance, in Sakr's (2019) study, when children drew on the iPad together, they showed more shared responsiveness and openness to new ideas than when drawing on paper. This revealed the affordance of tablets to support collaborative creativity (Sakr, 2019). In addition to this, making use of the Makerspaces, wherein peer-supported crafting activities were dominant, was also a typical practice facilitating collaboration (González-González & Arias, 2018).

Finally, it is pointed out that the knowledge and craft involved in developing expertise could be also a significant component of creativity, although they are under-emphasised in literature (Lucas, 2016). For example, the Experience, Represent, Apply framework (ERA) developed by Lowrie and Larkin (2020) not only allows children to acquire conceptual knowledge, but the feedback from apps or practitioners could also make children correct errors and improve expertise through practice. Within this framework, children are given opportunities to first experience a concept physically, then to playfully interact with an app that presents this concept, before finally applying the idea in real life (Lowrie & Larkin, 2020). This provides opportunities for early years educators to constructively integrate digital technologies into Science, Technology, Engineering and Mathematics (STEM) activities (Lowrie & Larkin, 2020).

However, there are some critical reflections on the relationship between digital technologies and creativity development. Firstly, it is argued that many activities should have been valuable in supporting children's creativity even without technology integration, like outdoor play and imaginative play (Robson & Rowe, 2012), and therefore the digital technologies might have simply maintained or extended such value. Furthermore, according to Arnott et al. (2017), even with technology integration, some activities, such as playing with construction resources like LEGO bricks, might not promote imagination and critical thinking because children are creating 'with the exact number and make-up of resources required to create' (p. 52). In the same vein, there is an argument that teachers 'also shape children's creativity, often more so than the affordance of the resource' (Arnott et al., 2017, p.55). Thus, it could be indicated that the essential factor of creativity development is not the technology itself, but the nature of activities (e.g. playfulness) and teachers' pedagogical strategies.

Play, learning and digital technology. Through the literature review, it could be inferred that play, learning and technology interrelate with one another. Firstly, there is a common sentiment that play is valued as a method for children's learning (Wood, 2013; Waller, 2010), and as noted in the beginning of this section, in ECE practices, the boundary between play and learning is vague. Moreover, many studies illustrate that the increasing use of new technologies strengthens this kind of relationship between play and learning (Wood, 2007). It is explained that the use of digital technologies could be seen as a part of play (Yelland, 2017), which could expand children's playful experiences by creating new forms of play, most notably converged play (Wood, 2007). Furthermore, according to Wood et al. (2019), from the perspective of process, the converged play could help children develop positive dispositions for learning, such as agency and creativity. From the perspective of content, the converged play could be related to the subject knowledge valued by national curriculum frameworks for early years learners. In terms of children's literacy development, play has been universally accepted as a basic context in which children's meaning making could happen (Edwards, 2016; Goncu & Gaskins, 2011). For example, as Arnott et al. (2017) point out, storytelling is a creative and playful experience for children. Accordingly, the narratives children developed through play could be distributed and embodied by the use of digital technologies, namely digital narratives (Marsh, 2005; Waller, 2010). Thus, it is suggested that the converged play and digital narratives are linked by the use of digital technologies (Wolfe & Flewitt, 2010).

To provide an example, Waller (2010) described an episode extracted from his outdoor exploration project in which a four-year-old boy picked up a plastic pipe and then kicked it as a football. The scene was filmed by one of his peers. After returning to the classroom, the pipe and the images were shared with the group of children. Based on this exchange, the children developed a digital narrative about ‘Bob the builder’ and constructed a builder’s yard in the imaginative play area. In this case, the technology enhanced children’s outdoor exploratory play and facilitated the narratives developed from the playful experience. Furthermore, children’s interests were revealed in their digital play and manifested through digital narratives (Waller, 2010).

Therefore, it could be concluded that using digital technologies to support children’s play and learning is a complex and fluid process that requires teachers’ critical curriculum planning and pedagogical approaches (Wood et al., 2019).

Suggested pedagogical strategies. As summarised in the section 2.2.4, ‘good’ pedagogy in ECE should achieve productive interactions, a play-learning balance and a social-cognitive development balance, with teachers’ carefully planning and maintaining positive relationships with families. Therefore, an effective digital pedagogy should also attain these outcomes. Researchers suggest conducting a detailed examination of the ways in which the successful use of digital technologies in early years classrooms could be accomplished (MaManis & Gunnewig, 2012; Yelland, 2018). In line with this, many studies have drawn some conclusions related to teachers’ pedagogical practices after analysing cases (Fleer, 2017; Undheim & Jernes, 2020). In the subsequent section, these will be discussed according to the distal and proximal guided interactions introduced by Plowman and Stephen (2007).

According to Plowman and Stephen (2007), distal guided interactions refer to the actions involved in teachers’ pedagogical framing and preparation, such as planning and providing resources. Thus, the distal pedagogical strategies that could benefit the successful integration of digital technologies are listed below.

Determining the clear goals. Lemon (2019) suggests that when planning for digital activities in early years settings, teachers should determine the explicit goals and learning objectives. This view could be supported by Entz and Galarza (2000), who argue for lesson planning goals. One is related to the long-term goals for developing children's general knowledge, whilst the other is concerning the immediate goals for activities, which could allow teachers to assist children's acquisition of skills.

Interlinking activities. Several scholars argue that the range of activities embedding digital technologies over time should be interrelated, as it is found that the activities with a direct link to previous class activities witness children's high motivation and high-quality work (Tavernier & Hu, 2020; Fleer, 2017). In particular, Wood et al. (2018) suggest that indoor and outdoor activities should be both supported and kept balanced to promote converged play.

Combining virtual and reality. This strategy has two aspects. Firstly, it is suggested that digital devices should be combined with concrete materials to support children's imaginative play and digital storytelling (Fleer, 2020). Secondly, teachers are advised to critically select the appropriate devices and applications, such as open-ended ones for constructing an imaginary situation and augmenting the reality, so that children could capture everyday life and create meanings (Fleer, 2017).

Centring children's interests. Teachers are advised to provide children opportunities to follow their own interests, to select the tools they like and to freely explore what they are most interested in (O'Mara & Laidlaw, 2011; Kontovourki & Tafa, 2019).

Supporting children's creation. It is mentioned frequently that teachers should create conditions by integrating digital technologies to allow for the collective creation of a narrative by children, instead of directly presenting all elements (Fleer, 2017).

Connecting with funds of knowledge. There is an agreement amongst almost all of the researchers that children's prior experiences and knowledge, especially those related to digital technologies at home, should be incorporated into digital activities in the classrooms (Vidal-Hall et al., 2020; Wood et al., 2019). As suggested by Marsh (2016, p.192), 'practitioners should not make any assumptions about children's prior digital literacy competencies without close observation and assessment, as that may lead to an exacerbation of difference and a widening of digital divides.' Therefore, personalising pedagogical plans to some extent for each child would be preferable (Gillen & Kucirkova, 2018).

In addition, the proximal guided interactions include all the direct interactions between teachers, children and digital technology, such as explaining, prompting, modelling, instructing and giving feedback (Plowman & Stephen, 2007). Furthermore, it is indicated that the proximal interactions might vary across different activities, or even within one activity, the interactions could depend on many issues, such as group/personal level (Tavernier & Hu, 2020). In the next, several important proximal guided interactions will be illustrated.

Co-working with children. Previous discussions on 'Pedagogy in ECE' reveal that the intersubjectivity between teachers and children is an essential factor in early years education. Similarly, in digital activities, the intersubjectivity between teachers, children and technologies is also necessary to achieve the effectiveness of digital activities. This requires teachers to work together with children and scaffold them as needed (Fleer, 2017). For example, when children encounter technical problems, teachers could help them to solve the problems (Fleer, 2017). Meanwhile, Yelland (2018) suggest that teachers should be physically and emotionally involved in the activities by respecting, listening to, observing and asking children. Moreover, it is pointed out that teachers might learn something from the children during the process (Vidal-Hall et al., 2020).

Furthermore, Undheim and Jernes (2020, pp.262-266) propose three significant pedagogical strategies that are particularly for digital storytelling activities, which are '***inviting to dialogue, explaining the practical and instructing for results***'. Firstly, inviting to dialogue during an activity means that teachers could describe the situation, ask children about what is happening or point out particular elements to encourage children to solve problems themselves. These types of actions could express teachers' interest and respect for children's ideas (Undheim & Jernes, 2020). Secondly, teachers could also explain the functions of digital devices and different steps of activities, allowing children to experience and implement for themselves in later phases (Undheim & Jernes, 2020). Finally, teachers' use of instruction might also be necessary in some digital activities, which could be supported by Bae (2012) and Klerfelt (2007). They argue that appropriate instruction could help teachers maintain the directions to finalise the product (Undheim & Jernes, 2020; Bae, 2012). Undheim and Jernes (2020) offer an example that teachers could say, 'I want you to...' to guide children's actions.

By reviewing all of the arguments relevant to pedagogies for integrating technologies, an 'ideal' picture of technology use in early years settings is presented. However, this picture might not be identical to what actually happens in kindergartens. Therefore, more importantly, there is a need to move beyond the discussion about good or bad practices to understanding how children engage with digital technologies in kindergartens. Despite this, the current arguments could still provide insights into understanding children's engagement with digital technologies and teachers' supporting strategies.

Next, the frameworks derived from the whole literature review will be clarified and how they guided the full study will be outlined.

2.4 Core Theoretical and Conceptual Frameworks

According to Merriam (2009), a theoretical or conceptual framework in qualitative study is perceived as the stance of the researcher, which informs the development of research questions, the methodological choices and the interpretation of results. Two frameworks guide this study. Firstly, the sociocultural theories guide the identification of the research query and the determination of the research focus (China). They also assist with the interpretation of the specific research findings (teachers' pedagogy). Secondly, the TPACK and its context framework specifically direct the design of the research instruments, as well as the development and interpretation of the third research question. These are explained in detail below.

2.4.1 Socio-Cultural Theories

Sociocultural theories are a set of theories developed and expanded by Vygotsky and post-Vygotskian scholars. From the stance of sociocultural theories, individual development is contextually situated and socially shaped (Vygotsky, 1978).

Accordingly, it focuses on the changes as well as the social contexts of those changes. As illustrated in section 2.1, the integration of digital technologies transforms the pedagogical practices in ECE, but the transformations could differ across countries. The existing research on teachers' technology integration into early years classrooms is located in western cultures and philosophical positions (Suzette, 2014). However, as demonstrated previously, Chinese traditional values and cultural beliefs are distinguished from European American ones. As a result, exploring Chinese ECE teachers' beliefs and practices with digital technology integration and situating these beliefs and practices within the context of China are what this study intends to achieve. Sociocultural theories are believed to be a powerful lens for examining the integration of digital technologies by Chinese teachers (Dong & Newman, 2018). This justifies the significance of conducting China-based research from a theoretical perspective, despite the existence of numerous similar studies. It also shapes one of the research objectives, namely, to study the contextual factors behind teachers' beliefs and pedagogical practices. At the same time, this sociocultural stance steers the researcher away from judgement and rationalised participants' perspectives in the light of the 'universal standards for technology integration' (Suzette, 2014, p.47).

Furthermore, not only do sociocultural theories generally contribute to interpreting teachers' development, but they could also be used as a specific pedagogical philosophy to guide teachers' pedagogical strategies in ECE. Underpinning the pedagogy in early childhood education, several theories have been developed by psychologists. Amongst these theories, the work of Vygotsky remains influential internationally in modern society (Marsh et al., 2019). Vygotsky's primary focus is on the development of children's higher-order mental functions. In particular, Vygotsky views play (particularly make-believe play) as a major source of development, as it prepares the foundation for two higher mental functions, symbolic thinking and imagination, and also promotes intentional and self-regulated behaviour (Vygotsky, 1978). This highlights the significance of authentic environments for children's learning and development, directing educators' attention to social and cultural contexts.

Additionally, sociocultural stances view children as capable and competent learners, but the emphasis is more on contexts and communities than children as individuals, as sociocultural theorists believe that learning is contextually situated and mediated (Vygotsky, 1978; Rogoff, 1990). In other words, ‘learning varies with children’s social and cultural experiences and the ways in which adults, other children, tools and resources support and shape learning’ (Stephen, 2010, p.21). Vygotsky (1978) argues that children first learn everyday concepts through informal daily experiences in their early years and subsequently develop conceptual knowledge in later schooling. Therefore, viewed from sociocultural perspectives, intersubjectivity is central to children’s learning and development in early childhood education. It is stated that dialogue and interaction are the key ingredients in the learning process (Stephen, 2010; Rivera et al., 2002; Farquhar & White, 2014).

In particular, children’s interactions with adults and peers are emphasised in Vygotskian theories. Accordingly, the concept of the Zone of Proximal Development (ZPD) is forwarded by Vygotsky, which describes ‘the distance between the actual developmental level as determined by individual problem-solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers’ (Vygotsky, 1978, p.86). The ZPD highlights that the assistance from knowledgeable peers and adults could support children to perform at a higher level (Rivera et al., 2002). Meanwhile, many other researchers provide further interpretations of ZPD. For example, Chaiklin (2003) views ZPD as a zone in which children’s daily experiences interact with the conceptual knowledge offered by adults. In addition, Lidz and Gindis (2003) describe the ZPD as a dynamic zone in mediation and interactions. In line with this, the concept of ZPD presents some implications for pedagogic practices in early years settings, such as calling for responsible and responsive teachers, tasks that are challenging but attainable with support and collaborative activities (Hedges & Cullen, 2012; Bowman et al. 2000). Furthermore, the concepts of co-construction and sustained shared thinking are emphasised by sociocultural perspectives, requiring practitioners not only to be involved in activities but also to jointly learn and think with children, critically evaluate and inspire in-depth conversations (Hedges & Cooper, 2018).

Post-Vygotskians further extend Vygotsky’s theories, for example the Cultural-Historical Activity Theory (CHAT) developed by Roth and Lee (2007).

Based on Vygotsky's fundamental ideas stressing the shared problem-solving activities of children and adults, more recent CHAT work has focused on the larger social context: communities (Rivera et al., 2002). It is illustrated that the features and values shared by communities shape the interactions between children and adults (Rivera et al., 2002). Derived from this principle, it is suggested that the issues surrounding community-level contexts, such as the overall classroom structure of activities, the classroom-community values and the connection between the classroom community and the larger community should be emphasised in pedagogy design (Tharp et al., 2000). Another scholar who contributes to the sociocultural perspective, Rogoff, puts forward the concept of guided participation (Rogoff, 1990). The guided participation approach, prioritising participation over mere presence, enables young children to collaborate with others for making new meaning, thereby helping them to assume progressively skilled roles and increasing responsibility (Dunphy, 2012). Rogoff (2003) also identifies and interprets the two forms of guided participation which are central to learning. These are the mutual bridging of meaning, referring to the understanding that develops between people in interactions, and the mutual structuring of opportunities, in which children and adults co-determine the activities. Within the concept of guided participation, the 'process' of children's participation is emphasised during analysis, but the 'outcome' is neglected (Rogoff, 2003). However, Hedges and Cullen (2012) argue that both process and outcome are significant because in addition to the knowledge acquisition, the conceptual understandings and dispositions would also be encompassed in the outcome of participation.

Sociocultural concepts such as intersubjectivity, scaffolding, co-construction, sustained shared thinking and guided participation not only influenced the 'good' pedagogy of ECE reviewed in 2.2.4, but also shed light on the essence of effective digital pedagogical strategies discussed in 2.3.4. Thus, sociocultural theories could be employed as a theoretical framework to interpret the specific research findings relevant to participating teachers' pedagogical approaches with technology integration.

2.4.2 Teachers' Knowledge Frameworks: Technological Pedagogical and Content Knowledge (TPACK) and Its Context Framework

Based on previous reviews, it could be presumed that preschool teachers' pedagogical beliefs about technology integration and self-efficacy could greatly affect their pedagogical practices (Orlando, 2014) and thereby students' achievements (Aldhafeeri et al., 2016). Accordingly, some scholars (e.g. Valtonen et al., 2011) suggest paying more attention to teachers' technological pedagogical beliefs and knowledge to support better understanding of how their practices are shaped. At the same time, Koehler and Mishra (2009) argue that because of the variable and dynamic nature of new technologies, as well as complicated features, affordances and limitations of various digital technologies, it is difficult for teachers to effectively integrate more technology into their teaching activities (Koehler & Mishra, 2009). Due to this, they develop a theoretical framework for evaluating teachers' knowledge about technology integration, TPACK, informing the discussion about the knowledge and pedagogy that teachers need to achieve a seamless utilisation of technology (Koehler & Mishra, 2009).

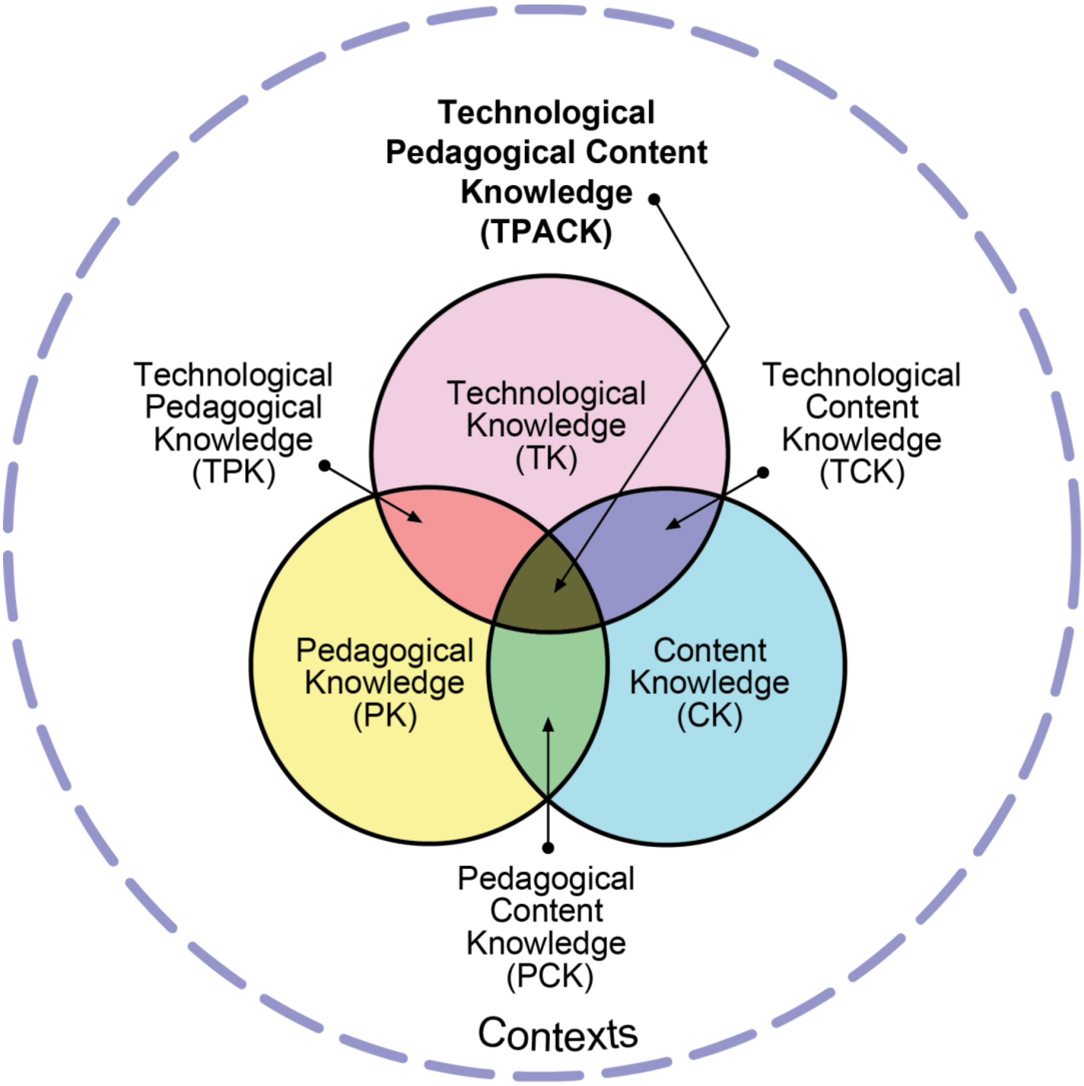
This framework consists of three core knowledge components: content, pedagogy and technology (Koehler et al., 2009). According to Koehler and Mishra (2009), technology knowledge (TK) represents teachers' knowledge about digital technologies encompassing specific tools, software and hardware, which enables teachers to identify, understand and apply them appropriately and developmentally. Pedagogical knowledge (PK) is teachers' comprehensive knowledge about the processes and methods of teaching and learning, including classroom management, lesson planning, assessment and the nature of the students. Content knowledge (CK) refers to teachers' knowledge about the subject matter that is taught and learnt.

Furthermore, Koehler et al. (2013) suggest that the interactions between technology, pedagogy and content knowledge are also important for effective technology integration, which requires teachers to flexibly navigate not only each of the domains but also the dynamic equilibrium amongst them. These dynamic connections are represented as technological content knowledge (TCK), pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPACK), which can be found in Figure 1. TCK denotes teachers' understanding of how technology and content ideas afford and constrain each other. This calls for teachers to identify which particular technological tools would be best suited for certain subject matters and to understand how the adoption of specific technologies could change the subject-matter learning. In addition, teachers also need to apply particular teaching strategies and techniques according to the subject content, which is PCK. This includes but is not limited to teachers' awareness of alternative ways of representing, students' prior knowledge, multiple instructional materials, connections between different content-based ideas and links amongst curriculum, pedagogy and assessment. TPK is categorised as an understanding of how teaching and learning could be changed by particular technologies' affordances and constraints. Finally, TPACK emerges from the complex interactions between technology, pedagogy and content, but goes beyond the scope of the three components individually by encapsulating the intersection of TCK, PCK, TPK. It is regarded as the basis for effective teaching by Koehler et al. (2009), who states:

> *TPACK is the basis of effective teaching with technology, requiring 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 to develop new epistemologies or strengthen old ones.* (Koehler et al., 2009, p.66)

Some considerations regarding the TPACK framework are pointed out by Angeli and Valanides (2009), who argue for further checks into whether progress in PCK, TCK and TPK constitute growth in TPACK. They also state that it is necessary to supply more practical examples of the integrative construct of TPACK. Despite this, the current TPACK framework could still be suitable for providing implications for teachers, teacher educators and researchers. It is traditionally employed to develop teachers' practices, but current researchers adopt it as a lens for measuring teachers' digital literacies, understanding their perceptions of technology integration or rationalising their practices (Starkey, 2020; Cavanagh & Koehler, 2013; Park, 2015). For example, Luo et al. (2021) used the TPACK framework to analyse teachers' digital competencies reported in reviewed literature. Also, Yang (2021) and Blackwell et al. (2016) employed it to explore teachers' decision-making processes around technology integration. In the same vein, although this study does not intend to formally and quantitatively measure early years teachers' digital competencies, the TPACK could facilitate addressing the research questions regarding teachers' beliefs and practices of technology integration. Firstly, it could assist with constructing research instruments encompassing interview outlines and observation protocols. For example, in interviews, participants are asked about their views on the affordances of technologies, which is exploring their TK. Additionally, during observations, the development of children's abilities as they engage with technologies is recorded, which falls into the TCK domain. Secondly, the TPACK model contributes to interpreting research findings. The range of knowledge domains and their intersections within the framework are used to theorise on teachers' understandings of digital technology and digital technology integration, their perceptions on the approaches to integrating technology as well as the rationale behind specific uses of digital technology. For example, my knowledge of the TPK domain within the TPACK framework allows me to identify the teacher's choice to arrange the children in pairs when using digital technology and to explain the arrangement. This provides insight into the teacher's knowledge of children's prior experiences with digital technology use and the teacher's pedagogical skills of integrating technologies in a constructive way.

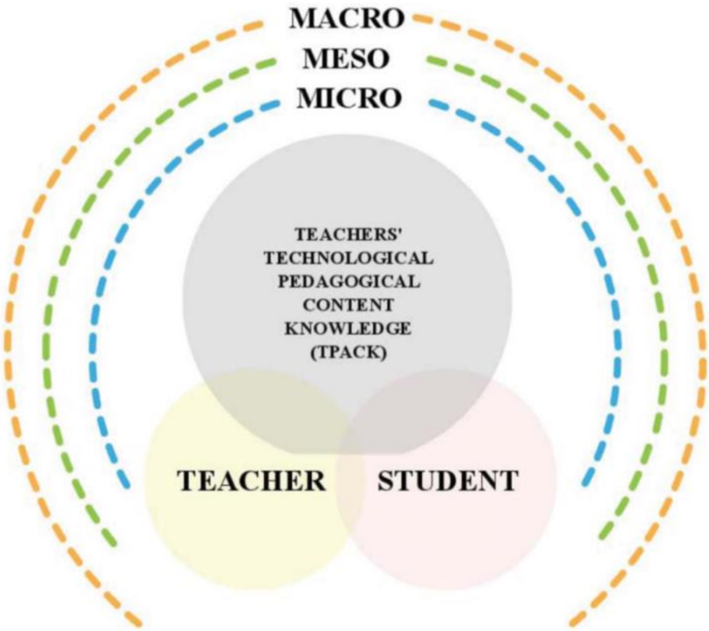
Figure 1. Technological Pedagogical and Content Knowledge (TPACK) Model (reproduced by permission of the publisher, © 2012 by tpack.org).



Furthermore, Rosenberg and Koehler (2015) highlight that the context in which knowledge acquisition takes place is very important to TPACK. They also indicate that as the essential part of educational research (Berliner, 2002 & 2006; Greeno et al., 1996) and the core of the TPACK framework (Mishra & Koehler, 2006; Angeli & Valanides, 2009; Kelly, 2007), the social and contextual factors could complicate the relationship between technology and education (Rosenberg & Koehler, 2015). They give the example that the TPACK would be very different between a teacher from an urban kindergarten and a teacher from a rural kindergarten. This could be supported by Angeli and Valanides (2009, 2013) who consider learners and context to be part of teachers' TPACK. In the same vein, Kelly (2007) argues that teachers should adapt to the unique context specific to each TPACK in order to effectively integrate digital technologies.

However, the meaning of context varies and constantly changes over time (Rosenberg & Koehler, 2015). Initially, Mishra and Koehler (2006) identify the following contextual elements: subject, grade, student and infrastructures. Following this, Kelly (2008) identifies additional factors, such as the learning environment and institutional characteristics. Moreover, the TPACK-in-Action framework proposed by Koh et al. (2014) systematically categorises the contextual factors of TPACK into Physical/Technological, Cultural/Institutional, Interpersonal, and Intrapersonal, respectively representing the influence of technology, school, teachers' beliefs and peers on teachers' ICT lesson design. Similarly, Porras-Hernandez and Salinas-Amescua (2013) advance a framework for context in TPACK research (see Figure 2). In this framework, the contexts for TPACK, ranging from teachers' personal perspectives to organisational supports, could be categorised into three levels, micro, meso and macro, and two actors, teacher and student. According to Porras-Hernandez and Salinas-Amescua (2013), the micro level includes the factors in the classroom, such as the layout and design of the classroom. Meso factors are related to the school or institution level, such as the availability of a support team within settings. Finally, the macro level encompasses the educational conditions provided by the society in which the schools are located, such as the national curriculum guide and the rate of technological innovation. Furthermore, the individual factors could also be included. The teacher factors refer to characteristics of teachers, such as their pedagogical beliefs, whilst the student factors are the characteristics of students, such as their backgrounds. This framework enables researchers to theoretically and critically consider the context for TPACK. Therefore, the context framework of TPACK contributes to answering the third research question, which further establishes the three levels of contextual factors (micro, meso and macro) based on sociocultural guidance. Moreover, the framework further shapes the interview questions and observation notes, thereby helping me to deductively identify the elements within these three levels and interpret them in analysis.

Figure 2. Representation of the Conceptual Framework for Context of TPACK as Advanced by Porras-Hernandez & Salinas-Amescua (2013)
(in Rosenberg, J. M., & Koehler, M. J., Context and technological pedagogical content knowledge (TPACK): A systematic review, Journal of Research on Technology in Education, © 2015, reprinted by permission of Informa UK Limited, trading as Taylor& Francis Group, http://www.tandfonline.com/).



2.5 Summary

This chapter presents the findings from reviewing literature related to digital technology integration in ECE. The review of the debates surrounding digital technology integration highlights the significance of integration approaches in achieving technology's educational potentials, which further directs the attention of researchers to the role played by early years practitioners. In particular, teachers' perceptions and practices of technology use in early years settings are believed to be influential for children's outcomes. Due to this, they are investigated in many studies and then situated in diverse contexts. However, the sociocultural stance suggest that the existing findings of western-based empirical studies might not be generalisable to the Chinese context. Specifically, the review of the ECE curriculum and pedagogy shows that the current ECE values in China are distinct from those dominant in western societies, both theoretically and practically. Therefore, it could be inferred that the pedagogical practices of technology integration by Chinese kindergarten teachers could be different from those reported in previous studies. In addition, the relevant studies situated in China are scarce, especially in-depth interpretive studies. Accordingly, this study aims to explore the digital technology integration of ECE teachers within the context of China, investigating their perceptions and pedagogical practices. Furthermore, the review of the reported barriers and influential factors affecting technology integration in ECE indicates a lack of detailed interpretations in previous studies on how contexts influence teachers' decision-making regarding technology integration. Thus, the study is also inspired to identify contextual factors and interpret how these factors shape teachers' perspectives. The research questions developed through the literature review are formulated as follows:

1. What are participating teachers' attitudes and perceptions in relation to the integration of digital technologies into kindergartens in China?
2. How do these teachers integrate digital technologies within their pedagogical practice?
3. How do a range of contextual factors shape these teachers' perceptions and practices in relation to digital technology integration?

The TPACK framework provides the conceptual base for understanding teachers' decisions about digital technology integration, whilst the contextual framework contributes to identifying and analysing the shaping factors of teachers' perceptions and practices. Moreover, in this chapter, potential effective approaches to integrating digital technologies into early years pedagogy, which are believed to facilitate children's play, learning and development, are reviewed emphatically. The findings drawn from these discussions assist me in explicitly identifying and understanding 'good' practices from a pedagogical stance.

In the next chapter, the methodological choices and rationales are illustrated.

Chapter 3. Methodology

In this chapter, I describe and explore the study's methodology in depth. The purpose of this study was to generate a deep understanding of what children's digital technology use in kindergarten settings looked like and to understand participating teachers' perceptions and practices of pedagogically using digital technologies. For that reason, the research followed an interpretive qualitative study design. Given the focus of the study on the particular context of China, this study did not intend to be representative. The participating settings were selected on the basis of certain criteria which will be referred to more later, and the findings will merely be specific to participating settings. The two-phase study included: (1) interviews with 14 teachers (Phase One), which were analysed with a thematic approach; and (2) subsequent in-depth case studies which centred on five of the teachers from Phase One, comprising (2i) classroom observations of the teachers, their classroom assistants and the children in their classes, (2ii) interviews with the teachers, and (2iii) document review of lesson plans, relevant policies and official documents (Phase Two).The findings were thematically generated from the case studies, and in particular, the observation data were analysed through a multimodal approach.

After conducting a literature review, I discovered some areas regarding preschool teachers' views on technology use in classrooms and their subsequent pedagogical practices that were under-explored. This study aimed to investigate and interpret the perceptions, beliefs and practices of a small group of practitioners in China surrounding the integration of digital technologies into early childhood education. In addition, due to the possible impacts of context on teachers' views and practices around technology adoption (Somekh, 2008), this study also sought to identify and interpret the specific contextual factors of different levels.

The research questions that guided this study were:

1. What are participating teachers' attitudes and perceptions in relation to the integration of digital technologies into kindergartens in China?

2. How do these teachers integrate digital technologies within their pedagogical

practice?

3. How do a range of contextual factors shape these teachers' perceptions and practices in relation to digital technology integration?

This chapter details and explains the broad methodological design of this research and discuss the specific methods employed to complete it. Firstly, I describe and give reasons for the overall research approach taken, specifically the interpretivism paradigm and the qualitative design. Then, the design of the two phases of the study is demonstrated separately in detail, justifying the sampling approach and participants, data collection procedures and data analysis methods of each phase. Next, I discuss the overall ethical considerations (although specific ethical issues are mentioned throughout this chapter where relevant). The penultimate section presents the debates on issues related to validity and reliability and also illustrates various steps undertaken to reduce bias. Finally, I offer some reflections on the researcher position as well as the difficulties caused by COVID-19.

3.1 Research Approach

This section will illustrate the whole research design of this study and explain the rationale behind its design choices.

3.1.1 Philosophies and Philosophical Approach

According to Thomas (2013) and Cohen et al. (2011), the research approach not only represents the method used to answer the research questions, but also indicates how the researcher thinks about and researches the social world. Whilst reducing epistemology to a binary discourse is an oversimplification, social researchers often focus on two commonly discussed paradigms for understanding human experience: positivism and interpretivism. Broadly speaking, these paradigms can be understood as being driven by researchers' ontological and epistemological concerns (Grieshaber, 2010). Ontology means the reality nature, while epistemology is related to how knowledge can be obtained (Sharp, 2009; Clough & Nutbrown, 2002). According to Kvale and Brinkmann (2009), these two presumptions of ontology and epistemology should be addressed by the researcher to tell a convincing story. When the ontological view is that knowledge about the social world can be discovered objectively, then from the perspective of epistemology, it can be quantified (Thomas, 2013; Sikes, 2004). Alternatively, when the ontological perspective is that the truth is not ‘out there’ but subjectively constructed, then epistemologically, this kind of knowledge cannot be measured and quantified but can be interpreted (Thomas, 2013; Clough & Nutbrown, 2002). Thus, these two points can direct the two above-mentioned research paradigms, positivism and interpretivism, respectively. Positivism, which has arguably been the dominant paradigm in the social sciences for many years, proposes that things in the social world can be studied scientifically through observation and experimentation like in natural science without personal values playing a role (Thomas, 2013). By contrast, interpretivists try to take the researcher’s values and views into account to understand not only what people do but also why they do it (Gage, 2007).

Whilst researchers have made attempts to quantify and measure attitudes and perceptions, doing so has its limitations. Studies within the positivist paradigm can only track the prevalence of an attitude or perception that has already been identified and presented to the participants as an option. This approach seemed to conflict with the objectives of this study, which sought to infer and interpret attitudes, perceptions and practices from participants’ words and actions (Rokeach, 1968). Due to this, I chose to examine participants’ experiences and attitudes using an interpretivist lens, which provides greater flexibility for researcher deductions and understanding.

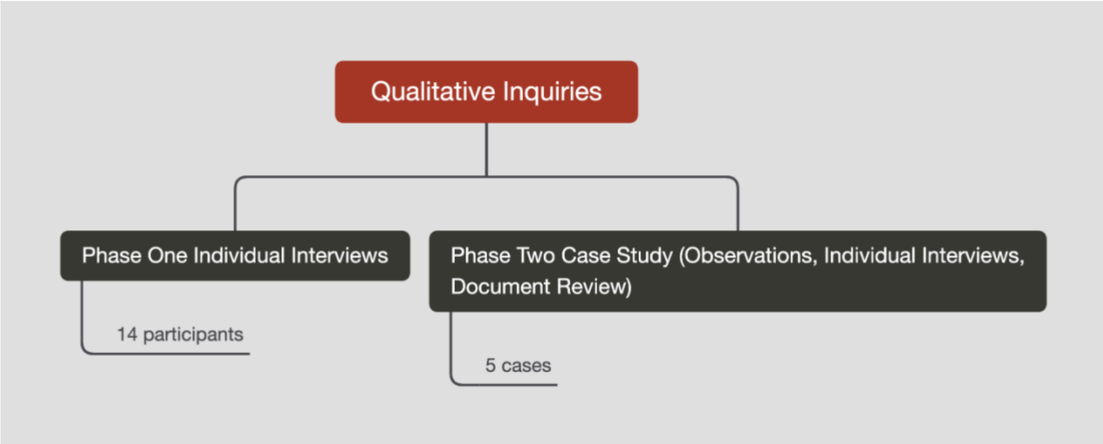
3.1.2 Qualitative Design

Different epistemological positions have frequently been associated with different methodologies (Carter & Little, 2007). The qualitative approach was often categorised within an interpretive tradition, whilst quantitative research was commonly considered to be aligned with the positivist epistemological perspective (Bryman, 2008; Merriam, 2009). However, many argued that this divide was over-simplified, rejecting the perceived ‘perfect match’ between epistemology and methodology (Philip, 1997; Seale, 1999; Brannen, 1992). For example, Lincoln et al. (2011) argued that the elements of diverse paradigms could be blended with each other and that, within each paradigm, mixed methodologies could make sense. In the same vein, Hammersley (1992; 2011) and Seale (1999) attempted to illustrate the limits of a paradigm-driven approach, arguing that the research practice should be conceived as relatively autonomous from a philosophical position. Looking beyond these important epistemological arguments, I considered a qualitative approach more appropriate than a quantitative one for this study. Qualitative research is defined as an inquiry approach to describe, understand and explain phenomena under specific social contexts (Merriam, 2009; Moustakas, 1994; Creswell, 2014; Janesick, 2011). Compared with a quantitative approach, a qualitative approach can provide richer and more holistic data on the studied topic (Fraenkel et al., 2012; Janesick, 2011). In particular, I felt that a qualitative approach allowed for a more detailed and in-depth exploration and interpretation of human behaviours and beliefs (Ritchie et al., 2013; Litchman, 2013). Taking this into consideration, I believed it to be the most suitable approach for this study, which attempted to understand the technology integration practices of kindergarten teachers and their perceptions of such technology integration.

Consequently, this study employed a qualitative method and was aligned with an interpretivist paradigm. It has been argued that qualitative research relies heavily on the individual researcher, whose biases can significantly affect the research results (Mays & Pope, 1995). According to Creswell (2006), given the interpretive nature of qualitative research, researchers' background, context and prior knowledge could influence their interpretations of participants' experiences and beliefs. This meant that different researchers might come to different conclusions (Mays & Pope, 1995). In addition, many scholars argued that the qualitative approach lacks reliability (consistency in retesting) but was relatively valid (Britten & Fisher, 1993; Pope & Mays, 1995). In order to minimise researcher bias and ensure reliability, I have elaborated on the research process in later sections. This includes a thorough description of the methodology selection, fieldwork procedures and the interpretation and analysis process. Additionally, I have provided raw data and information about the transcription process, enabling readers to gain better insights into the project and replicate the steps taken. Furthermore, when collecting the data, I focused on understanding the meanings that participants made for themselves, rather than imposing parameters based on my personal experiences and existing literature. During the data analysis and interpretation stages, however, it was not possible to avoid the influence of prior studies that contributed to the deductive approach, nor my own experiences. Another concern some scholars have raised about the potential weakness of qualitative research is the lack of generalisability caused by its typically small sample size (Mays & Pope, 1995). Whilst I agree, as many researchers have argued, that it is not necessary to generalise the findings of qualitative research (e.g. Merriam, 1998; Patton, 2015; Lincoln & Guba, 1985), I have chosen to describe the contexts and specifics of this study. I have also highlighted the similarities and differences between this study and other works, enabling readers to examine different perspectives. My aim was not to encourage readers to make generalisations based on these descriptions, but rather to offer a contextual foundation for the study.

In order to comprehensively explore teachers' perceptions and practices of digital technology integration within the ECE sector, I adopted a two-phase design (see Figure 3). The first phase was individual interviews of fourteen participants. The second phase was case studies of five teachers and their classes. In the first phase, my goal was to gather comparatively general information. This encompassed teachers' backgrounds and their overall attitudes and perceptions towards technology use, as well as a broad overview of how they were using digital technologies. I used individual interviews to collect this information. In the second phase, I aimed to investigate teachers' specific approaches to integrating technologies into the curriculum and their pedagogies, as well as the detailed reasoning behind their decision making. Therefore, the case study approach, known for its practicality when looking at multiple perspectives (Thomas, 2013; Litchman, 2013), was chosen to fulfil the research objectives. Case study research is a qualitative approach used to study an issue by analysing one or several cases within a bordered system, such as settings and contexts (Cohen et al., 2007; Creswell, 2006). The focus of a case study is to deeply describe and analyse a case, which can be an event, program, activity or individual, and to report case-based themes (Creswell, 2006). Derived from disciplines such as medicine, psychology, law and political science, this approach has also been explored in educational research by Merriam (1998). It is most commonly used within research that seeks to understand a phenomenon in a particular setting involving specific participants (Maxwell, 2013; Merriam & Tisdell, 2016). Case study research recognises context as a powerful determinant (Cohen et al., 2007). Due to this, I decided that a case study approach would be the best way to explore the factors that shaped teachers' viewpoints and pedagogical practices concerning technology integration. Five participants, along with their students and classrooms, were examined as the cases for this study. The objective was to gather detailed information about their pedagogical approaches to technology integration and the thought processes behind these approaches. These case studies can provide insights into other teachers' technology integration in similar situations.

Figure 3. The Two-Phase Design



According to Yin (2014) and Thomas (2013), in case studies, combining data sources was necessary and important for understanding what is going on in a specific context. Yin (2014) also identified several sources of data for case studies, encompassing relevant documents, archives, interviews, observations, as well as tangible materials. In this research, direct observations, individual interviews and document reviews were applied to collect data, which will be discussed in detail later.

In the next section, the processes of phase one and two will be described and interpreted separately.

3.2 Phase One

3.2.1 Research Settings and Participants

China contains four megalopolises: Beijing, Shanghai, Shenzhen and Guangzhou. Within China, they are commonly referred to as first-tier cities. The tier system also includes second-, third-, fourth-, fifth-, and sixth-tier cities. Considering that the research topic involved both 'education' and 'technology', I decided to base this study on developed and advantaged urban areas in China. This was because kindergartens in these cities seemed more likely to have rich digital resources than those in suburban and rural areas. Likewise, the settings and individuals participating in this study were all from first-, second-, and third-tier cities. The rationale was that conducting research in these specific settings with rich technological resources would help to explore the diversity of teachers' pedagogical practices. Accordingly, the knowledge generated from this study was specific to these settings and the findings were not generalised to the whole country. In particular, the findings of this study did not represent the experiences of teachers in suburban and rural areas where preschools usually have a shortage of both teachers and infrastructures (Zhu, 2008; Hu et al., 2015), as well as a lower quality of education (Li et al., 2016). Specifically, through a literature review, Luo et al. (2021) identified urban-rural gaps in the ICT configuration rate, with 42.1% in rural contexts (Liu, 2018, cited in Luo et al., 2021) and more than 70% in Shanghai preschools (Dong, 2016, cited in Luo et al., 2021). This is likely to affect teachers' digital technology integration experiences (Luo et al., 2021).

After getting ethics approval from the University of Sheffield, I began recruiting participants. The detailed ethical considerations will be presented below (Section 3.4). For the first stage of the recruitment process, I tried to negotiate access to kindergartens in the middle of September 2021. The kindergarten selection was purposeful and criterion-based to narrow the search to settings where teachers had more technology use in their daily routines. Reports suggest that in Chinese kindergartens, commonly used equipment like televisions, computers and IWBs have gained popularity in recent years (Luo et al., 2021). Moreover, some kindergarten classrooms have also introduced new technologies such as tablets, augmented reality (AR) devices and robotics (Luo et al., 2021). On this basis, my intention was to include kindergartens where classrooms were equipped with at least commonly used devices, giving higher preference to classrooms with new technologies. Selecting kindergartens where technology was readily available would help to ensure that the study's aim of understanding early years teachers' views and pedagogical practices with regard to technology was met. This was because the purpose of this study was to understand what standard usage patterns and perceptions were like in environments with strong access to technology. Before choosing settings for the study, I contacted friends who worked as early years practitioners in developed urban areas. Through informal conversations, I asked them to recommend settings that were relatively advanced in terms of their technology integration. Upon receiving the recommendations, I conducted online searches and reviewed the official websites of each suggested early childhood education setting. This was done in order to assess how much they incorporated digital technologies into their educational practices. Through screening surveys, and with reference to official websites, I identified 16 kindergartens that had some level of technology integration, including both public and private settings. For the next stage, I contacted kindergarten principals via email or phone call. I outlined the purpose, data collection process, duration, potential impact and study outcomes of my research, just as Cresswell (2014) suggested (see Appendix B), requesting permissions and referrals to recruit participants. However, I received few replies and did not obtain any permissions.

After experiencing how difficult it was to connect with the kindergartens directly, I decided to approach individual kindergarten teachers. Purposeful sampling was used to select potential participants. This method allowed me to intentionally choose participants who displayed the specific characteristics required (see the criteria below) and possessed relevant experiences or knowledge related to this research topic (Creswell, 2014; Cohen et al., 2011). The use of purposeful sampling is also supported by Patton (2015) and Kisely & Kendall (2011) who regarded this method as useful for selecting information-rich individuals. In this study, I opted to focus on the meanings participants made from their experiences and their subjective understandings of technology integration in early childhood classrooms. Following this decision, I created a participant recruitment advertisement (see Appendix C) and posted it online through multiple platforms (WeChat groups for early years teachers, Weibo Super Topic about early childhood education, Douban groups related to early childhood education and practitioners). All of these platforms are popular social media in China and each one features sections for specific discussion topics (e.g. education, entertainment, sports). Due to this, I was able to engage with the target population directly. The advertisement listed the research topic and purpose, data collection process, duration, participant criteria and ethics guarantee (see Appendix C). In particular, the criteria for participants were as follows: 1) be working at a kindergarten in a first-/second-/ third-tier city; 2) be currently using digital technologies in the classroom; 3) have at least one-year teaching experience as an early years teacher; and 4) currently be the lead teacher of a class. The reasoning behind the criteria was twofold: firstly, to ensure that the teachers had some experience with pedagogy and technology and had something to contribute and secondly, to ensure that I could observe their current practices. Both of these conditions were necessary for me to explore their pedagogical beliefs about technology integration in depth. In addition to the advertisement, I also used convenience sampling through my friends to gain access to several kindergarten teachers who met the criteria. Finally, I connected with 15 potential participants in total. However, as I wanted the study to explore different demographics and characteristics, such as the teacher's age, city and education level, the age of the students and the type of kindergarten, I narrowed the scope of participants even further. Additionally, in light of Kvale and Brinkmann (2009), I used our initial communications to identify potential participants who were motivated, talkative and had the capacity to provide long and engaging accounts of their experiences and viewpoints. These were not obligatory criteria but preferred traits. As a result, nine of the 15 teachers were selected to participate in my research and formal invitations were sent to them with specific details about the study. However, given the sensitivity of in-person interactions during the COVID-19 pandemic, as well as concerns for the young children's privacy and health, the nine teachers could only participate in the first-phase virtual interviews but could not accept the following face-to-face observation sessions without permission from their principals. This circumstance led me to the realisation that connecting to the principals and constructing a relationship of trust with them would be an essential step in the research process.

For my third attempt, I tried to approach more participants who could be observed in person by using a guided sampling strategy to connect to principals via trusted mediators (Wellington, 2015). Introduced by my supervisor, I connected with a professor at an Australian university who conducted early years education research in China. With the help of this professor, I approached the principals of two kindergartens. After providing them with the details of my research, I obtained permission from the two principals to conduct research within their settings. In the interest of gaining access to participants who met the selection criteria for the study, I communicated with the principal of each kindergarten and asked them for some suggestions. Subsequently, I chose five potential participants from the principal's suggested list at random. Next, invitations were sent to these potential participants specifying the details of the study and assuring them that the process was completely voluntary. All five teachers accepted my invitation. Afterwards, I sent them the study's information sheet and informed consent form, both of which they accessed and signed through WeChat. Finally, 14 participants in total were recruited to be interviewed in the first phase and 5 of them would then participate in the second-phase case study. Patton (2002) and Creswell (2012) indicated that a small sample size can allow the researcher to manage the intensive process of data collection and analysis, thereby strengthening credibility. Furthermore, in qualitative interviews, the interviewees are usually described as communicators (Rubin & Rubin, 2005), working with researchers to co-construct meaning. Therefore, having a small number of participants would allow for the gathering of in-depth information within time constraints (Lunenburg & Irby, 2008).

The demographic information of all 14 participants is presented below. The age range of the participants spanned from those in their 20s to 40s, reflecting the age distribution of kindergarten teachers in China (MoE, 2020). In addition, most of the participants were female, with only one male included. This is broadly representative, as the male kindergarten teachers are scarce in China, constituting only approximately 2.21% of total teachers (MoE, 2020). Observable variations existed within each category, potentially contributing to the diversity of the sample. Although I did not intend to generalise the findings of this study, the diverse backgrounds of participants may provide insights into the possible nuances in teachers' perceptions and technology integration practices. This contributes to data interpretation.

Table 1. Demographic Data of Fourteen Participants in Phase One

Pseudonym	Age	Teaching Years	Education	Class	Kindergarten	City	Notes
Luo	44	22	Vocational college	Upper	Public	Shenzhen	The leader of ICT group
Ye	41	21	Diploma	Middle	Public	Shenzhen	
Shi	32	11	Diploma + Bachelor	Lower	Public	Shenzhen	Was English teacher
Zhang	40	16	Vocational college	Middle	Public	Shenzhen	
Wang	35	13	Bachelor	Upper	Public	Shenzhen	
Lsq	29	6	Bachelor	Upper	Public	Wuhan	
Zhou	25	5	Diploma + Bachelor	Lower	Public	Shaoyang	
Yan	26	4	Diploma + Bachelor	Middle	Private	Beijing	
Hu	27	2	Master	Lower	Public	Shenzhen	
Huang	29	2	Bachelor	Middle	Public	Shenzhen	
Bai	30	5	Master	Library teacher	Private	Shanghai	
Ly	35	7	Bachelor	0-3 years old	Private	Beijing	Non-early childhood education major
Yang	28	6	Bachelor	PE	Public	Beijing	Male
Chen	52	27	Vocational college	principal	Private	Zaozhuang	

3.2.2 Data Collection

After discussing and obtaining informed consent from participants, I began the data generation for the first phase. Due to the restrictions of the COVID-19 pandemic, I decided to conduct online individual interviews from mid-November 2021 in order to collect early years teachers' accounts of their attitudes, perceptions and beliefs on the use of digital technologies with children. The COVID-19 pandemic's impact on the work will be discussed in more depth below (Section 3.6.2). An individual interview is defined as an approach to constructing meaning and producing knowledge through communications and interactions between interviewers and interviewees (Kvale & Brinkmann, 2009; Janesick, 2011). According to Sharp (2009), interviewing was commonly appropriate for research projects exploring opinions, preferences and behaviours, as well as for gathering details from a relatively small sample size. Similarly, Warren (2002) argued that interpretations could be derived from interviewees' descriptions through conversations with interviewees. Individual interviews have previously been used in similar research. For example, Suzette (2014) interviewed four teachers in a Jamaican kindergarten to explore their perceptions, beliefs and practices in relation to digital technology use. Likewise, Chen et al. (2018) conducted interviews in kindergartens in Taiwan to understand practitioners' perspectives on the technology use. For this research, the first set of interviews, prior to the classroom observations, focused on teachers' attitudes and beliefs in relation to digital technology integration, and their pedagogical practices in the kindergarten. Moreover, these interviews generated data on the participants' backgrounds, personal experiences using technologies and professional development. This aligned with the third research question, which aimed to explore the contextual factors that might influence them. Such interviews were intended to contextualise participants' opinions, further enabling me to understand participants' practices.

Three basic types of interviews are broadly employed by researchers: structured interviews, unstructured interviews and semi-structured interviews (Thomas, 2013; Sharp, 2009). Considering the objectives of the study, I determined to use semi-structured interviews, which are the most commonly employed method in educational research, to collect information about teachers' attitudes and perceptions. This allowed participants to express themselves and communicate freely, whilst ensuring that the discussion remained centred around the research topic. Because semi-structured interviews are more flexible than structured interviews, participants can talk about aspects of the topic that are important to them (Opie, 2004), allowing more accurate inferences made by the researcher (Pajares, 1992). Furthermore, in line with the suggestions of Janesick (2011) and Merriam (2009), the interview protocol I designed, including the interview aims, interview questions and related guidance (see

Appendix H), was used to guide the interview process. However, the actual interview process was conducted as an open-ended interview in order to reveal unintended categories and themes. Specifically, alongside interview questions pertaining to teachers' knowledge and perceptions of integrating digital technologies into early childhood education, questions inquiring about teachers' background experiences were also included. As suggested by Thomas (2013), questions were organised and structured as follows: main questions, follow-up questions and probes. Whilst the main questions were predetermined, semi-structured interviews require the researcher to be responsive to interviewees' answers (Rubin & Rubin, 2005), leading to varied follow-up questions and probes for each interviewee. Examples of interview questions are presented below.

Table 2. Examples of Phase-One Interview Questions

Main question		
What do you think about the role of digital technologies in the everyday activities of your kindergarten?		
Participants	**Follow-up questions**	**Probes**
Participant A	How does it facilitate your teaching?	Any drawbacks?
Participant B	How does it facilitate children's development?	How about children's creativity development?

Before the formal interviews, I conducted a pilot test to check the interview protocol's effectiveness and understandability (Yin, 2014). Two of my friends, who worked as kindergarten teachers in my hometown, were invited to do the pilot interview. Their feedback helped me to modify the protocol, making it clearer and more effective. For example, when giving an introduction of the interview to the interviewees, I originally listed some examples of digital technologies, which I found could limit their answers. Accordingly, I revised the introductory paragraph by replacing the examples of digital technologies with clear definitions, ensuring that I could accurately assess their understanding of digital technologies.

The time and date for the interviews were dependent on participants' schedules, and participants were sent a reminder before every interview. The phone call function of WeChat was used to conduct the interview. WeChat is the most common instant messaging app in China and is used by almost every citizen, so most participants were already familiar with the platform and did not need to download and learn a new app. Due to this, WeChat was a practical tool for conducting individual interviews for this study. It should be acknowledged that things like WeChat and WhatsApp have become huge issues in ethics policies in UK universities in recent years, but this was not considered an issue when the present study initially underwent ethical review. Before the beginning of each interview, I always ran a test on devices and connections in order to ensure an uninterrupted interview process. During the interviews, I used a digital audio recorder to record conversations with the permission of interviewees. This step was taken to enhance the accuracy of collected data. Additionally, I also took field notes, enabling me to ask additional questions when necessary and to clarify participants' answers (Ramsey, 2018). My primary focus during conversations was not on taking notes as I was mindful that it could distract myself. Instead, I adopted an active listening approach and only jotted down relevant ideas. At the end of conversation, I expressed my gratitude to every interviewee and also reiterated their right to withdraw and to withhold the use of their data. Consistent with King and Horrocks' (2010) suggested duration for individual interviews, the interview sessions with each participant lasted for approximately 45-60 minutes. The conversations were transcribed in Chinese immediately after the first interview session and the participants were provided with the transcript to review (Gibbs, 2012; Wellington & Szczerbinski, 2007). All of the data was tagged with pseudonyms and stored on my password-protected personal computer.

3.2.3 Data Analysis

Drawing from the methodologies of other qualitative studies, such as Chen et al. (2018) and Palaiologou (2016), who investigated people's perceptions using interview data, I used a thematic approach to analyse the qualitative data for addressing research questions. According to Braun and Clarke (2012, p.57), thematic analysis could be defined as 'a method for systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a data set'. Therefore, the thematic analysis approach aimed to uncover shared meanings and experiences across the data sets, rather than focusing on the unique characteristics within individual pieces of data. Researchers have argued that this method is appropriate for interpretive studies (Alhojailan & Ibrahim, 2016; Boyatzis, 1998). Furthermore, there are multiple possible approaches to adopt within thematic analysis, such as inductive/deductive, experiential/critical, essentialist/constructionist, and semantic/latent (Braun & Clarke, 2006). As this study aimed to investigate the sociocultural and structural rationales behind teachers' perceptions and pedagogical practices, I chose to apply a constructionist thematic analysis. This enabled me to focus on latent themes, thereby providing 'a more detailed and nuanced account of a group of themes' (Braun & Clarke, 2006, p.83). It is important to acknowledge that the analysis of the individual interview data featured aspects of both an inductive and deductive approach. As the project's researcher, I recognised that I could not remain fully impartial when coding and interpreting the data due to my own pre-existing concepts, theories and ideas. Moreover, as Cohen et al. (2011) and Dey (2003) noted, qualitative data analysis requires the researcher to organise, classify and interpret the data, thereby making meanings and identifying thematic commonalities. The purpose of this study was to understand teachers' different views and pedagogical practices related to digital technology integration in early childhood settings. Therefore, comparisons were made throughout the analysis among each participant's statements and actions (Corbin & Strauss, 2008). In particular, I compared the most recent data against data and themes that had already been reviewed to highlight similarities and distinctions across the database. Crucially, because my intention was to represent the diversity of data rather than to attempt general inferences, even the data derived from only one participant was included in the analysis.

The data analysis procedure of this research was similar to other qualitative studies, which generally begin with the transcription of all recorded material. In practice, the transcription process closely followed each interview. According to Male (2016), approaches to transcription can range from focused transcription, which should include every word made by the participant, to summary transcription. In this study, I transcribed the materials (in Mandarin) word by word to preserve the integrity of the data. The transcriptions were first processed using the professional software, iFLYREC. Afterwards, I listened to the recordings and made any necessary revisions.

Each transcript was then sent to the respective participant for feedback, verification and final approval.

In order to get familiar with the data, I engaged in multiple rounds of reading and listening to the transcripts. I made notes throughout the process, enabling me to consider the significance of the data.

I will give an example from Luo's interview:

> *I typically try to introduce digital devices little by little and then evaluate how much the children benefit from the integration. I then adjust my approach based on the results*. (Luo1)

I attempted to uncover the rich meanings within the data and wrote down some ideas: a) Luo used digital technologies actively and cautiously; b) Luo's independent efforts and navigation indicated a lack of developed external guidelines; c) the practices could affect the teacher's views. These reflections led me to appreciate the depth of the data, but I also observed that not all extracts offered such rich information. Consequently, I was not concerned with finding out the meanings of every data item at this stage and instead chose to concentrate on recording my ideas about the data. In addition to documenting my understanding of the data's meaning, I also took notes on the questions I wanted to delve into in the later case study observations and the second interviews. For example, I wrote in a memo, 'I noticed several teachers mentioned children using digital technologies independently in small-learning-area activities, so what role did the teacher play in that process?' This note contributed to the development of the observation protocol for Phase Two of the research (see below).

During this initial stage of the data analysis, each piece of data was read and listened to in its entirety at least twice. Furthermore, certain transcripts were revisited multiple times as later transcripts inspired new ideas that prompted me to read and make notes on the earlier data. At this point in the research process, I did not translate the Chinese transcripts into English. This was due to the fact that translation can sometimes cause ambiguity and misunderstanding and I intended to use the language that I was most familiar with to interpret the data (Cormier, 2008).

According to the guidelines set out by Creswell (2014) and Braun & Clarke (2006), the next step of the data analysis would be coding. This would involve a thorough search for items and elements of the data that could be categorised (Patton, 2015). I conducted two cycles of coding. In the first cycle, each set of interview data was coded separately using descriptive and deductive codes related to concepts from the literature. The second round consisted of grouping the whole data set into the existing codes and then merging and modifying those codes. Meanwhile, after further synthesising the information, the latent codes were also added.

Thus, the generated codes were a mix of inductive and deductive, descriptive and interpretive. I presented some coding examples from Zhou's interview to illustrate the diversity of codes (see Table 3). Using the inductive approach, I generated the codes from the data which could directly answer research questions about teachers' attitudes, beliefs and practices in relation to digital technology integration. Existing literature also contributed to my coding process. For example, studies that identified barriers to teachers' technology integration provided code examples that aligned with the contextual information. This could be regarded as a deductive coding process. Moreover, the descriptive codes captured what the participants meant, such as 'frequent use of IWB', whilst the interpretative codes identified the meanings behind the data, such as 'not-for-children devices'. Additionally, the examples below also demonstrate that some codes were directly generated from the participants' words, such as 'broadening children's horizons', whereas others reflected my own ideas, such as 'teacher-led use'.

Table 3. Coding Examples from Zhou's Interview

Transcripts	**Codes**	**Coding Methods**
I will get extra credit for using digital technologies in open classes and this is how the authorities encourage us to use digital technologies. Also, previously, the education department at province level held a safety education teaching competition, which required the use of micro-lecture.	Education authorities encourage technology use	Deductive Descriptive
The IWB was not only used in teaching activities, but also outside of formal classes, such as for reading nursery rhymes or listening to music during pre-dinner activities, or for reviewing stories or songs children have learned during the transitional time.	Frequent use of IWB	Inductive Descriptive
The IWB is installed quite high up and children are not tall enough to touch it. Perhaps most of the children can touch the lower part of it. I had to pick them up so they could access it and it was mostly the teacher who operated it.	Not-for-children devices	Inductive Interpretive
For children, it (the digital technology) could broaden their horizons.	Broaden children's horizons	Inductive Descriptive
The digital technology was very helpful for teaching when I used it to present slides, pictures and videos.	Teacher-led use	Deductive interpretive

As suggested by Braun and Clarke (2006), the codes generated from the interview data extracts were all relevant to the research questions and were made as succinct as possible for clarity. In addition, it is worth noting that the initial codes were written using Chinese language and were not translated into English until all the codes were identified. This was done in order to capture participants' meanings and my understanding with more accuracy. The coding process was iterative, involving constant reviewing and revising, and resulted in the creation of inclusive and systematic codes and subcodes. Some code examples are presented in the following table.

Table 4. Code Examples

Codes	Lack of guidance	Children's home experiences	Technology use for connecting to families	It is just a tool	Affecting children's eyesight
Extracts	A. It (the ICT training) did not tell us in detail how to use the digital technologies in our teaching (Luo) B. The workshops organised in the kindergarten provided limited content to us, so I tended to learn and explore by myself (Bai) C. The concept of technology use in kindergartens given by	A. Through communicating with some parents, I learnt whether children had access to technologies more or less at home. The majority only passively watch but do not actively interact with technologies (Luo) B. The upper class children tend to use iPad apps for learning literacy and numeracy (Wang) C. When we had an open class relevant to ICT use, I had children use the tablets,	A. I usually use the WeChat group to communicate with parents, like posting children's photos (Wang) B. The technology is good for connecting to children's parents, but it also burdens us - we not only need to take photos and videos for children, but also have to do video editing to post these works on diverse public	A. It is just an assisting tool for my teaching, a method but not the main focus (Yan) B. The technology is a supplement not a focus (Zhou) C. It (digital technology) is not a 'must-have' thing in 'a day in life'. It's just an assisting tool which will not influence the practices too much	A. I worried about the adverse impact of the long screen-time on children's eyes (Wang) B. The screen could cause harm to children's eyes (Yan) C. Over use of computers or smartphone by children could affect eyesight (Huang) D. The children's visual function is still

	official documents was quite vague without any specific cases. Implementing technological pedagogy was quite complicated, and we didn’t know how to achieve it without detailed guidance (Yang)	through which I found that children had prior experiences of using them at home, as they could operate the tablets without my instructions (Lsq) D. I know some of my children attended online courses at home, like drawing courses or early English courses （Yan)	platforms for parents to review (Yan) C. I tended to record video footage of children’s activities with my own smartphone, which would be edited and combined together for sending to parents (Ye)	(Hu) D. It is just an auxiliary material (Huang) E. As a tool, it can be used when necessary, but it cannot replace children’s direct experiences (Bai)	developing and current children have various eye health problems like astigmatism. In my view, children should try to use digital devices as little as possible, given its potential to harm children's health (Chen)

For the next step, the codes were categorised into potential themes. The codes that seemed to share some common characteristics were grouped together and I identified similar or overlapping areas which could represent the patterns across codes. This was the process for generating themes. For example, the codes ‘improving work efficiency’ and ‘facilitating professional development’ were similar in indicating teachers’ perceived benefits of technology use for their own work. Due to this, they were combined to construct the ‘recognising the significance of digital technologies for their work’ theme. In addition, since the codes ‘satisfied with technical skills’, ‘no more training needed’ and ‘just beginner of integrating technologies’ were all related to the level of teachers’ confidence about integrating technologies into pedagogies. As a result, I clustered them and generated the theme ‘confident in technical skills’. Furthermore, codes such as ‘principal’s attitudes’, ‘available digital devices’, ‘IT staff’ and ‘kindergarten training focusing on technical skills’ were combined to develop the theme of ‘meso kindergarten context’. Additionally, as highlighted by Braun and Clarke (2006), the relationships between themes needed to be considered. Therefore, I constructed a thematic map consisting of all the candidate themes to help me clarify the relationships between them. At that stage of the process, the map was not developed and completed as these themes needed to be reviewed and modified further. I was also aware that the second phase of the study would contribute more content to input. Consequently, the undeveloped version of the thematic map has not been presented in this thesis. Instead, I have included the completed version in Appendix N. The finalised version provides insights into my thoughts on the relationships between themes as the process progressed.

At the subsequent stage, I reviewed these candidate themes to check whether they worked in relation to the data set and answered the research questions. Accordingly, I made some modifications. For instance, the theme of 'teachers' knowledge and skills of technology integration' seemed to evaluate teachers but did not reflect participants' perspectives, so I revised it to the theme of 'teachers' perceived knowledge and skills'. Additionally, I found that the 'meso kindergarten context' theme was too general to relate directly to the data. Thus, I added sub-themes under this theme ('leadership' and 'kindergarten support') to align themes with the data and to create a coherent narrative. Along with the reviewing process, I defined and named these themes, which was the fifth step of Braun and Clarke's (2006) six-step process for conducting thematic analysis. The final step of the data analysis was to produce a report which could be approached in different ways: 'by groups', 'by individuals', 'by themes', 'by research questions', 'by instruments', 'by case study' and finally 'by narrative' (Cohen et al., 2011, pp.467-468). This would be determined after the entire analysis of all the data.

3.3 Phase Two: Case Study

3.3.1 Research Settings and Participants

As stated previously, five of the fourteen participants were involved in the second-phase case study. They were named Luo, Ye, Shi, Zhang and Wang. They were all based at two kindergartens in Shenzhen, Guangdong Province. The profile of the two kindergartens is presented in Table 5. Shenzhen, as one of the four first-tier cities in China, has a huge population and a high level of economic development. In particular, the digital technology industry has been well-developed and many technology enterprises have settled here. In addition, the educational resources are abundant and advanced. Therefore, the kindergartens in Shenzhen tend to have more access to digital technologies than those in other areas, which made it an appropriate site for collecting data related to educational technologies.

Table 5. Demographic Information of Case Study Setting

Kindergartens	**Types**	**Levels**	**Number of children**	**Number of classes**
Lotus Kindergarten	Public	Provincial Exemplary Kindergarten	380	12
North Kindergarten	Public	Provincial Exemplary Kindergarten	257	9

Both kindergartens were public and received government funding. In Shenzhen, the number of public kindergartens accounts for approximately 50% of the total number (998/1935). Furthermore, it is worth mentioning that both are classed as a Provincial Exemplary Kindergarten, which is the highest level of kindergarten quality in Shenzhen (74/1935). This means that the educational quality of the two participating settings may be higher than that of most local kindergartens. The five teachers from these settings were the lead teachers of different classes. Each of them worked with two colleagues to oversee one class. Table 6 lists the demographic information for each participant and their class. The five participants ranged in age from their 30s to 40s. Teachers in their 20s were not included in the case studies. Additionally, all five teachers were female as the number of male teachers (2.21%, see MoE, 2020) was far less than that of female teachers in China. Moreover, the educational degrees of participants represented the general ECE teacher population (14.89% were vocational-college degree, 57.53% were diploma, 25.47% were bachelor’s degree, see MoE, 2020).

Table 6. Demographic Information of Case Study Participants

Pseudonym	Age	Teaching Years	Education	Class	Class size	Kindergartens
Luo	44	22	Diploma	Upper	35	Lotus Kindergarten
Ye	41	21	Diploma	Middle	31	Lotus Kindergarten
Shi	32	11	Diploma + Bachelor	Lower	32	Lotus Kindergarten
Zhang	40	16	Vocational college	Middle	32	North Kindergarten
Wang	35	13	Bachelor	Upper	31	North Kindergarten

Furthermore, children were also included as participants in the case studies. In particular, they were involved in the classroom observations, and their practices were analysed to support an understanding of how the pedagogical approaches of teachers appeared to impact on the practices of children in their classes. Thus, I also sought consent from children and their parents in an appropriate way (see 3.3.2). Nevertheless, the primary focus of this study was on the teachers, so I did not collect social demographic information about the children, and not all of the children were included in the reported vignettes. Moreover, I would have liked to interview the children, but it was not possible within the scope of the study. In addition to children, classroom assistants were also observed in the case studies. However, they were not regarded as formal participants as I did not include them in the presentation and analysis of the observation data.

3.3.2 Data Collection

Observation

In the second-phase case study, observations were used to collect further data on teachers' pedagogical practices in relation to technology integration within early childhood classrooms. In order to gain insights into participants' experiences, it is believed that combining both types of data - participants' accounts of their behaviours and observations of their actions - provides the most valuable information (Cohen et al., 2011). In addition, Patton (2015) and McMillan & Schumacher (2010) shared the view that observations enable the researcher to enter the situation being studied and gain a deeper understanding of it. Accordingly, observations have been used by many researchers working in a similar field to understand the actions and practices of subjects. For example, Yelland (2018) used a participant observation methodology to explore how teachers in early years settings design multimodal experiences to support children's emergent literacy. Similarly, Fleer (2015) used video observations to understand teachers' roles in children's imaginary play.

According to Cohen et al. (2011), the types of observation can differ in their degree of flexibility, from unstructured to structured. This study employed a semi-structured observation. Although it had a set list of issues to cover, the data collection was less predefined. Furthermore, in line with the dimensions that need to be considered before conducting observations, as suggested by Flick (1998) and Cooper & Schindler (2001), the observation type of this study was decided as direct, non-participant, overt and in natural settings. Particularly, unlike participant observation, in which the observer also works as part of the observed group (Deacon et al., 1999; Pope & Mays, 1995), I kept a distance from the observed teachers and children, although they were aware of my presence. According to the degrees of participation in observation, defined and developed by Gold (1958) and LeCompte & Preissle (1993, p.93) - including categories such as 'complete participant', 'participant as observer', 'observer as participant' and 'complete observer' - I did not fit into the category of a complete observer, who usually observes in an experimental design or artificial setting. Instead, I occupied a position between the roles of 'observer-as-participant' and 'complete observer' (Hammersley & Atkinson, 1983).

The purpose of these observations was to capture the details of the teachers' pedagogical practices around the use of digital technologies. Furthermore, the primary focus of the observation was on teachers' practices, but the children's involvement formed a significant part of the observed pedagogical practices. All observations were purposefully scheduled and conducted to ensure that some technologies were used by participants in pedagogical activities and to try to cover a diverse range of subject areas. Furthermore, the observed sessions included both the activities in which digital technology was specifically planned (e.g. thematic activities) and the general sessions in which digital technology was used without an explicit plan (e.g. small-learning-area activities). Also, the participating teachers were informed in advance that the purpose of the observation was not to judge them but simply to understand their practices. I also explained that it would not harm their personal or professional status, with the aim of minimising their potential anxieties as much as possible (Patton, 2015). Similar to the previous interview protocols, I designed an observation protocol (see Appendix I) based on themes arising from previous interviews and guided by several frameworks developed by researchers examining similar topics. These themes included: 1) classroom environment, 2) the type of technology used, 3) teachers' instructional strategies with technology integration, as well as the nature and purpose of their interaction with students and 4) student engagement. These frameworks were: 1) The Teacher Roles and Technology Observation Schedule and The Overall Classroom and Technology Observation Measure developed by Rollins (2011), with reference to the Teacher Roles Observation Schedule (TROS) (Waxman et al., 1990) and the Classroom Observation Measure (COM) (Ross & Smith, 1996), 2) the Checklist for Exemplary Technology Integration used by Cameron (2015) to observe how teachers use technology with young children in a P-3 classroom and 3) observation protocol developed by Bogott (2017) to explore what technology implementation resembles in subject classrooms. It should be acknowledged that these existing frameworks were only used to provide inspiration for my protocol. Elements that they contained unrelated to my study (e.g. the subject learning assessment) were excluded, as formal assessment were not allowed in kindergarten classrooms in China. Furthermore, despite the use of the observation protocol, I also looked beyond the protocol at more spontaneous observations.

In the preparation period for classroom observations, obtaining consent from every participant was crucial. I acquired consent from teachers at the start of the study. Moreover, I took great care to be ethical when including children as participants of classroom observations. Therefore, I also gained consent/assent from children and their parents with the assistance of teachers. It has been suggested that parents are gatekeepers of children (Dockett & Perry, 2010), so I initially tried to obtain informed consent from the parents by distributing printed information sheets and consent forms to them (See Appendices F and G). However, after discussing this issue with participating teachers, they suggested that they could help upload the two documents to the class WeChat Group for parents to review, introducing my research to them. I followed this suggestion and gained consent from all parents. However, because of the understanding that young children at this age (three to six) are not mature enough to give informed consent, the concept of obtaining assent has been emphasised as important in children making decisions about their participation in research (Dockett & Perry, 2011). Following the suggestion that acquiring children's assent should be a continuous process (Lambert & Glacken, 2011), I implemented steps for informing the children, ensuring voluntary involvement and evaluating their understanding (Dockett & Perry, 2011). When I arrived at the classroom and was introduced to the children by the teacher, I gave verbal explanations to them using simple language about the 'who, what, why and how' of this study. I also made it clear that if any of them did not want to be video recorded by me, they could tell me and I would stop recording. Also, verbal assent from children was negotiated through informal conversations on an ongoing basis, as suggested by Lambert and Glacken (2011). None of the children expressed discomfort.

Initially, I had planned to visit every classroom twice in the second semester (March - July 2022) for half a day each time. However, due to the continuing COVID-19 pandemic, all of the kindergartens in Shenzhen did not reopen and conduct in-person teaching until May. Also, the two participating settings carried out a series of special activities celebrating International Children's Day in the first week of June, which were not the normal routines and practices. This left about one month for the observations. Therefore, I decided to do a one-time observation for a whole day in each classroom to see whether patterns emerged. Table 7 lists the information of every visit.

Table 7. Classroom Observation Schedule

Site	Time & Date	Participants	Length
Upper A Classroom, Lotus Kindergarten	8:30 - 11:20 am 14:00 - 16:00 pm 8 June, 2022	Luo, her assistant teacher and children	4 hours 50 minutes
Middle E Classroom, Lotus Kindergarten	8:30 - 11:10 am 14:00 - 16:00 pm 7 June, 2022	Ye, her assistant teacher and children	4 hours 40 minutes
Lower K Classroom, Lotus Kindergarten	8:30 - 11:00 am 14:00 - 16:00 pm 6 June, 2022	Shi, her assistant teacher and children	4 hours 30 minutes
Middle 4 Classroom, North Kindergarten	8:30 - 11:00 am 14:00 - 16:00 pm 9 June, 2022	Zhang, her assistant teacher and children	4 hours 30 minutes
Upper 2 Classroom, North Kindergarten	8:30 - 11:10 am 14:00 - 16:00 pm 10 June, 2022	Wang, her assistant teacher and children	4 hours 40 minutes

On every observation day, I went to the classroom in the morning. During the beginning informal time for children's breakfast and free play, I set up the video camera in advance at the back of the classroom. I then observed the physical environments within and outside the classroom. I also took notes, recognising that they could help me to understand the environment and context of teachers' practices (Tran, 2018). Meanwhile, the participants, especially the children, became more comfortable with me and accustomed to the existence of the digital camera (Li et al., 2012). During the observation, I played the role between a complete observer and an observer as a participant, as discussed previously. I made a concerted effort not to communicate or interact with the teachers and children during the formal time, in order to avoid disrupting the normal environment (Bogdan & Biklen, 2007). In reality, however, children were unable to completely ignore my presence. For example, the children (especially upper-class children) occasionally came to me for conversations during the five observations. Some expressed interest in my camera, some told me what they were doing and some asked for my help. I did not reject such interactions as they were natural and because they helped me immerse myself in the context, which contributed to my understanding of teachers' pedagogical practices and children's engagement.

To increase the accuracy of data, the digital camera recorded the sessions with technology integration. During the small-learning-area time, my smartphone was also used to record because children engaged with different digital technologies in different learning corners. The duration of each session in these five classrooms ranged from 15 minutes to 45 minutes and the total time of video recordings in each classroom was between 60 minutes and 100 minutes (see Appendix K). Also, during the observations, I continuously took field notes for recording details and unexpected things. This could provide additional supporting evidence and also keep me focused and detail-oriented (Patton, 2015; Bogott, 2017). At the end of every observation day, I wrote in the reflective fieldwork diary for each observed class, which could support later data analysis. In summary, the video recordings, field notes and my reflective diary constituted the observation data.

The second individual interview

The second interview for each of the five participants was conducted following the completion of all five observations and every initial analysis of the observation. This aimed to provide reflections on the teacher's reported beliefs and observed pedagogical practices in relation to digital technology integration. According to Seidman's (2006) three-interview series, multiple separate interviews could allow the researcher to learn more about the interviewee's contexts, experiences and reflections on the meanings they made (intellectual and emotional connections). For example, the post-observation interviews conducted by Cameron (2015) required participants to explain the data from previous surveys and observations with reference to their beliefs and practices of technology use at the primary-grade level. Also, teachers in Tran's (2018) research were interviewed to provide their reflections on their pedagogical practices observed by the researcher, enabling the researcher to understand the relationship between teachers' perceptions and practices.

For this study, semi-structured interview protocols were developed based on the analysis of interviewees' narratives in the first interviews and the observed practices. Firstly, I tried to dig out participants' beliefs emerging from the first interview, such as their views on children's use of digital technologies in kindergartens. Secondly, participants answered questions related to details observed by me in the observation session and interpreted the intentions behind their practices. By delving further into the dialogical process of interpretations with participants, I sought to expand the interpretations (Gillen et al., 2007). The questions for this part were not fully determined until after the initial analysis observation and were expected to evolve naturally out of the discussion. Specifically, I tried to avoid asking leading questions such as 'what was your goal here' and instead prompted the discussion (Gillen et al., 2007). Thirdly, participants were encouraged to reflect on the meanings (e.g. successes and challenges) of their pedagogical practices. More importantly, I also explored the ways in which their contexts (including personal knowledge and experiences, micro classroom environment, meso kindergarten conditions and macro educational policies) shaped their beliefs and influenced their practices. Throughout this process, it was reiterated that the interviews were intended for learning, not making judgments.

The second interview session for each participant lasted for about 40 minutes. The process was the same as the first interview, encompassing device testing, audio recording, note taking and acquiring ongoing informed consent.

Document analysis

During the case study stage, I also conducted the document review and analysis, which consisted of two parts. The first was the analysis of printed materials provided by participating teachers, encompassing the weekly lesson plan or the lesson plans for the observation day, along with the timetable of a day. The second part referred to the review of relevant policies and official documents. This approach could serve as data triangulation for interviews and observations as well as provide further insights into the phenomenon being studied (Merriam, 2009). With regard to the documents for the first part, the purpose was to find evidence of teachers' decision-making about technology integration. These materials were reviewed before every observation to identify whether teachers intentionally integrated technologies into activities, what technologies would be used, whether the technology-integrated activities were connected to other activities and the objectives of these sessions. This data can be treated as part of the observation data. However, not every participant supplied all three materials to me and some materials provided insufficient details. For example, Luo and Wang did not have specific lesson plans for the observation day, whilst Zhang and Wang could not provide the weekly lesson plans for me. In view of this, the second interview could complement the missing information.

Regarding the second type of document, I not only analysed the policies mentioned by the participants from both interviews, but also searched the official website of the Ministry of Education in China to identify technology-related and early years education documents. Additionally, given the case study site (Shenzhen in Guangdong), I reviewed the documents issued by the education department of Guangdong Province. All of these documents were listed in Table 8. These documents were analysed based on the keywords of 'ICT' 'Digital technologies/ technologies'. After identifying contents in relation to the use of digital technologies, I inductively coded them. The examples of codes generated from document analysis can be shown in Table 9. Through analysing these documents, I learnt about the political contexts for early years teachers' digital technology use, such as whether the policies encouraged digital technology integration in early years education and how the digital technology integration was demonstrated officially. This was intended to help me establish if and how the educational policies affected teachers' decision making about digital technology integration.

Table 8. Documents Reviewed

Documents	Issued By	Year
A Guide to Learning and Development for Children Aged 3-6 Years	Ministry of Education, China (MoE)	2012
Guidelines for Kindergarten Education (Trial)	Ministry of Education, China (MoE)	2001
Regulations of Kindergarten Work	Ministry of Education, China (MoE)	2016
Professional Standards for Kindergarten Teachers (Trial)	Ministry of Education, China (MoE)	2011
Teacher Education Standards (Trial)	Ministry of Education, China (MoE)	2011
Ten-Year Development Plan for Education Digitisation (2011-2020)	Ministry of Education, China (MoE)	2012
13th Five-Year Plan for Education Digitisation	Ministry of Education, China (MoE)	2016
Education Digitisation 2.0 Action Plan	Ministry of Education, China (MoE)	2018
ICT Application Ability Standards for Primary and Secondary School Teachers	Ministry of Education, China (MoE)	2014

ICT Application Ability Training Curriculum Standards for Primary and Secondary School Teachers	Ministry of Education, China (MoE)	2014
Teachers' Digital Literacy	Ministry of Education, China (MoE)	2022
The National ICT Application Ability Promotion Project 2.0 for Primary and Secondary School Teachers	Ministry of Education, China (MoE)	2019
Guide to the implementation of ICT Application Ability Improvement Project 2.0 for Primary and Secondary School Teachers in Guangdong Province (Trial)	Department of Education, Guangdong Province	2020
A Guide to the evaluation of Digital Teaching Ability of Primary and Secondary Schools in Guangdong Province	Department of Education, Guangdong Province	2020

Table 9. Examples of Codes Generated from Document Analysis

Codes	**Transcripts**	**Documents**
Encouraging development of children's digital literacies	to initially perceive the relationship between commonly used technological products and their own lives, and know that technological products have both advantages and disadvantages	A Guide to Learning and Development for Children Aged 3-6 Years (MoE, 2012)
Requiring teachers' technological skills	(kindergarten teachers should have) some knowledge of modern information and communication technology.	Professional Standards for Kindergarten Teachers (Trial) (MoE, 2011a)
Emphasising the development of educational resources and platforms	... promote the development and sharing of high-quality digital education resources	Ten-Year Development Plan for Education Digitisation (2011-2020) (MoE, 2012)
Encouraging the integration of digital technologies and curriculum	(teachers should) design technology-integrated teaching activities on the basis of curriculum goals	Teachers' Digital Literacy (MoE, 2022)

3.3.3 Data Analysis

At this stage, I collected and analysed the data from observations, interviews and documents, which constituted an iterative process. Specifically, once the observations on the five cases were completed, one of them was analysed. This was followed by the collection and analysis of the second-interview data for that case. The process was repeated until all of the data for each of the five cases was collected and analysed. Finally, based on the findings of the above analysis, the policy data was collected, reviewed and analysed. The analytic approach and process for each type of data will be clarified in detail in this section.

The observations yielded a range of data, including video recordings and photos that recorded classrooms and classroom activities, documents provided by teachers, my field notes and my reflective research diary during the observation period. For answering the research questions, the video data acted as the main data source and was examined in detail using both inductive and deductive methods. The other forms of data functioned as supportive evidence and were frequently consulted during the analysis stage. In order to explore the role of digital technologies in teachers' pedagogical practices, the interactions between the teacher, children and technologies within each classroom were studied in depth. This was done because these interactions directly demonstrated the practices. The interactions within the classroom tended to be complex as meanings were not only embodied in the spoken language but also in the actions of participants. Therefore, the video data analysis drawn on the multimodal approach was applied to generate a comprehensive and detailed understanding of teachers' practices. My implementation of the multimodal approach was influenced by the work of Flewitt (2011) and Scott (2018). Using this method, these researchers were able to provide thick descriptions of children's digital literacy experiences. They believed that multimodal analysis could capture the complexity of experience by zooming in on moment-by-moment interactions at a micro-level (Flewitt, 2011).

Given the time restrictions of the PhD study, however, such a large volume of video data could not be analysed second by second using the multimodal approach. Thus, I intentionally selected which parts of the data would be analysed and reported in detail. The first step of the selection process was to list all of the activities featuring technology use observed in each classroom, specifying the nature of activities, the types of technologies used and also who was using the technologies (see Appendix M). After reviewing and comparing these elements, I selected nine activities to analyse. This included two small-learning-area sessions (society corner and art corner) from

Case 1, along with one thematic activity and one reading corner session from Case 2. Furthermore, I selected one sharing activity and one thematic activity from Case 3, one child presentation and one role-play session from Case 4, and one whole-class rehearsal from Case 5. A small excerpt from each recorded session was also selected to form the basis of the video data analysis.

When I chose these examples, my first inclusion criterion was that the teacher had a high level of actions and reflections within the activity. This approach aimed to capture the teacher's strategies when integrating digital technologies. This criterion followed Patton's (1987) suggestion to select examples that would generate useful information. Thus, any excerpts where the teacher had no interactions with either children or technologies were not chosen. This did not mean that this kind of data was excluded from the analysis; rather, it was consulted during the analysis of selected excerpts and used as a complementary or contrary point. As my intention was for the examples to represent a range of activity types that could incorporate technology, I used a second inclusion criterion. This guideline stipulated that similar activities across the cases were not repeatedly selected. Although generalisation was not the goal for this study, examining the diverse nature of digital activities could help to generate rich insights when making comparisons across cases. Accordingly, the patterns within teachers' pedagogical practices could emerge from the data and the differences among cases could also be drawn upon to explore influencing factors. As stated, the examples that were excluded from the video data analysis still played a role in drawing research conclusions. Therefore, although only a portion of the data was presented, it is important to highlight that the data analysis relied on the data in its entirety.

The step of the data selection was the initial process of coding the data. The chosen examples were moments that represented the typical practices of teachers. After the data selection, I transcribed and translated these excerpts. They were then presented in primarily visual and verbal formats (see Chapter 5). By breaking down the complexities of the interactions between the teachers, children and digital technologies, I was able to find detailed connections between multiple variables. Through analysing the multiple modes of interactions, my intention was to generate information about a series of inquiries. Firstly, I wanted to learn about how technologies were used in pedagogical activities: Were they used by the children or the teacher? For what purposes? Which functions were employed? Secondly, how the children behaved in the presence of digital technologies was considered: Were they passively receiving or constructively making meaning? Did they cooperate and communicate with peers? How did they respond to teachers? Lastly, I sought to find out about the ways teachers engaged in children's use of technologies: Were they instructing? Did they co-work with children? How did they scaffold? In response to this, the multimodal transcripts were coded with four filters: the subject body (teacher, children or digital technologies), the intra-action (instructing, presenting, asking for help, encouraging, etc.), the object (teacher, children or technologies) and the specific moment. The final codes used labels such as 'teacher instructing a boy to use touch the screen' and 'a girl sharing her taken photo with the teacher'. These details were deductively and inductively coded. Following the discussion about 'good' digital pedagogy in the Literature Review chapter, the deductive coding featured tags such as 'teacher appreciating children's work produced with iPad', 'child asking for help from a peer' and 'IWB presenting an animation for children'. The inductive codes identified interactions specific to certain scenarios, such as 'two children's unspoken agreement to take turns' and 'teacher helping to solve the child's pronunciation problems when voice typing'. These codes were then combined with codes generated from later interview data to form themes and illustrate each individual teacher's approach to integrating technologies into their pedagogy.

The second-interview data was analysed using similar methods and processes to those of the first interview. The distinction was that the purpose of this analysis was not to identify patterns across cases, but to consider each data item. In particular, both a deductive and inductive coding approach were employed as the second interview aimed to complement, extend and interpret findings drawn from previous interviews and observations. Some of the generated codes explained the teacher's decision making, such as 'fulfilling children's digital interests' (Case 1) and 'choosing easy-to-use devices' (Case 2). Others added information for observed episodes, such as 'session theme generated from previous movie watching' (Case 2) and 'parents helping child slide-making' (Case 4). Some extended the contextual information, such as 'cannot afford expensive devices' (Case 3) and 'district education department instructing curriculum' (Case 5). How the documents were analysed were illustrated in 3.3.2 ‘Document analysis’ section. Then, these codes generated from the second-round interviews and documents, along with previous codes, were either categorised into existing themes or produced new themes to answer research questions. For example, the code ‘cannot afford expensive devices’ from the second interview could be merged into the theme of ‘kindergarten funding’, whilst the code ‘session theme generated from previous movie watching’ was combined with observations to develop the theme of ‘interlinked activities’. In specific, the observation data combined with the codes generated from analysis of the first type documents were employed to answer the second research question regarding teachers’ pedagogical approaches of integrating digital technologies. Then, the codes generated from second interviews were attributed to themes across the three research questions, while the codes generated from the official document analysis were providing insights into the third research question regarding contextual factors especially the macro-level context. All of the themes generated in this study can be found in Appendix O Thematic Map.

Based on the volume of data contained within each case study, the findings for each case were reported separately. In the end, comparisons were drawn across the five studied cases and summarised to highlight similarities and differences. For the study as a whole, the findings were reported by research questions, using collated information and data from a diverse array of sources. When answering each research question, the findings were illustrated and interpreted by themes. The final presentation of analyses can be located in the chapter 4, 5 and 6. It is worth noting that when quoting the transcripts of two-rounds interviews, the quotations from the first round interview were marked as like Luo 1 (who participated in both interviews), Bai (who was only involved in the first interview), and the second-round interview quotations were marked as like Luo 2.

In the next section, I will reflect on some of the ethical considerations related to participants' rights and privacy.

3.4 Ethical Considerations

For the sake of the rights and privacy of the participants (Sieber, 1993), several ethical issues needed to be considered. Some have already been discussed in previous sections, as it is not possible to separate them from methodological debates (Scott, 2018). In addition to approaching participants and beginning data collection after gaining ethical approval from the University of Sheffield's ethics review panel, further considerations included obtaining informed consent, keeping confidentiality and protecting the data.

Central to ethical research (Coady, 2010), informed consent ensured that all participants were informed about the purpose of the study, what would be involved, and the potential risks (Greig et al., 2013). In practice, I gave each participant a digital copy of the information sheet and a copy of the consent form, which was digitally signed by every participant and collected by me. Furthermore, Miller et al. (2012) stated that ongoing consent was also important in research. Therefore, at the beginning of the two phases, participants were reminded of their right to refrain from answering any questions and withdraw from participation at any time. They were also notified of the presence of the audio or video recorder and their willingness to be recorded was checked throughout the process. Along with these measures, at the end of each interview and observation I verbally checked with participants whether or not I had understood their views and actions correctly. Additionally, transcriptions were provided to the participants to ensure they were still willing for the materials to be used in the study (Wellington & Szczerbinski, 2007).

The second ethical consideration involved preserving anonymity and confidentiality, namely making sure that the participants could not be identified through any information reported in this study (Cohen et al., 2011). To achieve this, pseudonyms were used for participants and kindergartens, and the names of participants were not contained in the names of files storing all the recordings and materials (Magnusson & Marecek, 2015). Another key consideration was to protect the data. All of the written materials and electronic recordings were stored in a personal computer that was protected by passwords, which can only be accessed by the researcher. After finishing the research, all data would be destroyed to ensure that it could not be obtained by other people.

Aside from these general considerations, some ethical issues specific to this study approach and the pandemic context remained, regarding respecting and doing no harm to participants. Firstly, the power dynamic was a risk to my participants. As demonstrated in 3.2.1, my process for engaging case study participants was facilitated by two intermediaries- an academic expert and the principals. The power relationship between the expert and the two principals was not clearly defined, as the expert did not hold any position in China, and they were simply work partners. However, the informed consent and voluntary participation of principals could still have been influenced by such a collaborative relationship. Thus, I discussed the details of this study with principals, briefing them on each step and making sure that they were fully informed about the participation of their kindergartens. I also emphasised their rights to withdraw at any time. In contrast, the power position principals held over participating teachers was explicit; the participants were recommended by principals to take part in the research, potentially limiting the participants' freedom to say 'no' (Yang, 2021). Therefore, I suggested that principals should assure teachers that refusing to participate in the study would not influence their employment. I reiterated this statement during my first meetings with participants.

From the perspective of relational ethics, the researcher-participant rapport could require significant considerations. Unlike the trusting relationship (discussed in the next section, which focuses more on the 'quality' of the study), the ethical researcher-participant rapport places a greater emphasis on morality and mutual respect (Pollard, 2015). Poole (2021) suggested that participants should be regarded as productive resources and given adequate freedom to express themselves. Due to this, when participants in interviews did not focus on the central topic of each interview, I did not stop or direct the discussion towards the particular experiences. Instead, they were free to discuss any experiences they believed relevant to the research. For example, in the second interview after observation, Wang discussed something that was a repeat from the first interview but gave no specific reflections to the observation, which was not constrained by me. This contributed to the construction of researcher-participant rapport (Poole, 2021). Moreover, in the data analysis, I returned transcripts and initial findings to participants for member checking, which not only contributed to reducing bias but also developed a dialogic and collaborative environment (Ellis, 2007). I gave the ownership of interpretation back to participants, thereby fostering their agency (Poole, 2021).

Furthermore, the pandemic context increased my sensitivity towards the potential risks to participants. Meskell et al. (2021) argued that the spatial restrictions made participants overloaded with online tasks and distance communications. Under this circumstance, there was a concern that the online interviews of this project would further bring about stress and anxiety to participants. In order to ease participants, the time of the remote interviews was solely determined and left subject to change by them. In addition, the phone call function of WeChat was used for the online interview, as I believed non-video communication could make them more relaxed and they would not be required to download a new app. Furthermore, according to Surmiak et al. (2022), technical problems could be an issue for both researchers and participants. Thus, I tended to conduct a device test prior to each interview. Moreover, along with the project information sheet, I notified participants of the time, form and outline of each interview in advance, intending to increase their sense of security and agency during the COVID-19 pandemic (Surmiak et al., 2022). Furthermore, in-person observations posed an increased risk to health, potentially causing teachers additional stress (Mwambari et al., 2021). Thus, ethically motivated, I waited until it was locally ethically appropriate to begin the in-person observation work, although it caused a big delay in the fieldwork. Also, I arrived in Shenzhen City three days prior to the first observation day and did a PCR test every day, the results of which were immediately reported to principals and participants. This was intended to help reduce their worries about health issues for themselves and children.

After outlining the ethical considerations, the next section will clarify the actions that were taken to reduce research bias.

3.5 Notions of Research Bias in Qualitative Inquiry

The concepts of validity and reliability were derived from, and are typically associated with, quantitative research. It was stated that validity in research meant the accuracy and truthfulness of scientific findings and that a valid study should successfully measure what it intended to measure (Brink, 1993). The reliability was determined by the consistency and repeatability of the research process (Selltiz et al., 1976). However, due to the different philosophical positions and purposes of qualitative and quantitative inquiry, there has been ongoing debate around the use of validity and reliability in qualitative research (Noble & Smith, 2015).

Firstly, in the context of assessing the quality of qualitative research, the traditional terminology of validity and reliability were challenged (Leung, 2015). When demonstrating rigour within qualitative research, many qualitative researchers tended to use terms such as truth value, consistency, confirmability, trustworthiness and credibility as alternatives to validity and reliability (Lincoln & Guba 1985; Leininger 1991; Glaser and Strauss 1967). In addition, some researchers proposed other criteria for evaluating the quality of qualitative research. For example, Meyrick (2006) used the criteria of transparency and systematicity for the assessment. Also, Kitto et al. (2008) proposed six criteria, including clarification and justification, procedural rigour, sample representativeness, interpretive rigour, transferability and reflexive and evaluative rigour to assess the quality.

Moreover, debate has also centred around whether there is a place for validity and reliability in qualitative research (Leung, 2015). Mays and Pope (1995) argued that unlike quantitative work, the representations of phenomena in a qualitative study mostly depended on the researcher's subjective judgement and skills, which was often questioned by the research community (Brink, 1993). Thus, demonstrating validity was essential in qualitative research (Brink, 1993). Similarly, according to Denzin et al. (1994), many scholars suggested that validity should not be dismissed but needed to be reconfigured radically (Enerstvedt, 1989; Scheurich, 1997; Smith, 1993). They listed some extended variations of validity, such as crystalline validity (Richardson, 1994, 1997), authenticity criteria (Guba & Lincoln, 1989), catalytic, rhizomatic and voluptuous validities (Lather, 1986,1993) and relational and ethics-centred criteria (Lincoln, 1995). Although no universally accepted terminology and criteria to assess qualitative research exists, many scholars (e.g. Mays & Pope, 1995; Brink, 1993; Noble & Smith, 2015; Silverman, 2009; Porter, 2007) have suggested some approaches to enhance the quality of qualitative research. These approaches, used to address the validity and reliability of qualitative study, are not the same as those used in quantitative research (Brink, 1993; Noble & Smith, 2015). They concentrate on considering the presence of rigour in the methods undertaken, as well as in the interpretations of results (Leung, 2015; Noble & Smith, 2015; Denzin et al., 1994). These approaches include elements such as data triangulation, member checks, thick description, and others.

Many other researchers, however, held contrasting views. Leung (2015) argued that the subjectivity and emotions of both researchers and subjects, which could lead to biased results in quantitative research, were inevitable and even vital in qualitative research adding that some changeability of results was acceptable. Furthermore, Schwandt (1996) suggested that we should reject the regulative criteria of ‘true’ and ‘false’ within qualitative research. In the same vein, Barbour (2001) and Rolfe et al. (2006) argued using any formal criteria and special strategies, such as triangulation and member checks, to judge and ensure the rigour of qualitative research was meaningless. Researchers maintaining this stance believed that it would be impossible to evaluate different qualitative studies with consensus due to its diverse genera and forms (Leung, 2015). Therefore, many deemed that it was unnecessary to discuss issues relating to reliability and validity in qualitative research, particularly for novice social researchers (Thomas, 2013; Leung, 2015).

Given these debates, I will not attempt to demonstrate that my study is valid and reliable. However, I will still present some insights into the rigour of my research, enabling the reader to judge its quality.

The first step I took to ensure the rigour of this study was to pilot-test the protocol before conducting individual interviews. As described in the previous section, two friends of mine who were kindergarten teachers in my hometown were invited to do the pilot interview. Through pilot testing, I received feedback on the intelligibility, clarity and feasibility of the questions, thereafter refining and revising the protocol (Creswell, 2012).

Another key component in a successful data collection approach was the construction of a trusting researcher-participant relationship (Creswell, 2012). Acquiring the trust of the participants allowed the researcher to obtain detailed and authentic information from the participants (Merriam, 2009). In this study, constructing a comfortable environment for interviews and developing familiarity with participants via frequent contact and visits could have contributed to this. The details can be found throughout the chapter.

The next consideration involved ensuring the accuracy of the collected data. In order to do this, all of the individual interviews were audio recorded and observations were video recorded and field notes were employed throughout the data collection, as previously discussed. Moreover, Lincoln and Guba (1991) suggested that the use of member checking could contribute to accurate data. As part of the research process, participants were provided with transcriptions of their statements to review and modify (Wellington & Szczerbinski, 2007; Yin, 2014). Following the data analysis, participating teachers were also given opportunities to comment on emerging findings (Merriam, 2009). Furthermore, the support from a professional translator benefited the translation of key materials, improving the accuracy of the data. However, I understand that the research is always a construction and accuracy is a complicated idea in relation to research data and its interpretation.

Finally, multiple sources of data, encompassing individual interviews, observations and document reviews, were used to validate the findings through triangulation, helping to offer a richer and deeper understanding of the data.

3.6 Methodological Reflections

3.6.1 My Position and Its Relation to the Study

In qualitative research, many researchers have argued that it is necessary to reflect on the role and position of the researcher. Scholars have suggested that a series of factors, including the researcher’s interest, experience, status, power and standpoint, could influence the research process and results to a different extent (Maxwell, 2013; LeCompte & Goetz, 1982). My personal characteristics could have affected participants’ responses and actions, how I designed and conducted the study and also how I interpreted and represented the data. Consequently, it is important that I reflect on my identity and its influences on the study.

First and foremost, my prior knowledge shaped this research. My acquisition of academic knowledge and skills through reading literature, attending training and communicating with my supervisors and colleagues helped me to conduct the research effectively. Such knowledge and skills included but were not limited to: how to develop research questions, how to ethically conduct the research, how to get in-depth details about the research topic through interviews, how observations can answer research questions, how to code and generate themes from the data and so forth. This knowledge formed the basis for conducting the research. Additionally, my knowledge about the research topic assisted when developing research objectives and research questions, as well as providing the foundation for analysis. However, my prior knowledge also introduced challenges, such as my potential judgement on participants impacting the interpretation and presentation phases of the study. For example, I might have compared the pedagogies of participating teachers against the 'good' pedagogies I learnt about through my academic studies, which should be managed with caution. Realising and acknowledging potential implicit normative judgments can serve as the first step to managing them. Secondly, as suggested by Snoek and Horstkötter (2018), I provided participants with opportunities to explain the motivations behind their behaviour, which is evidenced in the second round of interviews. As a result, I gained a better understanding of the reasons behind those observed interactions and avoided judging participants' actions against my pre-existing knowledge. Thirdly, when presenting the findings, I employed descriptive and interpretive language instead of using judgmental expressions, aiming to convey the significance and meanings of the data. In addition, I tried not to predict the outcomes of participants' practices and only report the results I witnessed. Finally, I presented my participants with the analysis to check and validate, which could also help reduce my personal bias (Noble & Smith, 2015).

Another point of note is that the relationship between the researcher and participants was regarded as a significant factor in the study's formation. Many researchers demonstrate this relationship by defining their position as 'in' or 'out' of the world of study (Yang, 2021; Suzette, 2014). For this study, I was initially an insider amongst the participants, as I shared their culture, tradition and educational background. This could have allowed participants to express themselves more comfortably in interviews. Moreover, the familiarity between me and the participants that developed through constant communication benefited the construction of a trusting relationship, which could have promoted teachers' authentic sharing and practising. At the same time, I was an outsider to the realm of early childhood education and kindergartens, as I was not a practitioner. From one perspective, this might have affected my understanding of teachers' expressions, observed teacher actions and children's engagement to some extent. Thus, I further probed and verified my understanding of their responses during interviews to avoid misinterpretation. From another perspective, this position had an advantage for data collection because I perceived myself as a learner. This meant that when communicating with participants and observing them, I did not assume that I knew more than they did about early childhood education. I emphasised this point when interacting with them. Nonetheless, during the research process, I still felt that the implicit 'worship' displayed by some participants towards an 'authority' symbolised my identity as a doctoral candidate. This could have impacted their responses as they may have tried to give more 'professional' answers rather than expressing their actual beliefs. The difference between the way participants attempted to portray themselves versus their authentic actions and beliefs was an unforeseen ethical dilemma. Poole (2021) provided some thoughts on this dilemma which he believed centred around the tension between validity and ethics. Following his relational-ethics-oriented strategies, I deferred to participants' presentations and not my perceived 'truth'. In this instance, the traditional concept of academic quality was reconfigured regarding ethics (Poole, 2021).

3.6.2 Research during the COVID-19 Pandemic

In addition, it is necessary to reflect on the greatest challenge to my research: COVID-19. In 2020, due to the global outbreak of the epidemic, quarantine control became a common measure adopted by most countries. Following the British government's policies, the University of Sheffield issued a series of regulations, one of which was to stop all in-person studies. Any application for ethical review of such research would not be approved. As a result, my statement to the school's ethics committee was not accepted, despite the fact that there were no stringent controls in China at the time and face-to-face communications were the norm. Under such circumstances, the proposed classroom observations could not be implemented (but the interview that had been originally planned as remote could still be conducted). Therefore, I had to adjust my proposal to accommodate a different approach, namely to digitally collect the observation data. In Surmiak et al.'s (2022) study, many researchers used a similar alternative approach in the pandemic context, which was believed to pose both opportunities and challenges to qualitative research (Hall et al., 2021). I planned to post cameras to teachers so that they could video record their own sessions. For the ethics application, I submitted both the original and the revised plans, stating that if the relevant university control was lifted, I would still implement the proposed in-person observations. After this, the ethics application was approved. Fortunately, the control was lifted in 2021 and I was finally able to collect the data under my original plan. However, the lingering effects of the epidemic made it extremely difficult to recruit participants, an issue which was also experienced by other researchers (Howlett, 2021). Due to the mutation of the virus, there were waves of transmission and the occasional random quarantine that came with it in China. Due to this, both teachers and kindergartens were cautious about face-to-face observation. Additionally, the pandemic hindered my ability to visit the field in person, a factor that Greeff (2020) found could make it challenging to build rapport with gatekeepers. As revealed in the section discussing participant recruitment, despite the extensive preparatory work I did to recruit and engage with participants, I failed to find participants who could be observed in person. It was with the help of my supervisor that I was able to connect to an expert who introduced me to kindergarten principals, thereby getting permission to conduct classroom observations. Approaching settings through the introduction of a knowledgeable expert was recommended by many researchers (e.g. Yang, 2021; Guo, 2015).

During the process of data collection, the epidemic once again affected my research. As mentioned earlier, intermittent outbreaks of COVID-19 delayed my observations and led to a decrease in the number of visits. As a consequence, the data collection did not go as well as I had expected. Fortunately, I was still able to collect valuable data from which patterns in teachers' practices have emerged. In summary, the impact of the epidemic restricted the number and diversity of my case studies, which may have limited the scope of my findings. In order to conduct a comprehensive study of this topic, future research involving a broader range of cases is necessary.

3.7 Summary

Within this chapter, a detailed description of the methodology of this study has been discussed. A qualitative case study was employed to explore teachers’ views and pedagogical practices regarding digital technology integration in early childhood settings. The sample for the first phase of the study consisted of 14 teachers from a range of kindergartens in different cities and five of them became involved in the second-phase case studies. The data was collected through two individual interviews, observations and document reviews, which were then analysed using a thematic approach and multimodal approach. In the next chapter, the findings will be presented.

Chapter 4. Findings From Phase One: Individual Interviews with Teachers

This chapter presents some of the findings from Phase One of the study. Some further findings from Phase One, in particular those relating to contextual factors, are presented later in the thesis, in Chapter 6. This allows for analysis across both Phase One and Phase Two. In the present chapter, however, I present findings relating to participating teachers' perceptions and reported practices of the integration of digital technologies in kindergartens.

4.1 Perceptions

4.1.1 Teacher Perceptions: What is Digital Technology Integration in Kindergartens?

The interview data showed that participating teachers' awareness towards technological development and their understanding of technology integration into kindergarten classrooms varied across individuals and times.

When discussing the digital technology that could be integrated into classrooms, participating teachers generally referred to screen-based technologies. Almost every participant described their use of the IWB in the classroom. Additionally, other screen-based technologies, including smart phones, tablets, and computers, also fell into most teachers' perceptions of digital technologies. Furthermore, they placed emphasis on the 'use' of digital technologies rather than the 'integration', without taking the combination of technologies and pedagogies into account. In particular, teachers proposed multiple ways of using technologies in their classrooms, such as presenting multimedia slides through screens, recording children with their smartphones and online communicating with parents. In this context, technologies were perceived more as teaching tools used by teachers than as learning tools used by children.

Moreover, most participants reported on their limited understanding of digital tools beyond these screen-based ones. For example, Yan illustrated this by stating, '*[I] personally know relatively little about other new technologies that can be applied to education*' (Yan). The majority of participants shared the same situation with Yan. However, this did not mean that these teachers knew nothing about new technologies. Some participants like Wang and Lsq indicated their knowledge about AR and VR but did not regard them as the 'mainstream educational technologies' (Lsq). Meanwhile, only several participating teachers (e.g. Ly, Huang, Luo, Ye) demonstrated their familiarity with other types of digital technologies and believed they were important teaching and learning tools.

> *Out of my own interest, I have learned about children's programming, which I believe will be an essential part of early years curriculum.* (Luo 1)

> *I have learned from foreign cases that VR could be used in classes for children to get immersive learning and I valued such adoption of VR in education.* (Ly)

Luo and Ly's narratives showed that their understanding of technology integration involved children's engagement with technologies, conveying that they also perceived technology to be a learning tool. In the same vein, Huang expressed her interest in a more in-depth adoption of technologies in education. She stated, '*currently the digital technology use in our kindergarten is very superficial with few child-technology interactions and I hope new technologies like VR and robotics could be integrated*' (Huang). However, some teachers indicated that their perceptions about the nature and purpose of technology integration did not exist initially but were shaped gradually over time. They believed that their views on technology integration were quite narrow at first but that they had gained a broader understanding through multi-pathway learning. In particular, many participants stated that The National ICT Application Ability Promotion Project 2.0 for Primary and Secondary School Teachers (MoE, 2019) updated their understanding by introducing some conceptual teaching strategies from abroad, such as micro-lecture and digital storytelling. Specifically, Ye acknowledged her changed beliefs about 'who uses technologies' and showed her willingness to allow children to operate technologies in the classroom rather than teachers, which she might not have accepted previously.

4.1.2 Teacher Perceptions: Should Digital Technologies Be Integrated in Kindergartens?

For the most part, teachers expressed quite moderate attitudes about digital technology integration in ECE in the interviews. For these teachers, digital technologies were perceived as 'effective assistance' for educational activities; however, they were 'just tools' and 'not a must-have' (Zhou). For example, several participants mentioned that the digital technology was only a supporting tool:

> *It (the technology) is only a means of support, a means of implementation, to help me with my teaching, or to achieve one of my educational goals, and 'using it' is not an end in itself.* (Yan)

> *In many activities within the daily routine, digital technology is unnecessary. For example, when I host a morning talk, I could just use a normal blackboard rather than an interactive whiteboard to present the theme and process.* (Hu)

The interview data showed that these participants recognised the significance of digital technologies and used them at work, but they still had their concerns about integrating digital technologies into classrooms. Next, participants' attitudes and opinions on whether to integrate technologies will be discussed across three themes: initiative to use digital technologies, recognition of the significance of digital technologies and criticism about technology integration.

Initiatives

As discussed above, the screen-based technologies were accepted by most teachers and they emphasised the 'use' of the devices. Accordingly, their responses indicated strong initiatives to use screen-based technologies. Firstly, some teachers showed their reliance on technologies for office tasks, including managing e-documents, communicating with parents through online tools and online learning. For example, Bai, Wang and Yan mentioned the '*smart phone applets*' and '*computer file-sharing platforms*' that they often used for collecting and managing children's data. Also, for communicating with parents, Zhou expressed that she was getting used to the ‘*time-saving virtual ways*’ (Zhou). Similarly, Zhang reported her initiative to try to organise online parents’ meetings. Many participants demonstrated their appreciation for numerous learning opportunities brought by the Internet. In particular, they reported the range of professional knowledge, encompassing theoretical and practical education knowledge, and/or research and academic writing skills they acquired through MOOCs, WeChat public accounts, professional apps or websites. In addition to office tasks and professional development, some teachers (Shi, Ye, Wang, Yan and Luo) also indicated their efforts to use screen-based technologies for pedagogical practices. This use mainly surrounded searching for, downloading and presenting digital teaching resources.

Aside from the initiative to use digital technologies for assisting work, several participants revealed their initiatives to learn more about digital technologies. For instance, Zhang autonomously acquired editing skills through watching training videos and Zhou attended online courses to learn courseware-making methods. Thus, it can be inferred that their learning focused on technical skills but not technological pedagogical knowledge, which was consistent with their understanding of technology integration.

To summarise, the interviews revealed that teachers had the initiative to use and learn about digital technologies. Furthermore, these initiatives were found to be based on their recognition of the significance of technology.

Recognition of Significance

The study revealed that teachers generally recognised the significance of digital technologies for their work. This could be divided into two categories: benefits for teachers and benefits for children. From the teachers’ perspective, digital technologies were viewed as positive contributors to their work efficiency and professional development. For example, Ly and Huang proposed that the online observation and evaluation system could map out the data of children, thereby improving the efficiency of analysing children’s behaviour and development. In line with this, Wang pointed out the important role of the Internet in searching for and exchanging knowledge, which she believed could reduce her '*workload for lesson preparation*' (Wang). Additionally, the significance of the Internet was reflected in teachers' personal learning. Many participants shared the argument that the Internet allowed them '*to learn anytime and anywhere*', facilitating their professional development (Luo).

Furthermore, teachers generally acknowledged the positive impact of digital technology integration on children's development. Some participants (e.g. Bai, Wang, Lsq) realised the importance of children's digital literacy, which was 'children's ability to learn through the Internet', thereby valuing the role digital technologies could play in its development (Lsq). Meanwhile, more participants recognised the significance in supporting children's knowledge acquisition. In particular, some participants provided specific explanations for why they believed digital technologies could promote the educational goal of children's knowledge acquisition. 'Attracting children's interests' was the first advantage identified by most participants. For example, the 'animated videos' (Shi), the 'cartoon appearance' of the reading robot (Ye) and the 'level design' of some children's apps (Yan) were all perceived to work towards encouraging children's engagements in learning. Secondly, Lsq noted that digital technologies enhanced the 'activity's efficiency and effect', which was a position shared by several participants:

> *For children, I believe the most important advantage (of digital technologies) is allowing them to virtually experience some abstract conceptions through images and sounds.* (Huang)

> *The technologies could present the 'lived' knowledge to children through videos.* (Wang)

> *I think the use of digital technology is mainly to help deliver the key and difficult points of an activity through vivid approaches*. (Lsq)

The above illustrations indicated teachers' acknowledgement of multimodal texts delivered by digital technologies, which they perceived to facilitate children's understanding of conceptual knowledge and even the world.

Only two participants highlighted the potential of digital technologies to facilitate child-centred approaches in daily routines:

> *For example, using the iPad in the art area is more about opening up children's horizons and then as they see more pictures and perceive more, they will be able to personalise their own representations, or think more and create more.* (Luo)

> *In fact, although we frequently communicate with children, we can't know 100% what they are thinking and what things in their world are like, but the digital technologies can help us to understand what children are thinking through new ways like children's photography. When we ask a child 'what do you like', he or she may not say directly, but if we let them get the camera to shoot, he/she may be able to shoot anything he/she likes, then we will know.* (Huang)

The former participant, Luo, connected the use of digital technologies to children's meaning-making. The latter, Huang, realised the potential of digital technologies to assist teachers in giving children a voice and accommodating children's interests. Both were essential elements of child-centredness.

Criticism

Alongside the positives, however, participating teachers have also expressed several negative concerns regarding the integration of digital technologies into kindergartens. Firstly, most teachers believed that digital technologies were not omnipotent and that there were many things in pedagogical practices that digital devices could not achieve. For example, the first-hand and direct experiences that children should acquire in early childhood education could not be gained through digital technologies. In particular, Hu pointed out that even VR could not support children's deep exploration, as it could 'only provide passive experiences but not active, hands-on activities'. Furthermore, participants argued that children needed to construct social relationships and establish emotional communications in the early years. For this, adults rather than digital technologies played the most essential role.

Secondly, every participant drew attention to the possible adverse impacts of digital technologies on children's eyesight and concentration. This was mainly in reference to screen-based technologies. Wang and Luo worried that too much screen time would harm children's eye health. Additionally, participants raised concerns that the entertainment aspect of these digital contents might outweigh the educational function, causing children to become addicted. Teachers were particularly cautious about introducing 'gamified' learning apps to kindergarten children, as they believed doing so would affect children's readiness for school. One participant, Yan, suggested that if children got used to the 'gamified' model of learning, they would feel unadapted and uncomfortable when starting their school life due to the lack of playful and gamified content in school classrooms. Furthermore, Li noticed that some cartoons contained inappropriate behaviour, and she believed that exposure could lead children to imitate this negative behaviour.

Thirdly, teachers reported that the use of digital technologies in classrooms could burden their workload to an extent. The first burden could arise during the lesson preparation stage. For instance, Wang complained about the substantial amount of time she spent searching through the plethora of information online for the educational resources she needed. She also added that when she prepared for a picture book reading lesson for the whole class, scanning the books page by page and then uploading them to the interactive whiteboard cost a lot of time. Similarly, Zhou indicated that it was not easy to produce slides for lessons, especially 'splendid' slides. She even stated that she only made elaborate slides for open class, as it was a time-consuming and energy-consuming exercise. Moreover, participants mentioned that connecting with families via a wide range of digital technologies increased their workloads.

Lastly, several participating teachers expressed their concerns about teachers' over-reliance on digital technologies. Hu specifically pointed to the novice teachers who might not have developed pedagogical skills and therefore would rely more on digital technologies to assist in teaching. She stated that '*some novice teachers relied on pictures and videos to attract children as they had trouble making conversations with children*'. Teachers believed that reliance on digital technologies could harm their creative approaches towards curriculum and pedagogy design. They also worried that it could lead teachers to neglect normal adult-child and peer interactions.

Overall, participants held the view that digital technologies should be used in kindergartens appropriately, with limits and purposes. Bai insisted that digital technologies should only be used when they are irreplaceable in an activity. She explained that digital technologies would be appropriate in two scenarios: when they could improve efficiency and/or when they could promote children's independent explorations. This view aligned with the arguments made by Lsq and Hu, who highlighted the specific purposes of using digital technologies and discouraged superficial and unnecessary applications.

4.1.3 Teacher Perceptions: How should Digital Technologies Be Integrated in Kindergartens?

The interview data generated three themes regarding teachers' understandings about how digital technologies should be used in their classrooms.

Teachers' Confidence in the Pedagogical Use of Digital Technologies

When asked, 'Are you satisfied with your current abilities to integrate technologies into classrooms?', most of the participating teachers said 'yes'. They were confident in their skills, indicating that their knowledge of digital technologies would be enough to support their current teaching.

> *I have no trouble using these (digital technologies) in my classroom and I believe I have mastered them.* (Hu)

> *I did not encounter many difficulties or problems during my attempts to integrate them (digital technologies), but it might be because I just used the general functions.* (Luo)

Even when asked about their possible training needs, several participants responded with 'no need'. For example, Wang stated that she could master the technology through self-study. Similarly, Yan expressed that she did not need further training related to digital technology use, as long as no new devices were integrated.

Conversely, a small group of interviewees acknowledged that they were beginners at integrating digital technologies into kindergartens. They admitted that there were still many things they needed to learn, especially when we discussed the approaches of integrating digital technologies into early years curriculum and pedagogy.

> *Actually, I do not know how to integrate technologies in a very creative yet appropriate way. Sometimes, when I attended open class, I found the selection of technologies and the approach to using them were best suited for the content and lesson goals. However, I cannot achieve this, so I would like to learn more.* (Lsq)

> *Currently, I am still integrating technologies based on my intuition rather than professional knowledge. There is a lack of a clear conceptual framework telling me about what should be involved in the technology integration, how to judge the appropriateness of a certain tool, how to teach using it, how the age of children matters, and so on.* (Bai)

The confusions shared by Lsq and Bai corresponded with the thoughts of Ye, who felt the need to continue learning pedagogies and keep updating beliefs relevant to technology integration. She added, '*It is not adequate for us just to present slides or videos in the classroom. It is still the fixed and old-fashioned way, but we need to explore a more innovative pattern for integrating technologies and pedagogies.*' It appeared that these teachers were less confident in their abilities to integrate digital technologies into kindergartens.

The reasons behind the variations in teachers' confidence levels could be explained by their different understandings regarding technology integration. As Huang said, '*My application of digital technologies is relatively unsystematic and I know little about this field, thereby I cannot have any ideas about it*.' In other words, some teachers' understanding of technology integration remained at the 'use' level but not the 'integration' level. Because some teachers only used technology as a multimedia presentation tool, they emphasised video editing skills and PowerPoint skills. To give an example, Zhang stated that she admired teachers who produced 'beautiful' slides and she was keen on improving her slide-making skills. From their perspective, mastering these technical skills was enough. In contrast, after acquiring more relevant information and knowledge through various approaches, Bai was amongst the small number of teachers who acknowledged the weaknesses in their pedagogical approaches and practices of technology integration. Puentedura's (2006) SAMR (substitution, augmentation, modification, redefinition) model can be borrowed in this context to examine the different levels of understanding. Teachers whose understanding remained at the 'use' level stayed at the Substitution or Augmentation stage, which meant that they regarded the digital technology as a substitute, offering no functional change or minimal functional improvement (Puentedura, 2006). However, the latter group started to progress towards the Modification and Redefinition stages, as they realised the potential of technologies to redesign or even create new tasks.

Digital Activities Should Be Learning-Based

As previously mentioned, interviewees' statements revealed that they prioritised the role digital technologies played in children's knowledge acquisition and cognitive development. Teachers generally held the opinion that, distinct from children's digital activities at home, digital tools should be used within kindergartens for educational purposes, namely '*to learn something*' (Luo). The 'knowledge' teachers perceived did not merely refer to subject knowledge (literacy and numeracy knowledge), but rather the understanding of the world. For example, Shi intended to use multimodal content in her classroom in order to promote children's concrete and vivid cognition of certain objects. Additionally, some teachers regarded the internet and digital tools as sources that could grant them access to libraries of information. As Wang illustrated, the main aim of her Internet use in the classroom was to '*broaden children's horizons and strengthen their cognition of the world they lived in*'. Similarly, Luo emphasised, '*When the points that children were interested in exactly fell into my knowledge blind spots, then the Internet would help them acquire these knowledge points.*' Furthermore, the children's development of learning dispositions was also pointed out by Bai. She demonstrated that the aim of digital activities was '*to promote their (children's) exploration and problem-solving competencies*'. She explained this further by stating, '*When children encounter something unknown, they can ask for help from the digital media and search for it. Then when they have found something but cannot write it* *down, they can learn how to document it using digital technology*.' (Bai).

Children's Exposure to Digital Technologies Should Be Supervised and Controlled by Teachers

As clarified in the previous section, some participating teachers understood that technology integration involved more than just the teachers' use of digital technologies; they recognised that children also played an important role in the process. Children should be given opportunities to operate digital technologies in the classrooms, instead of being '*passive receivers*' (Luo). This technological belief mirrored their general pedagogical belief. They highlighted that in early years education, children should be the subject of activities in order to play the agent role, with or without the involvement of digital technologies. Accordingly, teachers acted as '*server and supporter*' (Huang) and should give less control over children and activities.

Most participants, however, pointed out that the child-led or child-dominated approach was only an 'ideal' design that they were '*moving forward to*' (Yan). They admitted that, in practice, most activities were still teacher-led, especially when they involved digital technologies. Participants such as Luo and Zhou did not believe that young children had the initiative and competence to instigate and advance digital activities. As a result, they believed that teachers should take the role of pre-designing and initiating tasks. Furthermore, teachers argued that adults should supervise and control the process of using digital technologies in classrooms. For example, Luo stated, '*What children do with technologies should be under the supervision of teachers and the tools should be put away at a set time*.' This belief was supported by Ly, who suggested limiting the time and content of children's digital technologies.

4.2 Teachers' Reported Practices

In addition to the attitudes and perception towards the integration of digital technologies, interviewees also reported their practices when integrating digital technologies, including which and how digital technologies were used.

4.2.1 Which Digital Technologies Were Used by Teachers?

In the first-phase interviews, thirteen participants reported their diverse pedagogical approaches to using digital technologies and described the strategies they employed to determine which to use. In general, the technologies that they were using in their classrooms can be categorised into the following three types: a) screen-based devices, such as projectors, the IWB, tablets, smartphones and various software; b) digital toys and learning devices, including the reading robot, learning tablet, reading pen and children’s camera; and c) supporting tools, such as loudspeakers, headphones and microphones. Each of the eleven teachers mentioned using at least two technologies in their practices. Additionally, they stated that determining whether to use technology and deciding which technology to use depended on the individual activity type and theme. In terms of the activity type, screen-based and supporting devices were usually associated with whole-class and group activities. For example, most teachers reported the frequent use of the IWB in educational thematic sessions, sharing activities after small-learning-area sessions and during transitional time (e.g. pre-lunch). For individual activities, however, digital toys and learning devices played a more important role. In relation to the activity theme, multifunctional and integrated devices had a wider range of applications across all areas of learning, whereas single-function tools had more limited uses. On the one hand, the IWB and tablet were reported to support the teaching and learning areas of language, music, art, science and society. On the other hand, devices such as the reading robot and reading pen could only support children's reading and language learning. The ways in which each device was used, as described by specific teachers, have been summarised in Appendix L.

4.2.2 How Were Digital Technologies Used by Teachers?

The study found that the integration of digital technologies in pedagogical practices could be divided into two categories: teachers’ use of digital technologies and children’s use of digital technologies. Teachers’ use was found to encompass two kinds of practices. The first was to present digital content with screen-based technologies, whilst the second was to record children with digital tools.

According to participants, they normally used the IWB or projector to present multimodal texts (with printed texts, pictures, audio and video integrated) in teacher-led, whole-class educational sessions. Almost all of the participants reported similar examples of using digital technologies within their practices. Moreover, most of this digital content was reported to involve predetermined slides, some of which were made by teachers and others that were downloaded from online. In particular, four teachers (Lsq, Luo, Ye, Wang) pointed to the 'micro-lecture' they made and presented to children, which was a pedagogical mode of sharing knowledge through concise and short videos. Luo interpreted that the video content could be '*an episode of animation*' or '*a recorded narration by some people*'. Furthermore, Lsq added that parents could also get involved in the recording to deliver knowledge to children. Alongside predetermined content, Yan's comments highlighted that teachers could also search for '*random*' texts as '*a response to some children's interests during the session*' (Yan) and present immediate results.

In addition, the research indicated that such use of digital technologies could span multiple learning areas and situations. Yang gave the examples that digital presentation could play a role in art activities for displaying artwork and in English activities for spelling exercises. Additionally, Yan proposed incorporating a picture book presentation activity into language sessions and introducing the mathematical concept through the screen. Ly also mentioned presenting the dynamic animation in a music session to show the rise and fall of melodies. In addition to these formal pedagogical activities, teachers also reported that they often used the IWBs to present pictures, music or storytelling to connect and transit between sessions and informal times, such as during pre-lunch periods (Zhou). Participants also pointed out that, despite the frequency of such use, screen time remained brief as it was usually combined with non-digital activities. For example, Shi said that digital content was normally used for the introductory stage of a thematic activity. Similarly, Yang illustrated that digital content only served as an introduction, followed by direct experiences and hands-on practices by children. Along with time control, distance control was also a rule repeated by several participants.

The other mode of use mentioned by all participants was recording children with smartphones or tablets. They recorded children 'from the moment they arrived at kindergarten', including the children's food, naps, learning, play, works and so on (Hu). These photos or videos were shared with parents to keep them informed of the children's activities at the kindergarten, thereby supporting parenting. More significantly, teachers emphasised the importance of sharing the children's play and work with the whole class. For example, Shi stated that this kind of sharing allowed children who were not fully engaged in play and learning to draw insights from the successful experiences of their peers, leading them to reflect on their own behaviour. In addition, these digital records were used by Ye as an integral part of each child's developmental profile, enabling her to track and evaluate the child's progress.

When discussing children's digital experiences in the kindergarten, teachers generally indicated that there were 'quite a few' direct operations performed by children (Zhou). The practices they talked about mainly focused on the digital toys and tools in learning corners, which were close-ended devices with specific functions. For example, in Huang's classroom, children used the headphones, reading robot and reading pen to listen to stories and read picture books in the language corner. Similarly, Shi reported children using the audio recorder to record their own storytelling for sharing with peers. Moreover, children normally operated the learning tablet for mathematical logic exercises. Furthermore, both Huang and Zhang discussed the children utilising the children's camera to capture moments of 'daily life'. These teachers agreed on the high-level autonomy of children when using these devices. In addition, this study found that such autonomy relied on the quality of operational skills delivered by teachers. Most participants reported the process of introducing new technology to children as follows: they initially instructed and explained the technology use to the whole class, then encouraged children to independently use the technology, during which stage teachers observed and intervened when needed. This suggests that teachers exhibited more 'child-centred' beliefs in these digital practices. In addition to children's autonomy, Zhang also revealed that she built on children's prior digital experiences and placed emphasis on peer collaboration and social interaction during the children's use of digital technology. Some teachers also indicated their low-level involvement, believing that '*the operation was easy enough for children, so teachers' in-depth involvement was not necessary*' (Wang). However, teachers' descriptions and comments demonstrated that most of these technological practices revolved around children's consumption but provided minimal creative engagement.

Additionally, children were reported to have less access to screen-based devices in the classroom. With regard to the IWB, only four participants described children touching the screen or writing and drawing on the screen under the supervision of teachers, whilst others stated that they did not intend to allow children to operate the IWB. Unlike the IWB, which was a popular teaching device in kindergartens, tablets were relatively ‘rare’ devices and only five participants reported having access to tablets in their classrooms. Alongside their own use of the tablet to record children or present them with pictures and videos, four of the five participants (Luo, Wang, Bai, Lsq) referenced the children’s use of the tablet in the classroom. This was only based around its basic functions, such as taking photos, recording sounds, taking memos and searching the internet. Lsq gave an example of a thematic activity within the Society development area. In this situation, teachers asked the children within each small group to use the iPad to audio record ‘*what they wanted to say to the delivery guys*’, subsequently sharing these recordings with the whole class. Furthermore, Wang stated that before children conducted their own experiments, she instructed them to use the iPad camera to scan the QR code on experiment materials and watch the operational videos. In addition to these basic uses of the tablet, Bai highlighted the range of apps available for children’s learning, such as the reading app, e-book making app and digital storytelling app. She argued that the creative apps could be employed by children between the ages of five and six, noting that the younger children might not be competent enough to use them. Bai was the only participant who mentioned digital technologies in terms of the creative practices of children. Furthermore, as with the process for introducing close-ended technologies discussed previously, teachers’ early guidance and instructions, as well as peer collaboration during children’s use of tablets, were also emphasised by the four participants.

In addition to these direct applications of technologies by children, four participants stated that the children in their classes were involved in the kindergarten’s STEM programmes, in which robotics programming was used to develop children’s computational thinking. However, they all expressed that such programmes were conducted by special teachers in the kindergarten. As a result, they were not responsible for such programmes and thus were not aware of the specifics.

4.3 Summary

Phase One of the study was the individual interview of fourteen participants. In summary, the most important findings of Phase One discussed in this chapter were teachers' reported perceptions and practices of integrating digital technologies.

The study found that **participating teachers' understandings of the digital technologies that could be integrated into kindergarten classrooms varied**. Whilst the majority of participating teachers perceived the digital technologies in ECE to be screen-based technologies, such as the computer, IWB and smartphones, several participants indicated their knowledge about digital technologies beyond screen-based ones, such as AR, VR and children's programming tools. In a similar vein, most teachers viewed technologies more as teaching tools used by themselves than as learning tools used by children. Only a few took children's engagement with digital technologies into consideration.

The summary of findings about participating teachers' perceptions on whether digital technology should be integrated begins by addressing those with **moderate attitudes**. For these teachers, digital technologies offered effective assistance for educational activities; however, they viewed them as just tools and not a 'must-have'. These participants recognised the significance of digital technologies in improving their work efficiency, benefiting their professional development and facilitating children's understanding of conceptual knowledge about the world. However, they also foresaw several potential problems regarding the integration of digital technologies into kindergartens, such as children's lack of first-hand experiences and social-emotional communications, the possible adverse impacts on children's eyesight and concentration, the increased workload and the negative implications of an over-reliance on digital technologies. For the most part, participants held the view that digital technologies should be used in kindergartens appropriately, with limits and educational purposes. Also, some participants insisted that children's exposure to digital technologies should be supervised and controlled by teachers in the classroom.

Furthermore, the first-phase interviews revealed that the digital technologies used in classrooms could include the following three types: a) **screen-based devices**, such as the projector, IWB, tablet, smartphone and various software; b) **digital toys and learning devices**, such as the reading robot, reading pen and children's camera; and c) **supporting tools** such as the loudspeaker, headphones and microphone. In addition, interviewees reported that the screen-based and supporting devices were usually associated with whole-class and group activities, whilst digital toys and learning devices played a more important role in individual activities. Furthermore, from the perspective of activity themes, multifunctional and integrated devices had a wider range of applications across all areas of learning, including language, music, art, science and society, whereas single-function tools were more limited in their use. Specifically, the interview data showed that teachers tended to present digital content to children using screen-based technologies for knowledge transmission and record children with digital tools. Meanwhile, children were reported to have less access to screen-based digital technologies within the classroom and they were provided with opportunities to use digital toys and close-ended learning tools in learning corners.

Further findings from Phase One of the Study, in particular those relating to contextual factors, are discussed alongside Phase Two findings relating to contextual factors in Chapter 6. Next, however, Chapter 5 foregrounds some important findings of Phase Two of the study - the Teacher Case Studies.

Chapter 5. Findings From Phase Two: Teacher Case Studies

This chapter presents some of the findings from Phase Two of the study. As noted, some additional findings from Phase Two, in particular those relating to contextual factors, are presented in Chapter 6 later in the thesis. This allows for analysis across both Phase One and Phase Two. In the present chapter, however, I present findings relating to teachers' approaches to integrating digital technologies into pedagogies in detail, case by case. Within each case, the information about the teacher (including beliefs and practices), classroom and observed activities is introduced first. Then, the selected vignettes of observed sessions are described and analysed moment-by-moment to illustrate interactions between the digital technology, teacher and children. Finally, the analysis and discussion of teacher's pedagogical approaches when integrating digital technologies are presented, which are drawn across the data from the observation, interview and document review.

5.1 Case 1: Luo

5.1.1 Introducing Luo (Beliefs and Practices) and Her Classroom

Luo was the teacher of an upper class with children aged between five and six years old. Luo's comments during interviews suggested a positive view of digital technologies. For example, she stated, '*I believe it is very necessary to integrate technology as a kind of modern teaching-assistant tool, as I have benefited from it.*' This positive attitude not only reflected her active use of digital technologies in pedagogical practices, but also her initiative to learn about digital knowledge and skills, such as children's programming and video editing. Meanwhile, as the leader of the ICT study-research group in this kindergarten, Luo was skilled at operating digital technologies, which was embodied in her own and her colleague's words:

> *I used digital technologies relatively more often than my colleagues in daily practices ... I believe my current abilities of applying technologies could be enough to support my pedagogical practices.* (Luo 1)

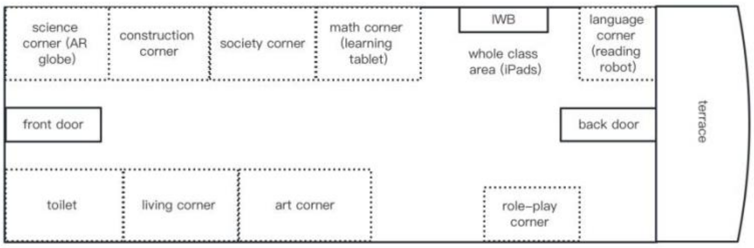
> *In our kindergarten, it is Luo that masters more skills of various software and is the*

most competent teacher in technologies among us. (Shi 1)

Luo's classroom was technologically rich. Both the quantities and types of digital technologies in Luo's classroom were more abundant than those in other classrooms observed in this study and far surpassed normal provisions in China. According to interviews and observations, the most common digital tool in kindergarten classrooms was the IWB, but that did not mean that it existed in all the settings involved in this study. For example, the participant, Chen, reported that the only digital technology in her classroom was a television. The situation reported by Chen was consistent with the results of others' survey research, which revealed that the traditional digital devices, such as TVs, DVDs and computers, were still dominant in kindergartens (Luo et al., 2020; Li, 2019). According to Liu and Chen's (2019) work, the TV, DVD and computer rates reported by participating teachers were all over 90%, whilst the IWB was only 61.2%. However, in Luo's classroom, it was observed that there was not only an IWB, but also mobile and new technologies, including four iPads, a learning tablet, reading robot and AR globe. In particular, the reading robot and AR globe were selected and purchased by Luo on her own initiative after applying for funding from the kindergarten.

According to the observation of the physical environment, it was found that the placement of devices accommodated the different needs for individual, small group and whole class activities. This was in accordance with the checklist for identifying exemplary uses of technology and interactive media for early learning (Pennsylvania Digital Media Literacy Project, 2012). In the middle of the classroom, there was space for the whole class, in front of which the IWB was placed on the wall. This area was for teachers to conduct small group or whole class activities. Four iPads were located above a shelf situated in the whole-class area. Additionally, other technologies were also distributed in various learning centres alongside traditional materials. For example, the reading robot was put in the language centre beside many books. The learning tablet was placed on a table in the maths corner, whilst the AR globe was in the science centre. Additionally, there were other small learning areas across the classroom, including the construction corner, living corner, role play corner and society corner. In the terrace outside of the classroom, some other areas existed, such as the plant corner.

Figure 4. Layout of Luo's Classroom



According to the distribution of these digital devices, it could be deduced that technologies were integrated across multiple learning areas. In practice, Luo embedded technologies implicitly into daily routines, which was in accordance with previous arguments that digital technologies should be integrated as an everyday tool to pedagogically facilitate children's experiences (Rivera et al., 2002; Johnson & Highfield, 2017).

According to Luo, she generally used the IWB in whole class teaching, whereas iPads would be integrated into small group activities and individual learning. Furthermore, Luo described that she frequently used her own smartphone to record children's experiences. The image recordings would be shared amongst the whole class or with parents through the WeChat chat group and the setting's WeChat Official Account. Moreover, in this class, digital technologies could be integrated into all of the five content areas of the Chinese ECE curriculum (health, language, society, science and art), as well as all kinds of activities.

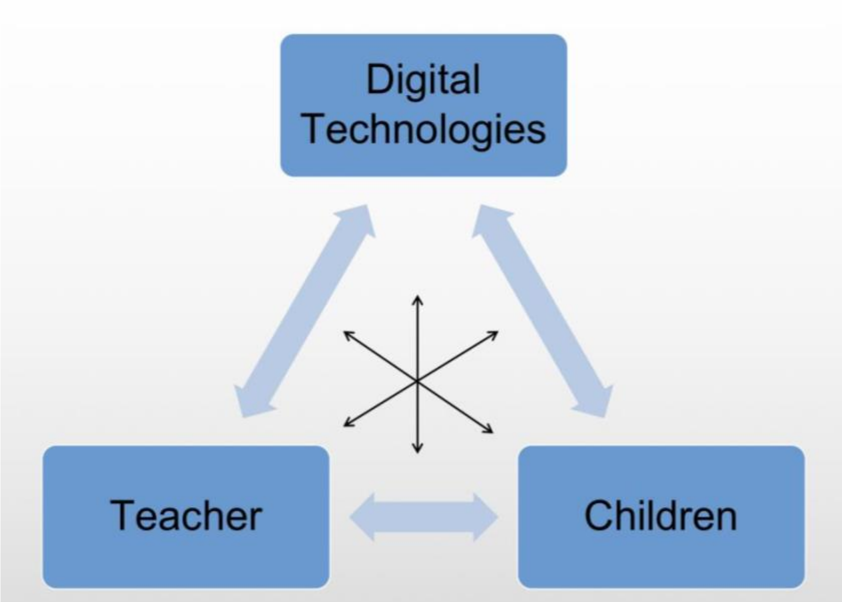
Four sessions with digital technology use were observed in this classroom, including a small-learning-area session, a sharing activity, free-play time and a transitional activity. During the small-learning-area session, children were observed playing and learning in pairs across various learning corners and using some of the digital technologies. In particular, four iPads were distributed to children: one was used to map out the route (see Vignette 1); two were used to present the pictures (see Vignette 2); and one was used to deliver the instructions for building with Lego. These children could use the basic functions of the technologies and demonstrated strong peer support. This may have been because some children frequently and expertly used touch-screen devices at home. This was supported by Luo's first interview, in which she stated, 'T*he children in my class have been exposed to digital technologies at home more or less, such as smartphones and tablets.*' Moreover, children's digital skills may have derived mostly from teachers' guidance, as Luo indicated that she has introduced the skills of using the iPad for voice searches to children. However, Luo demonstrated limited digital intervention and only supported the children when needed.

Subsequently, a sharing activity following the small-learning-area session was observed. Luo presented photos of children's working processes and outcomes on the screen, and several children were invited by Luo to introduce their work. During the process, Luo guided the whole group to reflect and comment on these works. Then, in the free-play time, the iPads were used autonomously by children. I observed that children took the initiative to use iPads for voice searching on different topics, such as 'how to construct a castle with blocks' and 'pictures of astronauts and outer space'. Finally, during transitional time, the IWB acted as a music player by the teacher. The music worked either as a backing track for children to dance to or just as a means for calming children down.

5.1.2 Description and Analysis of Observed Child and Teacher Practices

In this section, I present the vignettes selected from observation sessions and analyse them with a multimodal approach. Before that, an overview of the session that the vignettes are drawn from is provided. Based on the video data analysis of selected vignettes drawn on multimodal approach, the digital technologies' roles, teacher's actions and children's interactions are identified separately. However, it should be noted that the interactions between any two of the three elements can still be related to the third one (see Figure 5). This applies to all the five case studies.

Figure 5. Representative of Interactions among Digital Technologies, Teacher and Children within a Classroom.



Activity 1: Small-Learning-Area Activities

Overview

There were several learning corners in the classroom, within which various open-ended materials were provided. In their daily routines, there was a fixed period when children could enter these learning corners and use these materials as they wanted. This kind of activity was called the small-learning-area activity. On the observation day, before the small-learning-area session, Luo conducted a short talk with the whole group. She guided children to review how to voice search with the iPad and then assigned children in pairs to different corners based on their own interests. Luo asked about children's preferences, such as 'Who would like to look after the plants?' and the children then raised their hands and were picked by Luo. Some technologies that existed in learning corners, such as the reading robot (language centre) and AR globe (science corner), were not used. However, the iPads were used as an important tool and learning focus in this session, which reflected Luo's previous words from her talk. Specifically, the learning focus for children was to use voice searching for solving problems. Thus, four children went to the art corner with two iPads, as they planned to search for pictures of tigers that could be copied.

Another two children took an iPad and entered the society centre, and Luo stated that she would work with them. They used the map app on the iPad as a reference to draw the route from their kindergarten to the future primary school. Meanwhile, two boys created cars with Lego using digital instructions on an iPad, whilst another two boys went to the maths corner to play with the learning tablet. Teachers walked around observing, recording and intervening as needed throughout the whole session.

Vignettes and Analysis Drawn on Multimodal Approach

Vignette 1

Alice and Bob walked into the society centre with an iPad. Their task, given by Luo, was to draw a route from the kindergarten to their future primary school with the help of the map on the iPad. Alice tried to touch the screen but was not sure what to do, so Bob helped to touch the search box and told Alice, ‘You should touch this first.’ When the keyboard appeared on the screen, Bob instructed Alice to touch the voice typing button in the bottom left of the keyboard. Then, Alice stated the name of their future primary school ‘Hua Xing school,’ but neither words nor the map appeared. Alice and Bob looked at each other in confusion and Alice said, ‘Why is there nothing?’

When Luo witnessed the situation, she went over and crouched down, asking, ‘Have you forgotten how to do voice search?’ Alice answered, ‘I searched just now but nothing appeared.’ Luo then asked, ‘What is the reason for this?’. Bob said, ‘I don’t know.’ After this, Luo asked, ‘Isn’t it your first day using it, right?’ and Bob replied, ‘I have an iPad at home and I can use it.’ Thus, Luo pushed the iPad towards Bob and suggested he tried voice searching. Luo helped to touch the search box and press the voice typing and Bob spoke out ‘Hua Xing school.’ However, the words appeared in the search box as ‘Hua Xin School.’ All three of them laughed. Luo gently tapped Bob and said, smiling, ‘Your pronunciation could be more accurate.’ Luo continued by saying, ‘All right, let me show you how to do it, okay?’

Next, Luo touched the iPad and verbally instructed step by step until the map appeared. After that, Luo asked Bob, ‘What do you think could influence the results of voice searching?’ and Bob answered, ‘It might be the voice.’ Luo furthered the conversation by saying, ‘Yes, do you mean the volume?’ and Bob nodded. Luo encouraged them both to try it for themselves. Thus, Alice repeated the sequence, touching the Map app, search box and voice typing key. She then voiced ‘Hua Xing School’ and the place was presented on the screen. Luo surprisingly pointed to the screen and yelled, ‘You see, you did it!’ Alice applauded happily for herself, whilst Bob was eager to get the iPad and said, ‘Let me see!’ As the two children were then immersed within the world of the map, Luo left them alone after taking a photo of them.

Vignette 2

Cathy and Daisy went to the art centre with an iPad and were told by Luo to search for pictures of tigers and then draw tigers on the paper. Another pair worked alongside them, holding onto the other iPad. During the process, Cathy kept hold of the iPad, as Luo placed Cathy in charge of this activity. In the first five minutes, they got the paint, brush and paper ready and also put on aprons. Cathy turned on the iPad and touched one app, but a blank webpage appeared. Cathy asked for help from Luo by saying, ‘This webpage cannot be opened,’ so Luo walked closer and said, ‘This is not what you need to open, where is the browser?’ Cathy appeared to have a sudden moment of enlightenment and touched the Safari app. However, the search page did not appear. As a result, Cathy walked to the other group for some advice but found that they had encountered the same problem. After constant attempts failed, Cathy had to turn to Luo for help again. Luo took the iPad and touched the screen several times, stating, ‘The WiFi was not connected which cannot be solved by you.’ Then, Luo pulled the child who held the iPad in the other group closer and said, ‘I will teach you. You see, this is WiFi, press the connection and now it joins the WiFi. Solved!’ Afterwards, Cathy tried to voice type ‘Tiger’ but was not successful, so she requested help one more time. She asked, ‘Mrs Luo, it still doesn’t work, why is it?’ A boy passing through suggested, ‘You need to speak louder.’ When Luo picked up the iPad and examined it for a while, she stated, ‘It is still a connection problem, perhaps you will have to draw the tiger without reference pictures.’ She kept trying to touch the screen as she was speaking and suddenly she found that it worked. Therefore, Luo pushed the iPad to Cathy and said, ‘Ah, it’s okay now, the pictures are coming up.’ Finally, Cathy put the iPad up on the desk and started drawing. Luo left.

What Roles Did Digital Technologies Play in Observed Vignettes 1 and 2?

Digital technology was used as a learning target. In vignettes 1 and 2, the technology was integrated into classroom activities as one of the learning objectives. As Luo commented in the first interview, children's digital competencies were '*necessary to prepare them for living in current society*' (Luo 1). Specifically, Luo organised this session with one of the purposes being to make children master the skills of online searching by voice typing.

This purpose first showed up in Luo's lesson plan for that day, which clearly stated that one of the learning objectives was 'to exercise voice searching skills'. Furthermore, in the morning talk session on the observation day, Lou guided Cathy to review the points of voice searching that she had learnt from the previous day's small-learning-area activities for the whole group. Luo further suggested that all of the children solved problems through voice searching. Then, as seen in Appendix N, during the activity time, Luo intervened and supported the two groups (Alice and Bob, Cathy and Daisy) several times to promote the children's development of voice-searching skills. Lastly, in the sharing time after this activity, Luo also directed the whole group to think about the influencing factors behind the voice recognition problems, thereby allowing children to gain an understanding of the knowledge related to voice searching.

Digital technology was used as a presenter. In the above vignettes, the iPad was used as an information carrier to present digital content. This was the most fundamental function of technologies, specifically screen-based ICTs. In particular, the digital content presented by technologies was used as a stimulus around which children produced their works. This was in line with the findings of Chung and Walsh (2006), who revealed the role of digital text as an object of reference. For example, in vignette 1, the iPad presented the map, following which Alice and Bob could draw the route from the kindergarten to the primary school. Also, in vignette 2, the pictures of tigers were delivered by the screen, which was referred to by children to produce their works of art.

Digital technology was used as a site for interactions around digital content. Furthermore, technologies and the digital content embodied in them encouraged interactions and discussions not only between peers but also between children and the teacher. This role of technology was also reported by Burnett (2010), who positioned technology as a site for interaction around the text. Firstly, there were discussions around the digital device itself. For example, in the activity that vignette 1 derived from, Alice and Bob had a conversation about whether the iPad was a real Apple or a fake one as they failed several times to do the voice searching. In the end, Luo proved its authenticity by showing children the Apple logo on the back. Secondly, there were also interactions around the process of using technologies. For example, in vignette 1, Luo would tap Bob and praise Alice to guide their operating actions. Meanwhile, in vignette 2, Cathy would walk up to the other group to talk about their common problem: the frozen website. More importantly, it was observed that children had many conversations and collaborations around the digital content presented by the technology, which was consistent with Burnett's (2010, p.257) recognition of 'the displayed text providing a shared visual stimulus around which children collaborate'. The two children in vignette 1 discussed the map on the screen, stating things such as, 'Does this look like a piece of meat to you? I really want to eat it', 'This is the police station,' and 'It looks like an ice cream!' In addition, there were collaborations. For instance, when they started drawing, Alice suggested that Bob should write down the place names whilst she drew the shape, as she could not write.

Teacher's Actions in Observed Vignettes 1 and 2

In the small-learning-area activities, the teacher usually played the role of supporter. The above vignettes showed that Luo only intervened and scaffolded when children asked for help or she noticed their need for help. According to guided interactions developed by Plowman and Stephen (2007), Luo's proximal guided interactions included observing, recording, inviting to dialogue, modelling, instructing, explaining and emotionally involving.

Observing. During the whole session, Luo kept observing and walking back and forth around the classroom with a short stay at some learning corners, as seen in multimodal transcripts (Appendix N). For example, in vignette 1, when Luo noticed Alice and Bob could not perform the task by themselves, she intervened through various approaches that will be discussed below. However, in vignette 2, it was observed that Luo scaffolded in response to the request from Cathy and not from her own observation. The rationale behind the different degrees of observation was that it was the children's first time carrying out the kind of activity in vignette 1, which required more scaffolding from the teacher, whilst vignette 2 was a continued activity from the previous day. Luo's words in the morning talk could explain this:

> *Now, I need two children to work with me in the society centre. We will find the primary school on the map through voice searching on the iPad and then draw a route from our kindergarten to the school. Who would like to join me?*
>
> *Cathy, you have searched for the tiger pictures online and haven't completed your drawing, right? (Cathy nodded.) So, you can now continue your work and choose a partner who you would like to lead and teach.*

Notably, along with observing, teachers (Luo and the assistant teacher) kept recording children and their work by taking photos with their own smartphones. They recorded not only during digital activities but also during non-digital ones.

Inviting to dialogue. Normally, the first step of Luo's mediation was asking children about their progress. The first two multimodal transcripts in Appendix N showed that in the society-centre activity, Luo started intervening by asking questions, such as, '*Have you forgotten how to do voice searching?*', '*What are you searching for?*', '*Can you begin now please*' and '*Have you guys succeeded?*'. Besides these inquiries about progress, Luo also asked about specific things, encouraging and redirecting children to think in more depth. Specifically, Luo asked Alice and Bob about the reasons for the search failure and the factors influencing the search results.

Modelling. Luo also used modelling to promote children's operational skill acquisition, which usually came in the form of verbal instructions. For instance, in vignette 1, Luo showed every step of searching for a place through voice typing and verbally demonstrated these steps. Also, in another instance that was not contained in vignette 1, Luo used two fingers to zoom in and out of the map and told the children how to do so. Then, in vignette 2, Luo modelled and explained to children how to connect to WiFi. All of the modelling actions primarily aimed to prompt children's development of digital skills.

Instructing for results. Instructing was the most frequent interaction between the teacher and children. As mentioned above, some verbal instructions could accompany the teacher's modelling operations. Moreover, Luo instructed verbally and used gestures such as pointing to guide children's operations. For example, when the place was searched for, Luo told children how to draw the route: '*You need to draw these arrows down and make these streets clear to show how to go from this point to that point.*' The instruction helped Luo maintain the directions for finalising the work, which was consistent with Undheim and Jernes's (2020) argument.

Explaining. In the society activity, Luo also explained every street and place on the map to Alice and Bob, allowing them to understand what constituted a route. Furthermore, in the art activity, when the website on the screen was frozen, Luo explained that the reason for this was connectivity problems.

Emotionally involving. More importantly, Luo demonstrated her emotional involvement by giving feedback, showing enthusiasm and listening to children. For example, when Alice searched for the place successfully, Luo expressed her excitement by exclaiming, '*You see, you did it!*' which enthused Alice so much that she applauded for herself (see Appendix N-1-Lines 47&48). Also, Luo provided feedback such as 'smiling', 'light tapping' and 'laughter,' as well as phrases such as, '*How clever you are*,' in recognition of children's efforts. Furthermore, Luo listened to and respected children's ideas. When Alice and Bob doubted the authenticity of the Apple iPad, Luo did not ignore this idea but took off the iPad case and showed them the Apple logo. In addition, when Bob indicated that he could use the iPad as he had one at home, Luo naturally pushed the iPad to Bob and encouraged him to give it a try (Appendix N-1-Line 15).

Children's Actions Observed in Vignettes 1 and 2

Interactions with digital technologies. In small-learning-area activities, digital technologies were usually used by the children, thus children's interactions with technologies were more frequent than interactions with others. In the above vignettes, due to the predetermined activity content and aim by the teacher, namely operating the online search through voice typing on the iPad, the interactions between children and technologies were limited to looking at, touching and speaking certain words out to the screen. During these processes, children were learning and practising the pre-established steps of voice searching and the search targets were previously set by Luo, not generated by the children. Accordingly, children's use of digital technologies in the above vignettes was close-ended in a passive and consumer-based pattern.

Interactions with peers. Despite the passive interactions with technologies, this did not mean that children had no autonomy. There were many instances of interaction and cooperation between peers, as Luo assigned them to work in pairs. Firstly, the physical interaction was reflected in children's alternate use of the iPad, which was evident in vignette 1. Although there was no prior agreement, Alice and Bob had the tacit understanding to take turns with the iPad, so no dispute occurred. However, in vignette 2, the iPad was kept and controlled by Cathy throughout the session, whilst Daisy just looked at it now and then. This was because Luo had assigned Cathy as the 'teacher' to teach Daisy the skill of voice typing. Along with the physical interactions, the children initiated many conversations. The above vignettes showed strong peer assistance, which was embodied in children's oral instructions. In vignette 1, Bob frequently instructed and helped Alice. For example, at the beginning of the session, Bob directed Alice to touch the search box and voice typing key successively (Appendix N-1-Lines 1&4). This was because Bob had experience of using an iPad at home whereas Alice did not, which was evidenced by their conversation. Bob told the teacher, '*I have an iPad at home and I can use it*.' Moreover, in a later verbal exchange, Bob asked Alice if she had an iPad at home and she stated, '*I don't have an iPad as my mom doesn't allow me to use it*.' Similar verbal instructions also appeared in vignette 2, in which a boy passing by instructed Cathy to '*speak louder*'. In addition to verbal instructions, the conversations between peers also included sharing and discussing. For example, in vignette 1, Alice and Bob spontaneously shared their ideas about the shapes on the map, describing them as like '*meat*' and '*ice cream*'. In addition, when Alice was drawing, she asked for Bob's suggestions by posing questions such as, '*Is this tree right?*' and Bob would nod and say '*yes*'. Meanwhile, when Cathy and Daisy encountered technical problems, the first people they turned to for help were their peers in the other group, not the teacher. After discussing their similar situations and confirming they were unable to solve them, they asked for Luo's help. These child-initiated conversations illustrated not only the children's social development but also their autonomy.

Furthermore, there were also shared emotions between peers. For example, Alice and Bob would laugh together when they found something funny on the screen, and they also expressed happiness and surprise when they located their future primary school on the map. Also, in the art activity, the two groups would share anxious and confused feelings when the websites were frozen.

Interactions with the teacher. Moreover, in the above activities, even though there were instances of the children asking for teacher's help, the interactions between the teacher and children were mainly dominated by the teacher. Children were only instructed and guided to think by the teacher, which was also reflected in the discussion of the teacher's actions.

Other: Drawing. Finally, both of the above activities required children to draw certain objects: the tiger and the route. This traditional activity was combined with the use of digital technologies, which was in alignment with previous research (e.g. Fleer, 2020; Arnott, 2016).

5.1.3 Analysis and Discussion of Luo's Pedagogical Approaches

Drawing on observations and following interview data, this section analyses and discusses the teacher's pedagogical approaches to integrating digital technologies.

Selection

The teacher intentionally decided to purchase and integrate digital technologies. According to interviews with Luo, her objectives were complicated and could be characterised as two needs and two goals.

Firstly, Luo's initiative to allow children access to technologies in the classroom was motivated by the need to reduce teachers' workload. In particular, Luo applied to purchase several digital devices along with other traditional materials to equip learning corners, the purpose of which was to solve the problem of the low teacher-child ratio in small-learning-area activities. Because digital devices tended to have clear instructions for children to use them independently, teachers could cover the whole class. Due to this, teachers usually intervened less in certain learning centres. Additionally, Luo integrated digital content into whole group sessions as it helped to release some pressure for lesson preparations. She explained that the digital content could sometimes replace physical props. For example, she stated, '*I don't have to print the pictures in advance for the session as I can just present them on the whiteboard*' (Luo 2).

Furthermore, teachers integrated technologies to meet children's interests and open their eyes to the world. Luo demonstrated that children could spontaneously initiate digital ideas in some cases, and she assisted in achieving these ideas. She gave an example that in the series of sessions of 'Movie Watching', some children proposed a seating system that mirrored the experience of purchasing movie tickets in real life. Based on this idea, Luo used a programme to produce a seating system and equipped it onto the IWB for the whole group of children to select their seats. Interpreting her motivation, Luo noted that this session could allow the children who proposed the idea to feel a sense of achievement and the other children could also engage positively with the activity. In addition to the whole group session, children's individual interests in digital devices could also be fulfilled solely by the teacher. For instance, when a child showed interest in the Digital Piano app, Luo assisted in downloading the app and individually guided them on how to use it.

In addition, Luo's selection of digital technologies was usually connected with curriculum and children's developmental goals. Its use firstly supported the achievement of specific session goals. Discussing these issues, Luo clarified that the session goals of vignette 1 were not only enhancing school readiness but also developing children's 'sense of space'. Thus, the integration of the digital map could significantly facilitate the goals, particularly the latter, which could be regarded as the 'immediate goals' proposed by Entz and Galarza (2000).

More importantly, throughout the second interview, Luo emphasised the development of children's digital literacies. However, rather than focusing on the acquisition of operating skills (immediate goals), Luo placed more value on children's willingness and initiative to use digital technologies in classroom activities, as well as the transferability of these abilities to their normal lives. This accorded with one of the four learning areas supported by interactions with technologies proposed by Plowman et al. (2012, p.36), namely 'understanding the role of technology in everyday life.' Specifically, Luo intended for children to learn how to autonomously solve problems in real life with the help of technologies, using methods such as voice searching pictures, referring to the digital map, collecting online information and so on.

Use and Integration

Interlinking activities. The technology-embedded activity was not an isolated activity and was interlinked with other activities. From the observation of the classroom environment, the one-week schedule taped on the door showed 'Our Primary Schools' as the common theme for the week. Under this theme, many small-learning-area activities and thematic activities were relevant and interlinked, such as the language centre activity 'The primary school I have known,' the thematic activity 'My alumnus of primary school' and so forth. Thus, from perspectives of theme and content, the society activity in vignette 1, in which children created a route to the primary school, was part of the common theme and interlinked with a range of activities over the week. This could indicate that children meaningfully engaged with the technology, as Tavernier and Hu (2020) argued that children could have increased motivation and produce higher quality work when involved in activities interrelated to previous activities. This digital pedagogy was also reported by Fleer (2017).

Furthermore, the interrelationship was also reflected in the combination of digital and non-digital elements. In vignette 1 and 2, the use of the iPad was integrated with the traditional drawing. Additionally, Luo informed the researcher of the following step for vignette 1, which required children to walk along the route after school in the company of their parents. In this way, the teacher connected classroom activities to real-life navigation outside of the classroom through the technology, thereby strengthening children's cognition of the application of technologies in real life.

Intersubjectivity. During technology-embedded activities, the intersubjectivity between children, the teacher and technologies was developed. Firstly, it was observed that Luo was sensitive to children's interactions with technologies. Luo could recognise children's need for help, then prompt and scaffold using her own initiative. In vignette 1, Luo intervened five times, therefore building shared understandings of voice searching steps, reasons for failure, the final task and product with the children. In vignette 2, Luo co-worked with the children to solve the technical problems and achieved a shared understanding of the reasons for the frozen website. Such prompts facilitated children's accomplishment of tasks. Secondly, as illustrated above, Luo was emotionally involved in the children's use of technologies. She could empathise with children, sharing the joy of success, listening to them and respecting their ideas. The emotional involvement of the teacher was essential for promoting children's confidence and enthusiasm towards using technologies. As a result, they could be more willing to transfer the digital experience from the classroom to daily life.

Meanwhile, digital technology was also integrated in a way that promoted collaboration between peers. Children co-worked through instructing, sharing and discussing, allowing for shared understandings of Internet issues, voice searching methods and the route drawing procedure. Thus, they 'effectively worked towards a commonly understood action' (Fleer, 2017, p.124). Commenting on this issue, Luo said that compared with teacher-child interaction, peer interaction could play a more important role for children's cognitive development.

Prior Experiences. Luo's interview indicated that she had a general understanding of children's previous digital experiences and their funds of digital knowledge. Although there was not a systematic record and assessment of children's digital literacies, the teacher could still identify children who had strong, average or weak digital abilities through home visits, inquiries during digital skill sessions and daily observations. In line with this, she normally assigned tasks with a range of difficulty levels on the basis of children's various capacities. As Luo stated, 'If I feel a child is relatively more proficient in using digital technologies, I will give more difficult tasks with higher requirements. In contrast, I will assign easier tasks to a child who can only use devices for watching videos.'

Furthermore, the observation data from vignettes 1 and 2 could suggest that Bob had more iPad experience at home than Alice, whilst Cathy had more experience of using the iPad to online search in previous classroom activities than Daisy. Luo was clear about such differences among the children, and she intentionally arranged two children with different skill levels to work in pairs. In particular, Luo pointed out that she intended to arrange strong/average pairs instead of strong/weak pairs, as she worried the wider gap between peers would not promote mutual reinforcement. Additionally, children with more digital experiences were provided the opportunity to connect and apply their prior knowledge in activities. Furthermore, Luo intervened and controlled less, only offering support when children asked for help. Luo's approach corroborated the recommendations of many previous researchers regarding children's funds of digital knowledge (e.g. Marsh, 2016; Wood et al., 2019; Gillen & Kucirkova, 2018).

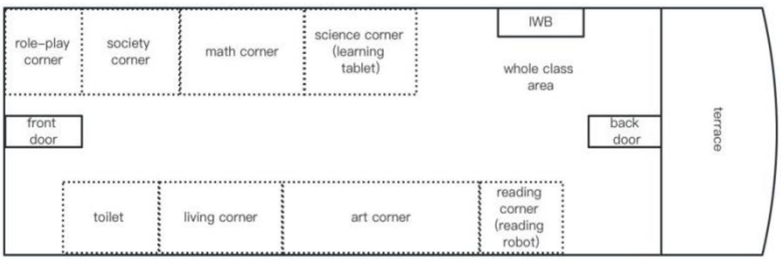
5.2 Case 2: Ye

5.2.1 Introducing Ye (Beliefs and Practices) and Her Classroom

Ye was the teacher of a middle class with children aged four to five years, and she had 20 years of teaching experience as an early childhood education practitioner. She clearly demonstrated her support for the integration of digital technologies into the classroom in the first interview. In particular, Ye believed that digital technologies provided '*vivid and intuitive*' content for children, thereby '*complementing the traditional pedagogies*' and '*improving the effectiveness in the classroom*' (Ye 1). She also gave the example that a video showing the process of leaves falling would be much more understandable for children than a verbal description by the teacher.

The layout of Ye's classroom was similar to Luo's, featuring several learning corners, the whole group space and the outside space (see Figure 6). However, compared with Luo's classroom, Ye's classroom was less technologically rich in terms of both quantity and variety. As with case 1, the IWB and learning tablet in this classroom were purchased and equipped by the kindergarten, which were placed in the whole group space and the science corner respectively. Moreover, a reading robot shaped like a blue rabbit could be seen in the reading corner. Ye indicated that she independently bought this device with funding from the setting in order to motivate children's reading and to 'disengage' teachers from ongoing assistance (Ye 1). She further explained that during small-learning-area activities, teachers needed to pay attention to the whole children across various learning corners. In such circumstances, the reading robot could partly replace the role of the teacher in the reading corner. Compared with case 1, the biggest difference was that there was no iPad in this classroom. This was because the funding of this rebuilt kindergarten was limited and teachers, especially the leadership of this setting, believed the iPad would be more appropriate for the older children in upper classes than for younger children.

Figure 6. Layout of Ye's classroom



Both the interview and observation showed that it was the teacher, Ye, that frequently used digital technologies in the classroom, whereas children had less access to them. In Ye's classroom, the most commonly used device was still the IWB, as Ye reported that it usually worked in whole group activities every day to present slides, videos and music. Despite the frequent use, the screen time and distance were strictly controlled and limited by the teacher. However, small-group, paired or individual activities were generally non-digital, unless children volunteered to use the reading robot and learning tablet during small-learning-area activities. It was illustrated by Ye that children often played independently with both devices after acquiring the operational skills from the teacher at the beginning of device introduction. During the process, the teacher only observed and supported children. Furthermore, in addition to delivering operational skills, Ye also emphasised developing children's appropriate use of technologies, such as self-controlling screen time.

Furthermore, Ye expressed her ongoing efforts to learn about multiple technology-integrating approaches, such as teaching through a micro-lecture, a short but complete educational video presenting the fragmented learning content surrounding a certain knowledge point (Zhang, 2013). She explained that she had been trying to produce similar videos to present in class sessions and to share with families. Moreover, Ye planned to equip extra devices that would be easy enough for children to use for online searching and taking simple statistics throughout the daily routine.

In addition, Ye supported digital bilateral home/school communications. She usually shared messages, photos of children and digital resources with parents. Also, Ye encouraged parents to film children's experiences at home to share with peers and teachers, even prompting them to record videos of exchanging knowledge amongst the children. In particular, during the COVID-19 pandemic lockdown, this connection was generally popular and frequently achieved.

In the observation phase, three sessions with digital technology integration were observed, including a physical session, a thematic activity and the small-learning-area time.

In the physical activity, an interactive ground projector was used to allow children to interact with the moving images projected onto the ground. This projection was purchased by the setting and placed in an open space within the building. Prior to the session, Ye tried to switch on the projection, but it seemed that she was not familiar with this device as she had to ask for help from her colleagues. She later explained that this device was equipped recently and not used often. It was observed that children were excited to interact with the images, happily jumping up and down. They interacted with each other both verbally and physically. During the process, the teacher primarily observed, photographed, controlled the number of children in this area and intervened when some fell over.

The second observed session was a whole group activity with the theme of 'The Dishes of Fish,' in which the IWB was used to present interactive slides (see vignette 1). Six empty plates appeared on the screen and children were invited to touch the plate to 'conjure' the dish up. It was evident that most of the children were positive and enthusiastic about touching the screen and they discussed every dish with excitement. Finally, Ye instructed the children to vote for their favourite dishes on a pre-made board displaying pictures of the six dishes.

Moreover, the researcher also observed the small-learning-area session as it was a compulsory part of the daily routine. Before this session, there was a short gathering time for the teacher to assign children to every learning centre in pairs according to their interests. In particular, two girls entered the reading corner to read with the reading robot and the teacher checked and switched on the device in advance (see vignette 2). Meanwhile, two boys walked over to the learning tablet and operated it themselves. It was observed that one of the boys appeared to be more skilled and would help the other. The teachers seldom intervened in these two activities but merely observed. This indicated that children were regularly involved in such activities and were skilled in operating the devices.

5.2.2 Description and Analysis of Observed Child and Teacher Practices

Activity 1 Thematic Activity: The Dishes of Fish

Overview

In every daily routine, there was a thematic activity in Ye's classroom. On the observation day, the topic of the thematic activity was 'The Dishes of Fish' Based on the observation of the physical environment and the second interview, it was concluded that the thematic activities within that week were all related to the 'fish'. For example, the theme of 'The Anatomy of Fish' had already been explored prior to the observation day. This was inferred from an existing poster board displaying photos in which the children were observing a fish, as well as some drawings of fish anatomy produced by the children. Moreover, another poster board displayed the children's drawings of various fish and the children's inquiries about fish, illustrating the theme of 'The Types of Fish.' Then, the observed session contributed to children's learning about the range of Chinese cuisines made with fish.

At the beginning of this session, Ye introduced the theme and presented slides. The first slide showed the words 'The Dishes of Fish' and Ye led the whole group to read it out. The next two slides presented three blank plates and Ye invited children to 'serve' the dishes. Six children were selected in turn to touch each plate on the screen and then dishes appeared on the screen. When every dish was presented, Ye would ask children about the dish name and encourage discussions on each one. Finally, the teacher got out another poster board made in advance displaying all of the six dishes and invited children to stick a tag to their 'favourite dish'.

Vignette 1 and Analysis Drawn on Multimodal Approach

At the beginning of this session, Ye crouched down in front of children and asked, 'What kinds of fish dishes did you have at weekends?' Four children gave various answers in turn, including 'grass carp', 'mandarin fish', 'tuna' and 'grilled fish'. During this time, when some children in the group were whispering together, Ye reminded them to be respectful by saying, 'Please listen to the sharing carefully.' Then, Ye explained to children that 'grass carp' 'mandarin fish' and 'tuna' were the types of fish, whereas the 'grilled fish' was the name of a dish. She further introduced the theme by stating, 'So, today we will learn about what kinds of dishes could be made by fish.' Afterwards, Ye stood up and walked to the IWB, touching the PowerPoint on the screen. The first slide presenting the title 'The Dishes of Fish' then appeared on the screen. Ye pointed to the words one by one and instructed children to read them out. The second slide, featuring three empty plates, was then presented. Ye immediately pointed at the screen and inquired, 'What are these?' Following the children's answer of 'plates' in chorus, Ye further asked, 'Are there any dishes in them?' and the children answered, 'No.' Ye invited children to 'conjure' dishes and children raised their hands in succession. Ye stated, 'I will invite a tall child to serve the first dish on the top.' Ellen then shouted, 'I'm the tallest,' so Ye picked her to do this. Ye instructed Ellen to touch the plate on the screen and a picture of the dish with its name, ‘Fish Head with Chopped Pepper,’ was presented. Afterwards, Ye talked to the whole group, asking, ‘Did anyone know the dish? Has anyone eaten it before?’ One girl answered, ‘It’s Braised Fish in Brown Sauce,’ whilst a boy called Frank said, ‘I think there are many peppers on it.’ Ye replied, ‘Is it braised fish? I don’t think so, and yes, there are many peppers, so guys, please look at it again. What is this dish made of?’ However, the children answered, ‘Peppers,’ which caused Ye to further clarify her question, ‘Yes, there are many peppers, but which part of the fish is it?’ Another girl, Gabby, replied, ‘The head.’ Therefore, Ye pointed at the words ‘Fish Head’ and said, ‘Yes, someone just identified the two words: fish head. Also, there are many peppers that were chopped by cooks with the kitchen knife, so the name of it is Fish Head with Chopped Pepper.’ Ye then asked many questions, such as, ‘Who has had this dish,’ ‘Was it spicy’ and ‘Would you dare to eat it?’ to further trigger discussions amongst the whole group.

What Roles Did Digital Technologies Play in Observed Vignette 1?

Digital technology was used as a presenter. In vignette 1, the IWB was used by Ye in the whole-group activity and was primarily applied to present digital content. The presented content encompassed two parts: texts and images (e.g. Appendix N-3-Lines 2&15). Ye added texts on every slide, including the theme on the theme page and names of all of the dishes. In terms of presenting the text, Ye pointed at and read out the displayed words one by one and the children shadowed Ye (see detailed analysis in the following parts). Thus, the IWB in this activity promoted children’s literacy development. Moreover, images were presented through the IWB. In particular, the presented images were from real-life situations, showcasing dishes from the children’s normal lives. Therefore, the technology facilitated children’s cognition of the world around them.

Digital technology was used as a site for interactions around digital content. Additionally, the IWB with the presented digital content triggered interactions among the teacher, children and the technology. Firstly, focusing on the pictures of fish dishes displayed on the screen, there were multiple rounds of Q & A between the teacher and children, during which both eye contact and verbal interactions took place.

Also, there were physical interactions between the teacher and the technology, such as 'pointing to' and 'touching.' More importantly, rather than simply watching the slides, the interactive design of slides enabled children to operate the whiteboard (touching empty plates) and receive responses (showing pictures of dishes). Notably, this interactive design inspired a higher level of engagement from the children in the whole-group activities, as children were excited and enthusiastic about operating the digital technology.

Teacher's Actions in Observed Vignette 1

Inviting to Dialogue. Ye frequently invited children to dialogue by asking questions. Firstly, the teacher's inquiries to children were made throughout the whole session in order to guarantee that children could follow the process. For example, at the beginning, Ye asked about what fish dishes children had eaten at the weekend to start the activity theme. Also, children were asked about the empty plates on the screen to start the second stage of the session: interacting with the whiteboard. Furthermore, Ye's inquiries tried to connect the activity theme with children's real-life experiences in order to strengthen children's cognition of the learning content, such as, 'Is it spicy?' and 'Would you dare to eat it?'

Explaining. Ye helped construct children's understandings of the learning content through timely explanations. For example, she described the difference between fish types and fish dishes during the beginning stage to shape children's understanding of the activity theme, thereby distinguishing this activity from the previous activity with the theme of 'The Types of Fish.' Also, Ye explained the name of each fish dish to strengthen children's impressions of them, such as her talking about the 'chopped peppers'.

Instructing. During the above vignette, Ye instructed several times to shape children's actions. Firstly, when children needed to answer the teacher's questions, Ye usually set rules to instruct children's behaviour through her own physical action of raising her left hand and the verbal instruction, 'Please raise your hands to answer.' Additionally, when a child was picked to operate the whiteboard, Ye instructed with a gesture to make the correct 'click'. Finally, when any texts were presented on the screen, Ye instructed the children to read aloud along with her by pointing at words one by one and slowing down her own reading.

Children's Actions in Observed Vignette 1

Interactions with digital technology. Through observations of the physical environment and the teacher's words, 'I'll invite a tall child to serve this first dish,' it became apparent that the height placement of the whiteboard did not take children's operations into account. Instead, the interactive whiteboard was usually used by the teacher in whole-group activities, which was supported by Ye in the interview. In spite of this, children were still provided with opportunities to operate the whiteboard in vignette 1, namely touching the plates on the screen to present pictures of the dishes. This interaction between children and the whiteboard was a single and fixed act instructed by the teacher, which merely aimed to improve children's engagement in the whole-group activity. Therefore, children operated the technology as consumers.

Interactions with the teacher. In this vignette, children only responded to the teacher, including answering Ye's questions and responding to Ye's invitation to touch the whiteboard. Such interactions could be viewed as passive.

Interactions with peers. In this teacher-led session, there were rarely peer interactions and communications. The only pattern that could be regarded as an interaction was that the children listened to other group members' responses to Ye's questions or experience sharing.

Activity 2 Small-Learning-Area Activities: Reading Corner

Overview

As introduced in case 1, small-learning-area time was a fixed part of the daily routine in early years settings. In Ye's classroom, an established practice was that children booked the learning centre that they would like to play in on the previous day and Ye paired them up to co-work in each corner. On the observation day, two girls, Helen and Iris, entered into the reading corner, in which the reading robot was placed along with plenty of picture books as the essential tools. In addition, there was a digital drawing board in the reading corner that children could use to draw any ideas during reading. According to the first interview with Ye, the purpose of equipping the area with the reading robot was primarily to reduce the teachers' burden, as teachers needed to cover all learning centres across the classroom. As intended, this device could act as a substitute for the teacher to some extent. Moreover, Ye also commented that the reading robot could attract children to stay focused on the reading. Therefore, it was observed that teachers rarely intervened in the reading corner and the two girls practised independent reading the whole time. Furthermore, it appeared that the children were familiar with and proficient in operating and using the device. I selected a vignette from this session for further and in-depth analysis because the interview data showed that the reading robot was a typical and popular device for both early years settings and families. Thus, it was expected to provide insights into teachers' pedagogical practices with the use of such reading robot.

Vignette 2 and Analysis Drawn on Multimodal Approach

In the reading corner, Helen and Iris prepared to read by placing a picture book and the reading robot on the table. Before this, Ye had checked and switched on the device in advance. Iris tried to scan the cover title of the book with the reading robot, but the device did not respond. After observing the situation, Ye approached and Iris asked for her help by saying, 'Miss Ye, the device does not work.' Ye double checked the switch to make sure it was on and tried scanning but failed. Thus, Ye suggested selecting another book to read and Helen asked, 'Why did this book not work?' Ye stated that the scanning was not sensitive and that it might work on another book. Afterwards, Iris took a new book out of the bookcase and Helen got the drawing board. Both girls scanned the title cover together and the reading robot identified the title as 'I Don't Know Who I Am (You're a Hero, Daley B).' The device then instructed children to turn the page by saying, 'This is the title page, please continue to turn the page down.' Iris volunteered to turn the pages and Helen began drawing on the drawing board. Iris could identify the pause at the end of the audio for every page and turned to the next page. Sometimes Helen reminded her or helped to turn the pages. When the fifth page was read, Iris turned to Helen, looking at her drawing and asking, 'What are you drawing?' Helen answered, 'It's a monkey!' After a while, Helen turned her back to the book and device and began to concentrate on her drawing. When Ye passed by and noticed this change, she helped turn the picture book and device to face Iris and left. Afterwards, Iris heard the device say, ‘Do you live in a kennel?’ so she laughed and repeated this sentence to Helen. At the end of this book reading, Helen reminded Iris, ‘We need to change to a new one and I’ll get it’ She then took a new book out, which was passed to Iris immediately, and continued her drawing. After scanning the title, Iris said to Helen that she did not want to read the book, so Helen suggested she should choose one by herself. However, Iris could not make a decision on a book that could be scanned successfully by the device. She asked Helen, ‘Which book could be read?’ Helen told Iris, ‘I don’t know, but maybe the small one on the table could be tried.’

What Roles Did Digital Technologies Play in Observed Vignette 2?

Digital technology was used as a deliverer. As a digital device with a single particular function, the reading robot was used to deliver story audios in vignette 2. Ye indicated that children at this age had limited literacy and were not able to read independently, therefore the reading robot could play the role of a surrogate teacher telling children stories. Due to this, teachers did not have to accompany the children in the reading corner all of the time, allowing them to supervise the whole group across the classroom. Furthermore, with its cartoon shape, the device could attract children to continue reading for a long time with less distractions, which was one of the affordances of the device reported by teachers. This was supported by the observation data, in which Helen and Iris read three picture books successively during the 25-minute session.

Teacher’s Actions in Observed Vignette 2

Observing. In vignette 2, and even the whole session in the reading corner, Ye and her assistant teachers were mainly playing the role of observer. Ye kept walking around the classroom, sometimes stopping to watch the children’s use of the reading robot for reading for a few seconds. The description of vignette 2 and the following multimodal transcript (see Appendix N) and analysis showed that only two interventions were associated with the use of the device. Firstly, Ye facilitated when she witnessed children struggling to scan one book title by checking the switch and giving the suggestion to change the book. The second intervention was when Ye adjusted the device position without any interactions with the children. Notably, Ye rarely engaged in children's activities unless technical problems occurred. In the follow up interview, Ye explained that it was easy for children to use the reading robot independently, so she usually just checked the charge and internet connection prior to the session.

Children's Actions in Observed Vignette 2

Interactions with digital technology. In vignette 2, children primarily interacted with the device. Helen and Iris used the reading robot to scan books, listen to story reading, turn the pages according to the device's audio or follow silent instructions. It was observed that both girls could skillfully operate this device and thereby completed the reading independently. The observation data showed that children were proficient in the use of this digital device.

Interactions with the teacher. The above vignette 2 highlighted the minimal interactions between the children and the teacher. The only interaction happened when there was a technical problem with scanning and Helen asked for Ye's help, inquiring about the reason for the scanning failure. Aside from this instance, there were no further interactions with the teacher, even when Ye intervened for the second time to adjust the device position.

Peer interactions. Peer interactions were significant for small-learning-area activities. The video data analysis drawn on the multimodal approach demonstrated that both verbal and physical interactions between the two girls took place in the following three forms. Firstly, they cooperated to complete the reading task. At the beginning of this session, Helen and Iris collected the device and picture book respectively and then gathered at the table. During the process, although it was Iris who was responsible for turning the pages, Helen occasionally reminded Iris to do so or did it herself. Secondly, sharing was also an essential part of peer interactions. According to the fourth multimodal transcript in Appendix N, Iris openly shared the interesting content that she heard with Helen, whilst Helen also shared her drawing with Iris when Iris showed her interest. Finally, peer help also played an important function. Compared with Iris, it seemed that Helen was the more capable child in this digital reading session. For example, Helen promptly reminded Iris to turn the pages and change to a new book. Moreover, Iris followed Helen when Helen took the initiative to search for a book from the bookcase. Also, Iris asked for Helen's suggestion about the book selection in the first place, not the teacher's. This indicated that Helen's help for Iris played an important role in completing the reading task.

5.2.3 Analysis and Discussion of Ye's Pedagogical Approaches

Selection

The digital technology integration by Ye was intentional. She used technologies in the classroom with the primary aim of enriching children's learning environment and stimulating their learning motivations, thereby improving their engagements. This purpose was emphasised by Ye in both interviews. She justified her pedagogical practice, explaining that providing children with interactive slides to touch one by one to present pictures, rather than presenting all of the pictures herself, created 'mystery.' Furthermore, she explained that such 'mystery' would encourage children to explore and get involved. Similarly, the motivation to equip the reading robot into the reading corner was also to promote children's interest in reading. This level of intentionality in determining technology usage not only indicated Ye's positive attitudes toward digital technology integration, but also significantly shaped further 'developmentally appropriate use' (NAEYC, 2012).

Despite the general intentionality, digital technologies were still used to serve the curriculum. Ye pointed out that she prioritised the curriculum over the technology that should be selected based on the session theme and purpose. She further clarified that digital technologies would not be integrated into all early years activities, such as music sessions in which the technology was not necessary. This belief could be supported by NAEYC (2012, p.8) who suggested that 'true integration' should be 'routine and transparent' and should focus on the activity instead of on the digital technology. Following this belief, Ye thought critically about the selection of digital technologies used in her classroom, which could be characterised as the following principle and two goals.

Firstly, the age-appropriateness of technologies was considered as the main principle. Ye reported that she intended to select devices appropriate for children aged between three and six years old. For example, the reading robot was easy to use and children of middle-class age were able to operate it. Ye demonstrated that she introduced the device and operating skills to children during the whole group time. Afterwards most children (estimated 80%) could master this and independently complete the reading in later practices through switching on/off, scanning and controlling the volume. This was consistent with the 'developmental progression in children's use of digital tools' proposed by the joint position statement (NAEYC, 2012, p.6), namely the process of exploration, mastery and functional subordination. Additionally, the learning tablet used during small-learning-area time had clear instructions and prompts which could be heard by children when using it, such as, 'Guys, please do...' and 'Challenge level 1, you need to....' Thus, children could 'absolutely use it by themselves according to the instructions' (Ye 1).

Secondly, the selection of digital technologies by Ye served clear teaching and learning goals. She used technologies to enhance classroom practices and thereby promote children's learning and development. For example, Ye selected the interactive whiteboard to present the interactive slides with pictures to make the content more understandable for children. As a result, the session goal to learn about the dishes of fish, as well as their production processes, could be achieved by assistance of digital content. In particular, the digital content was closely associated with real life so that children's understanding of the world could be further strengthened. Moreover, Ye selected the reading robot because it could replace the teacher to tell stories for children, improving children's reading skills and literacy. It was an essential part of digital competence for an ECE teacher to plan digital technologies for explicit learning goals (Lemon, 2019).

Apart from the curriculum goals, the teacher's determination to integrate digital technologies also took children's digital literacy development into consideration. Ye expressed her intentions for children to understand the development and application of modern technologies, as well as to acquire the approaches to using them in normal life. She gave an example that when children needed to calculate in a book count but did not have sufficient maths ability, she set a calculator app on the whiteboard for children to touch and calculate on. Accordingly, she intended to encourage children's initiative to solve problems in life with the help of digital devices. In addition, the teachers in Ye's classroom lent their own smartphones to children for online searching when needed. These examples indicated Ye's deliberate selection of appropriate resources based on children's needs.

Use and Integration

The observation showed that the technology-integrated activities within multiple learning areas in Ye's classroom were hands-on and engaging, giving children opportunities to operate and use technologies. Despite the diversity of integrated technologies, such as the all-in-one interactive whiteboard as well as single-functional devices like the reading robot, learning tablet and interactive ground projection system, it was evident that the application approaches of these technologies were close-ended and children did not interact with them creatively. Furthermore, the integration strategies differed between the whole-group sessions and small-learning-area activities.

Interlinked vs. non-interlinked activities. The whole-group session with technology integration was interlinked with other activities. According to the second interview with Ye, these ongoing interlinked activities were technologically-enhanced and co-constructed a general theme in addition to correlating conceptions. This was in line with one of the digital pedagogies summarised by Fleer (2017). In detail, the observed thematic activity, 'The Dishes of Fish', was extended from a group movie-watching session of *Finding Nemo*. Along with this theme, there were other associated thematic sessions with topics surrounding the anatomy of fish, the types of fish, salt production, kelp food and so forth. The enthusiasm children showed for their involvement in the activity supported Tavernier and Hu's (2020) argument that children could demonstrate higher motivation and better performance when engaged in activities that were related to previous sessions. Furthermore, Ye remarked that all of these connected themes were generated according to children's own interests, although some of them were presupposed by the teacher. More importantly, these themes were associated with children's real lives beyond the classroom. In this vein, the interactive whiteboard was used to explore real world issues, which was regarded as one of the significant criteria for exemplary technology integration (Cameron, 2015).

One drawback was that the small-learning-area activities integrated with technologies were observed to be more separated from other activities. However, within the activities, the digital tool was one of multiple options including traditional materials that children could choose to use. In vignette 2, the reading robot was placed alongside plenty of picture books, pencils and a drawing board, so both digital and non-digital reading were supported.

Teacher's control vs. children's control. In the above whole group session, it was observed that the teacher controlled the session process and technology use to a great extent. Although children had the opportunity to operate the interactive whiteboard, such interaction could still be instructive but not constructive. Both the observation and interview confirmed that children were not empowered to determine how to use the interactive whiteboard. Furthermore, even the objects they needed to touch were formulated by the teacher.

Nevertheless, the teacher gave children more control over the activity in the reading corner, whilst the teacher herself played the role of observer and only assisted when technical problems occurred. For example, Ye reported, 'If a child is particularly interested in a certain book, but the book can't be identified by the reading robot, I may have to support by giving a rough idea of what the book is about' (Ye 2). Moreover, Ye demonstrated that she normally checked the charge and internet connection of the reading robot in advance of the reading session. In addition, she sometimes guided children to review the reading content (although this was not observed). According to Ye, children could decide whether or not to use the reading robot and which picture book to read. Moreover, an important finding that emerged from the observation was that children could read independently throughout the whole session with the help of the reading robot. However, the interaction between the children and the technology was still centred around consumption and was not playful or creative.

Intersubjectivity. In the technologically-enhanced whole-group session, the dominant role of the teacher, as well as the instructive interaction between the teacher and children, was emphasised, whilst peer interaction was rarely observed. Surrounding the digital content, the teacher Ye used the techniques of inquiring, instructing, guiding and explaining to deepen conversations, thereby promoting the shared understanding between the teacher and children. Through the meaningful conversations, the teacher learnt about children's prior experiences relevant to the learning content (not digital experiences). At the same time, children were guided to think deeply in order to develop associated conceptions. However, it was difficult to determine how much these teacher-child interactions were influenced by digital technology integration, as Ye employed similar pedagogical strategies with or without digital content. Digital content was just one of many subjects that could trigger discussion, much like non-digital content. The affordance of digital content lay in supplementing current content with more visual and specific forms, thereby enhancing the classroom practice. This could be evidenced by Ye's comment, 'Without them (interactive slides), my class could be very dry and dull, and children might not understand the concepts easily.'

However, in the small-learning-area activities, the role of the teacher was substituted by digital tools to some extent and the peer interactions were more obvious. Children collaborated, shared information and helped each other to use digital technologies (the reading robot and learning tablet). However, this was not a unique feature of digital activities, as cooperating in pairs to accomplish tasks was also observed in other learning centres without digital technologies, such as the sand area and role play area. Furthermore, in Ye's account of peer interactions, the two-person team setup was not deliberately chosen by her and was just a result of the popularity of the reading robot and learning tablet amongst the children. This indicated that although the teacher did not intentionally use digital devices to provide opportunities for collaborative work, the digital devices and content did inspire children's interactions.

5.3 Case 3: Shi

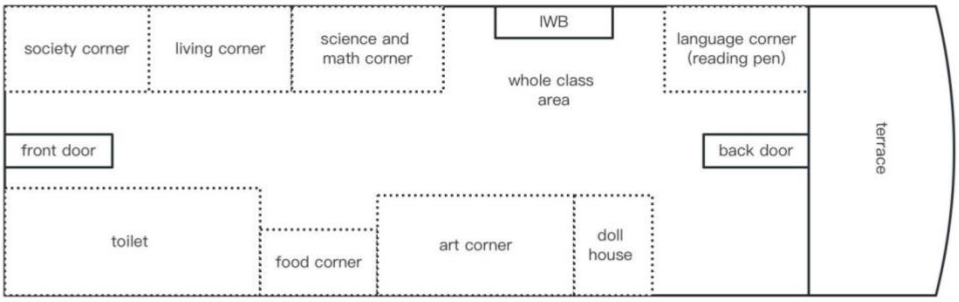
5.3.1 Introducing Shi (Beliefs and Practices) and Her Classroom

Shi was the teacher of a lower class in which the children were aged around three or four years old. Before being in charge of the class, she was the English language teacher at this kindergarten. Shi reported her frequent exposure to online resources for professional development and indicated her self-confidence in technical skills, such as lesson recording and video or audio editing. However, with regard to the pedagogical use of digital technologies, Shi still felt uncertain about integrating them into curriculum and desired further study in the approaches of using technologies in a range of activities.

In general, Shi believed digital technology was already an inevitable part of the daily routine in kindergartens. In this case, the technology was specific to the multimedia courseware, the application of which was recognised by Shi. Similar to Luo and Ye, Shi also identified its affordance to provide 'lively' and 'lucid' content for children, 'motivating' their explorations.

Furthermore, given the uniform guidance from the setting, the layout of Shi's classroom paralleled Luo's and Ye's. There were a range of learning corners, some of which contained digital technologies. The difference was that compared with the middle and upper classes, the lower class had more low-structured materials in learning areas, so there was less space for close-ended digital devices. Thus, only the reading pen was equipped. In addition, the IWB was also placed on the wall of group space.

Figure 7. Layout of Shi's classroom



Generally, there were three typical uses of digital technologies in Shi's classroom.

Firstly, the IWB was used by the teacher to present slides, images and videos, which only contributed to the introduction part of the sessions. Secondly, children used close-ended devices during small-learning-area time. Shi believed that more teacher guidance was needed in this class than in the upper and middle classes, as it was more difficult for children aged between three and four to operate digital devices independently. Moreover, Shi pointed out that children were not competent at using the IWB, and they could not touch, write or draw on the screen until they were promoted to the middle class. Finally, the teacher filmed children and their works with her own smartphone, not only to share with the whole group but also to share with parents.

The activities that were observed were small-learning-area activities, a sharing activity and a thematic activity. During the small-learning-area time, the reading pen in the reading corner was not used by children. In the following sharing activity, Shi used the IWB to show photos of children's works completed during small-learning-area time, including a photo of sand art, a photo of a rabbit made by a child and a photo of a painting (see vignette 1). Then, in the thematic activity with the theme of 'Our Teeth', Shi drew teeth on the IWB to explain different types of teeth to children. She also played a short animation on the screen introducing relevant knowledge about teeth (see vignette 2).

5.3.2 Description and Analysis of Observed Child and Teacher Practices

Activity 1 Sharing Activity Following Small-Learning-Area Activities

Overview

Following the small-learning-area activities, Shi tended to organise an activity for sharing children's works. She usually recorded the progress and products of children's work with her own smartphone during small-learning-area time, subsequently presenting these photos or videos on the screen to the whole group. Shi believed that such recording and sharing would help children reflect on their own previous activities and behaviour after witnessing what their peers were doing.

In our sharing time, we tended to tell the children, "We can see XX went into this learning centre and did this kind of work. She/He worked very hard and you have to work hard as well.". This is because some children may not take the work seriously, walking all around or acting up. Then, the images of peers' work allowed these children to judge their own behaviour, inspiring them to regret their bad behaviour and thereby modify it the next time. So, this is an important effect. (Shi 2)

At the beginning of the activity, Shi and the children sat in a circle on the ground. Shi firstly showed the children's works on the screen and then guided the maker to introduce their own works. During the whole process, a sand table project, an object handmade by the 3D printing pen and a painting on the writing tablet were respectively presented and introduced. In particular, during the sharing of works produced using the 3D printing pen and the writing tablet, Shi added an introduction of the two tools and how to use them. Moreover, she reminded the children of the safety concerns associated with their use., For example, she instructed the children to use the 3D printing pen with the supervision of the teacher as it could become very hot.

Vignette 1 and Analysis Drawn on Multimodal Approach

After sharing the sand table work, Shi stated, 'Now I invite another child to share their work from the small-learning-area activities. Who wants to do it,' motioning with her left hand for children to raise hands. Then, Shi pointed to a boy and said, 'Jack, you can share.' Jack stood up and replied, 'I have drawn in the art corner.' Thus, Shi addressed the whole group and said, 'Well, I have taken photos, so let's see what Jack has done in the art corner.' Straight away, Shi touched the screen to identify the photo of Jack's work and instructed him to introduce this work. Jack went up to the screen and told his peers, 'This is a rabbit which I've made just now.' She prompted him to further introduce every part of the rabbit, 'ears, eyes, mouth and tail,' its colour, 'yellow,' and the tool he used, '3D pen.' After Jack's introduction, Shi took out the 3D pen and held it up for the children to see clearly. She then added, 'This is the 3D pen that Jack has used and I have told you previously that it is an electric tool and could be hot after being used for a while. It is a little dangerous. So, you guys should use it when teachers are present and cannot use it alone. Does that make sense?' The whole group replied, ‘Yes!’ Afterwards, Shi asked the children if they knew how to use the 3D pen, which encouraged children’s discussion: ‘I know and I have one at home,’ ‘I also have one’ and ‘I don’t know.’ Then, the teacher gestured to calm the children down and introduced the functions of each button on the pen. In particular, she explained, ‘Flip the switch up, and then the light will turn to red. And after a short time of preheating, the light will turn to green, so you can start to use it.’

What Roles Did Digital Technologies Play in Observed Vignette 1?

Digital technology was used as a presenter. As discussed in previous cases, the interactive whiteboard was mainly used as a screen to present or deliver digital content. In this vignette, some photos recording children’s works were displayed (Appendix N-5-Line 6), which initiated conversations between the teacher and children. According to Shi, before the screen was equipped, the physical products made by the children were usually shown to the whole group, which were sometimes so small that could not be seen clearly by the group. With the IWB, the photos presented on the screen could be zoomed in and out, so all of the group could see the details of the products. Accordingly, the aim of the sharing activity to promote children’s reflections on their own behaviour could be better achieved. From this perspective, the technology enhanced the teacher’s pedagogical practices and children’s experiences.

Teacher’s Actions in Observed Vignette 1

This was a session led by the teacher who controlled the whole process and the interactions between digital technology, children and the teacher through instructing, guiding and explaining.

Instructing. Shi verbally and physically instructed children’s actions. For example, she instructed children to come to share (Lines 1 & 3), calmed children down (Line 25) and instructed the boy back to his seat (Line 19).

Guiding. Additionally, Shi tried to guide children and redirected children’s thinking. During the sharing process, Shi prompted the child to deliver more details of the work

(Line 9, 11, 13, 15 & 17), as young children at this age were normally not able to provide a complete description.

Explaining. In order to equip children with the skills of using tools within small learning corners, Shi explained every part of each tool and the steps of operating it during the sharing session (Line 25 & 27). This not only took place in this vignette, but the teacher also did the same in other parts of this session, such as explaining the approach of using the writing tablet when sharing a child's drawings.

Children's Actions in Observed Vignette 1

In the whole-group session, children's actions were limited and most of their interactions were consumption-based and passive.

Interactions with digital technology. There was minimal interaction between the children and digital technology. Even the children who went up to share did not directly interact with the whiteboard. The observation of the physical environment and activities revealed the high placement of the whiteboard, as children could not touch the higher part of it even when standing on tiptoe (Line 12). This indicated that the interactive whiteboard was not for children to use in the lower class. The first interview with Shi, in which she claimed that lower-class children were unable to proficiently operate the whiteboard, whereas children from the middle and upper classes were more competent in comparison, could support this finding. Consequently, children at this age (3-4 years old) could only passively receive the digital content presented through the whiteboard.

Interactions with the teacher. In this vignette, children were instructed or guided by the teacher, whether they were sharing on the stage or listening in their seats. Their actions were only in response to the teacher's instructions (Line 4, 8 & 26) and answering questions (Line 20, 22, 23 & 24).

Interactions with peers. In the same vein, there was minimal independent interaction amongst children, as all interactions were under the control of the teacher. Interactions between children were limited to one speaking whilst the others listening. Additionally, the children whispered to each other, especially when the teacher directed children to a question (Line 21). However, these personal discussions were not encouraged by the teacher and were instead suppressed. This might be linked to the 'discipline' that was emphasised in the context of Chinese education (Li & Chen, 2017; Rao et al., 2010).

Activity 2 Thematic Activity: Our Teeth

Overview

This was a whole-group thematic activity which was arranged in the everyday routines of most kindergartens. Similar to Ye's case, the thematic activities across one week in Shi's class usually had relevant themes. The theme of the observed session was 'Our Teeth' and other themes were also related to 'teeth,' such as 'The Order in Which Teeth Grow' and 'The Teeth Soaked in Coke'.

At the beginning of the session, Shi introduced the theme 'Our Teeth' by giving a riddle, the answer to which was 'teeth.' She then instructed children to observe each other's teeth in pairs and asked for their findings, guiding children to think about the general functions and features of teeth. Based on children's answers, such as, 'Some teeth are big and some are small,' Shi introduced three types of teeth: 'incisor,' 'canine' and 'molar.' Afterwards, Shi drew the three teeth on the whiteboard in sequence, delivering the special shape, feature and function of each kind of tooth through quizzing and answering. An animation related to the teeth was played on the whiteboard, during which Shi put questions to the children according to the content of the animation. Following the animation, children were prompted to summarise their knowledge of teeth by Shi. Finally, Shi gave a task to all the children, requiring them to count the number of their teeth and their parents' teeth at home.

Vignette 2 and Analysis Drawn on Multimodal Approach

This vignette presented the part of the session in which Shi delivered knowledge of teeth to children through playing the animation on the whiteboard. After Shi drew and introduced the three kinds of tooth, she told the children, ‘Well, now let’s see which kind of tooth is the sharpest.’ She then touched the screen and found the content that would be played, stating, ‘Some of you said the canine teeth were sharp as they can tear stuff up and some voted for the incisors and molars. So, let’s see it.’ After pressing the ‘play’ button, Shi walked back to the children and they watched the animation together. Initially, some children were whispering, so Shi gestured to keep them quiet. When the anthropomorphised incisor in the animation appeared, Shi turned her head to the children and explained, ‘This is the incisor.’ Then, when the canine tooth appeared, she asked, ‘Which kind of tooth is it?’ and the children answered in unison, ‘Canine tooth.’ She also later reminded the children, ‘This is the molar.’ During the process, Shi frequently gestured to the children to watch the animation carefully. Finally, when the animation ended and the frame was frozen on the group photo of three teeth, Shi stressed the identification of the ‘incisor,’ ‘canine tooth’ and ‘molar’ again. She then asked the children, ‘You have seen the various types of teeth now. What are their different functions?’ and signalled for children to raise their hands to answer. All of the children talked over each other, so Shi had to instruct them to answer one by one. One girl answered that ‘the incisor is to cut the stuff off,’ whilst another girl said that ‘the canine tooth is for tearing up.’ Shi further asked, ‘How about the molar?’ and a boy responded that ‘the molar is to chew the food up.’ Accordingly, Shi stressed that ‘molars are for chewing, so the food we eat can be easily absorbed, which could lead to our growth.’

What Roles Did Digital Technologies Play in Observed Vignette 2?

Digital technology was used as a deliverer of knowledge. In this vignette, the role of the animation presented on the screen was to deliver knowledge to the children. As in previous examples, the interactive whiteboard was used to present digital content: the video which aimed to help develop children’s knowledge of teeth. In practice, the teacher had already covered relevant points about incisors, canine teeth and molars through her earlier introduction and interpretation, which overlapped with the points delivered by the animation to some extent. However, compared with the teacher’s verbal delivery with the assistance of drawing on the screen, the multimodal form of the animation could motivate children and allow the knowledge to be more understandable, thereby strengthening children's mastery of these points.

Teacher's Actions in Observed Vignette 2

Instructing. In such a teacher-led activity, the main action of the teacher was to instruct children. On the one hand, Shi verbally and physically instructed to move the process forwards, such as telling children to watch the screen (Appendix N-6-Line 1) and to raise their hands for answering (Line 23). On the other hand, Shi instructed with gestures to maintain discipline, such as keeping children quiet and listening carefully (Line 5, 15, 23 & 31).

Inviting to Dialogue. Additionally, questions from Shi ran throughout the whole session. In particular, when the animation was played on the whiteboard, Shi invited children to dialogue according to the video content (Line 10, 23, 24, 26 & 28). However, these questions were all close-ended, aiming to strengthen children's memorisation of knowledge.

Explaining. Finally, apart from asking questions, Shi also explained the video content to children during and after the animation time (Line 8, 13, 21 & 30). Similar to the purpose of asking questions, explaining was also intended to deliver knowledge. Furthermore, the occasional quizzing and explaining could also help children avoid distraction to some extent.

Children's Actions in Observed Vignette 2

In this session, children had less involvement and interactions with others. Firstly, children's main interactions were with the teacher, but as with the previous example, such interactions were passive and instructive. The observation showed that children mostly responded to the teacher's actions. Secondly, in terms of the interaction between children and technology, there were hardly any direct interactions. However, it was evident that children were attracted by the animation and would keep watching (Line 18). Also, it was observed that children had strong reactions to the animation content (Line 4 & 22). Thirdly, there were also few interactions among peers when the technology was integrated. This was because children's meaning making was not pre-planned and encouraged by the teacher and was limited. However, in the predetermined interaction, Shi encouraged and valued children's conversations and expressions. For example, in the part of the session prior to vignette 2, children were instructed by the teacher to observe their peers' teeth and discuss them.

5.3.3 Analysis and Discussion of Shi's Pedagogical Approaches

Selection

The interviews and observation indicated that Shi's decision to use digital technologies in daily routines depended on the following two needs.

Firstly, similar to Luo in case 1, Shi recognised the effects of digital tools on reducing teachers' workload. Both of them mentioned the digital content as an alternative to physical props which could eliminate prop making and thereby save preparation time. Also, Shi reported the substituting role of digital tools for teachers in some situations. She gave an example that the media player could play the sequence that children could follow to dance and exercise, so the teacher did not have the burden of shouting out directions.

Not all of the sessions in Shi's classroom required the use of digital technologies. Shi usually judged if the digital technology could produce the effects that other methods could not accomplish based on the teaching and learning goals. In this instance, she specifically referred to the digital technology of IWB along with the presented digital content. Shi stated her preference for using digital content to assist in children's understandings of abstract conceptions, thereby supporting the learning outcomes. Furthermore, she explained her belief that digital technologies could help children visualise and comprehend things that they could not experience in person, such as making rice puddings in the introduction of the Lantern Festival. This supported the illustrated positive effects of technologies on children's cognitive and social development (NAEYC, 2012). Moreover, Shi tended to use technologies in whole-group sessions, as she believed the images of objects presented on the screen could be enlarged and made more visible to the whole group than some physical objects. For instance, in vignette 1, Shi presented the images of the children's work processes and their products, allowing the rest to learn together about the operating skills of various materials in the learning corners. Also, in the second observed session, Shi drew different kinds of teeth on the screen for children to clearly see their different shapes and locations within the mouth. In this case, digital technology worked as an extended teaching approach to support the achievement of teaching goals.

The teacher's discussion above focused on her own use of digital technologies. Whilst mentioning children's use of technologies in the classroom, Shi pointed to the age-appropriateness of digital tools. Firstly, she reported that compared with children in the middle and upper classes, lower-class children had less opportunities to use digital technologies in the classroom. Additionally, the tools and approaches they used differed from those of older children. She gave the example of placing materials in the learning corners. As far as the language corner was concerned, the lower-class teacher usually placed an MP3 player for children to listen to recordings of stories. Once transferred into the middle class, children had the opportunity to record their own stories with the digital recorder, which could be shared later through the QR code. As Shi illustrated, even in the upper class, the iPad could be provided for children to independently search for information (such as the examples in case 1). Moreover, Shi added that the teacher normally offered more guidance for lower-class children when operating digital tools. She summarised the rationale for these differences as the consideration of zone of proximal development.

Use and Integration

Instructive guidance. The above vignettes revealed that Shi normally used digital technologies in teacher-led, whole-group sessions. In such sessions, the subject using technologies was the teacher rather than the child. Shi usually employed digital tools in more instructive ways to support children's acquisition of knowledge and skills, such as the operating skills for materials in the learning corners (vignette 1) and relevant knowledge of teeth (vignette 2). In this case, children passively received information most of the time due to the planned purposes and predetermined learning content. For instance, in the vignette 2, the teacher used animation to present information about teeth. During this time, she asked questions and explained the digital content to summarise important points and reinforce children's memorisation of knowledge. Furthermore, it was noted that children's autonomous expressions and interactions were not encouraged but restricted by the teacher. For example, when Shi introduced the 3D pen in vignette 1, many children reported their prior experiences, shouting out, 'I have it at home,' but Shi did not try to extend such statements. Similarly, in vignette 2, when children showed their interests in the content of the animation through whispers, such as, 'How large are the teeth,' Shi restrained such free discussions to forward the process of the activity and maintain discipline.

To sum up, the IWB was only used as a carrier of digital content and the teacher-led intervention was the main part of such an activity, which aimed to help children acquire knowledge and skills. Although this kind of session could be effective for children's knowledge acquisition, it ignored the agency, autonomy and interests of children, which should be treated as essential in early years pedagogy (Burnett, 2010).

Additionally, although children's use of digital tools was not observed on the observation day, Shi reported that it took place in the small-learning-area time, but only on occasion due to children's young age. As discussed in the previous Selection section, the teacher provided simple and close-ended digital tools in the learning corners, such as an MP3 player. She described her priority as allowing children to self-explore the use and operation of tools, emphasising that she only provided timely scaffolds when observing that children needed help. This strategy was in accordance with the developmental process of children's tool use (NAEYC, 2012). Regarding children's interactions with digital tools, despite their methods mainly involving consumption, children had relative agency over their use.

Interlinking activities. Similar to Luo and Ye, Shi also employed digital technologies in sessions that were interlinked with other activities within the classroom. For example, the sharing activity in vignette 1 was associated with the previous small-learning-area session. The small-learning-area activity provided materials for sharing, whilst the sharing session offered feedback on the previous activity. In this practice, the interactive whiteboard worked as the bridge connecting the two activities.

Also, vignette 2 was closely interlinked with other activities as they had a common theme: teeth. Shi reported that this theme was derived from a movie, *The Mole and Lollipop,* that children watched together. Shi made links between the lollipop and tooth health, developing a series of activities around teeth. These included making toothbrushes, reading picture books related to teeth and an experiment involving soaking teeth in cola. She interpreted that the knowledge about teeth that children acquired through digital content in vignette 2 could be strengthened and memorised through the successive activities.

As discussed above, from the perspective of external connection, the digital technologies were integrated into activities interlinking with other activities. Similarly, from an internal perspective, Shi reported her belief that digital content should cooperate with non-digital content, and she demonstrated this in her practices. In the sharing activity, she used both digital images and physical tools to introduce the operational steps of those tools. Also, in the thematic session, not only did she draw teeth and play the animation on the screen, but she also arranged children to observe each other's teeth in person and gave them a home task to count teeth. Accordingly, the combination of on-screen and off-screen content extended children's learning.

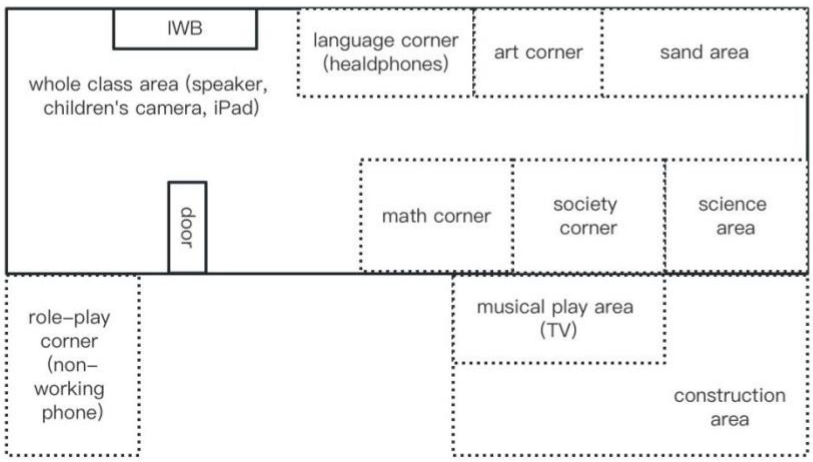
5.4 Case 4: Zhang

5.4.1 Introducing Zhang (Beliefs and Practices) and Her Classroom

Like Ye, Zhang was also a middle-class teacher. With more than sixteen years of teaching experience, she was the head of all middle-class teachers in this setting. As far as digital technology use was concerned, Zhang not only frequently employed many digital tools in her own life, such as a smartphone, computer, smart speaker and projector, but also tried to acquire more operational skills for professional software that could be used in pedagogical practices, such as video editing and slide making. She believed that the setting's decision to equip digital tools like the IWB and iPad in the classroom was rational, which was why she intended to employ them fully. Meanwhile, Zhang indicated her support for children's use of digital technologies not only in the classroom but also at home, although she stressed on the importance of limiting screen time for the sake of children's eye health.

Similar to previous cases, Zhang's classroom was also rich in technologies. Firstly, it was observed that the IWB was placed on the wall facing the classroom door. On a desk below the IWB, a speaker, a mouse, a keyboard and a children's camera were positioned. The children's camera was not observed in previous cases. Moreover, some other digital tools and toys were distributed across the range of learning corners. For example, I witnessed headphones in the language centre, whilst the other speaker and a large screen could be found in the musical performance area. Also, in the role-play corner, a non-working landline phone was provided for children to use. Finally, an iPad was placed together with the teachers' personal smartphones within the classroom.

Figure 8. Layout of Zhang's classroom



According to Zhang, digital technology was used in nearly every daily routine and each tool was applicable to particular sessions. Firstly, as the most frequently used device, the IWB was mainly employed to present videos and slides across various group sessions, such as thematic activities and 'picture book reading sessions' (Zhang 1). Notably, Zhang illustrated her practices of controlling the children's screen time and screen distance. In addition, the only iPad in this classroom was mostly used by teachers to photograph children for whole-class sharing and making connections with family. Meanwhile, Zhang stated that parents also captured their children's activities and crafts at home to share with teachers. In this case, the connection between classroom and home was based on digitally recording children.

As for children's access to digital technologies in the classroom, the children's camera was the most frequently used device. Zhang reported that children autonomously and spontaneously used this camera to capture peers, teachers and any details in their daily routine. She encouraged them to use it in various contexts, including indoor and outdoor sessions. More importantly, Zhang pointed out the essential role of the camera in the Mosaic approach and series of generative activities, as it not only helped capture children's interests but also facilitated cooperation and social interactions between peers. Finally, in the small-learning-area sessions, children also used some other special tools. For example, the headphones were used along with the USB drive by children to listen to stories taped by parents; the IWB was provided to some children for free writing and drawing; and the iPad occasionally presented online pictures that could be referred to by individual children for handcrafting.

In this class, the children were usually divided into two groups that were each led by a separate teacher to carry out activities for the day. During the observation day, I followed group A (consisting of 15 children) led by Zhang, witnessing their engagement with a morning-talk session, a small-learning-area session, the following sharing activity and an outdoor activity. In particular, digital technologies were integrated into the former three sessions.

At the beginning of the morning talk, Zhang presented a set of photos on the screen of the IWB, which had recorded the outdoor experience of a girl in the class, Jojo, catching cicadas with her parents during previous weekends. On the basis of these photos, Zhang guided Jojo to share her whole experience, inspiring the rest of the children's reflections and discussions. This vignette will be analysed in detail in the next section (see vignette 1).

In the small-learning-area session, all of the digital tools distributed across the learning corners were used. Specifically, in the group A session, two children pretended to run a restaurant in the role-play corner, during which they used several electronic toys and the children's camera. This vignette will be further discussed later (see vignette 2). Moreover, the teacher continued recording the children's work throughout the whole session.

During the sharing activity, different from the previous cases, Zhang did not use the IWB to present photos of children's works. Instead, they directly showed children's physical works or photos on the iPad to children. As Zhang explained, the division of the whole group halved the number of children, so they could view the objects or iPad photos clearly and did not need the IWB to zoom in. Then, the teacher guided each child to introduce their work and creative process.

5.4.2 Description and Analysis of Observed Child and Teacher Practices

Activity 1 Morning-Talk Session

Overview

Zhang led group A to have a 15-minute morning talk, in which a girl, Jojo, described her experience beyond the classroom. The purpose of this session was to cultivate children's meaning making, as Zhang illustrated. Given that the main theme of recent activities was 'Insect,' Jojo introduced her experience of catching cicadas with parents on weekends. The presentation slides were provided by Jojo's mother and included some photos that she had taken, along with relevant pop-science pictures downloaded from online.

Zhang presented a photo on the screen and explained to the group that the item in the image was the insect found by Jojo. She then invited Jojo to share her experience along with these photos. Based on many details from the photos, Jojo described the approach and process of catching the cicada, pointing out its features and the different cicada varieties, as well as knowledge about its shedding cycle. Throughout the session, Jojo, Zhang and the rest of the children explored issues such as, 'Why was the tree taped when catching cicadas,' 'Why did the cicadas differ in colour' and 'What kinds of shapes did these cicadas have?' Moreover, Jojo brought several physical cicadas to the classroom and Zhang showed them to the group for observation.

Vignette 1 and Analysis Drawn on Multimodal Approach

After the discussion amongst the children about why the tree was taped during cicada catching, Zhang touched the screen to change to the next photo, in which a cicada was laying on the trunk. She asked the children, 'This is the up-close photo of a cicada captured by Jojo's mom. Please observe, what does it look like? What are the features of it?' Immediately, Jojo told her peers, 'The cicada in the photo looked different from these physical ones in this glass. Do you know why? The photographed one seemed golden as it was exposed to some light.' Afterwards, Zhang repeated Jojo's question and asked her to explain to her peers again, stating, 'Oh, Jojo said the colour of the cicada on the screen was different from these ones that she caught. Why? Jojo, you can explain to us again.' Jojo then did so, and Zhang repeated her explanation. Following this, Jojo made eye contact with Zhang, asking for permission to move to the next slide. She told peers, 'This slide presented a variety of cicadas and there were so many breeds.' Zhang responded to her, 'Yes, many breeds of cicadas, so do you know which breed these cicadas in this glass are?' Neither Jojo nor the other children had any ideas, so Zhang suggested that they could compare the physical ones with various ones on the screen in detail later. After switching to the next slide, Zhang instructed the children to watch it and prompted Jojo to continue her presentation. Jojo asked another question, 'Do you know why there is an idiom about an unshelled golden cicada but not an unshelled grey cicada?' A boy answered her, saying, 'Because when a cicada climbs higher its wings will throw her body up.' Jojo denied his answer and said, 'It's because some cicadas were golden.' Immediately, another child questioned this interpretation by saying, 'But some of the ones we just watched were blue'. In response, Jojo replied that 'the blue was the colour of its wings but its body was a little golden.' Jojo then continued her presentation about the process of cicada sloughing, after which Zhang further explained Jojo's description and referenced the physical cicadas brought by Jojo.

What Roles Did Digital Technologies Play in Observed Vignette 1?

Digital technology was used as a deliverer. As in previous cases, the IWB still played the role of deliverer, presenting the slides made by Jojo's mother to the group. The delivered digital content involved photos captured by Jojo's family and the pop-science information downloaded from online (Appendix N-7-Lines 2, 14 & 21).

Digital technology was used as a site for interactions. More importantly, the digital content initiated children's reflections and conversations. For example, the 'tape' and 'cicada wings' captured in the photos encouraged children to think about and discuss the issues of why to tape the tree during cicada catching and why their wing colours differed respectively (Lines 3, 5, 6 & 7). Also, the sloughing process displayed on the screen triggered children's conversations about the idiom of 'a golden cicada sloughing off its skin' (Lines 22, 24, 26, 27, 28 & 29).

Teacher's Actions in Observed Vignette 1

Mediating. In this vignette, Zhang mediated between digital content, the presenter and the group. As the mediator between digital content and the children, Zhang not only operated the IWB for presenting digital content to the whole group (Lines 13 & 20), but also verbally introduced and explained this content to them (Line 1). More importantly, Zhang constantly facilitated interactions between the presenter, Jojo, and the listeners throughout this session. Firstly, she refined the focus of the content and reiterated to the group after each part of Jojo's presentation in order to construct the shared understanding between the presenter and listeners (Lines 4, 8, 31 & 38). Secondly, Zhang also guided the children group to reflect on Jojo's meaning making through questioning or explaining, promoting conversations and discussions amongst the children, including the presenter (Lines 23, 25 & 33). The vignette showed that Zhang gave the presenter control of both content and pace. At the same time, the rest of the children were allowed to freely express themselves and question others, which made it a child-dominated activity.

Children's Actions in Observed Vignette 1

Interactions with digital technology. Similar to other cases, there were few direct interactions between children and technologies in such kinds of whole-group activities and even the presenter did not operate the device in this session. However, the presenter's access to digital technologies may have happened during the preparation stage, as the slides were produced by her and her family, not by the teacher. Despite Jojo's mother being the primary maker, Jojo was also involved in the making process, contributing by selecting materials and preparing the speaking content to accompany every slide. Furthermore, the other children just watched the slides presented on the screen, thinking and speaking accordingly.

Interactions with the teacher. Children had different interactions with the teacher. On the one hand, the presenter cooperated with the teacher to present information about the 'cicada' to the children. During this process, the presenter, Jojo, played the main role, assisted by the teacher (Lines 3, 5 & 15). On the other hand, the children interacted more passively with the teacher. They were instructed and guided to observe, reflect and make meaning. For example, after the teacher instructed children to observe the cicada forms in the glass (Line 33), the group described what they were seeing and judging (Lines 34, 35, 37, 38, 39 & 40).

Interactions with peers. Moreover, the interactions between peers varied across time. Initially, the interaction between Jojo and her peers was just delivering/listening. As discussed above, Jojo presented the information to the rest of the children, which was a one-way output. In particular, Jojo dominated this session. Then, under the guidance of the teacher, conversations took place between them. Some of these conversations were initiated by the presenter through asking questions to her peers (Line 22), whilst others were generated by the audience through the proposal of new ideas (Lines 6 & 27).

Activity 2 Small-Learning-Area Activities: Pretend Play

Overview

Before the small-learning-area time, Zhang arranged for children to enter various learning corners in pairs according to their own interests. In particular, two children respectively used a headphone and a 'click to speak' machine to read stories in the reading corner. Also, another pair of children started the pretend play in the role-play area, in which two children pretended to run a restaurant. The ‘cook’ (Kevin) used cooker toys, food toys and Play-Doh to cook for the ‘customer’ (Lily). More importantly, Lily used the camera during play time. Other children were distributed across the construction area, the art corner, the science corner and the musical performance zone. Throughout the session, Zhang kept walking around the classroom and capturing media of the children across various learning corners.

In the next part, I selected a vignette from the pretend play to discuss the integration of the camera in small-learning-area activities.

Vignette 2 and Analysis Drawn on Multimodal Approach

Within the first few minutes of play, the ‘cook,’ Kevin, made a ‘doughnut’ with the Play-Doh for the ‘customer,’ Lily. The teacher Zhang then went over to them and recorded them with the iPad. After that, Zhang invited the two children to dialogues by asking what they were doing, and they discussed the ‘food’ they had made. After saying, ‘I would like some dumplings, could you do them for me, Kevin? I’ll take them away later,’ Zhang left this area. Thus, Kevin began making the dumplings. He was so proud of his ‘cooking’ that he told his peer, ‘Look! I made dumplings!’ Inspired by Kevin, Lily also made two dumplings with the Play-Doh, after which she took out the camera to photograph her peer and the ‘food’. Occasionally, she found that the camera lens was switched from the back lens to the front one for taking a selfie, so she excitedly told the teacher, ‘Miss Zhang, I can do a selfie with this camera!’ In response, Zhang encouraged Lily to demonstrate by asking, ‘Can you show me how to do it?’ and Lily demonstrated. After a while, Lily also captured the teacher. Kevin seemed to be enthused by Lily’s actions and he asked for the camera to use. However, Lily refused his request, so Kevin had to continue his work. In the following sharing session, Kevin and Lily showed the ‘food’ they made, as well as camera photos taken in the role-play corner to the group. Building on this, Zhang encouraged children to autonomously use the camera for capturing their materials and works.

What Roles Did Digital Technologies Play in Observed Vignette 2?

Digital technology was used as a medium of recording. In this vignette, it was the children's camera that was used by children to capture and record the classroom activity (e.g. Appendix N-8-Lines 12, 14 & 18). Differing from previous examples, in which digital technologies were designed to deliver digital content that was consumed by children, this vignette showed that the digital technology itself moved out of focus and children as agents made meaning through it. Furthermore, in the following sharing session, these photos were displayed and introduced to the children by the producer. Thus, it could be interpreted that the camera provided opportunities to capture children's perceptions of the play and gave them a voice.

Teacher's Actions in Observed Vignette 2

Recording. In the small-learning-area session, the teacher recorded children with the iPad camera (Line 1). As well as the two children in this vignette, others across various learning corners were photographed by the teacher. However, unlike in previous cases, Zhang mainly captured a moment from the process of children's activities but not the final products. She explained that these fragments could help to remind children of their experiences so that they could introduce the process to peers in the subsequent sharing session.

Inviting to dialogue. Also, Zhang invited children to dialogues through asking questions about the ongoing play (Lines 1, 3 & 17) and commenting on specific points (e.g. 'dumplings' in Lines 5 & 15). These actions showed her interests in the children's play, thereby encouraging them to become more engaged in the activity.

Emotionally involving. More importantly, Zhang showed emotional involvement in the children's play by respecting and providing positive feedback to them. Firstly, she verbally and physically praised children for particular actions, such as Lily's self-exploration of the camera functions (Lines 23 & 26). Furthermore, she learnt from the children (Lines 20, 21 & 22) and physically co-worked with the child to use the camera (Lines 23, 24, & 25), which supported the argument of Vidal-Hall et al. (2020).

Children's Actions in Observed Vignette 2

Interactions with digital technology. In this vignette, children were provided open-ended opportunities to engage with the technology, namely the camera. The girl, Lily, independently and freely used the camera to capture any people and any materials that she could access. Additionally, she autonomously explored the functions of the camera and mastered the 'selfie' skill, which had not been introduced by the teacher previously.

Interactions with the teacher. The two children were not only passively guided by the teacher, but also actively interacted with the teacher surrounding the use of technology. For example, Lily told Zhang about her new discovery of the 'selfie' based on her own initiative (Line 19). In addition, Lily took a photo of Zhang (Line 27), which was shared with Zhang later.

Interactions with peers. The interactions between peers ran through the whole session, from the non-digital part to the digital part. The pretend play provided the opportunity for children to collaborate in paired roles: the cooker and the customer. Although this portion was not included in the vignette description, the two children did have conversations surrounding the 'business.' As the play progressed, the role boundary between the peers was blurred and they co-worked to produce 'dumplings' (Lines 8, 9, 10 & 11). Furthermore, the presence of the camera allowed for the children's physical interaction of 'capturing' and 'being captured' (Lines 12 & 13) and produced communication around the right to use the camera (Lines 28, 29 & 30).

5.4.3 Analysis and Discussion of Zhang's Pedagogical Approaches

Selection

Similar to the previous cases, Zhang had the ability to apply for more digital tools besides those uniformly purchased by the kindergarten. When selecting from the range of digital devices, Zhang gave priority to the age-appropriate ones. However, her understanding about age-appropriateness differed from the understandings of the teachers from previous cases, Ye (case 2) and Shi (case 3). Ye and Shi both focused on whether or not it was easy for young children to operate the tool, whereas Zhang placed the emphasis on whether the content provided by the tool was consistent with the developmental goals of children aged from three to six. For example, Zhang reported, 'I would exclude the tools which provided schooling content or some other content inappropriate for young children.' She also indicated her cautiousness about materials that 'gamify' use, which she believed might bring about adverse impacts to young children.

Apart from the age-appropriateness, children's interests were also taken into consideration by Zhang when selecting digital tools to equip. According to the second interview, she usually allowed children to bring their favourite digital toys from home to the classroom and she could then select appropriate devices based on the popular technologies. For example, the cartoon audio player in the language corner was chosen in this way. Moreover, Zhang had applied for one more camera from the kindergarten when she identified children's interest and passion for using the existing camera in vignette 2.

The above analysis showed that Zhang took the time to evaluate and select appropriate digital technologies for daily routines. Additionally, the interview revealed that she tended to observe children's use of digital technologies in their initial stage of introduction, identifying the opportunities and problems and thereby adjusting. This also embodied her relevant knowledge of these new technologies. Therefore, her intentional selection of 'what to integrate' was in accordance with the DAP.

Furthermore, the DAP also guided Zhang's determination of 'when to use' digital technologies. Her selection of the individual digital tool for specific sessions was usually based on educational goals. Firstly, the selection of technologies served to achieve specific curriculum goals. For example, arranged by the teacher, children could use the headphones and USB drive in the reading corner to listen to stories that were recorded by their peers at home. Furthermore, the integration of technologies aimed to help cultivate the reading interests and habits of both listener and storyteller, also promoting the latter's literacy. In addition, when conducting thematic activities to help children construct their understandings of the world, Zhang generally selected the interactive whiteboard to present still or moving images. She explained that the visual mode could make it easier for children to understand concepts. In addition to the two examples, the vignette 2 could also support this argument. In particular, Zhang used the iPad to capture children in the learning corners with the aim of assisting with their later sharing of corner experiences. Thus, it was demonstrated that Zhang emphasised the important role of digital technologies in developing children's language proficiency. Secondly, Zhang's decision to use specific technologies also supported digital goals. She reported that in order to develop children's digital competencies, she usually gave children as many opportunities to operate devices as she could, such as allowing them to audio record with her smartphone, turn pages of slides and zoom in and out of the pictures on screen.

Use and Integration

Child-dominated use. Zhang attached great importance to children's meaning making in her pedagogical practices. As a result, she tended to enable children's technology-supported meaning making. Similar to previous participants, Zhang employed multimedia materials in the teacher-led, whole-group sessions to deliver knowledge and conceptions. However, she still valued the significant role of digital technologies in child-dominated activities, whether in group sessions or individual sessions. As described in vignette 1, the child presenter dominated the whole session and the presence of the interactive whiteboard and slides assisted in her articulation. Zhang reported that these kinds of child-dominated presentations were routinely conducted in this class with themes covering daily anecdotes, fairy tales and news issues. In these presentations, the presenters were given opportunities to express themselves and control the process, whilst the audiences could freely comment and question. Similarly, in the second example, the individual child's open-ended use of the camera also facilitated their personal meaning making and thereby encouraged them to communicate with the teacher. In particular, according to the interview, the photos captured by the children would be printed with texts for displaying to their whole peers. Notably, the texts were also produced by children themselves and the teacher just helped to polish them when necessary. Not only were the interactions between children and the camera playful, but children also had the autonomy to control the medium and outcome. To summarise, in both examples, the teacher did not intervene in any of the children's decisions and actions, showing her respect for children's interests and autonomy.

Furthermore, it was observed that Zhang's introductions of new technologies to children were somewhat different from children's developmental progression in the use of tools (Exploration - Mastery - Functional Subordination) (NAEYC, 2012). Specifically, Zhang illustrated that she normally conducted an initial introduction of new digital materials to the children before allowing them to autonomously and independently explore these tools. According to her interpretation, the high price and the fragile nature of most digital tools motivated her to do the first introduction, which she believed could reduce the economic losses caused by improper use. However, the initial introductions only covered the primary functions of digital tools, leaving space for the children to explore independently. For example, when the camera was first introduced to the children, Zhang only explained the key buttons, such as the on/off switch and the one to take a photograph, whilst the subordinate functions like the selfie mode and filters were discovered by children themselves.

Co-working. Although some technology-integrated activities were dominated by children, as discussed above, the teacher was not separated from these sessions and instead co-worked with children. Firstly, Zhang usually got involved in children's activities by adopting the role of a 'peer.' For example, the observation data showed that she acted as a 'customer' to engage in the pretend play, prompting the play process. Furthermore, she learnt about the subordinate function of the camera from the child, and they practised it together, thereby achieving the shared understanding of the 'selfie' function. Secondly, the co-work also took place when children needed technical support. As observed in vignette 1, Zhang acted as an audience member like the other children during most of the presentation. She only facilitated as a collaborator when the presenter needed her help to explain or control slides. In addition to the group activities, Zhang also supported children with their technology use in small-learning-area sessions. In particular, she intended to encourage 'peer help' for solving children's technical problems rather than to directly intervene herself. She explained that the interactions between peers could benefit children's mastery of operational skills, which was consistent with Luo's belief.

Connecting with families. Furthermore, Zhang employed the digital technologies to strengthen connections with families, as such connections were based on digitally recording the children. Notably, the connections between classroom and home were no longer limited to one-way classroom/home interactions, in which children's experiences at the kindergarten were digitally shared with parents. Instead, home/classroom interactions were also strengthened through the involvement of digital technologies. For example, Zhang mentioned that she encouraged parents to video record their child’s daily activities, performances or creative works and she then shared these images with the whole class. In addition, the previously mentioned audio-recorded storytelling at home and the slides made by children and parents for presentations could enhance the interactions between home and classroom, helping the teacher and peers to understand more about the children.

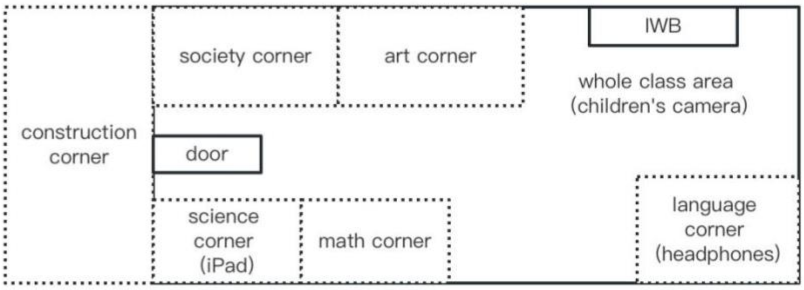
5.5 Case 5: Wang

5.5.1 Introducing Wang (Beliefs and Practices) and Her Classroom

Working at the same kindergarten as Zhang in case 4, Wang was the lead teacher of an upper class. She had thirteen years of teaching experience as a kindergarten teacher. Regarding the use of digital technologies, her individual views were consistent with the findings of the first phase interviews. Zhang acknowledged the assistance of digital technologies in her daily work and also supported the employment of them to help children acquire ‘lived’ knowledge and an awareness of digital learning (Zhang, interview, 23 Jan 2022). Despite this, she still insisted on using them in moderation, avoiding her own reliance on them as well as the adverse impact on children’s eye health.

Wang’s classroom was fairly rich in digital technologies. The whole-group area contained a mouse, keyboard and the IWB, which were placed lower than in previous cases in order for children to access them with ease. Furthermore, the camera and an iPad were located on the table below the IWB and there were headphones in the language corner.

Figure 9. Layout of Wang's classroom



These digital technologies were integrated into a range of whole-class, group and individual activities. In particular, the IWB was employed in the whole-class and group sessions by both teachers and children. The teacher normally used it to conduct music lessons, play videos and search for online information for children. Meanwhile, children were provided with opportunities to use it for broadcasting news and telling stories to their peers, which was the same as in Zhang's class. Moreover, in the small-learning-area sessions, individual children might use different kinds of digital tools. For example, Wang illustrated that sometimes the children were instructed to scan the QR code with the iPad or her own smartphone to watch the videos of experiment examples. They then conducted scientific experiments accordingly. Also, the headphones were used by the children to listen to stories, whilst the camera was often operated by the children to capture moments of 'a day in the life.' In addition to these pedagogical uses, Zhang also connected with families daily through her smartphone and computer.

In this upper class, readiness for primary school was an essential theme.

The observation of the physical environment showed many drawings and posters relevant to 'the primary school,' such as the countdown to graduation and the various paintings with common themes including 'What Is the Primary School Like' and 'The Route From My Home to Primary School'. Thus, it could be inferred that the teacher was helping children to build their emotional readiness for school. At the same time, the learning lessons were aimed at cultivating academic readiness, including numeracy and literacy development. More importantly, the use of digital technologies varied in these sessions. In an observed numeracy session, Wang aimed to deliver the concepts of date and time to the children. To this end, she searched for and presented the calendar on the screen and guided children to figure out the number of days until the summer holiday. Later, when delivering the skill of time recognition, she also presented a video explaining the inner workings of a clock. Aside from this session, Wang also employed the IWB in another music session (see Vignette 1). In order to rehearse the choral song for the graduation party, she played back the track and typed the words of the song on the screen, requiring children to identify the words and sing along. In the next section, I selected one vignette from this music session and thereby analysed Wang's approaches to integrating digital technologies.

5.5.2 Description and Analysis of Observed Child and Teacher Practices

Activity 1 Music Session

Overview

This was a whole-class music activity prior to the lunch period, in which Wang instructed the whole group to rehearse as a choir that would be performing in the coming graduation party. The purpose of this session for the children was to memorise the lyrics and the children's literacy could also be strengthened in this context. Wang began by searching for and playing the musical backing track through the interactive whiteboard, so the children sang the words over it spontaneously. Afterwards, Wang typed the words on the screen as they went along and guided the children to read these lyrics word for word. During this process, she corrected children's pronunciation of each word. She also made the font of the more confusing words larger and bold on the screen. Thus, children could practise and remember the right lyrics.

Vignette 1 and Analysis Drawn on Multimodal Approach

After typing the words on the screen, Wang played the backing track again and allowed children to sing along. When she recognised an error, she stopped the music and the children stopped singing as well. Wang pointed to one line of words and asked the children, ‘Can you see this sentence? How do you pronounce it?’ Then children replied, ‘Zhuang dian feng jing shi jie (decorate the world of scenery),’ but Wang corrected them by saying, ‘It should be zhuang dian feng jing shi pian (decorate the poem of scenery). Now read the right words aloud. Can you see the words clearly, guys in the back?’ Immediately, she increased the font size of all words and also put this sentence in bold font. Then, Wang instructed the children to read through all of the words, pointing at them one by one. During the process, Wang realised that some characters in the lyrics could not be identified by the children. Thus, she took the lead in reading the sentences one by one, followed by the children’s shadowing. Once finished, Wang instructed the children to read out loud without her leading the reading. However, the children still could not complete the task smoothly as they had not achieved competent literacy. As a consequence, Wang repeated the process of shadowing several times, during which she constantly corrected and explained for the children. Finally, she spot-tested some children to ensure that most of them could accurately read these words out. Wang then played the backing track again and instructed children to sing along with the words and music.

What Roles Did Digital Technologies Play in Observed Vignette 1?

Digital technology was used as a deliverer of text. In this whole-class teaching session, the interactive whiteboard was still used to present text and music to children. In particular, it supported the instructionist form of pedagogy and subject-based curriculum, as children were simply instructed by the teacher to learn the text on the screen. Although this was not a mere word-recognition session, the pre-prepared content from the teacher assisted in children’s literacy learning and memorisation.

Teacher’s Actions in Observed Vignette 1

Instructing. During this session, the teacher was in control of the technology and instructed children to complete tasks. Specifically, the teacher instructed the whole group or an individual child to read out the lyrics on the screen. To do so, she used instructional language, such as, ‘Please do X,’ ‘Can you X’ and ‘It should be X.’ This was accompanied by instructional actions like 'pointing to' and 'tapping' (e.g. Appendix N-9-Lines 1, 3, 5, 7, 15 & 21). Such instructions aimed to promote children's practices. Moreover, the teacher evaluated and corrected in instructional ways throughout this session.

Children's Actions in Observed Vignette 1

Drill and practice. As for the children, they were engaging in sedentary literacy learning. During this session, they spent most of the time practising and listening (e.g. Lines 2, 6, 12 & 14), so their autonomy with the interactive whiteboard could not be observed. Furthermore, sustained conversations and interactions both between the teacher and children and amongst peers were uncommon.

5.5.3 Analysis and Discussion of Wang's Pedagogical Approaches

Selection

The observation and second interview indicated that Wang's decisions on digital technology use in the classroom were based on the need for classroom management and curricular goals These purposes were also shared by the previous teachers. Firstly, from a classroom-management perspective, Wang emphasised 'discipline' in the classroom and tried to avoid a 'noisy classroom environment' (Wang). Therefore, it was observed that during the transition phase between activities, Wang used the IWB to play soft music and combined this with verbal gestures to calm children down and get them ready at the activity area. This was confirmed in her subsequent interview:

> *For example, on a graduation photographing day when we did not schedule any pedagogical sessions, some of the children went outside to see other classes' photography, while others wanted to stay in the classroom. It was difficult to manage all of them. Then, I had to make them watch an animation video so that they could calm down, otherwise they would be really noisy in the classroom.* (Wang 2)

Wang's narrative showed that she tended to use the digital media for keeping the children quiet. In addition, Wang reported that in order to strengthen the child management and the development of ‘good’ habits, she used a ‘Class Optimiser’ app to evaluate the children. In this app, the teacher manually adds or subtracts points for each child based on a series of behavioural evaluation indicators as a way to encourage children to ‘do more positive behaviour and reduce negative behaviour’.

In terms of the learning goals, there were separate short-term goals for each session, but Wang stated that the school readiness objectives were spread throughout all sessions over the year. Accordingly, her use of digital technologies in her teaching was also primarily to facilitate the school readiness goals. In particular, the subject content learning was prioritised by Wang. In the second interview, Wang explained, ‘Although school readiness included many aspects, such as emotional readiness, learning readiness, social readiness and life readiness, the learning aspect was still emphasised by parents, and therefore we focused on this aspect in our practices’.

For example, I observed the IWB being used in a whole-class maths session, as recorded in my field notes:

10 June 2022 Classroom Observation Field Notes

> [The] *teacher used an IWB to present the calendar, instructed children to identify the date of today (10 June 2022) and the date of coming graduation (25 June 2022), and to elicit the question, "How many more days until the summer holiday comes?" Then, the children were guided to do the mathematical calculation using the ‘round up to 10’ method.*

Similarly, the IWB was also used for children’s literacy learning, as shown in vignette 1. Moreover, the observation also indicated the role that the IWB played for children preparing and adapting to life at school. For instance, I observed Wang using the IWB to search for and present an instructional video of ‘eye exercises’ to the children, as ‘eye exercises were a regular recess activity in primary school’ and she ‘wanted the children to get used to this activity earlier’ (Wang).

Use and Integration

According to observations and interviews, the pedagogical use of digital technologies in Wang's classroom showed the following characteristics. Firstly, it was closely associated with subject learning. This was revealed by the teacher's determinations on technological use for achieving school readiness goals discussed above. Secondly, the technology was used by the teacher in an instructive manner. As presented in vignette 1, all of the teacher-child interactions around digital content fell into the 'instructing and being instructed' dynamic in order for children to meet their literacy learning goals. Moreover, the children consumed digital content. For instance, Wang told me that she normally searched for and presented videos that combined animation and knowledge for the whole group of children, using this entertaining approach to allow children to acquire knowledge. In addition, although there were some digital devices in the learning corners, I observed minimal use by the children during the small-learning-area session. Wang recognised this finding in the follow-up interview, stating:

> *I found that the children in our class were no longer interested in the digital devices in the learning corners, like, compared with the reading robot in the language area, it was obvious that children were more interested in the materials next to it for writing in calligraphy. Also, the little square table in our classroom which accommodated some digital tools like the headphones was not accessed by any children*. (Wang 2)

She believed the reason for this was that these devices could only provide content for children to consume and there was no two-way interaction between the child and the device. Due to this, she thought such a device could not attract children's interests constantly.

5.6 Summary

Generally speaking, the practices observed in the case studies were consistent with reported practices in previous interviews. The most frequently used digital technology was the IWB, which was usually operated by teachers in whole-class activities but accessed in a limited capacity by the children. This use of digital technology was observed in all classrooms. Furthermore, the technologies that children used in kindergartens were mostly closed-ended learning tools, which were observed in small-learning-area sessions.

Specifically, four themes emerged from the case studies regarding teachers' approaches to integrating digital technologies into pedagogical activities.

Digital technology was not used as a focus itself, but integrated into daily routines. Firstly, in most examples, digital technology use was not the end of pedagogical practices. Instead, technology was used as a tool to facilitate activities with diverse forms and goals. This approach to using digital technologies was consistent with the main attitude towards technology integration reported by teachers (see section 4.1.2). More specifically, the digital technology was regarded as a helpful tool for teaching and learning but not a necessity in kindergartens. The digitally-enhanced sessions were across the five development areas specified in *Guidelines for Kindergarten Education (Trial)* (MoE, 2001), including language, health, society, art and science. They were also conducted in a range of forms, such as thematic sessions, sharing activities, transitional time and small-learning-area activities. In these activities, the technology used supported different goals, such as improving work efficiency, assisting in class management and promoting children's learning and development. With regard to the goal for children's learning and development, teachers tended to select digital devices to accommodate specific tasks, such as facilitating children's reading, school readiness, knowledge acquisition and promoting discussion. This was in accord with teachers' perceived affordances reported in section 4.1.2. Furthermore, although in case 1 the technology use itself (acquiring the skills of voice searching in iPad) was an educational goal set by the teacher, this goal was combined with other pedagogical targets, including developing children's sense of space, drawing skills and school readiness.

Interlinked with non-digital. Secondly, the digitally-enhanced activities did not exist separately, but were interlinked with non-digital activities. The two thematic activities observed in case 1 vignette 1 and case 2 vignette 1 showed the themes linked with other sessions (both digital and non-digital). Moreover, the sessions observed in case 3 vignette 2 and case 4 vignette 1 were connected to children's home experiences. Furthermore, even within a session, the technology use was interlinked with the non-digital tasks, such as the combination of voice searching and paper drawing in case 1.

Intentional selection with consideration of age. Thirdly, when teachers determined which digital technologies could be used by children as learning tools and which approaches to employ, the age of the children was taken into consideration. Teachers generally held the belief that the younger children in the lower classes were less competent than the upper-class children at operating digital devices. Thus, it was observed that the lower-class children in case 3 did not have access to screen-based technologies and only used operator-friendly devices like the reading pen. In contrast, the middle-class children in case 2 and 4 could perform simple operations with the IWBs (e.g. touching the icon and scrolling) and used relatively complex devices like the reading robot and children's camera. Moreover, older children in the upper class in case 1 were allowed to use iPads independently. The different ways in which children interacted with technologies were not only contingent on children's ages but were also influenced by teachers' beliefs regarding whether and how technologies could be integrated into children's learning and play. For example, Ye demonstrated in the first interview that the ICT-related training made her realise the necessity of children's technology use. Furthermore, the observed sessions in case 2, in which children interacted with the IWB and reading robot, suggested that she had put the belief into practice. Also, teachers' concerns about the adverse impacts of technology use on children's eyesight and concentration motivated them to control the duration and distance of screen-based technologies, as was observed in all cases.

Instructive and consumption-based use. Finally, teachers primarily integrated technologies in an instructive way and most of children's technology use involved consumption. When digital technologies were used as teaching tools, teachers mainly employed them to present digital content, such as texts, pictures and videos (e.g. case 2 vignette 1, case 3 vignette 2 and case 5 vignette 1). In these sessions, the children were observed to passively receive content, whilst teachers instructed children to follow a predetermined process. Additionally, digital devices were also used to record children's playful activities, which were then presented to children through the screen (e.g. case 3 vignette 1 and case 4 vignette 1). In these examples, an individual child was able to make meaning from the recordings with the instructions of the teacher, whilst the other children still received information provided by the presenter. Moreover, when technologies were employed as learning tools, children mostly used close-ended devices and followed instructions by the devices or teachers. They then consumed the content, such as images and stories, delivered by the devices (e.g. case 1 vignette 1 and case 2 vignette 2). During children's interactions with digital technologies, teachers were observed to mainly respond to children's inquiries. There were rare examples in which children were provided with opportunities to independently explore digital technology use, such as the interaction with the iPad in case 1 vignette 1 and the engagement with the children's camera in case 4 vignette 2. However, the two teachers in the two cases showed different pedagogical strategies. Whilst Zhang in case 4 applied responsive guidance in supporting the child's interaction with the digital camera, Luo in case 1 provided the appropriate scaffolding for the children's use of digital technologies.

Next, I present further findings from Phase Two of the Study, in particular those relating to contextual factors. These are discussed alongside Phase One findings relating to contextual factors.

Chapter 6. Findings from Phase One and Phase Two: Contextual Factors

The previous chapters 4 and 5 reported the attitudes, perspectives and beliefs of participating teachers, as well as their pedagogical practices. Moreover, in accordance with earlier studies, this study identified the significant role context played in shaping teachers' perceptions and practices of technology integration in early years settings. It also made important contributions by determining the contextual factors. I thematically analysed the data generated from interviews, observations and document reviews. Past frameworks offered useful models for analysing these factors. In particular, the framework of barriers to IT integration in ECE organisations, developed by Plumb and Kautz (2015), influenced the deductive coding process for identifying the diverse contextual factors. In addition, the adapted framework of context for TPACK, originally developed by Porras-Hernandez and Salinas-Amescua (2013), was used to categorise these factors. This framework emphasised that teachers' knowledge of technology integration was constructed within the whole system, including the micro classroom (encompassing the individual actors, teacher and student), the meso school and the macro society. Thus, the contextual factors identified in this study were examined across three levels: micro-level, meso-level and macro-level. Furthermore, because the analysis also indicated that these contextual factors were interrelated, the relationships between them are also presented in this section.

In this chapter, I begin by presenting the micro-level contextual factors, including teacher-related, child-related and classroom contexts. Next, the meso kindergarten factors are presented. Then, I identify the macro sociocultural contexts. Finally, interrelations are discussed.

6.1 Micro-Level Contextual Factors

6.1.1 Teacher-Related Factors

Prior Digital Experiences in the Personal Lives of Teachers Influenced

Perceptions and Uses of Digital Technologies in Kindergarten Settings. The interviews with some participants suggested that teachers' digital-related experiences in their personal lives impacted how they perceived and used digital technologies in kindergarten settings. These digital-related experiences were associated with either their own use of digital technologies or their families' digital experiences. Almost every participant mentioned using digital technologies frequently and effectively in their personal lives to engage in social, entertainment and learning activities. These digital technologies included computers, smartphones, tablets and smart speakers, etc. This made some of them adopt more favourable views about using technologies for work. For example, Luo reflected in the interview, '*I believe it is necessary to use them (digital technologies) as a modern pedagogical tool, as I myself have benefited from their use in work and life, so I believe children could also benefit from them. Thus, I should do this (use digital technologies in the classroom).*' Luo's statement showed that her exposure to digital technologies in her personal life contributed to her positive attitude towards technology integration into the workplace. In addition to their attitudes, teachers' skills and confidence in using digital technologies in kindergartens also benefitted from their prior digital experiences. This was evidenced by Bai:

> *I have a smart speaker, 'Xiao Du', at home. I routinely verbally instructed it to report the weather and play music and so on, so when my kindergarten introduced a similar device from another brand, I could easily master all its functions and deliver this knowledge to my children, such as how to take a photo, set a reminder, search for information and audio record.* (Bai)

Bai's narrative indicated that her prior exposure to a certain type of digital device helped her to develop the relevant operational skills, increasing her confidence when introducing it to children at work.

Moreover, participants' perceptions appeared to be shaped by observing and talking to the people around them (mainly family and friends) about positive technology-related experiences. For example, Ly had a friend who worked at an educational technology company that developed and sold an 'educational robot'. Through conversations with this friend, she learnt about the educational potential of this robot. As a result, her interest in this product motivated her to introduce it to several kindergartens, including the one she was working at. Along with her friend, Ly also described the important roles played by her husband and daughter in forming her understanding of the relationship between educational technologies and children's cognitive development:

> *My husband is working in the animated movie industry and his company also gets involved in the development of VR applications. Accordingly, my daughter was invited to experience VR animation and she showed great excitement and passion for it. Meanwhile, in daily life, she frequently paints using the iPad and interacts with the smart speaker at home, through which I noticed her knowledge acquisition of primary and complementary colours and the development of her language proficiency and logical thinking. When she gave the wrong instruction to the smart speaker, it would not reflect the right operational results, so she had to keep trying, correcting and thinking. All of these observations make me reflect on whether the current technology integration in the early years education sector is quite conservative and lagging.* (Ly)

This example demonstrated that Ly developed her understanding of the educational potential of digital technologies by witnessing and communicating with her friend, husband and daughter about their digital experiences. In particular, her experience prompted her to reflect on kindergarten children's use of technologies. This finding did not emerge from all participants but only from a subset. In addition to Ly, Yan mentioned that her receptivity towards educational technologies came in part from witnessing her nephew's greater enthusiasm for literacy learning through the iPad than for paper-based learning.

Teachers' Knowledge and Skills of Digital Technology Integration as well as How They Perceived Their Knowledge and Skills Influenced Their Practices. AS discussed above, teachers' previous digital experiences influenced their confidence and skills in using digital technologies, which could further affect their practices (Plumb & Kautz, 2015; Blackwell et al., 2013). Ly's statement supported this point. She reported, '*When I think I am not good at using a tool, I will not use it often*.' In this study, the majority of participants expressed their confidence in using digital technologies for pedagogical purposes. As Zhou reflected, '*My courseware designing skill is quite outstanding among all teachers in my kindergarten, as I usually teach myself technical skills through online resources every time I need them for pedagogical purposes, such as slide making, audio/video editing and animation making.'* Hu reported a similar confidence, stating, '*I don't think I need more training on technical skills. I use quite normal technologies in my daily routine and my abilities to use them are enough for pedagogical activities, encompassing editing audio and videos.*' They claimed their confidence in their own digital skills and believed they were enough to allow them to use digital technologies with children. Furthermore, their confidence and technical skills shaped their normal practices of using a projector or IWB to present multimodal digital content for whole-group educational activities. However, as the TPACK model clarified, teachers' knowledge and skills of integrating digital technologies included more than just the technological perspectives; they also involved viewing things through a pedagogical and content lens, which was only realised by some teachers (see below).

As Blackwell et al. (2014, p.88) argued, that the ways teachers incorporated digital technologies into their practices could be 'qualitatively different'. They gave two examples of this: 'using a digital camera to take pictures and document children's learning' and 'having children use the iPad to write and illustrate stories'. Accordingly in this study, the multiple approaches used by teachers, such as using slides to deliver knowledge, having children use the iPad to search for a route and allowing children to use the children's camera for self-expression, were different. Part of the reason for this difference was that teachers' knowledge and information gaps guided their different understandings of technology use, thereby leading to different methods of achieving integration within their practice. When asked if they had any knowledge of integrating digital technologies into the curriculum and pedagogy beyond operational skills, teachers' diverse responses indicated their different levels of cognition. From one perspective, taking Hu as an example, she reported, '*I don't systematically know much about how to integrate technologies into curriculum and pedagogies, but I do think it is quite a simple thing that doesn't need very strong competence. My current skills are enough.*' Bai, however, displayed a stronger intellectual curiosity for gaining a deeper understanding of integration. She stated, '*I have learnt about some and I am currently learning and exploring relevant knowledge and skills. However, there are* *still many vague concepts in my brain to be clarified; for instance: how to develop children's specific digital literacies, how to accommodate children's ages and how to better associate digital technologies with the curriculum*.' The former response represented the viewpoints of most participants in this study, whose understandings of technology integration were still from a technological perspective. In contrast, the latter minority had progressed towards technological pedagogical knowledge and technological content knowledge. Similarly, the former example addressed the teacher's use of technologies within their practice but did not consider children's interactions with technologies, whereas the latter focused on children's independent use of technologies in more detail. These differences in knowledge and practices were closely linked with the structural elements within the institution, which will be discussed in 6.2.

Teachers' Demographic Characteristics (Educational Degree and Age) Did Not Influence Their Digital Technology Integration. In previous research, teachers' educational level and age were believed to influence their attitudes and practices in relation to technology integration (e.g. Karaca et al., 2013; Hsiac, 2003). In particular, the quantitative data collected by Blackwell et al. (2013) indicated that teachers with higher educational attainment could have higher levels of income and thereby might have more access to technologies that their students could also access. However, in this study, although the degrees of participants varied between associate (college), Bachelor's and Master's, there was not an obvious correlation between educational attainment and access to digital technologies. Specifically, all of the 14 participants had very similar technology access. This could be due to the changing nature of digital devices, which were no longer considered to be the 'luxury' items they were in previous years. Instead, they became common staples in people's lives. Moreover, the research data did not show any connection between teachers' educational attainment and their perceptions and practices. In fact, the only participant (Ly) who did not engage in majors relevant to early childhood education demonstrated a more open mind and more advanced knowledge of technology integration than most others. This could be explained by most participants' statements that they did not receive specific training or courses in technology integration when earning their qualifications. For example, Yan reported that although there had been a module on 'Educational Technology' on her college course, the content was focused on the operational skills of some office software. However, given the small sample size and the qualitative nature of the study, significant inferences cannot be made about the relationship between teachers' educational degree and their access to digital technologies, attitudes and practices.

Furthermore, the age of teachers, together with their number of teaching years, has been demonstrated to affect teachers' confidence levels and practices of using technologies in kindergarten settings (Russell et al., 2003; Venkatesh et al., 2003). To elaborate, it has been suggested that newer teachers with fewer teaching years, who grew up in the digital era, might be more confident about technological issues, whilst older teachers with more teaching years might be more conservative (Plumb, 2017). Many participants in this study expressed similar opinions. For instance, Shi perceived that older teachers in her kindergarten might be less skilful at using digital technologies than the younger generation. In the same vein, Zhou and Hu noted that newer teachers may use digital technologies in classrooms more often than older teachers. Whilst some educators believed that age was a shaping factor, this was not reflected in reality. The participants in this study ranged in age between their twenties and forties, but they all shared a similar, broadly moderate attitude towards technology integration (as discussed in 4.1). They believed that technology was simply a tool with both strengths and weaknesses and that it should be used appropriately. In addition, the perceived negative effect of the teacher's age on technological practices was not observed in this study, as the oldest participant, Luo, demonstrated a high-level of confidence, expertise in operational skills and appropriate approaches to integrating technologies into the curriculum. These features might be connected to her role as the leader of the ICT group within her kindergarten, although the direct causal link between them cannot be assumed. Typically, this particular identity was derived from the institutional structure, which will be discussed in 6.2.

6.1.2 Child-Related Factors

Teachers' Knowledge of Children's Digital Experiences at Home Influenced Their Technology Integration Practices. The interview and observation data indicated that teachers learnt about children's digital experiences at home through observing children, communicating with parents or conducting home visits. Almost all of the participants referred to children's extensive prior experience with technology use. To be specific, they summarised children's online learning activities (e.g. online reading, attending virtual lesson and playing with educational apps) and entertainment activities (e.g. playing video games and browsing TikTok videos). It was found that some teachers then drew on these existing digital experiences in different ways in the classroom. For example, Wang knew that children had primary tablet competencies, such as 'unlocking', 'scrolling' and 'touching' the screen, so she gave children the opportunity to perform 'simple operations' when needed. I observed these types of actions from the children in Wang's classroom, such as 'unlocking the iPad to get the time' and 'zooming in and out of the pictures.' Similarly, Zhang said that she was aware that most children used headphones at home. Due to this, when introducing the headphones to the reading corner, she allowed children to explore them on their own without the initial instruction that she generally gave for other digital devices. Additionally, because Yan was aware of the children's passion for various puzzle games and the cartoon, *Dora the Explorer*, she incorporated the character of Dora and level design into her courseware. Furthermore, after witnessing the passivity of children's digital experiences at home, Luo illustrated the steps she took to avoid this happening in the kindergarten. Consequently, during discussions about her classroom practice, she reported that she intervened and attempted to 'guide children's active learning in their interactions with technologies' (Luo), which was consistent with my observations.

Teachers' Knowledge of Parents' Views on Technology Use Influenced Their Practices. Moreover, through the interviews, parents' views on technology use were found to influence teachers' digital practices. Most teachers revealed that they valued parents' views, which could be consulted for modifying their practices. Although none of the participants reported parents requesting them to refrain from using digital technologies in the classroom, some participating teachers mentioned individual parents' worries about screen time and children's eye health. For instance, according to Zhou, Chen and Lsq, some parents told them they did not want their children to watch cartoons on the TV in the classroom. Similarly, Yang stated that several parents asked him to deliver the idea of 'less touch-screen time at home' to their children. Therefore, many participants demonstrated their control of screen time and distance in the classroom, which was evidenced by my observations. The distance between the children and the IWB screen was at least 1.5 metres and screen watching was usually combined with other traditional activities. As a result, screen time was kept to less than five minutes per session.

Furthermore, some other responses from the teachers indicated that, except for expressing concerns about screen time, parents were generally supportive of educational technology. For instance, in Zhang's classroom, some parents were willing to provide simple digital devices to the classroom for children to use in small-learning-area activities, such as reading robots. Zhang demonstrated that these encouraged children's digital practices.

6.1.3 Classroom-Related Factors

The Large Classroom and Great Class Size Influenced Teachers' Technology Integration Practices. Lastly, the physical environment and class size appeared to influence teachers' technological practices to varying degrees. Several teachers reported that the 'large classroom' and 'great number of children' made them 'have to use some tools for assistance' (Luo). The size estimates that I obtained from the observation sessions showed that each classroom covered about 50 square feet, with approximately 30 children and two to three teachers. In most whole-class sessions, such as the sharing session, '*children's products were too small to be seen clearly by the whole class*', but with the help of the IWB screen, 'every child could see the zoomed-in images' (Zhou). Moreover, in small-learning-area activities, the teacher to child ratio was roughly 1/10. As a result, many participants pointed out the reality that teachers could not keep an eye on all of the children across the classroom. This was the reason that they had put the devices with clear instructions, such as the audio reader, the learning tablet, the reading pen and the headphones, into learning corners as a 'substitution' for the teacher (Shi).

Due to the large class size and the demanding work, teachers were left with minimal time to learn about the combination of technologies and pedagogies. As Luo stated, '*The teaching-research fellow encouraged me to research technology integration, but I have too many things to do in my daily work, so I don't have enough time to do this*.'

Similarly, Zhou expressed the time constraints imposed by her substantial workload. She reported, '*As the front-line preschool practitioner, especially in a public preschool, I have many trivial things to do every day. We have to organise the class, communicate with parents, prepare the lessons, make activity plans and so on during my both on- and off-hours. I can only complete these regular things and do not have extra time to think and learn about the technology issues*.' As a consequence, teachers were not able to deeply and creatively integrate digital technologies, instead taking a surface-level approach with activities such as presenting slides and using teaching substitutes within the classroom.

Table 10. Summary of Micro-level Contextual Factors

	Element	**Characteristics**	**Influence on digital technology integration**
Micro-level factors	Teacher	-Experiences in personal life: Frequent access and use of digital technologies in daily lives	- Teachers did not reject the use of digital technologies at workplace - Their prior exposure to certain technologies makes them confident in operating digital technologies for pedagogical purposes.
		- One teacher's family members (friend, partner, child) had special experiences related to digital technologies	- The teacher has developed understandings of educational potential of digital technologies through observing and communicating with her family members.
		- Knowledge and skills: confident in their own technical skills	- Teachers' confidence contributed to their normal practices of using projector or interactive whiteboard to present multimodal digital

			content for whole-group educational activities
		- Some teachers had technological pedagogical knowledge and technological content knowledge	- Their TPK and TCK allowed them to try new ways of integrating digital technologies into pedagogical practices
		Education, age and identity: - teachers' access to digital technologies were not linked to education attainment - most teachers have not received specific training or courses to technology integration in their qualification educations	- No connection between teachers' educational attainment and their perceptions and practices was shown
		- Teachers perceived newer teachers might would be more skilful and more often use digital technologies in the classroom	- participants across the range of ages shared the similar attitude towards technology integration - the perceived negative effect of teacher age on technological practices was not experienced by teachers in practice
		- The teacher as the leader of an ICT	- the identity relevant to digital technologies positively

		group	influence attitudes and practices
	Children	- Children’s digital experiences at home	- teachers were found to drew on these children’s digital experiences in different ways in the classroom.
		- Parental views	- parents’ worries about screen and child eye health contributed to teachers’ controls of screen time and distance in the classroom
	Classroom	- large classroom and great class size	- teachers frequently used some digital technologies to assist in pedagogical practices - the great class size, the messy and heavy work left teachers rare time to learn about the combination of technologies and pedagogies, so teachers were not able to deeply and creatively integrate digital technologies

6.2 Meso-Level Contextual Factors

6.2.1 Types of Settings and Funding Status Influenced Teachers' Digital Technology Integration

The interview data revealed that the nature of the settings appeared to have an impact on the teachers' practices regarding digital technology integration. As discussed in the Introduction chapter, there are public and private kindergartens in China. All public kindergartens and the majority of private ones are inclusive kindergartens (not-for-profit) with uniform and low fees (Puhui, which aims to get as many children involved in preschool as possible). A small minority of private kindergartens are premium kindergartens, for which parents are charged high fees. In this study, participants' kindergartens covered these various types, showing the impacts of settings on technology integration to some extent. Firstly, the funding resources and budget constraints differed between the settings, thereby affecting teachers' access to technologies and approaches to integrating them. Secondly, a diverse range of educational philosophies and further curricula were present in the different setting types, creating multiple potentials for the integration of technologies.

As far as the funding was concerned, public kindergartens were completely supported by various departments of the government. In contrast, private inclusive kindergartens received much less funding from the government and had to be self-financed. Thus, the public ones generally had a larger budget than private ones, which could be confirmed by Ly's and Yan's narratives. Correspondingly, the interviews indicated that the private kindergartens where Ly, Yan and Chen worked had fewer types of digital technologies available than most public kindergartens, with only the Internet connection and an interactive whiteboard/projector. Moreover, Ly mentioned that her kindergarten had proposed introducing an online observation and evaluation system, but this project had been interrupted due to funding problems. In comparison, the public kindergartens possessed more extensive infrastructures in addition to the basic Internet and screen-based devices. For example, the kindergarten that Luo, Shi and Ye worked at equipped each classroom with an IWB, audio player, reading pen, learning tablet and even iPads (in some classrooms). Also, this kindergarten had an interactive ground projector and a technology room where children could participate in programming sessions. Similarly, there were iPads and children's cameras in Zhang, Wang and Huang's classrooms, whilst both Hu and Lsq mentioned the robotics sessions in their settings. Furthermore, some participants from public settings reported that they were granted autonomy by the setting's leadership to organise materials for small learning corners within the classroom. This arrangement also meant that they were able to apply to principals for extra digital devices that could be equipped in their classrooms. For example, Zhang mentioned that she was applying for an additional children's camera for her class as it was popular among the children. In contrast, Ly worked at a private kindergarten and illustrated that she was limited to the equipment provided by the setting and was unable to choose the devices. Additionally, Bai worked at the only premium kindergarten in the study. This was reported to have the largest budget to equip a range of digital devices, including IWBs, iPads, smart speakers and reading robots. As a result, teachers in the public kindergartens and the premium kindergarten had better access to educational technologies, which was evidenced by teachers' reported devices. Greater access to technologies in public kindergartens contributed to a more diverse use of technologies, especially by children. The findings presented regarding reported practices, located in section 4.2, supported this argument.

Although public settings had a higher budget, the money that could be used for digital technologies was still limited. Due to this, some teachers revealed that the purchase and potential uses of technologies were considered with care. Ye implied that requesting equipment through the administrative hierarchy was a complicated process and that not all requests could be approved. Shi also admitted that as a rebuilt setting, her kindergarten had spent a considerable amount of money on purchasing a range of infrastructures, so her request for an iPad might take a long time for the administration to approve. Huang reported a similar problem, explaining that she had proposed the online observation and evaluation system and the fitness tracker watch for children to the setting's leadership, but both were rejected because of insufficient funds. All of these barriers were linked to the higher prices of digital devices than traditional materials. Moreover, another consequence was that teachers used digital technologies with caution. For instance, Zhang's approaches to integrating technologies were closely associated with the prices of the devices:

> *I worried such digital devices (children's camera, headphones and the reading pen, etc.) could be easily broken, so I usually introduced them to children first and then put them into the learning corners for children to use. However, the traditional materials were normally put into the learning corners first for children to autonomously explore and then the children introduced them to the whole class.... As for the iPad, it was mainly used by teachers but children used it very rarely. This is because the iPad is quite expensive, so if it is dropped and broken, troubles will come and requesting another one could be very difficult. If it is cheap, we definitely give children autonomy to use it.* (Zhang 2)

Zhang's narrative showed that her decision about whether children could use the device or not was dependent on its price. As a result, the normally high prices of digital technologies limited children's access to them. In the same vein, Yang demonstrated that, with the intention of ensuring the safety of the devices, the IWB in his kindergarten were usually put in a high place, avoiding children's access and potential damages.

In addition to the funding issues, another key difference between public and private settings was that the individual private kindergarten had the autonomy to set the curriculum, whilst the curriculum of public kindergartens within the same area was uniformly guided by the educational department. The entire curriculum was based on the premise set out in *A Guide to Learning and Development for Children Aged 3-6 Years* (MoE, 2012) and *Guidelines for Kindergarten Education* (Trial) (MoE, 2001), which will be discussed in detail in section 6.3.1. Zhou confirmed this difference by stating that '*the curriculum in my current public setting is standardised and follows a fixed timetable given by the educational department. Also, course resources are shared across all the public kindergartens within the region, whereas the private setting I used to work at had the autonomy to decide on the curriculum system and choose the appropriate resources on the market (e.g. software, courseware, etc.), which would also be more abundant*.' In keeping with this, the diverse curriculum systems across private settings created different opportunities for technology integration. For example, according to Bai, she worked at an International Baccalaureate (IB) bilingual kindergarten (a premium kindergarten), which had '*a well-developed system and detailed guidelines for technology integration*'. The kindergarten document clearly stated that children's digital literacies should be developed, and it also provided training workshops and seminars discussing '*how to develop and evaluate children's digital literacies*.' Consequently, Bai exhibited a deeper understanding of technology integration and reported richer practices of integrating technologies into her classroom, including some open-ended creative activities. In contrast, Ly and Chen worked at Montessori kindergartens which placed more emphasis on the '*physical environment*' and children's '*physical manipulation*' of tools and toys (Chen). As a result, these settings might not have placed as much value on digital technologies, especially when they faced budget constraints. This could explain why there was less integration of technologies and hardly any interactions between children and technologies in these two settings. The above narratives indicated that the curricular autonomy of the kindergartens did not necessarily lead to effective technology integration. Instead, it was the educational philosophies and funding that made a difference.

6.2.2 Leadership in Kindergartens Influenced Teachers' Digital Technology Integration

From an institutional perspective, aside from the nature of the setting, the leadership also appeared to play an essential role in shaping teachers' beliefs and practices about technology integration. The interview data showed that the leadership was usually comprised of both principals and teaching-research fellows who '*made decisions on curriculum and pedagogies*' (Wang). It was discovered that the leadership first decided on teachers' access to digital technologies. According to Zhang, her principal '*was passionate*' about digital products and '*actively introduced a range of software and apps*' to teachers. Lsq also mentioned an app called 'Qing Can Xue Tang' that they were using at the request of the principal. It was indicated that the principal could make direct decisions on whether or not to use a certain technology. Furthermore, the study revealed that the beliefs of principals and teaching-research fellows had indirect impacts on teachers' technological practices by influencing teachers' beliefs. For example, Lsq referred to the teaching-research fellow's suggestion that digital technologies should be used appropriately and not misused or overused, which shaped her own pedagogical belief that the technology '*was expected to serve certain curriculum goals and solve practical problems in practices*'.

Moreover, another participant, Chen, who was the only principal among the participants, demonstrated her support for teachers using digital technologies in the classroom but not for children using such devices. In line with this, she reported hardly any interactions between children and technologies in her kindergarten.

Furthermore, the interviews indicated that the beliefs of leaders shape teachers' beliefs and practices through the decisions made on setting-based support. This finding was consistent with Blackwell et al.'s (2013) argument that the support could influence teachers' understanding, confidence and attitudes about using technologies in their classrooms, thereby affecting their practices. In particular, four kinds of setting-based support that could impact teachers' views and practices were drawn from interviews and observations: training, technical support, teaching-research events and special curriculum, which will be discussed in the next section.

6.2.3 Setting-based Support Influenced Teachers' Digital Technology Integration

Training. Most of the participants reported 'rare' and 'content-limited' training relevant to technology integration (Yang). They told me that the technology-related training focused on the development of operational skills for software or devices and could only be organised when new technologies were launched. It was reported that such training sessions were normally delivered by IT staff within the setting, external professionals or software/equipment providers. Accordingly, participants expressed confidence in their skills in photography, audio and video editing and slide making. However, when it came to the integration of technologies into the curriculum and pedagogies, the majority expressed '*not knowing much of this*' (Zhou).

Only five participants (Luo, Ye, Shi, Bai and Lsq) mentioned undergoing the uncommon beyond-operational training. They reported that the training merely inspired their ideas and updated their beliefs of digital technology integration but did not provide '*clear conceptions*' (Bai) or '*specific guidelines*' (Lsq). Nonetheless, such training encouraged them to explore relevant knowledge and try new practices independently. In particular, three participants, Luo, Ye and Shi, who worked at the same Lotus Kindergarten, pointed to a training event organised by the principal and teaching-research fellow. The event allowed them to learn further practical uses for digital technologies, such as '*micro-lecture*' (Shi, Luo) and '*digital storytelling*' (Luo). It also instilled the new belief that '*children should be allowed more interactions with technologies in the classroom*' (Ye). The effects of this training were evidenced through the observation data. Luo encouraged children to independently use the iPad for solving real-life problems in order to develop their digital literacies, and Ye prompted children to engage with the interactive whiteboard.

Technical Support. Aside from training, some settings also had IT staff on site helping to deal with technical problems, which was reported by nine participants. According to them, there were occasionally technical issues related to Internet disconnection and broken hardware. As observed in the fieldwork, the iPad could not be connected to WiFi in Case 1 and the headphones made no sound in Case 5. Teachers stated that they could solve these technical issues by themselves in most cases. If this was not possible, they usually asked their trained colleagues within the IT staff for help, so it was '*not a big problem*' (Huang). Thus, the research indicated that the technical support from colleagues allowed teachers to be more confident in using technologies.

Teaching-Research Events. Furthermore, five teachers pointed to the teaching-research teamwork chaired by teaching-research fellows, in which they shared quality courseware resources that were either downloaded or self-created and also effective teaching tools. Although such teaching-research events were not usually centred around technology integration, sharing and working in collaboration could improve teachers' efficiency at preparing lessons, making them more receptive to using '*existing slides*' for multimedia teaching (Yang). One possible drawback of sharing resources, however, could be the negative impact on pedagogies if teachers borrowed these slides and neglected their own reflection and creativity. In addition to these general teaching-research activities, Luo also mentioned a unique 'ICT study and research group' at the Lotus kindergarten. This group was initiated by the principal of the kindergarten in response to *The National ICT Application Ability Promotion Project 2.0 for Primary and Secondary School Teachers* (which will be discussed in detail in the section 6.3.1). Luo was appointed as the group leader. According to Luo, she directed the group to engage in learning about 'micro-lecture making' and 'in-depth use of computers and tablets'. Three participants within this setting reported that they were gradually applying what they had learnt through the group to their practices, though to different extents.

Special Modules. Finally, various special curricular programmes carried out by kindergartens provided diverse opportunities for the applications of digital technologies. I will use three examples to clarify this point. To begin, the special 'News Broadcasting' session, referred to by Zhang, Wang (North Kindergarten) and Hu (Twelfth Kindergarten), was a session in which every individual child presented a piece of news to the whole class. In order to achieve this, children worked with parents to select news stories and make relevant slides at home. This session gave children an opportunity not only to interact with the whiteboard in the classroom, but also to get involved in making slides at home, thereby developing children's literacies. Meanwhile, both kindergartens were selected as the subjects for a university research project on the 'Mosaic Approach', which was an approach designed to let teachers hear from children. According to the participants and relevant literature (e.g. Clark, 2017), this approach encouraged teachers to use traditional interviews, surveys and engagement tools, such as children's photography and map-making, to create avenues for children to share their voices. Specifically, in the North Kindergarten, children's photography was encouraged as an essential participatory tool, which introduced the use of the children's camera. This special activity was then extended to capture children's 'a day in life' moments but was not limited to the 'Mosaic Approach'. This meant that children could use the camera to '*freely and independently*' record elements of their kindergarten experience and add text to further enhance these images (Zhang). Thus, it can be assumed that the introduction of the Mosaic Approach allowed teachers to access new methods for integrating technologies and enriched the ways children interacted with technologies. In contrast, the third example, 'Anji Play,' that was introduced to Zhou's kindergarten restricted digital time. This was because Anji Play promoted a natural and open environment for play and encouraged children to interact freely with certain play objects in outdoor environments. Zhou illustrated that children's outdoor playtime significantly increased after the introduction of Anji Play, reducing the use of digital technologies indoors. Therefore, it can be inferred that this special programme had a quantitative influence on technological practices.

Table 11. Summary of Meso-level Contextual Factors

	Element	Characteristics	Influence on digital technology integration
Meso-level factors	Types, funding and curricular system	- generally, public kindergartens had more funding than private kindergartens	- public kindergartens had more types of digital technologies than most private kindergartens - teachers in some public kindergartens had the autonomy to apply for more digital equipment
		- limited funding for technology purchase and complicated equipment application process even in public kindergartens	- the limited budget could hinder teachers and children's access to more new technologies - the normally high price of technologies made teacher use them with more cautions and sometimes avoided children's access to them
		- diverse curricular systems in private kindergartens	- the IB international bilingual kindergarten focused on children's digital literacies and had systematic guidelines for technology integration, so the teacher Bai had more deeper understanding of tech integration and richer practices - Montessori kindergartens, placed more emphasis on the physical environment and children's physical manipulation of tools and toys,

			so there was relatively less integration of technologies and hardly interactions between children and technologies
	Leadership	- supportive with technology	- the principal could directly make decisions on whether or not use a certain technology
		- teaching-research fellow of Lsq suggested that technologies should be used appropriately - Chen as the principal supported teachers' using digital technologies in the classroom but not children's use	- beliefs of principals and teaching-research fellows had indirect impacts on teachers' technological practices via shaping teachers' beliefs
	Setting-based support	- 'rare' and 'content-limited' training focused on technical skills - beyond-operational training	- The technical training made teachers confidence on skills of photographing, audio and video editing, slide making - The beyond-operational training updated teachers' technological pedagogical beliefs and introduced new approaches to them, allowing teachers gradually modify their digital practices
		- IT staff	- the technical support from IT staff allowed teachers to be

			more confident in using technologies.
		- teaching-research events in which effective tools and resources were shared - ICT study and research group at Lotus Kindergarten	- sharing and co-working within the teaching-research events could greatly improve teachers' efficiency of preparing lessons, so they were more willing to use these 'existing slides' for multimedia teaching - teachers at the Lotus Kindergarten were gradually applying what they have learnt through the group to their practices to different extents.
		Special modules: News broadcasting; Mosaic Approach; Anji Play	- the News broadcasting and mosaic approach allowed teachers to get access to the new approach of integrating technologies and enriched the ways of children's interacting with technologies - after the introduction of Anji Play, the use of digital technologies indoor has been reduced

6.3 Macro-Level Contextual Factors

6.3.1 Official Policies and Support Influenced Teachers' Digital Technology Integration

With regard to pedagogical issues, several participants pointed to two official documents, *A Guide to Learning and Development for Children Aged 3-6 Years* (MoE, 2012) and *Guidelines for Kindergarten Education (Trial)* (MoE, 2001), which guided their curriculum and pedagogy. However, teachers commonly indicated the 'broad' (Ye) and 'general' (Yang) nature of the references to digital technology use in such official documents. Additionally, Luo, Lsq and Bai noted that without having a list of systematic and specific cases and guidelines, it was hard to implement educational technologies. After collecting and reviewing essential policy documents related to kindergarten education and kindergarten practitioners issued by the MoE of China, including *Regulations of Kindergarten Work* (MoE, 2016b), *Professional Standards for Kindergarten Teachers (Trial)* (MoE, 2011a), *Teacher Education Standards (Trial)* (MoE, 2011b) and the above two mentioned by participants, I found that three of them mentioned the use of digital technologies. The first was *A Guide to Learning and Development for Children Aged 3-6 Years* (MoE, 2012), which listed one of the educational goals in the Science Area. This was for four to five-year-olds: '*to initially perceive the relationship between commonly used technological products and their own lives and know that technological products have both advantages and disadvantages*.' It is important to note that this educational goal was set for four to five-year-olds in particular, implying that these aims might not have extended to younger children. Although no participant explicitly referred to this article, it was consistent with the ideas and practices revealed by some teachers in this study. For example, my observation at the Lotus Kindergarten showed that only the upper classroom (with children aged five to six) was equipped with the iPad for children to use and the children from the middle class (aged four to five) had simple interactions with the IWB. Technologies were mainly used by teachers in the lower class (aged three to four). As discussed in the section of meso-level forces, inadequate funding could be one of the reasons for this. Alternatively, it could be due to the beliefs of kindergarten decision-makers and educators that only children older than four had the '*competence to interact with digital technologies*' (Shi). This perception could have been shaped by their understanding of children's developmental stages, which may have been acquired from this document. However, this document only contained a sentence listing the science goal without citing any further explanations or strategies, therefore teachers might not have held clear ideas about how it could be achieved. Teachers who were interested by the idea may have learnt and explored by themselves, whereas it might have been missed by others.

Meanwhile, in the other two documents, *Professional Standards for Kindergarten Teachers (Trial)* (MoE, 2011a) and *Teacher Education Standards (Trial)* (MoE, 2011b), the requirements for teachers' ICT skills were proposed:

> *(Kindergarten teachers should have) some knowledge of modern information and communication technology.* (MoE, 2011a)

> *Professional ethics and professional development: [...] music skills; dance skills; art skills; modern educational technology applications, etc.* (MoE, 2011b)

Neither of them gave detailed interpretations or made a connection with ECE pedagogies, which might be the reason for the emphasis placed on technical skills in both pre-service and in-service training.

In addition to these kindergarten-focused policies, many participants mentioned *The National ICT Application Ability Promotion Project 2.0 for Primary and Secondary School Teachers (ICT 2.0 Project)* started in 2019, which aimed to improve the digital literacy of teachers in kindergartens, primary schools and secondary schools. As a result, it focused on teachers' use of digital technologies for a range of purposes but did not detail children's use. Moreover, according to participants' responses, kindergartens were at different points in their implementation process. For example, the aforementioned training event and the ICT study and research group in Lotus Kindergarten were responses to this ICT 2.0 Project. These initiatives updated teachers' beliefs about digital technology integration and thereby their pedagogical practices. In the same vein, Hu reported accessing documents relevant to this project and revealed some measures taken by her kindergarten to prepare for the future check and acceptance review by the Department of Education. Priority use of digital technologies was allocated to administrative tasks such as ‘setting management’, ‘teacher training’ and ‘connecting with families’ (Hu), resulting in few changes to teachers’ pedagogical practices. In contrast, Zhou stated that she had only attended training for the ICT 1.0 Project at the start of her career and did not know about the aforementioned ICT 2.0 Project. Most other participants had heard about this project but had not had any involvement in it yet. The research indicates that because this national project had to be implemented following the top-down hierarchy system, the speed of implementation and understanding of the policy differed between regions and settings. As a result, the knowledge and practices of teachers were also varied.

Through reviewing the documents for ICT 2.0 Project alongside other national documents, including the *Ten-Year Development Plan for Education Digitisation (2011-2020)* (MoE, 2012), *Education Digitisation 2.0 Action Plan* (MoE, 2018), *13th Five-Year Plan for Education Digitisation* (MoE, 2016), *ICT Application Ability Standards for Primary and Secondary School Teachers* (MoE, 2014a), *IT Application Ability Training Curriculum Standards for Primary and Secondary School Teachers* (MoE, 2014b) and *Teachers' Digital Literacy* (MoE, 2022), I identified similar characteristics between the policies. Firstly, they focused more on formal teaching and learning in primary, secondary and higher education than in early years education, prioritising the development of educational resources and educational platforms. Secondly, they generally listed the digital objectives to be achieved but lacked specific guidelines on how to achieve them. Thirdly, the emphasis of these documents gradually transitioned from teachers’ ICT operational skills to teachers’ competencies at integrating ICT into the curriculum and also to enhancing students’ digital literacy. Particularly, in 2022, *Digital Literacy of Teachers* (MoE, 2022) was published, detailing standards for evaluating teachers’ digital literacy across a range of dimensions. Although these policy documents were largely unknown to participating front-line teachers and did not supply them with concrete practical guidance, they represented a macro-level orientation. This provided insights into how teachers’ practices could gradually change through a combination of setting-based supports, explained in the previous section, and official supports, which will be discussed in the next.

In terms of official support, several special events issued by national and local educational departments were found to have a positive influence on teachers' digital practices. These were the Continuing Education Platform, Open Lesson and Teaching Contest. During the interviews, four participants mentioned being required to learn and complete a certain number of credits on the Continuing Education Platform. This programme offered various professional courses involving technical skills, such as programming for young children, video editing and micro-lecture making. In particular, Luo spoke highly of this platform, reporting that she could use the skills she had learnt from it in practice. In addition, several teachers discussed the positive effects of the Open Lesson and Teaching Contest on their technology use, as the use of digital technologies was '*a huge plus*' in these kinds of evaluative activities (Zhou). The Department of Education applied these approaches to encourage the digitisation of education, so teachers tended to use pre-made '*fancy*' courseware and multimedia devices for giving an open lesson (Zhang). However, it should be noted that the pedagogy for an open lesson or contest might not be representative of normal pedagogies. For instance, Lsq pointed to one successful open lesson centred around the theme of 'Chinese Pilot', in which she used the IWB to present interactive slides, had children design the aeroplane using iPads and also connected to an aeronautics engineer outside the classroom at the end of the session. Although this lesson was effective, she explained that the iPads were usually shared by the whole kindergarten and that it was not possible for her to deliver such a 'complicated' session every day. Ly expressed a similar difficulty, stating that the principal might help to borrow some multimedia devices for teachers who were going to deliver an open lesson but would not do this for normal lessons. In the same vein, Zhou reported the great time and effort consumed by making the 'fancy' slides for an open lesson, conveying her limited enthusiasm for doing the same thing for normal sessions. Although the pedagogical use of digital technologies in open lessons cannot be applied fully to everyday sessions, many teachers stated that they had acquired valuable knowledge and approaches to integrating technologies from this process. Firstly, they taught themselves '*the necessary knowledge and skills during the preparation*' for the open lesson or competition, which could be used in later practices (Zhou). Furthermore, they learnt from other participating teachers in the competition regarding their integrating methods and pedagogical ideas, which they could later apply to their own pedagogical practices.

6.3.2 COVID-19 Pandemic Influenced Teachers' Digital Technology Integration

Another exceptional macro-level factor was the COVID-19 pandemic, which positively influenced teachers' attitudes and practices. From the perspective of the teachers, the lockdown during the pandemic increased the number of online learning opportunities, allowing them to appreciate the '*convenience of online learning*' and the '*richness of online resources*' (Yan). As a result, they reported that they became more open-minded about digital technologies than before. From the perspective of the children, some teachers believed that the Internet and technology could eliminate the negative impacts of pandemic restrictions on children's learning to some extent. For instance, Luo pointed out that the travel restrictions hindered children's direct experiences of the world, but the existence of digital technologies allowed children to see the world indoors through tools such as 'VR Museum' and 'Micro-Lecture'. Thus, Luo insisted that technology was necessary in the post-pandemic period. However, not all of the online learning attempts during the pandemic were positively acknowledged. For example, many participants mentioned the live or recorded webinars conducted during the pandemic, but these sessions were believed to be far less effective than offline activities on site. This was partly because child management was an issue during online sessions and '*classroom chaos*' could easily happen (Shi). Moreover, the types of activities that could be performed online were reported to be limited and play-based or collaborative ones were less possible. As a consequence, many teachers indicated that they would not continue such an approach after the pandemic.

Table 102. Summary of Macro-level Contextual Factors

	Element	**Characteristics**	**Influence on digital technology integration**
Macro-level factors	Official policies and support	- broad ICT objectives in general ECE policies - the focus of ICT documents was on teachers' use of digital technologies	- Policies represented a macro-level orientation, which initiated teachers' change of perceptions and practices - pre-service and in-service training guided by these policies focused on merely technical skills - teachers might not have clear ideas about how to achieve ICT objectives
		- Continuing Education Platform, Open Lesson and Teaching Contest	- teachers acquired knowledge and skills through these support, which they could later apply to their own pedagogical practices.
	Covid-19 pandemic	- Travel Restrictions	- Teachers' personal learning online and children's exposure to the world through the Internet developed teachers' positive attitudes towards technologies

6.4 Interrelations Among Factors

The above analysis demonstrated that several factors were interrelated, jointly shaping teachers' beliefs and practices. Firstly, it was found that the factors present within the same context level had strong relationships with each other. For example, within the micro classroom, the large class size and resultant heavy workload left less time for teachers to learn about technology integration, thereby contributing to most teachers' lack of TPACK. This could negatively impact teachers' beliefs and practices of integrating digital technologies. It should also be acknowledged that the micro classroom environment was shaped by the macro-level context to an extent, as large class size was allowed in the national ECE policy. Moreover, the technology-related roles of individual teachers (e.g. Luo as the leader of an ICT study and research group) were closely connected with the teacher's knowledge and skills of integrating technologies. In this instance, Luo's existing competencies distinguished her from others and allowed her to become the leader. In turn, her identity as leader encouraged her to learn more knowledge and skills in digital technology integration. Thus, she performed an open mind towards digital technology use and diverse pedagogical use of them. With regard to kindergarten level, the relationships between factors were more obvious. It was found that technology access, technical support and curriculum development were directly influenced by the leadership and/or funding, which directly influenced teachers' pedagogical practices of integrating digital technologies. Several teachers demonstrated that applications for purchasing equipment had to be approved by the principal. Moreover, the principal's decision depended on their personal beliefs about technology integration and also the budget of the kindergarten. For example, Huang's and Ly's digital ideas were reported to be denied by their principals due to inadequate funding. In addition, the principals also decided on whether to have IT staff and teacher training events within the kindergarten by taking the budget into consideration. Furthermore, the available budget was significantly affected by the nature of the kindergarten. As previously revealed, public kindergartens were often more financially supported than private not-for-profit kindergartens, whilst private premium kindergartens tended to show more advantages in technical infrastructures because of the funding generated by their high fees. Thus, the practices were affected by the budget. Within the macro context, the launch of educational policies related to technology integration was followed by a series of teacher training projects and teaching competitions, which could significantly impact on teachers' knowledge and beliefs about technology use and thereby the relevant practices. The ICT-related courses in the Continuing Education Platform and the emphasis on technology use in the Open Lesson and Teaching Contest reported by participating teachers were all initiated within the context of *education digitisation*. Meanwhile, the spread of COVID-19 also prompted this digitisation of education to an extent (Dong et al., 2022).

In addition to the interrelation of factors within the same context level, the range of factors across different context levels also demonstrated a top-down influential relationship. This meant that the macro educational policies influenced the decisions of individual kindergartens, which further affected the individual teacher and practices within the micro classroom. Taking the Lotus Kindergarten as an example, the ICT 2.0 Project document implemented by the national education department was conveyed to the kindergarten through the provincial and municipal education departments. Therefore, the principal of the kindergarten decided on a series of actions to respond to the policy, including equipping the upper classes with tablets, organising a teacher training lecture by outside experts, setting up the ICT study and research group that got all the head teachers involved and appointing Luo as the group leader. As a result, teachers' knowledge of technology integration expanded to encompass more approaches to technology integration, such as digital storytelling and micro-lecture. Moreover, teachers' beliefs about technology use began to change, including a shift towards recognising the benefits of children's access to digital technologies. This could lead to an eventual expansion of their teaching practices.

The top-down relationship presented across the three levels of context indicated the prevailing role of kindergarten as the meso-level context than other contextual factors. This was because it could directly decide how technological policies were implemented and also influence teachers' personal beliefs and knowledge about technology integration. Moreover, this may explain why not all of the participating teachers were informed of the national educational policies related to technology integration and not all of the kindergartens involved had the relevant equipment, teacher training and curriculum development to promote the effective integration of digital technologies. In relation to authority, the meso-level context of the kindergartens superseded teachers' personal beliefs to affect their final practices, which could be due to the right of the kindergarten to determine access to technologies and curriculum. For example, benefiting from her diverse personal experiences, Ly expressed her receptive attitude towards digital technology use and her knowledge of advanced educational technologies. However, the pedagogical practices she reported were narrow in scope. This nuance was believed to be caused by the limited funding and infrastructures in the private setting, as well as the principal's distinct expectations. A similar situation was also highlighted by Huang, whose many digital ideas were not valued by her kindergarten and thus could not be put into practice. In comparison, although Zhang was very cautious about the children's use of digital technologies, her kindergarten's series of actions, such as purchasing a children's camera, promoting the Mosaic Approach and practising special sessions of 'News Broadcasting', still provided multiple opportunities for children to engage with digital technologies.

6.5 Summary

In summary, this chapter drew across Phase One and Phase Two data to identify the contextual factors that influenced teachers' beliefs and pedagogical practices of integrating digital technologies. More importantly, the findings discussed in this chapter clarified how these factors interrelated with each other and how they jointly shaped teachers' perceptions and practices. In particular, the prevailing meso-level kindergarten context was emphasised. Next, the findings across both phases, as presented in chapters 4, 5 and 6, are discussed, to highlight how the study makes a contribution to the understanding of kindergarten teachers' integration of digital technologies, building on existing literature.

Chapter 7. Discussion

This study addressed three research questions:

1. What are participating teachers' attitudes and perceptions in relation to the integration of digital technologies into kindergartens in China?

2. How do these teachers integrate digital technologies within their pedagogical practice?

3. How do a range of contextual factors shape these teachers' perceptions and practices in relation to digital technology integration?

In this chapter of the thesis, I will discuss the most important findings of the study in greater depth, along with highlighting the important practical and theoretical implications of the findings. Findings have been selected for inclusion in the discussion chapter based on their perceived relevance to these research questions, as well as their significance for practice and theory. The Discussion Chapter is divided into two sections: (1) Empirical Discussion, wherein I interpret the results and discuss their implications, thereby establishing the practical and scholarly significance of the study; and (2) Theoretical Discussion, wherein I draw on the study's empirical findings to review the relevance of existing theoretical frameworks and make suggestions for the future direction of theory in this field.

7.1 Empirical Discussion

In this section, I will foreground three important findings from the study and discuss them in more depth. These are:

1. The pedagogical practices of early childhood teachers in the present study appeared to foster a greater use of digital technologies for consumption purposes, rather than for creative functions.

2. The pedagogical practices of early childhood teachers in the present study were interconnected with their perceptions of digital technologies.

3. Meso-level kindergarten forces played an important role in shaping how digital technologies were used in kindergartens in the study.

7.1.1 The Pedagogical Practices of Early Childhood Teachers in the Present Study Appeared to Foster a Greater Use of Digital Technologies for Consumption Purposes, Rather Than for Creative Functions

As pointed out in the Literature Review (Chapter 2), Armstrong et al. (2015) proposed the concepts of consuming and creating to distinguish between people's engagements with digital technologies. The present study found that children in participating kindergartens were mostly consuming premade content available via digital technologies for learning and play. This was the case in terms of both teachers' use of digital technologies for teaching and children's uses of them. When teachers employed screen-based technologies to present digital content, children had few interactions with these technologies. Instead, they encountered predetermined information relevant to particular subject areas, which supported their acquisition of knowledge about the world. During other periods, such as free play, children were provided with opportunities to use certain digital technologies in ways that connected with teachers' educational goals. These were demonstrated across Plowman et al.'s (2012, p. 6) four defined learning areas: 'acquiring operational skills, extending knowledge and understanding of the world, developing dispositions to learn, and understanding the role of technology in everyday life'. However, children's interactions with digital technologies in the study remained close-ended and largely based on consumption. Interestingly, participating teachers rarely recognised the value of the instances in which children proactively applied digital technologies to create, explore and investigate.

This finding was consistent with the conclusions reached by several similar studies, which reported children's experiences within kindergartens to be that of digital consumers rather than creators (e.g. Morgan, 2010; Rollins, 2011; Suzette, 2014). For example, Rollins's (2011) observations in pre-kindergarten to fifth-grade classrooms reported that students never used technologies to create, but merely for drill and practice. Similarly, participating teachers in Mertala's (2017) study described their methods of using digital technologies in the classroom as delivering instructions through technologies and having children perform digital drills. Kindergarten teachers' pedagogies relating to the use of digital technologies for instructional and consumptive activities have frequently been studied and reported on in previous years. However, in recent years, some studies, often within western contexts, identified the significance of children's creative experiences with digital technologies. For instance, Tran (2018) uncovered the diverse pedagogies observed in five kindergarten classrooms. These included not only children's consumptive experiences, such as listening to stories with the iPad, following instructions on the smartboard and learning mathematical and literacy concepts through game-based applications, but also creative activities, such as having children record and document their works or create collages with iPads. She categorised the latter type of practices as children using digital technologies for 'demonstrating their learning' (Tran, 2018, p.80). As a 21st-century skill, the development of children's creativity has been highly valued in early childhood education (Arnott et al., 2017). Additionally, much of the key literature suggested that digital technologies could support children's creative practices (e.g. Marsh et al., 2018; Harwood et al., 2015). Due to this, an increasing number of studies have explored the ways in which digital technologies can facilitate the creative practices in early years (e.g. Fielding & Murcia, 2022; Mona, 2019). My literature review for the present study highlighted two notable types of children's creative experiences with digital technologies. Firstly, children used technologies to produce artefacts such as drawings, photos, videos and multimodal texts (Tavernier & Hu, 2020; Kanuf, 2016). Secondly, children wrote programs for solving problems (Fessakis et al., 2013). Researchers pointed to the high value of such activities, especially artefact creation. Kontovourki and Tafa (2019, p.195) advocated children's 'open-ended creation of shared texts' as one of the effective pedagogies for early literacy learning with technologies. In the same vein, Fleer (2017, p.124) summarised one feature of digital pedagogy as supporting children's 'collective creation of a narrative'. Furthermore, some typologies, such as multiliteracies (Yelland, 2018), multimodality (Kress, 2010), digital storytelling/narratives (e.g. Robin, 2008) and digital animation (Fleer, 2018), centred on children's meaning-making with technologies to draw on appropriate pedagogical approaches. It should be acknowledged, however, that both consumptive and creative practices of children had a place in kindergartens and sometimes the boundary between them was difficult to define.

In this study, several participating teachers (Luo, Bai and Zhang) either indirectly or explicitly indicated their awareness of good pedagogy and how it might support children's creative activities with digital technologies, whilst this was not displayed by others. For example, Luo mentioned the 'digital storytelling' concept when she discussed what she had learnt from the ICT-related training session, but she did not provide examples of putting this into practice. Moreover, Bai reported children's engagement with the recording and creative apps on the iPads at her kindergarten. In addition, Zhang described children's use of cameras for capturing photos of their daily routines, which was observed in the fieldwork. Despite the knowledge and perceptions that teachers had about creativity and digital technologies, however, there was little evidence of their understanding in action. As discussed in more detail below (Section 7.1.3), this might be related to the differences in setting support. Luo's awareness of the 'digital storytelling' idea was the direct result of an ICT workshop organised by her kindergarten. Additionally, children's digital creative activities at Bai's IB kindergarten might have been guided by the specific curriculum target of developing children's digital literacy and the associated guidelines. Moreover, the devices provided by the setting could have played a role. In the same vein, although Zhang did not specify any knowledge related to digital literacy or digital storytelling, the camera that her setting offered to each classroom prompted her to conduct similar activities to digital creation. In contrast, other participants who did not receive this kind of support from their kindergartens were not guaranteed to have 'creating' awareness and practices. As a result, it can be inferred that institutional forces played a significant role in forming the digital divide in classroom practices, which will be discussed in Section 7.1.3. Broadly speaking, the lack of emphasis on creative activities recognised in this study could be interpreted within the sociocultural context in China.

As discussed in the Literature Review, Chinese ECE curricular and pedagogical beliefs were shaped by the hybrid combination of Confucian culture, communist ideology and western ideas. Chinese traditions emphasised unity, order, collectivism and harmony, which is reflected by the ECE valuing lesson planning, instructing, memorising and transmissive pedagogy (Li et al., 2012; Rao et al., 2010; Naftali, 2010). Western ideas, however, focused on child-centred, inquiry-based, play-based and constructive pedagogy (Li et al., 2011). Although both policies and researchers increasingly valued and advocated the free play and individualism of western beliefs, the existing studies indicated that Chinese traditions prevailed over western ones to influence ECE practices (Dong & Mertala, 2020; Cheung, 2017; Zhu & Zhou, 2005). Thus, the fixed schedule, predetermined lessons and the instructional pedagogy left few opportunities for children's free creating activities. Even the integration of digital technologies could not change these traditional pedagogical approaches. As Rivera et al. (2002) argued, the introduction of digital technologies to teaching might change pedagogy to some extent, but the fundamental principles of pedagogy are likely to remain fixed. As a consequence, this study found that most teachers achieved a technology-mediated transmissive pedagogy, which supported Dong and Newman's (2018) argument. Furthermore, although the western ideology did not dominate the Chinese ECE curriculum and pedagogy, it still influenced ECE practitioners' beliefs to some extent. The interview and observation data showed that almost all participants presented pictures, videos and especially animations to attract children's interests in whole-class sessions. Respecting children's interests was found to be an important concept surrounding child-centredness (Robertson et al., 2015). However, considering this in more depth, it could be concluded that the ultimate purpose of respecting children's interests was to achieve teachers' pre-set curriculum goals. For example, Shi justified her decision to present the teeth-related cartoon to children by stating, '*Children were interested in such cartoons so they could keep concentrating on it and learn the knowledge embodied in it.*' According to Georgeson et al. (2015, cited in Dong & Mertala, 2020), child-centredness valued the core position of the child in making educational decisions. Shi's statement, however, which focused on encouraging children to learn something, seemed to be in conflict with this notion. Instead, it showed that Chinese traditions were operating under the guise of western ideas, which supported the argument that sociocultural backgrounds and historical traditions deeply influenced people's perception of the world and also their construction of meaning (Blanck, 1990, cited in Dong & Mertala, 2020).

Thus, although digital technologies have been shown to facilitate children's creativity development in many studies (e.g. Marsh et al., 2018; Murcia et al., 2020), the absence of appropriate pedagogies could still lead to difficulty in developing creativity. As others have argued, simply providing digital technologies will not necessarily result in improvements to children's creativity (Arnott et al., 2017). As mentioned previously, children's creative engagement with technology was observed in Case 4, in which a child freely used the camera to capture their work, peers and the teacher during a small-learning-area session. The analysis of this episode drew on multimodal approach identified some instances of the child showcasing their creativity that were in line with Lucas's (2016) Five-Dimensional Model of Creativity, such as exploring, imagination, and collaboration. The teacher did not use scaffolding to further develop and expand this creativity. Moreover, in the following interview, the teacher did not connect the digital practice to children's creativity development. This supported the argument, located in the Literature Review, that teachers' pedagogical strategies for using digital technologies were essential factors in creativity development, in addition to the nature of the activities. Teachers were suggested to teach for creativity which was distinguished from teaching creatively (Murcia et al., 2020).

My findings suggested that in order for teachers to promote children's creative practices with digital technologies, they had to first understand how creativity can relate to digital technologies and how it could be demonstrated. Previous research indicated that most teachers (even those attempting to provide opportunities for children's creative development) were unclear about creativity in general (Bereczki & Kárpáti, 2018), whilst the participants in this study appeared to feel uncertain about creativity in digital practices. Although there is still no universal definition of creativity, many scholars have developed various frameworks to help teachers identify the thinking and behaviour behind creativity. For example, the aforementioned Five-Dimensional Model of Creativity (Lucas, 2016) was developed by focusing on school students and formal assessments, categorising the five key elements of creative habits as Inquisitive, Imaginative, Persistent, Collaborative and Disciplined. Additionally, Murcia et al. (2020) developed the 'A' to 'E' of Children's Creativity Framework for identifying young children's creativity when coding with digital technologies within early childhood classrooms. This synthesised the five characteristic clusters as Agency, Being Curious, Connecting, Daring and Experimenting. These frameworks were not developed specifically for normal digital experiences, but they could still help teachers to clarify how to identify creativity, thereby enabling them to recognise, encourage and develop children's creative thinking and behaviour during interactions with digital technologies.

Furthermore, support from educators was argued to be significant for children's engagement in creative practices (Johnston & Highfield, 2017). By reviewing both the literature and all of the research data, I identified four levels of teachers' pedagogical strategies during children's interactions with digital technologies, including non-intervening, instructing, responding and scaffolding.

Firstly, the teachers did not always get involved in children's digital activities. The episodes in which I observed children independently using the learning tablet in the maths corners did not include any participation from teachers. In this activity, children's actions relied on the instructions given by the app. According to Taylor's (1980, cited in Hsin et al., 2014) framework, which classified the roles of digital technologies in education as tutor/too/tutee, the tablet app in these episodes played the role of tutor for the children. As a result, children consumed the predesigned content without teachers' involvement. However, the use of the headphones associated with the tablet also hindered children's interactions with peers. Thus, children in these episodes did not demonstrate any creative development.

Secondly, teachers instructed children's practices with digital technologies. Teachers' instructions were often necessary at the beginning of a digital activity, as children needed to acquire technical skills through teachers' guidance and modelling (NAEYC, 2012; Johnston & Highfield, 2017). However, if the teacher guided children's practices in an instructive way throughout the process, children could become reliant on this direction, potentially impeding the development of creativity (Grandin, 2006).

Thirdly, Kewalramani et al. (2020) suggested that educators should use responsive guidance instead of instructions, allowing children to engage in creative practices. Accordingly, children were able to freely and autonomously dominate the digital activities, therefore demonstrating some creative characteristics. This could be supported by Scott's (2022) finding that children could be creative when provided with both technical skills and a free environment for digital creation. The example of the child taking photos with a camera in Case 4 indicated this point. However, as noted previously, the child's creativity in this example was merely demonstrated but not identified and developed by the teacher. Therefore, key publications advocated the fourth strategy: appropriate scaffolding.

Teachers were advised to maintain a balance between providing the necessary scaffolding and allowing for children's agency and autonomy to promote their creativity through digital technologies (Fielding & Murcia, 2022). Specifically, Johnston and Highfield (2017) illustrated the teacher's essential role as a mentor in modelling, monitoring, assisting and reframing children's creative experiences. Moreover, Murcia et al. (2020, p.1401) pointed to the vital role of communication in promoting creativity, suggesting the benefits of 'intentional learning conversations, hearing and valuing children's ideas, open inquiry questioning and facilitating verbal or non-verbal dialogic conversations between children'. Finally, it was indicated that the appropriate scaffolding from teachers could enable children to become independent, smart and purposeful creators with digital technologies (Murcia & Tang, 2019).

To summarise, within this study, the methods that young children used to engage with digital technologies in kindergartens were not in alignment with the supportive approaches to children's creative development recommended by the existing literature. Whilst studies suggested that teachers' constructive guidance and children's creativity could unlock the full potential of technologies for children's play, learning and development (Yelland, 2018; Fleer, 2017; Marsh et al., 2016), the participating teachers in this study tended to integrate digital technologies in an instructive way and children were observed consuming the digital content. One explanation for this could relate to the socio-cultural context of China, wherein Confucianism and communist ideologies dominated education, despite the introduction of western educational philosophies such as individualism and child-centredness. These factors could pose challenges to the development of children's creativity, which has been increasingly focused on by policy-makers, researchers and educators. This finding suggested that there were opportunities for educators to foster and enhance children's creativity in relation to the use of digital technologies in kindergartens in China. However, it was evident that teachers would require support in understanding and identifying children's diverse creative practices with digital technologies, as well as learning how to appropriately scaffold for children. Many educators would likely benefit from the provision of dedicated training in this area.

7.1.2. The Pedagogical Practices of Kindergarten Teachers in the Present Study Were Connected With Their Perceptions of Digital Technologies

The interview data showed that participating teachers generally conceptualised digital technologies as screen-based devices, such as the IWB, projector, computer, smartphone and tablet. This finding was similar to the conclusions drawn by Dong & Mertala (2019) and Yang (2020), who also explored Chinese kindergarten teachers' perceptions of technology use. One interpretation could be that screen-based technology was predominant in the technological landscape. Furthermore, screen-based technologies were what teachers accessed most frequently in both their personal lives and workplaces. Moreover, the public discussion surrounding young children and touchscreen technology amongst researchers, policy-makers, educators and parents may also have strengthened teachers' emphasis on screen-based technologies (Dong & Mertala, 2020). Furthermore, the study also found that although several teachers indicated their awareness of other new technologies, they had a limited understanding of the educational potential of these technologies and their connection to children's learning. In academia, on the other hand, researchers have been increasingly exploring children's engagement with new technologies like AR, VR and programming robotics and uncovering the significant potentials of these tools to promote children's learning and creativity. For example, Scott (2022) discovered the affordances of an AR coding app, 'Little Red Coding Club,' to facilitate young children's coding competencies and creativity. Also, Murcia and Pellicione (2017) revealed the benefits of coding technologies like 'Bee-Bot' and 'Cubetto' for fostering children's communication and collaboration. It is important to note that such studies were western-centric and newly published within the last decade. With this in mind, teachers' lack of understanding regarding the educational potential of new technologies could be ascribed to a shortage of up-to-date and relevant available information on this topic. The existence of this type of research-practice gap provided vital implications for kindergarten teachers' professional development, which will be discussed later.

The study found that teachers valued the ability of digital technologies to inspire children's enthusiasm for learning and provide accessible educational content. This was consistent with their tendency to perceive 'digital technologies' as primarily screen-based technologies. However, it is also worth noting that screen-based technologies could be used for more than just knowledge acquisition and increased engagement (Yang, 2021). Participating teachers' understanding of technological value appeared to be reflected in their intentional selection of digital content, which aimed to persuade children to engage with activities and, in the process, participate in opportunities to acquire knowledge. However, as Dong and Newman (2016) argued, using digital technologies to entice children into learning was not enough to achieve high-quality development of dispositions such as creativity, collaboration and problem solving.

Teachers' understandings about digital technologies and technological affordances for children's learning provided the foundations for their pedagogical beliefs regarding digital technology integration. As illustrated in section 4.1, teachers believed that digital technologies should be integrated into learning-based activities. This was in line with their perceived technological affordances as attracting children and providing understandable content. Interestingly, the 'learning' that teachers referred to did not specifically mean subject knowledge learning; instead, it encompassed a broader definition of learning that involved children gaining knowledge about the world around them. This finding differs from Mertala's (2017) conclusion which proposed that teachers tended to connect digital technologies with children's literacy and maths learning. Arguably, the reason behind the nuance could be that, in China, formal subject learning was officially prohibited for kindergartens in national educational documents. Although there may have been some discrepancies in practice, as the implementation of policy varied from kindergarten to kindergarten and from teacher to teacher (e.g. in Case 5, children's learning of literacy and maths were observed), there was a common view that teaching and learning subject knowledge at kindergarten was inappropriate.

Another finding with regard to pedagogical beliefs surrounding digital technology integration was that whilst some participants supported children's use of digital technologies in the classroom, they still insisted that the activities should be supervised and controlled by teachers. This belief was partly associated with teachers' perceived adverse impacts of digital technologies on children's eyesight and concentration. Another reason could be that the teachers did not know more creative approaches to using digital technologies, employing them exclusively for instruction and consumption. Therefore, they may not have been able to recognise the benefits of children's free use. This could explain why teachers who were informed of the appropriate approaches by researchers in researcher-intervention studies (e.g. Vidal-Hall et al., 2020) were often more open-minded about children's use and showed more constructive beliefs about technology integration. In general, insufficient information resulted in teachers' limited understanding of technology and its potential, which affected their pedagogical beliefs. This provided important insights into the future training needs of early childhood educators.

The intentions of this study were not simply to explore whether early years teachers' attitudes towards digital technologies were positive or negative and to quantitatively study the frequency and duration of teachers' use of digital technology. Rather, I aimed to understand teachers' perceptions of what digital technologies were, why they used or did not use technologies and how digital technologies should be integrated, as well as what, when and how technology was used in their practices. Thus, I could compare and discuss the relationship between these perceptions and practices. Based on the findings of the present study, it appeared that participating teachers' perceptions and practices in relation to digital technologies were generally consistent and interconnected.

The influence of teachers' perceptions on their practices of digital technology use had already been broadly studied and discussed in the literature (e.g. Blackwell et al., 2013; Fisher, 2006; Tondeur et al., 2008). For example, many studies reached the conclusion that teachers who were positive about digital technology's benefits for children's learning were more likely to use technology in their pedagogical practices (Tran, 2018; Miranda & Russell, 2012). Furthermore, Ertmer et al. (2012) argued that the shaping of teachers' technological beliefs on practices could be critical, which meant that belief could play either the role of a predictor or a barrier to technology use. Most of these studies employed a quantitative analysis of teachers' self-reported data to reveal the relationship between their beliefs and the motivation or frequency of using technologies. The impact of specific beliefs and knowledge on how technologies were used was less researched. The findings of this study offered some insights relevant to this issue. As illustrated in the Findings chapter, teachers' specific experiences (e.g. personal digital technology use, professional development training, communication with parents, etc.) could influence their knowledge and beliefs about technology integration, which collectively shaped their pedagogical practices. For example, most participating teachers conceptualised digital technologies in early childhood education as screen-based devices, which could explain their frequent use of touchscreen technologies in normal teaching activities to present and record. Presenting and recording were the fundamental functions of screen-based technologies used by teachers and children in the study. Moreover, teachers valued the affordance of digital technologies to promote children's learning. Therefore, in practice, technologies were employed in diverse educational activities, such as thematic activities across the five learning areas (health, language, science, art and society), and in the learning corners, such as the reading corner and maths corner. Additionally, teachers expressed caution about digital technology use by children in kindergartens, which was the possible explanation for why children in their classes had limited access to screen-based media and only used close-ended devices. On the whole, teachers' emphasised learning and indicated control over students' activities. In combination with a lack of words like 'creativity', 'active learning', 'autonomy' and 'collaboration' in their narratives, this reflected their more traditional pedagogical beliefs towards technology integration. Similarly, the knowledge transition, instructive teacher-child interactions and children's consumption of technologies observed during my kindergarten visits were consistent with teachers' aforementioned pedagogical beliefs about digital technology use. This finding supported existing conclusions regarding the relationship between beliefs and practices. For example, Mertala (2017) found that when teachers connected digital technology use and pedagogy, they valued the affordances of digital technologies to support children's academics. As a result, in practice, they tended to use digital technologies in whole-class instructions and drill-and-practice exercises. In a similar vein, Yang (2021) illustrated that teachers' understandings of technological potential influenced their perceptions of digital technology use, which played an important role in their decision-making about when and how to integrate digital technologies in pedagogical activities.

Previous research focused on the impact of perceptions on practices, but how practices shaped perceptions was less explored. This study argued that early years teachers' practices of technology integration could inform their beliefs by modifying their understanding of technological affordances and appropriate uses. This shaping process usually began with the introduction of new technologies. As analysed in the Findings chapter, the introduction of the children's camera into the classroom provided an example of how practice resulted in a shift in belief. Before the introduction of the camera, teachers had no concept of its uses or advantages. After it was equipped and used by the children, teachers found that the camera could allow them to hear from children and learn about children's interests, which could not always be achieved through general teacher-child conversations. Once they recognised the benefits afforded by the camera, teachers normalised children's free use of it and further developed this learning approach by exhibiting children's photographs and letting them add captions. The research indicated that teachers updated their beliefs by making changes to their normal practices and then observing and reflecting, which in turn informed subsequent practices. The interplay between beliefs and practices was also reported by Vidal-Hall et al. (2020). This relationship supplemented our understanding of teachers' digital technology integration, providing implications for professional development of teachers.

To give a brief overview, participating teachers' understanding of digital technologies and their educational potential was limited, as was their knowledge about how technology could promote children's active learning, play and creativity development. Their understanding shaped their pedagogical beliefs that technologies should be used in learning-based activities and that they should be cautious about children's use. These pedagogical beliefs about digital technology were consistent with their instructive pedagogical practices of technology integration, as reported and observed. My intention was not to judge such beliefs and practices as wrong. However, my findings suggested that new elements, such as creative and productive activities, could be introduced to pedagogies to extend participating teachers' digital technology use, which could help to establish a more effective pedagogy. With this in mind, it could be helpful for frontline practitioners to connect with academic researchers in order to learn about progressive research findings surrounding new technologies and the opportunities they afford. Achieving this type of connection would require the joint efforts of academia and early childhood education settings. Furthermore, given the interplay between participating teachers' pedagogical beliefs about technology integration and their practices, improvements to both teachers' conceptual understandings and their practical skills regarding digital technology integration would be necessary. The findings indicated that teachers did not have adequate knowledge about diverse approaches to integrating technologies into early years classrooms. As a consequence, they would need to be provided with examples of how to modify their practices and why these changes would be beneficial. My suggestion would be to develop detailed guidelines for technology integration into early years education, promoting teachers' effective technology use. More importantly, given the significant role that external factors played in shaping both teachers' beliefs and practices (Ertmer et al., 2012), surmounting the external barriers would also push technology integration forwards. The external factors summarised in the literature included physical conditions, such as funding and equipment, and technical issues, as well as support (Blackwell et al., 2013; Plumb & Kautz, 2015a). The findings of this study uncovered more specific and complex external factors that could influence teachers' beliefs and practices, the details of which can be found in the previous chapter. Managing these external factors would mainly depend on the efforts of both kindergartens and the education sector, which will be discussed further in the next section. Finally, the previous argument that teaching practices could alter teachers' beliefs, which in turn could develop their practices, might carry implications for both pre-service and in-service teacher training. To elaborate, intervention in practices, rather than merely educating teachers on technology integration and shaping their knowledge, skills and beliefs verbally, might be necessary for the successful implementation of new approaches. This was supported by Marsh et al. (2017), who suggested that teachers should be provided with opportunities to try out new approaches through an intervention and to reflect on their practices. Similarly, the findings of Vidal et al. (2020, p.176) also illustrated that through 'observation, reflection, changes to practice and more reflection', beliefs were shifted. Furthermore, the findings suggested that the training programme allowed teachers to learn and change through practices, thereby internalising the knowledge needed to further extend their technology use.

The above implications highlighted the significant role that the kindergarten could play in shifting teachers' pedagogical beliefs and practices surrounding technology integration. They also pointed to its role in shaping the digital divide, which will be discussed next.

7.1.3 Meso-Level Kindergarten Forces Played an Important Role in Shaping How Digital Technologies Were Used in Kindergartens in the Study

As clarified in Chapter 6, teachers' perceptions and practices of digital technology integration were shaped by multiple elements categorised as micro-, meso- and macro-level factors. Furthermore, I argued that although all of these factors in combination affected teachers, the meso-level kindergarten forces seemed to be the most influential. From the perspective of the top-down relationships amongst the three levels presented in the findings, the kindergarten as the mediator between the education department and individual teachers could directly decide the implementation of technological policies and also influence teachers' personal beliefs and knowledge about technology integration.

To take Lotus Kindergarten as an example, the three teachers' (Luo, Ye and Shi) acquisition of knowledge about digital technology integration and changes in pedagogical beliefs mainly came from the two events organised in the kindergarten, the training workshop and ICT study-research group. In particular, the richer knowledge of educational technologies demonstrated by Luo could also be associated with the fact that the kindergarten authorised her to be the head of the ICT study-research group. The increased awareness and knowledge had positive impacts on their pedagogy. For example, the case study showed that Luo had children independently use the iPads in pairs and provided appropriate scaffolding to extend children's learning with technology use and improve their digital competencies. She explained that the training events provided by the kindergarten inspired her to try diverse approaches to technology integration, including the approach observed in the study. In addition, Ye made interactive slides for the thematic activity to encourage children to engage with the IWB, which she perceived as a practice change prompted by the training workshop. Similarly, the kindergarten where Bai was working clearly listed the development of children's digital literacies as one of the curriculum objectives and had corresponding regulations. As a result, she showed a more comprehensive understanding of digital technologies and affordances than other participants. Meanwhile, she reported constructive approaches to technology integration in her kindergarten, such as digital narratives by children. Furthermore, from the perspective of authority, the institutional forces prevailed over teachers' personal beliefs to affect the final practices, which could be due to the right of the kindergarten to determine the access to technologies and curriculum. For example, benefiting from her diverse personal experiences, Ly expressed an open mind towards digital technology use and her knowledge of advanced educational technologies. However, the pedagogical practices she reported were quite narrow. She interpreted this nuance as caused by the limited funding and infrastructures in the private setting, as well as the principal's distinct expectations. A similar situation can also be indicated by Huang, whose many digital ideas were not valued by her kindergarten and thus could not be achieved. In contrast, although Zhang was cautious about children's use of digital technologies, her kindergarten's series of actions, such as purchasing the children's camera, promoting the Mosaic Approach and practising special sessions of 'News Broadcasting', still provided multiple opportunities for children to engage with digital technologies. These findings suggested that if the kindergarten could appreciate the value of technology integration, provide more training and guidelines, support teachers' ideas, offer more equipment or develop the curriculum to give a chance for technology integration, the technology integration practices could improve in either quantity and/or in quality. This highlighted the essential role of institutional forces.

In accordance with the presented argument, previous studies also demonstrated that institutional forces were the most influential. The impacts of external support on teachers' personal beliefs have been widely discussed and agreed upon (e.g. Ertmer et al., 2012; Yang, 2021; Blackwell et al., 2013). For example, as Dolan (2016) found, when teachers were appropriately trained and supported in school, they would be more willing to integrate digital technology. Moreover, the conclusion that external factors were more influential than individual factors was also raised in some studies. For example, Hernandez-Ramos's (2005) survey found that external factors, such as training events, principal's commands, school culture and decisions on funding and curriculum, had a greater impact on teachers' technology integration than teachers' personal beliefs. In the same vein, Dong (2016) also revealed that a lack of training was the main barrier to teachers' technology integration.

Due to the prevailing role of institutional forces in affecting technology integration, there tended to be less difference among practices within the same kindergarten, but the digital divide across kindergartens could be more substantial. The term 'digital divide' was originally developed to refer to the gap in technology access, but more recently the discussion on the digital divide has been extended to include more complicated issues like capabilities and outcomes (Dolan, 2016). Accordingly, many scholars developed the levels of the digital divide. For example, Van Deursen and Helsper (2015) defined three levels. The first-level digital divide refers to people's different access to ICT facilities. The second-level digital divide concerns differences in abilities and usage patterns. Lastly, the third-level digital divide draws more attention on users' autonomous receptiveness and the outcomes of their usages. Furthermore, research on the digital divide increasingly focused on K-12 education and developed a framework for discussing the levels of the digital divide between schools. Within these parameters, the first-level digital divide compared schools by the amounts of digital infrastructures and technology support. The second-level digital divide could be measured by the frequency, purpose of digital technology used by teachers and students and the level of integration into daily routines. Finally, the third level was concerned with how schools prepared students for digital literacies (Hohlfeld et al., 2008; Ritzhaupt et al., 2013). This framework for K-12 education could also be applied in early childhood education settings. Whilst this framework provided the three domains to discuss the technology integration disparities among kindergartens, which not only focused on digital technology access but also concerned the quality of the provision, my study offered more detailed insights into how kindergartens differed in the three levels.

Findings about teachers' decisions on what, when and how digital technologies were used in the participating kindergartens contributed to the understanding of what the digital divide meant in early years settings. In terms of the first-level digital divide, this study provided evidence of significant differences in equity for the access to digital devices through interview and observation data. In particular, the Appendix L showed that amongst all 11 kindergartens involved in this study, only four settings were found to have tablets for teaching and learning, but the number of tablets and access to them in these four settings were still nuanced. Specifically, the four tablets in Lsq's kindergarten were shared across all classes; the Lotus Kindergarten only provided tablets for the upper classes (two in each); the North Kindergarten provided one for each classroom; and each classroom of Bai's kindergarten had several. Moreover, access to other technologies could be more complicated and diverse, such as the children's camera reported in two kindergartens and the coding robot mentioned in four kindergartens. Furthermore, even the IWB was not present in every kindergarten. For example, Chen stated that there were no IWBs in her kindergarten and that the only technology was a television. This situation reported by Chen was consistent with the results of other survey research in China, which revealed that traditional digital devices, such as TVs, DVDs and computers, were still dominant and that the equipping ratio of IWBs was only approximately 50% in kindergartens (Luo et al., 2021; Li, 2019; Liu & Chen, 2019). These results supported the conclusions made by Luo et al. (2021) and Liu (2018) that the digital divide regarding access to digital technologies in classrooms is evident in Chinese kindergartens. In addition to infrastructure access, this study also identified differences in the level of support available for technology integration across the settings, which could also be regarded as the first-level divide. Whilst some participants reported the support they received from IT staff or training events, most teachers illustrated that support for technology integration was rarely provided by their settings. These findings were consistent with the previous results of quantitative surveys conducted in different regions across China. For instance, Dong (2018) reported that only 31% of participating teachers from Shanghai kindergartens had attended ICT-related training. Moreover, the findings of the present study expanded on previous results by identifying the disparities in training focus and quality. Most kindergartens were reported to support teachers with technology-related issues, whilst only two kindergartens (the Lotus Kindergarten and Bai's kindergarten) provided pedagogy-focused training.

Furthermore, the findings regarding teachers' decision-making on when to use digital technologies provided evidence of the second-level digital divide across settings. The frequency of technology use in each kindergarten was similar, as technologies were reported to be used almost every day in all participating kindergartens. However, the duration of technology use was nuanced across kindergartens. In most settings, the technology was integrated throughout daily sessions, including thematic activities, small-learning-area sessions and transitional time. Some special sessions in individual kindergartens could leave less space for technology integration, such as the Anji Play and Montessori pedagogy. Thus, the duration of technology use in these kindergartens could be less than in other settings. In addition, the findings identified a gap between kindergartens with regard to the purposes of technology use. The purposes were defined as: work improvement, knowledge transition and children's digital literacy development. These purposes often appeared in combination and the first two were the most common. However, the concerns for children's digital literacy were only presented in two kindergartens, the Lotus Kindergarten and Bai's Kindergarten. The identification of the different purposes of technology use expanded upon the existing literature's findings about the second-level digital divide. For example, Hohlfeld et al. (2008) only identified the purposes of delivering instructions and administration, although this was in relation to K-12 education. Extending the list of purposes regarding children's digital literacy development reflected the new trends introduced by new technologies. The second-level digital divide demonstrated by participants indicated teachers' different levels of knowledge and skills of technology integration, which were greatly shaped by the support they received (the first level).

In terms of the third-level digital divide, although my observational sample was small and there was no formal assessment of children's knowledge and capabilities of using technologies, the findings still showed the significant differences in children's interactions with digital technologies. This indicated the disparities in kindergartens' awareness and practices of preparing children to use digital technologies for their personal empowerment. I have grouped the interactive actions of children into the following categories: first, merely watching/listening and reacting; second, simply operating by touching the screen or pressing the button; third, purposefully using technologies, such as voice searching, photographing and audio recording; and fourth, meaning making with technologies. The first type of use was the most common, wherein children could acquire information from digital media. The second category was less common and some kindergartens did not encourage children to operate screen-based devices but only close-ended digital tools. The third category was even rarer, with only four kindergartens reporting such use, whilst the fourth category of technology use was only mentioned by one participant. These different interactions between children and digital technologies were believed to be closely related to teachers' pedagogical strategies and TPACK (Yang, 2021; Dong, 2014) (the second-level digital divide).

Many studies interpreted the main factor shaping the digital divide across settings to be the socioeconomic status of the settings, which not only influenced both teachers' and students' access to technologies, but also affected the ways in which technologies were used in classrooms (Dolan, 2016; Rowsell et al., 2017). Numerous research findings showed that the technologies were accessed more frequently in low-SES schools, but in traditional ways, such as for drill and practice, whilst teachers in high-SES schools used technologies in dynamic ways, focusing on students' higher-order thinking and productive activities (e.g. Rafalow, 2014; Wood & Howley, 2012; Warschauer & Matuchniak, 2010; Hohlfeld et al., 2008). In this study, the socioeconomic status of participating kindergartens was not strictly defined and categorised due to the complicated elements involved. However, the analysis and findings surrounding the meso-level contextual factors, especially regarding the kindergarten types and funding status, could still contribute to the SES-related interpretations behind the digital divide across kindergartens.

As specified in the Introduction chapter, there were three types of kindergartens in China: public, private not-for-profit and private premium kindergartens. The impacts of kindergarten type on teachers' digital beliefs and pedagogical practices have been analysed in detail in the Findings chapter, which indicated that the disparities in funding and curriculum between different kindergartens shaped the digital divide between them. The impacts of setting type and associated funding were also emphasised by Plumb and Kautz (2015a), who identified a link between different types of early childhood education organisations, such as public/private organisations, school-based/non-school kindergartens and home-based care centres, and the barrier of 'lack of funding'. They also highlighted the ways in which the 'lack of funding' influenced teachers' access to technology by citing the arguments of Blackwell et al. (2013) and Ihmeideh (2010). Furthermore, it was important to mention that in China the private not-for-profit kindergartens generally served children from low-income families, whilst the students attending public and premium kindergartens had higher socioeconomic status (Bu, 2008). Several scholars argued that the socioeconomic status of students also contributed to the digital divide (Watters, 2013; Garland & Wotton, 2001), which provided further insights into the relationship between kindergarten types and the digital divide.

In summary, the findings of the present study, regarding the decisions teachers made about technology integration and the meso kindergarten forces, extended the knowledge base about the support available for technology integration in Chinese kindergartens. This was achieved by providing details illustrating how and why technology integration practices differed across settings. These findings could help to inform kindergarten principals and policymakers about the current digital divide in the early years sector and provide characteristics of digital divide that they can further examine and define.

7.2 Theoretical Discussion

The existing literature showed that teachers' practices were affected by first-order barriers (in line with Ertmer's definition), but that their knowledge and beliefs, which Ertmer might have called second-order barriers, were also impacted by contextual factors (first-order barriers). Similarly in this thesis, I argued that a range of contextual factors influence teachers' knowledge, beliefs and practices.

The TPACK model presented by Mishra and Koehler (2006) attempted to present the essential elements of teacher knowledge required for digital technology integration in education, whilst addressing the 'complex, multifaceted, and situated nature of this knowledge' (p. 1017). The context for TPACK has been considered significant, and the meaning of it varied and changed over time (Rosenberg & Koehler, 2015). The authors' conceptualisation of context focused on subject, grade, student, and available devices (Mishra & Koehler, 2006), while Kelly (2008) identified some contextual factors such as learning environment and institutional characteristics. In the present study, Porras-Hernandez and Salinas-Amescua's (2013) more recent framework for understanding the context of TPACK was employed as the conceptual framework for identifying the shaping forces behind both teachers' perceptions and teachers' practices in relation to the integration of digital technology. As clarified in the

Literature Review chapter, within this framework, teachers developed their TPACK across three levels of context: macro, meso and micro. Additionally, the two actors, the teacher and the student, were foregrounded as they were believed to play significant roles in influencing the technology integration practices (Rosenberg & Koehler, 2015). Furthermore, it was important to note that the three conceptual levels of context not only referred to the external conditions influencing teachers' knowledge development, but also illustrated teachers' knowledge of contexts for developing TPACK (Porras-Hernandez & Salinas-Amescua, 2013).

The macro-level context was defined as the social, cultural, political, economic and technological conditions that affected teaching and learning, as well as the developments of teacher and student (Porras-Hernandez & Salinas-Amescua, 2013). The framework provided examples such as the national equipment investment projects, teacher training programmes and technical skills courses. In this study, the participating teachers commented on the educational ICT policies and identified a series of relevant courses and competitions nationally or locally, as well as the particular societal condition of the COVID-19 pandemic, which could be categorised as the macro-level contexts. The meso context was mainly defined as the school environment, placing the emphasis on the important role of the principal and supportive staff (Porras-Hernandez & Salinas-Amescua, 2013). This study not only identified the human factors, such as the principal's leadership and support from colleagues, as the meso contexts, but also found that the non-human contexts within the institution, encompassing institution type, funding, curriculum and teacher's professional development opportunities, could also alter teachers' practices of integrating digital technologies. Finally, the micro classroom conditions included not only the physical environment, such as classroom layout and available resources, but also the norms and rules within the classroom (Porras-Hernandez & Salinas-Amescua, 2013). More importantly, the researchers also regarded the characteristics of the two actors (teacher and student) and their contexts to be part of the micro-level environment. Thus, in this study, many micro-level factors were found to influence the technology integration practices. These included class size, teachers' personal technology access, teachers' family life, teachers' knowledge and skills in technology integration, children's digital experiences at home and parental views.

The multilevel nature of this conceptual framework categorised the complex contexts for teachers' technology integration to account for various shaping factors, including both human and non-human elements. It was viewed as a systematic and comprehensive framework for clarifying the contexts of teaching with technology (Rosenberg & Koehler, 2015). In addition, it considered the subjective variables of the teachers within the contexts. This may have resolved some ambiguity about whether teachers were separate from or part of the context. This complicated issue aligned with the sociological premise that it was difficult 'to conceptually separate the person from his/her context' (Porras-Hernandez & Salinas-Amescua, 2013, p.231).

Despite the positive aspects of this conceptual framework, the findings drawn from the present study provided some insights into its limitations. Firstly, this context framework could not recognise the interrelations between factors. As demonstrated in the section 6.4, the factors within each domain interacted with each other and the factors across levels also showed the top-down relationships. However, the nested form of this framework could not represent these interrelations effectively. Secondly, in addition to the above context elements that could find a place within the framework, there were still implicit factors that could not be accommodated into any of the three spheres of context. For example, the dissemination process of educational policies was not explicitly identified by participating teachers as a shaping factor. Instead, it was through comparing participants in the analysis that the subtle policy distinctions conveyed by local education departments were discovered. These differences caused a divide in policy implementation across different settings, which resulted in the differing practices of teachers. Thirdly, this framework was mainly developed for school education and focused on the TPACK of teachers across all stages, but the specifics of early years education, such as the children's age and the informal nature of learning, were not taken into consideration. Thus, it could be adapted slightly to apply to the early years practitioners.

Focusing on the above shortcomings, I made some modifications to this framework based on findings and empirical discussions.

First of all, the 'teacher' was set as the focal subject of this framework because they constituted the central focus of this research. The 'teacher' in this instance referred to the teacher's characteristics, encompassing TPACK, skills, beliefs and practices. These characteristics interacted with each other. These interactions have been omitted from the visualisation because attempts to include them all resulted in a graphic that was prohibitively complicated. However, these interactions can be summarised descriptively: as clarified in the previous empirical discussion section, teachers' knowledge and beliefs surrounding technology integration influenced their practices, whilst in turn the practices could also shift their knowledge and beliefs. Due to this, in order to simplify this framework, I considered these intrinsic characteristics related to teachers as a unified focal point. However, teachers' external contexts, such as their access to technologies in their personal life and their social/family environment, were distinguished from their intrinsic factors to form a micro-environment. This micro environment exhibited both differentiation and overlap with the micro classroom.

Furthermore, the 'student' actor in the original framework was adjusted to 'children' to reflect early years education. In addition, the meaning of this was also adjusted to include not only children's characteristics, such as knowledge, expectations, beliefs, preferences and goals, but also parental views. The latter was regarded as an element of the meso-level community. The reason for combining children and parents was that, in the early years, children's expectations, goals and beliefs could not be distinguished from those of their parents.

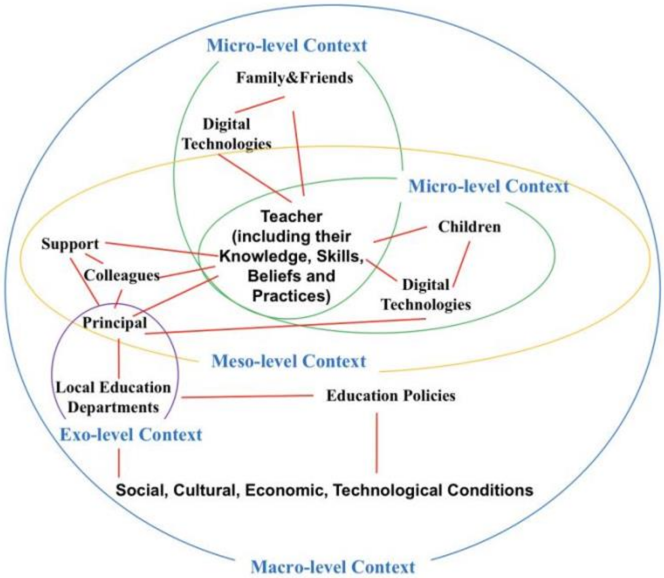
Moreover, I added an exosystem level to address the important policy conveyance process, which could not be accommodated in the original structure. This was inspired in part by Bronfenbrenner's (1974) Ecological System Theory. The exosystem was defined as 'a setting-or set of people engaged in social interaction-that does not include, but whose participants interact directly or indirectly with, the focal individual' (Neal & Neal, 2013). The findings of this study argued that the implementation of educational policy was supposed to filter down from the national education department, through local education departments at all levels and then reach kindergartens. Although the individual teacher could not directly engage in this process, any interactions within this system could have a direct or indirect impact on them. Therefore, these interactions acted as an exosystem. This external environment was different from the meso-kindergarten environment and the macro-level education policy itself.

Additionally, in the findings of the study, participating teachers only indicated their macro-context knowledge about education policy and societal condition of COVID-19, but the following empirical discussion section extended the meaning of the macro environment. For example, examining the impact that cultural traditions, such as Confucian and communist ideologies, may have had on the beliefs of stakeholders could complement our understanding of the macro social, economic and cultural context. This also applies to the role played by the socioeconomic status of the settings in shaping the divide in technology integration practices.

Finally, I modified the nested framework to include networked structures for demonstrating the interrelations among individual factors and also across spheres. The concentric three-level design of Porras-Hernandez and Salinas-Amescua's (2013) framework was influenced by Bronfenbrenner's (1999) Ecological System Model. However, the nested form of this model was critiqued by some scholars (e.g. Neal & Neal, 2013; Carrington, 2013; Alaimo, 2016). In particular, Neal and Neal (2013) suggested that the emphasis should be placed on how and with whom individuals interact, but not on where they interact. Due to this, they redesigned the original nested systems (micro, meso, and exo) to a networked model (Neal & Neal, 2013). Inspired by this reformulation, I intersected all of the factors within this study and connected the multiple levels to the focal subject directly or indirectly, finally producing an overlapping configuration of relations. This network of overlapping structures not only demonstrated clear interrelations between elements, but also underlined the vital role of the meso-level kindergarten in connecting different spheres. However, since the micro classroom should ideally have been contained within a meso kindergarten, the nested structure between them remained. Furthermore, because the extended macro environment impacted on all of the other context levels, I also maintained the encompassing structure of this level.

I created a visual representation of the modified framework to highlight the relationships amongst factors (see Figure 10). With the purposes of this study in mind, the teacher was positioned as the central subject in order to represent their attitudes, knowledge, beliefs and practices of technology integration. Within this research, the teacher directly participated in two different environments. The environment shown on the right of the diagram was composed of interactions between the teacher, children (and associated family) and technologies, which could be regarded as the micro-classroom context influencing technology integration. In reality, every child's family environment, including the interactions between the child, families and technologies, was an implicit micro-environment. However, because the teacher occupied the focal position, the child's micro family system was not developed but was incorporated within the context element of 'children'. The upper portion of the diagram contained the social interactions of the teacher and the teacher's families and friends, along with technologies, representing the teacher's micro family system. The interactions between elements in both micro systems (micro classroom and micro family) were found to have the ability to affect teacher's technology integration and these two systems overlapped with one another. The environment surrounding the micro classroom was the meso kindergarten context, composed of interactions between the principal, colleagues and support, as well as their direct or indirect impacts on the teacher and technology access. For example, in the line of principal - support - teacher, the principal decided on whether to provide the teacher with technical support and what kinds of support would be provided, thus affecting teacher's knowledge, beliefs and practices of technology integration. In the lower left corner of the framework diagram was a system that did not contain the 'teacher.' This system was composed of social interactions between local education departments at all levels and the principal, mainly referring to the conveyance process of education policies from the macro context to the meso system. Since the teacher did not actually participate in this system, but nonetheless directly or indirectly interacted with its participants (directly with the principal and indirectly with the local education departments via the principal), this system could be an exosystem. This exosystem overlapped with the meso kindergarten system by the link of principal, connecting the meso system indirectly to the education policies. These interactions could be interpreted by the social pattern of transitivity (Neal & Neal, 2013). Within this model, the educational policies were considered to be an element of the macro context but not the exosystem. This was because they could not only influence the meso-level support via the exo-level conveyance process but could also have a direct impact on the teacher's micro family environment and the children's micro family interactions. Similarly, the macro social, cultural, economic and technological conditions not only connected with policies on education and education departments at all levels, but they could also directly or indirectly affect any participants of all systems. This was what was meant by the encompassing macro system.

Figure 10. The Conceptual Framework for Understanding the Contextual Factors Shaping Teachers' Digital Technology Integration Beliefs and Practices in the Present Study



It should be acknowledged that the visualised context elements, levels and the interrelations amongst them (as shown in Figure 10) could not be completely adapted to display every teacher's construction of attitudes, beliefs, knowledge and practices towards technology integration, as TPACK was argued to be a 'personal form of dynamic and situated knowledge' (Yang, 2021, p.243). Nonetheless, this context framework still provided an organised and comprehensive knowledge base for identifying and understanding the complexity of early years teachers' decision making in relation to technology integration.

In particular, the added micro system (teacher's family environment) and exosystem (policy conveyance process) contributed to the capacity of this framework to more comprehensively and systematically conceptualise not only the objective contextual factors (context for knowledge construction) and their effects but also teachers' understanding of contexts (context knowledge). It was argued by Yang (2021) that there might be differences between what teachers perceived the contextual elements to be (context knowledge) and what these elements were in practice (context for knowledge construction). Moreover, the original framework of Porras-Hernandez and Salinas-Amescua (2013) only provided the broad meanings of the context levels but did not identify specific variations within each context system. As a result, this study empirically constructed the specific meanings for context by both deductively exploring the possible factors influencing teachers' decisions about technology integration and inductively finding out teachers' perceived context elements. By detailing the meanings of each context, the ambiguity surrounding context levels was eliminated. As indicated by Neal and Neal (2013), researchers directed more focus towards micro systems than other systems when studying the ecological systems. This could be supported by Rosenberg and Koehler (2015), whose literature review found that the factors of classroom, school and teacher were more often explored in TPACK research than student and social contexts. The reason behind this gap was thought to arise from researchers' lack of comprehension about the explicit meanings of these context elements rather than from a disinterest in these systems (Neal & Neal, 2013). Therefore, this study, together with the updated framework, could work as a starting point for researching the widespread variation in context meaning, thereby contributing to the in-depth study of each context system. Moreover, the consideration of teachers' context knowledge in this framework could provide implications for developing future teacher training and evaluation schemes for teachers' TPACK.

Furthermore, from the perspective of networked contextual factors, the findings of this study contributed to the knowledge base on the application of Porras-Hernandez and Salinas-Amescua (2013)'s framework. Firstly, it highlighted that the interactions between different context levels could help to investigate and understand teachers' decisions about technology integration. Secondly, the resultant networked framework, illustrating how these elements affected one another, also provided the basis for researchers to study more complex interrelationships between systems in the future.

However, this reconfigured framework may have had some limitations. Firstly, given the study's modest sample size and qualitative nature, the generalisability of this framework could be limited. Therefore, more empirical studies would be necessary to expand the meaning variations and networks. Secondly, the exosystem (policy conveyance process) might not have been as straightforward as it appeared within this framework. In the Chinese context, the exosystem could have been complex in practice and may have involved complicated administrative hierarchies and divisions of labour amongst government departments. However, since this was not the focus of this study and the data related to this area was narrow, refinement in this study is not possible. Thus, in the future, more research could be developed to explore specific interactions within the exosystem and their impacts on teachers' technology integration.

7.3 Summary

The present chapter explored the study's findings in more depth, highlighting the ways that the study contributes to understandings of kindergarten teachers' integration of digital technologies, building on existing literature. In the final chapter of the thesis, I summarise the study's key findings and contributions, emphasise limitations and, finally, explore the implications of the study for a range of stakeholders.

Chapter 8. Conclusion

As young children were increasingly exposed to digital technologies, there was a recognised need for more research about the use of digital technologies in ECE. In particular, the important role of early years practitioners in facilitating effective digital technology use was highlighted in literature, leading researchers to call for more investigations on practitioners' perspectives. Although the existing western-centric studies revealed some teachers' beliefs, knowledge and general approaches to integrating digital technologies into kindergarten activities, there was little empirical evidence of kindergarten teachers' digital technology integration within China, where the social and cultural contexts were different from western contexts. As a result, the purpose of the present study was to provide insights into digital technology integration in the kindergartens of China from the perspectives of teachers, with a specific focus on teachers' perceptions, pedagogical practices and the multiple contextual factors behind them. The sociocultural ideas developed by Vygotsky were adopted to provide the theoretical bases for this study, whilst the TPACK model (Mishra & Koehler, 2006) and its context framework (Porras-Hernandez & Salinas-Amescua, 2013) were employed to conceptualise some of the research findings. This study addressed the research questions by employing the two-phase qualitative research design, which included individual interviews of 14 kindergarten teachers and five case studies with kindergarten teachers and their classrooms in China. The data were generated from individual interviews, classroom observations and document reviews. The thematic analysis approach and multimodal analysis approach were used to analyse generated data and the findings were presented by research questions and themes. Firstly, participating teachers' understanding of digital technology and how it was applied in kindergartens, whether to integrate digital technologies and how digital technologies should be integrated into their pedagogical activities were reported. Secondly, the pedagogical practices with digital technology integration reported by participating teachers were presented. Thirdly, the findings drawn from case studies regarding teachers' specific pedagogical strategies when using digital technologies in the classroom were reported in detail. Furthermore, multiple contextual factors that teachers perceived to influence their digital technology integration practices were identified. How these factors worked together to shape teachers' digital practices was explored at length.

In this final chapter of the thesis, I will begin by summarised the key findings and the contributions of them. Next, the whole study will be reviewed to identify its limitations. Finally, drawing on the research findings, the significant implications for stakeholders (early years teachers, principals, teacher educators, policymakers) in order to achieve effective integration of digital technologies in ECE in China will be presented. Additionally, the recommendations for future research within this field will be made.

8.1 Summary of Key Findings and Contributions

8.1.1 What Are Participating Teachers' Attitudes and Perceptions in relation to the Integration of Digital Technologies into Kindergartens in China?

The study found that participating teachers' understandings of the digital technologies that could be integrated into kindergarten classrooms varied. Whilst the majority of participating teachers perceived the digital technologies in ECE to be screen-based technologies, such as the computer, IWB and smartphones, several participants indicated their knowledge about digital technologies beyond screen-based ones, such as AR, VR and children's programming tools. In a similar vein, most teachers viewed technologies more as teaching tools used by themselves than as learning tools used by children. Only a few took children's engagement with digital technologies into consideration.

The summary of findings about participating teachers' perceptions on whether digital technology should be integrated begins by addressing those with moderate attitudes. For these teachers, digital technologies offered effective assistance for educational activities; however, they viewed them as just tools and not a 'must-have'. The interview data showed that these participants recognised the significance of digital technologies and used them at work, but they still had concerns about integrating digital technologies into classrooms. Participating teachers believed that the use of digital technologies could improve their work efficiency, assist in the class management and benefit their professional development. Furthermore, they acknowledged the value of digital technologies in facilitating children's understanding of conceptual knowledge about the world. However, teachers also foresaw several potential problems regarding the integration of digital technologies into kindergartens. They believed that there were many things in pedagogical practices that digital technologies could not achieve, such as children's first-hand experiences and social-emotional communications. They also expressed their worries about the possible adverse impacts of digital technologies on children's eyesight and concentration. Moreover, concerns were raised about an increased workload and the negative implications of an over-reliance on digital technologies. For the most part, participants held the view that digital technologies should be used in kindergartens appropriately, with limits and purposes. They were generally of the opinion that, distinct from children's digital activities at home, digital tools should be applied within kindergartens for educational purposes. Furthermore, some participants insisted that children's exposure to digital technologies should be supervised and controlled by teachers in the classroom.

As argued in the Literature Review chapter, teachers' perceptions were believed to be contextually situated (Oldridge, 2010) and to affect their classroom practices of using digital technologies (Suzette, 2014). The above findings regarding teachers' perceptions of digital technology integration showed nuance from conclusions drawn in western-centric studies, as teachers in this study placed a greater emphasis on their own technology use rather than on children's use. More importantly, their perceptions were found to closely connect with their pedagogical practices (see the next section). These findings supported some of the limited prior studies conducted in the Chinese context, such as Dong and Mertala (2019), which highlighted the impact of Chinese traditional culture on early years teachers' beliefs of digital technology integration. Accordingly, the findings provided implications for future teacher training.

8.1.2 How Do These Teachers Integrate Digital Technologies Within Their Pedagogical Practice?

The first-phase interviews revealed that the digital technologies used in classrooms could include the following three types: a) screen-based devices, such as the projector, IWB, tablet, smartphone and various software; b) digital toys and learning devices, such as the reading robot, reading pen and children's camera; and c) supporting tools such as the loudspeaker, headphones and microphone. In addition, interviewees reported that the screen-based and supporting devices were usually associated with whole-class and group activities, whilst digital toys and learning devices played a more important role in individual activities. Furthermore, from the perspective of activity themes, multifunctional and integrated devices had a wider range of applications across all areas of learning, including language, music, art, science and society, whereas single-function tools were more limited in their use. Specifically, the interview data showed that teachers tended to present digital content to children using screen-based technologies for knowledge transmission. They also recorded children with digital tools, which were further shared with the whole class and also parents. Meanwhile, children were reported to have less access to screen-based digital technologies within the classroom and they were provided with opportunities to use digital toys and close-ended learning tools in learning corners.

The observations from case studies supported the above findings and provided further insights into teachers' pedagogical approaches to using digital technologies in detail. Firstly, the case studies revealed that the digital technology was not used as a focus itself but integrated into daily routines. The observed digitally-enhanced sessions (in which digital technology was used by teachers and children) were across the five learning areas (Health, Society, Language, Science, Art) and in a range of forms, such as thematic sessions, sharing activities, transitional time and small-learning-area activities. Also, the use of digital technologies served diverse goals, such as improving work efficiency, assisting in class management and promoting children's learning and development. Secondly, the digitally-enhanced activities did not function separately, but were interlinked with non-digital activities, such as children's home experiences, other activities sharing similar themes and non-digital tasks within the activity. Thirdly, it was found that teachers tended to select different digital technologies for children to use based on their age group. The older the children were, the more opportunities they had to use diverse digital technologies. Finally, the case studies indicated that teachers tended to use digital technologies in an instructive way. Children were directed to engage with teachers and digital content in the whole-class activities for knowledge acquisition. With regard to children's use of digital technologies in the classroom, I have summarised the interactive actions of children into the following categories. Firstly, the most common form of engagement observed was merely watching/listening and reacting to the content delivered by the IWB, tablets or reading robot. Secondly, simply operating devices by touching the screen or pressing the button was observed in most cases. Thirdly, purposeful use of digital technologies, such as voice searching on the iPads, photographing with the camera and audio recording with recording machines, was only observed in two cases. This indicated that the most typical occurrences of children's digital technology use (the first and second categories) were passive, whereas more creative uses by children were rarely observed. Moreover, the pedagogical strategies teachers employed during children's interactions with digital technologies were revealed in case studies, including non-intervening, instructing, responding and scaffolding. The first three strategies were commonly observed in the case studies. However, the appropriate scaffolding, which was viewed to be an essential step in the development of children's creativity through the use of digital technologies, was only demonstrated in one case.

The Literature Review chapter suggested that although research investigating teachers' practices of using digital technologies in ECE settings existed, these studies primarily focused on the available digital devices and the purposes of using them. Due to this, less attention was paid to pedagogical details, especially the strategies teachers used to support children during their use of digital technologies. This study not only 'zoomed out' on the digital practices to draw the overall picture, but also 'zoomed in' to explore the pedagogical moments of using digital technologies. In particular, through providing rich details from the perspective of 'guided interaction' (Plowman & Stephen, 2007), this study explored teachers' instructive habits and children's consumption of digital technologies in great depth. Ultimately, this empirically extended the knowledge base on young children's use of digital technologies in classrooms and teachers' supporting strategies.

8.1.3 How Do a range of Contextual Factors Shape these Teachers' Perceptions and Practices in relation to Digital Technology Integration?

By analysing the data generated across the two research phases, the multi-level contextual factors were identified and the interplay among them was presented.

Within the micro classroom level, teachers' prior digital experiences in their personal lives, their knowledge and skills of digital technology integration, parents' views and their knowledge of children's digital experiences at home were determined to influence their perceptions and practices of using digital technologies in kindergartens. Moreover, the large classroom and substantial class size were also found to affect practices. In addition, these factors interrelated with each other. Within the meso kindergarten level, the kindergarten types, funding status and leadership were found to primarily shape the support provided by kindergartens, which further impacted teachers' knowledge, beliefs and practices surrounding digital technology use. Furthermore, the meso influences were found to prevail over teachers' personal beliefs to affect the final practices. Lastly, the macro educational policies (National Education Digitisation) and official support scaffolded each other, thereby shaping teachers' practices. The COVID-19 pandemic was also perceived to promote digital practices in kindergartens.

These factors were found to interrelate with one another, thereby jointly shaping teachers' beliefs and practices. In addition to the interconnections between factors within the same context level, the range of factors spanning different context levels also demonstrated a top-down influential relationship. This meant that the macro educational policies influenced the decisions of individual kindergartens, which further affected the individual teachers and practices within the micro classroom. The top-down relationship between the three levels of context indicated that the kindergarten played an important role as a meso context. As such, it could directly decide the implementation of technological policies and also influence teachers' personal beliefs and knowledge about technology integration. Furthermore, the top-down influences highlighted the important role of the local education departments in conveying the policies, which could be regarded as the exo-level factor. This expanded the original framework of Porras-Hernandez and Salinas-Amescua (2013).

It has been suggested that teachers' digital technology integration was not affected by a sole influential factor but was shaped by the co-working of diverse contexts (Yang, 2021). Therefore, I argued in the Literature Review that simply identifying these factors was not adequate. Instead, the research needed to investigate how these factors worked and co-worked to influence teachers' technology use. The above findings, which explained the interrelations amongst the multi-level factors, contributed to the understanding of teachers' decision making surrounding digital technology integration. Moreover, they offered insights into how potential changes could facilitate effective integration. Additionally, the identified interrelations helped to adapt the context framework for TPACK developed by Porras-Hernandez and Salinas-Amescua (2013) to a networked framework, providing the basis for researchers to study more complex interrelationships between contextual systems in the future.

8.1.4 Summary of Contributions

Through answering the three research questions, this study makes multiple contributions to knowledge. In general, the empirical contributions address the noted gaps in existing literature. Firstly, as illustrated in the Literature Review, the existing literature within this research topic is Western-centric, and the majority of them are researcher-intervened studies. Situating the research topic of digital technology integration in ECE within the context of China, this study empirically contributes to providing a complete picture of digital technology integration in ECE within different social and cultural contexts. Specifically, by presenting participating teachers' nuanced perceptions and practices and discussing the impacts of particular contextual factors, the present study highlights the significant role of particular sociocultural contexts in shaping the educational use of these technologies. For example, although participating teachers' attitudes and beliefs varied, they commonly perceived the digital technologies that can be used in ECE as screen-based teaching tools. This important finding shows a difference from some existing Western conclusions and highlights the influence of Chinese traditional cultures.

Secondly, while previous empirical research focused on the devices generally used in kindergartens and the purposes of using them (e.g. Yang, 2021; Dong, 2014), the two lenses (zoom out and zoom in) employed in this study made the presentation of findings on this topic more comprehensive and detailed. The reported perceptions and practices through individual interviews provide an advanced overview and breakdown of the full landscape of technology use by participating teachers, whilst the case studies allow for a micro-level analysis of the pedagogical moments. More importantly, this study not only focuses on teachers' use of digital technologies as teaching tools in kindergartens but also examines children's use of digital technologies as learning tools in classrooms. In particular, teachers' instructional strategies during children's technology use have been explored in greater depth from the perspectives of 'guided interaction' (Plowman & Stephen, 2007). Thus, it extends the existing understanding of how digital technologies are used as both teaching and learning tools in the daily routines of kindergartens in China, providing comprehensive descriptions and interpretations of digital technology integration in ECE. Furthermore, the revealed consumptive use of digital technologies by children in kindergartens provides significant implications for stakeholders, which will be specified in section 8.3.

Thirdly, the in-depth investigation on multiple contextual factors closes a gap in previous literature, as this study not only clarifies the influence of individual factor on digital technology integration but also explores how the multiple contexts worked together to shape digital technology integration through identifying the interrelationships among factors and the comparative advantages of certain contextual forces. This justifies teachers' decision-making about digital technology use and adds to the knowledge base related to the interplay amongst teachers' perceptions, practices and contexts, thereby offering insights into how potential changes could facilitate effective integration. Specifically, this study supports existing conclusions regarding the impacts of teachers' perceptions on practices and also extends the knowledge of how practices shape perceptions. It provides inspiration for future teacher training (see 8.3.3). Moreover, this study interprets the top-down interrelationships between macro-, meso- and micro-level contextual factors and identifies the prevailing role of meso-level contexts, thereby highlighting the important role of meso-kindergarten forces. It contributes to the understanding and interpretation of the current Digital Divide across early years settings in China and extends the knowledge base about the support available for digital technology integration in Chinese kindergartens. Thus, kindergarten principals and policymakers could be informed of the current digital divide in the early years sector and provide characteristics of the digital divide that they can further examine and define.

Theoretically, this study makes a significant contribution to the development of a framework visualising complex context systems. Falling into the interpretive paradigm, the present study not only investigates what participating teachers' perceptions and practices are but also explores why they perceive and practise as reported and observed. Accordingly, the TPACK model (Mishra & Koehler, 2006) and its associated context framework of Porras-Hernandez and Salinas-Amescua (2013) were employed as the conceptual framework for identifying and accommodating the shaping forces behind both teachers' perceptions and teachers' practices in relation to the integration of digital technology. In turn, the findings of this study around teachers' decision-making about the pedagogical use of digital technologies contribute to revisiting the context framework and to the knowledge base on the application of it. The most important adaptation I made in this study was the added networked structures within the framework, which not only demonstrates clear interrelations between elements but also underlines the vital role of the meso-level kindergarten in connecting different spheres. The previous models did not include them. The adaptation is important because it emphasises that the interactions between different context levels could help to investigate and understand teachers' decisions about technology integration. More importantly, it also provides the basis for researchers to study more complex interrelationships between systems in the future.

In addition to the networked structures, the added microsystem (teacher's family environment) and exosystem (policy conveyance process) contributes to the capacity of this framework to more comprehensively and systematically conceptualise the contextual factors and their effects. Meanwhile, by empirically constructing and detailing the specific meanings of each context, the ambiguity surrounding context levels could be eliminated. Thus, this study could work as a starting point for researching the widespread variation in context meaning, thereby contributing to the in-depth study of each context system.

8.2 Limitations

This study also had some limitations. Firstly, due to the impact of the COVID-19 pandemic, I was only able to visit each classroom once for observation. Although each visit lasted for the whole day and some patterns regarding teachers' pedagogical approaches of integrating digital technologies emerged, more visits in each classroom would have provided richer data and generated more themes for this study. Secondly, the number of case studies was small, involving only five teachers and classrooms. The pandemic made the participant recruitment process for case studies very difficult and I could only gain access to participants who could be observed in person through introductions by my supervisor and an academic scholar. Thus, the number of case studies was limited and also the diversity of case study participants could not be guaranteed. This could lead to unsaturated data. For example, Bai, who took part in the first-phase individual interview, reported relatively developed approaches to using digital technologies in kindergartens, including many constructive and creative practices, which were not observed in the case studies. As a result, my intention was not to statistically generalise the findings drawn from the case studies to all kindergarten teachers in China. Instead, the similarities and differences revealed in participating teachers' approaches to digital technology integration were treated as specific to the participants. However, these specific findings invite questions about the universal similarities and differences in kindergarten teachers' digital technology integration across the whole country, which relates to the general digital divide discussed previously. In addition to their limited quantity, the participating kindergartens in the case studies also demonstrated homogeneity in setting type and geographical distribution. This was closely associated with their socioeconomic status, as both kindergartens were government-owned in the same city. With this in mind, in order to further investigate the digital divide across kindergartens in China, private kindergartens and kindergartens in less developed areas should be involved in future research. Finally, restricted by the duration and manageability of the study, the small-scale case studies did not explore the stakeholders' experiences and views further. This could extend to aspects such as the principal's perceptions, parents' views and children's digital experiences at home, which were believed to significantly influence teachers' TPACK and digital technology integration (Porras-Hernandez & Salinas-Amescua, 2013). Although participating teachers self-reported their perceived knowledge of the principals' preferences, children's home experiences and parents' views, direct observations and interviews could provide more detailed insights into the connections between these perspectives and teachers' digital technology integration. Therefore, future studies could further investigate relevant stakeholders' beliefs and practices.

8.3 Implications

This study revealed that the integration of digital technologies was shaped by the collective beliefs and actions of all stakeholders, encompassing early years teachers, principals, policymakers, researchers and parents. When gaps or conflicts emerged, the effective integration of digital technologies was often hindered. The present study found that participating teachers had little knowledge about the educational potentials of digital technologies identified in recent research, which was a research-practice gap within the context of China. Moreover, although the relevant documents and policies for 'Education Digitisation' and ICT 2.0 were published within the last five years at the national level, not every participant was aware of them or employed relevant practices. The present study argued that the differences in understanding and implementing educational policies amongst local education departments and principals led to the policy-practice gap. This could be supported by Fullan (1992), who also attributed the policy-practice gap to the implementation process of policies. Additionally, the narratives of participants indicated the varied attitudes and views of parents towards digital technology integration, which were found to influence teachers' practices to some extent.

Therefore, the first implication of this study is that constructing a community where all the stakeholders can communicate, discuss and finally reach a shared understanding about the use of digital technologies in ECE could be significant for facilitating the effective integration of digital technologies in kindergartens. Johnston et al. (2018) argued that the discussions among stakeholders could promote the development of curriculum related to technology use. By discussing the affordances of digital technologies for children's development and the possibilities for integrating them into ECE, teachers, principals, policymakers and parents could gain a conceptual and theoretical understanding of these elements. This is the basis for potential changes of practices.

In the following sections, I will further detail the specific implications that this study has for stakeholders.

8.3.1 Implications for Teachers

Some of the findings generated by this study share similarities with previous research within the context of China regarding kindergarten teachers' passive use of digital technologies, which differed from the espoused pedagogical approaches in the literature. Thus, for teachers, the findings of the present study might inspire them to reflect on their current practices of using digital technology in the classroom. In particular, it is recommended that teachers should consider the ways in which digital technologies were used, how children engaged with digital technologies and how they supported children's interactions with digital technologies, identifying potential areas for improvement. In order to achieve this, it would be useful for teachers to engage themselves in developing TPACK through multiple opportunities. For example, as the affordance of digital technologies to facilitate children's creativity has been generally acknowledged by many scholars (e.g. Marsh et al. 2018; Sakr, 2019), developing a greater understanding of how to support children's active and creative use of digital technologies should be prioritised. Thus, young children's creativity could be developed through engaging with digital technologies, which has been valued in many early years curriculum frameworks as one of '21 century skills' (Craft, 2010). As argued in the Discussion chapter, the practices and beliefs of teachers interplay with one another. Consequently, the acquisition of TPACK could allow teachers to reflect on and modify their digital practices, which might further influence their beliefs and promote improvements in the integration of digital technologies.

8.3.2 Implications for Principals

The findings also have implications for kindergarten principals. The study highlighted the positive impacts of setting-based support on teachers' practices of digital technology use. Thus, it is recommended that principals should provide a range of resources for facilitating digital practices, including but not limited to the ones identified in this study, such as digital infrastructures, training opportunities, IT staff and teaching-research events. Furthermore, respecting and supporting teachers' digital ideas, encouraging teachers to participate in relevant competitions to digitally enhance pedagogical practices might also be useful. Moreover, given the disparities of digital technology integration revealed between kindergartens in this study, promoting teachers' communication and cooperation with teachers from other kindergartens with more advanced digital integration systems could also be beneficial. In addition, the study identified the principal as an essential subject for implementing educational policies, suggesting that principals should pay close attention to documents and projects relevant to digital technology integration and actively promote the on-site implementation of these policies. As a result, children could benefit from the technologically-enhanced sessions.

8.3.3 Implications for Teacher Educators

The implications for teachers' professional development have been discussed throughout the thesis. Three principles were generated from the whole study. Firstly, the findings suggested that participating teachers did not have equitable access to training related to technology integration in either quantity or quality, which had a direct influence on their beliefs and practices. Accordingly, providing equitable opportunities for kindergarten teachers to attend both pre-service and in-service training could be the first step. Secondly, most participants reported that the training they attended was short-term or even 'one-off'; however, Graafland (2018) suggested that digital technologies were continuously evolving and that it was vital for teachers to keep up-to-date with dynamic developments. With this in mind, I suggest that teacher educators should provide ongoing training for teachers on how to pedagogically integrate digital technologies, allowing them to develop sustainable changes in knowledge and skills. Thirdly, the narratives of most participants indicated that the training they received was focusing on operational skills, which connected to their passive use of digital technologies to present digital content. However, the Literature Review chapter indicated that both the conceptual understanding and the practical skills of using digital technology as a pedagogical tool were significant for kindergarten teachers to effectively and appropriately use technologies in classrooms. The implication of this is that there is a need for teacher educators to provide more 'pedagogy-based' content, including guiding teachers on the wide affordances of digital technologies for children's play, learning and development, alongside providing practical examples of effective technology integration. Furthermore, as discussed in 5.1.2, by observing, reflecting, changing and further reflecting on practices, teachers' beliefs could be updated, which could in turn further inform the practices (Vidal-Hall et al., 2020). This argument inspired the teacher educators to provide teachers with opportunities to practise new approaches and also to reflect on their practices, which supported the suggestion of Marsh et al. (2017).

Additionally, since decision makers within kindergartens play an important role in shaping what happens pedagogically in relation to digital technologies, there is also a need to provide better information and training for these decision makers. This information and training should emphasise the potential benefits of using digital technologies for children's learning, play and development, alongside suggesting practical approaches for integrating them into pedagogy.

8.3.4 Implications for Policymakers

Furthermore, the study also made implications for policy-making. The analysis of relevant documents and policies suggested that although the use of digital technologies was advocated at a policy level, it was less prioritised in the ECE sector. In particular, there was a lack of emphasis on and pedagogical suggestions for children's use of digital technologies as a learning tool. The general and ambiguous document statements confused principals and teachers about how to practise the digital technology use. This suggested that clarifying the position of digital technologies in ECE, connecting it with ECE curriculum and emphasising the importance of children's engagements with digital technologies in policies could be useful to eliminate confusions for principals and teachers. Moreover, given the different levels of policy implementation demonstrated by local education departments and principals, it might be useful for policy-makers to supervise the on-site implementations of policies and projects. In addition, it is recommended that policy-makers should control the development of detailed guidelines for technology integration containing specific cases and rules, advancing the appropriate integration of digital technologies in ECE. Finally, the funding status of kindergartens was found to have a significant impact on the technology integration practices and private kindergartens and kindergartens in rural areas tended to lack digital infrastructures and resources. Taking this into consideration, I suggest that the government should allocate more funding and educational resources to disadvantaged regions and private not-for-profit kindergartens in order to reduce the disparities in infrastructure as much as possible.

8.3.5 Implications for Future Research

Finally, the present study also provided implications for future research. The qualitative case study design produced in-depth and detailed descriptions and interpretations about participating teachers' decision-making on digital technology integration in kindergartens. The small-scale nature, however, hindered its ability to present a more diversified and holistic picture of technology use in ECE in China. Thus, further similar research involving different kindergarten types (public and private) in different areas (north and south China, urban, suburban and rural regions) could be conducted to comprehensively investigate the digital divide across kindergartens in China. Additionally, based on the identified influences of other stakeholders except for teachers in this study, future research could further investigate their perspectives. This could encompass parents' attitudes, principals' perceptions, children's engagement with digital technologies at home, policymakers' views and also the impacts of specific training. More importantly, it might be useful to conduct quantitative research to statistically explore the findings of the present study on a larger scale. Examples of such analysis could include testing the relative significance of multiple factors and, in particular, a statistical comparison of the effects of different context levels. The visualisation of the contextual factors shaping Teachers' digital technology integration beliefs and practices in the present study (see Figure 10) could be useful for future research exploring context.

8.4 Final Thoughts

Throughout this project, I kept reflecting on the relationship between contexts and digital technology integration in the early years. My thinking about this issue initiated the research topic, that is how digital technologies are used in kindergartens in the specific socio-cultural context of China and how different it might look like from what happens in Western contexts. Following these questions, I investigated the practices of using digital technologies in Chinese kindergartens and further studied how multiple contextual factors shaped teachers' pedagogical use of digital technologies. During this process, I tried to combine the TPACK model (Mishra & Koehler, 2006) and the context. Based on the context framework of Porras-Hernandez and Salinas-Amescua (2013), this study developed an adopted Context-TPACK framework (Figure 10). It is a novel approach to elaborate how multiple contexts worked and co-worked to influence kindergarten teachers' decision-making of digital technology use. Previous studies have examined the impacts of certain contextual factors on teachers' attitudes, perceptions and practices in relation to digital technology integration. Nevertheless, teachers' decision-making tends to be shaped by the co-work of multiple contexts which not only have comparative advantages or disadvantages but are also interconnected with each other. Therefore, developing such a systematic and comprehensive framework is necessary.

Previously, some scholars proposed similar models, such as Yang (2021), who combined the TPACK with the ecological system theory to develop an Ecological-TPACK framework. This combination inspired the present study and contributed to the development of the Context-TPACK framework. However, the framework in my study shows some nuances from that of Yang (2021), which mainly lies in the networked nature of my framework. Based on keeping the nested structure, I visualised the networks among different context factors. I intersected all of the factors within this study and connected the multiple levels to the focal subject directly or indirectly, finally producing an overlapping configuration of relations. This network of overlapping structures not only demonstrated clear interrelations between elements, but also underlined the vital role of the meso-level kindergarten in connecting different spheres.

Therefore, this theoretical framework could provide significant practical implications for policy-makers, teacher educators and researchers. For policy-makers, this framework allows them to recognise the different influences of various contexts, thereby making pertinent policies based on specific contextual factors. For example, when they realise the top-down interrelationship among macro-, meso- and micro-levels of contexts and the exosystem of policy delivering, they could intentionally supervise the implementation of relevant policies to make sure that the policies can be accessed by individual setting and be implemented. For teacher educators, they could be allowed to realise that merely involving the skills and knowledge that every practitioner needs in training might not be enough, rather, the different training needs of teachers in different contexts should be taken into consideration. Accordingly, the training should explicitly reflect the different contexts and inspire practitioners themselves to reflect on how these contexts or how working in different contexts might impact the appropriate pedagogical approaches. Lastly, this framework could work as a starting point for researchers to research the widespread variation in context meaning, thereby contributing to the in-depth study of each context system.

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Chinese)

Appendices

Appendix A. Ethics Approval

The University Of Sheffield.

Downloaded: 06/01/2022
Approved: 04/11/2021

Ruxue Wang
Registration number: 190190325
School of Education
Programme: PhD Education

Dear Ruxue

PROJECT TITLE: A qualitative study on perceptions and pedagogical practices of Chinese preschool teachers about technology integration
APPLICATION: Reference Number 043378

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 04/11/2021 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 043378 (form submission date: 12/10/2021); (expected project end date: 30/09/2022).
- Participant information sheet 1097276 version 3 (09/10/2021).
- Participant consent form 1097277 version 1 (06/09/2021).

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since written approval will be required.

Your responsibilities in delivering this research project are set out at the end of this letter.

Yours sincerely

Anna Weighall
Ethics Administrator
School of Education

Please note the following responsibilities of the researcher in delivering the research project:

- The project must abide by the University's Research Ethics Policy: https://www.sheffield.ac.uk/rs/ethicsandintegrity/ethicspolicy/approval-procedure
- The project must abide by the University's Good Research & Innovation Practices Policy: https://www.sheffield.ac.uk/polopoly_fs/1.671066!/file/GRIPPolicy.pdf
- The researcher must inform their supervisor (in the case of a student) or Ethics Administrator (in the case of a member of staff) of any significant changes to the project or the approved documentation.
- The researcher must comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data.
- The researcher is responsible for effectively managing the data collected both during and after the end of the project in line with best practice, and any relevant legislative, regulatory or contractual requirements.

Appendix B. Letter for Principals (in Chinese and in English)

尊敬的 XX 幼儿园园长/老师:

您好！我是一名教育专业的在读博士生，目前就读于英国谢菲尔德大学教育学院，学号为 190190325。目前我正在进行 XX 地区学前教育信息化的调研，此次来信是想邀请贵园参与我的课题研究，共同探讨在信息化时代如何运用现代信息技术优化园所教育环境和创新幼师的教学模式。本课题的当前阶段力图了解幼儿园在职教师对于科技融合教学活动的看法、教育理念和教学法实践，因此我想邀请贵园 **1-2 位老师**参与**线上访谈及课堂观察活动（线上线下均可）**。对于参与的老师来说，此次经历一方面有利于他们深入地审视和回顾自己的教学活动，反思教学过程，另一方面与研究者的深入访谈或许会促进他们教育理念的更新，了解到国际国内多种科技融合的教学模式，从而有利于创新教学模式。此外，参与研究的教师会得到赠书或现金报酬用以感谢他们的参与。本研究课题将会涵盖国内各大城市不同类型的幼儿园，最后的研究成果也将与贵园共享。

我承诺此次研究将**全程匿名**，收集到的任何信息和数据都会**严格保密**，并将只用于本人学术论文的撰写，这也是谢菲尔德大学学术研究伦理审查委员会所要求研究者做到的。

最后，创新从来都不是一件简单的事情，教育领域的创新更是需要万千教育工作者共同的努力。通过信息搜集，我了解到贵园以科学教育和艺术教育为特色课程，并配备有专门的科学活动室和智慧化科技设备，将'以促进儿童发展为本'作为教育理念，十分注重儿童创造力和自我表达的培养。此外，我了解到贵园十分重视教育科研，有多项教研课题立项，这充分体现了贵园教师优秀的教研能力以及对教育科研的开放态度。因此，我十分期待与贵园的合作，并坚信此次合作会碰撞出不一样的火花，为未来学前教育信息化的发展提供更多的可能。

附件一为我的学生卡，附件二为关于参与此研究的详细信息表。十分期待您的答复。

祝您工作顺利，生活愉快!

王茹雪

2021.11.03

Dear kindergarten officer,

I hope this email finds you well.

I am a PhD student majoring in Education at the University of Sheffield, and I am currently conducting my PhD research project which seeks to explore the perceptions and pedagogical practices of kindergarten teachers regarding technology integration into classrooms. I am emailing to invite 1-2 teachers at your kindergartens to participate in my research, which involves an online individual interview and a classroom observation (online or offline). Participating in this research will not only allow teachers to deeply review their instructing strategies and processes but will also benefit to the innovation of pedagogies. Additionally, participating teachers will get paid for their contributions to this project. This research project involves diverse types of kindergartens across China, and the final research findings will be shared with your setting.

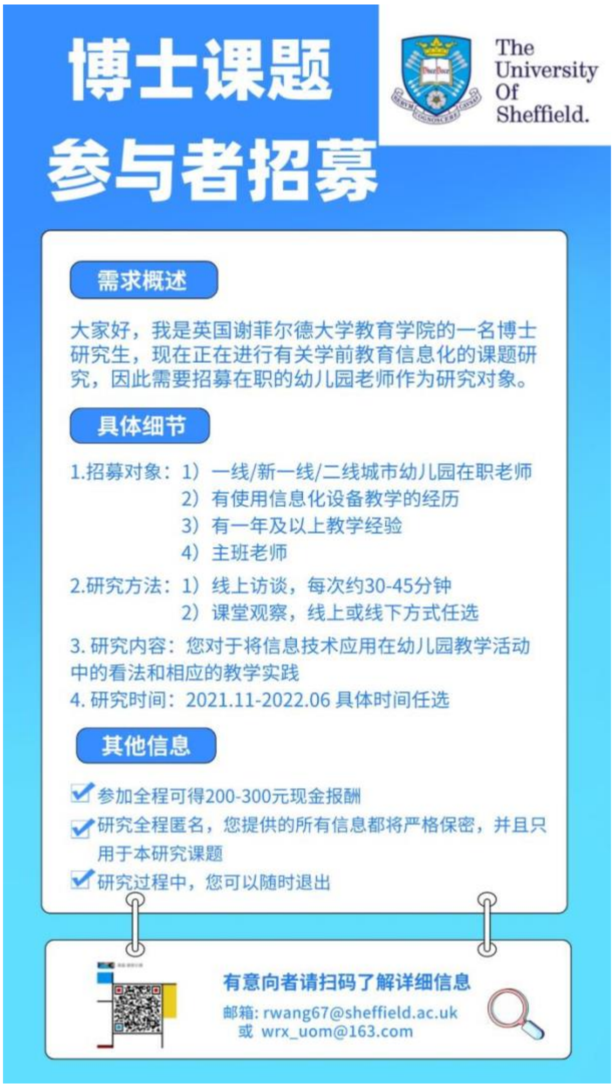
I promise that your school and teachers will be pseudonymised, and all the data I collect will be strictly confidential and only can be used in my PhD thesis, which are required by the University of Sheffield, School of Education's ethics review procedure.

I have attached my student card and research project information sheet to this email. Should you require any more information, please do not hesitate to email me.

Thanks for your time and looking forward to your reply.

With Best Wishes,
Ruxue

Appendix C. Participant Recruitment Advertisement



Appendix D. Information Sheet for Teachers

INFORMATION SHEET: INTERVIEWS AND OBSERVATIONS (TEACHERS)

访谈和课堂观察信息表（教师版）

Research Project Title:

项目名称

Teachers' Perceptions and Practices in relation to the Integration of Digital Technologies in Kindergartens in China: A Qualitative Study
中国学前教育教师对于数字化科技融合教学的看法和教学实践

You are being invited to take part in a research project. Before you decide whether or not to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.
老师您好，我很荣幸地邀请您参与我们的研究项目。在您决定是否参加之前，我会详细地告知您这个项目的研究背景和研究内容。请您抽出您宝贵的时间仔细地阅读以下内容，如果您有任何不清楚的地方或需要更多的信息，欢迎您向我们提问。非常感谢您的阅读和考虑，祝您工作顺利，生活愉快。

1. What is the project's purpose? 此研究的目的是什么？

Given the increasing use of technologies in early childhood education, this project aims to explore preschool teachers' views and pedagogical practices about integrating technologies into the classroom and to identify the influence of personal, institutional and policy-level factors on teachers' attitudes and practices regarding technology integration in Chinese early years settings. This project is for a PhD thesis and will last for 3 years.
随着互联网科技的发展，电子科技产品与人们的生活工作学习之间的关系越来越密切。近些年来，电子科技逐渐被应用到学校教育教学中，学前教育领域也不例外。本研究旨在探究中国早期教育教师对于科技融合教学的观点和教学实践，分析个人、机构和政策因素对于老师态度和实践的影响。本项目将持续三年，数据和结果将应用于研究者的博士论文。

2. Why have I been chosen? 为什么选择了我？

We invited teachers in preschools with technology integration to volunteer to participate in the research. You were one of the teachers who volunteered. We have selected 20 participants including you in this research phase to ensure a diverse sample.
我们邀请了一些在职幼儿园老师参与到我们的研究项目中，您是其中之一。在本研究阶段，我们一共选择了包括您在内的 20 位参与者以保证样本的丰富性。

3. Do I have to take part? 我必须要参加吗？

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep (and be asked to sign a consent form) and you can still withdraw at any time. You do not have to give a reason. Please note that that by choosing to participate in this research, this will not create a legally binding agreement, nor is it intended to create an employment relationship between you and the University of Sheffield.
参加与否完全取决于您个人的意愿。如果您决定要参加，您会通过这份信息表了解到本研究的详细情况，并需要在知情同意书上签字。但是您可以随时选择退出且不需要说明原因。需要说明的是，您选择参加此次研究并不会构成法律上的捆绑协议，也不会存在任何雇佣关系。

4. What will happen to me if I take part? What do I have to do? 如果我参加这个项目需要我做什么？

You will be invited to take part in two online interview sessions and two observation sessions. Firstly, you are going to be interviewed by the researcher about your views with relation to the use of technologies in your classroom via WeChat video calling. The interview will last about 45-60 minutes with several open questions of 5 themes. All of the questions will enable open answers, so you can freely share your opinions. After that, the researcher will observe two of your classroom sessions with technology integration. There are two plans to conduct the observation session: in Plan A, the researcher will come to your classroom and observe your class face to face; in Plan B, the researcher will post a camera to you to record your class process for observation. Before the classroom observation, you will need to provide your lesson plan to the researcher for review through electronic way. After the observation, you will be interviewed via WeChat again to share your reflections and ideas about your pedagogical practices of technology integration.
您将被邀请参加两次访谈和两次课堂观察。首先，研究者将会通过微信视频通话对您进行访谈，访谈的内容是您关于科技融入学前教育的一些看法。采访分为五大主题，大约持续 45-60 分钟。所有的问题都是开放式的，所以您可以自由地分享您的观点。采访之后，研究者将会对您的两次科技融入的课堂活动进行观察。对于观察部分有两种计划：计划一，研究者将会来到您的教室进行面对面的观察；计划二，研究者将会邮寄相机给您从而记录您的活动过程以便观察。在每次课堂观察之前，我们将需要您提供您的备课笔记以便进行分析。在两次观察之后，您将会被再次邀请进行微信访谈，在这次访谈中，您可以分享您关于科技融入课堂实践的想法和深思。

5. What are the possible disadvantages and risks of taking part? 参加这个项目有哪些潜在的弊端和风险吗？

There are a few risks associated with taking part. The first potential disadvantage is the time taken to participate in the individual interviews and observation. Also, in the observation session, no matter the face-to-face (Plan A) or video recorded (Plan B),

the presences of the researcher and/or the camera might make you feel uncomfortable. In addition, given the current pandemic of COVID-19, if the face-to-face observation is going to be conducted, the researcher will wear the mask and keep social distancing with the children and you throughout the process.
参加这个项目有一些极小的弊端风险。首先，参加访谈和课堂观察需要花费您一些时间。其次，在课堂观察阶段，不管是采用面对面的方式还是视频记录的方式，研究者或者相机的存在可能会使您感到一些不自在。除此之外，由于当前新冠疫情还在持续，如果采用面对面观察的方式，研究者将会全程佩戴口罩并且与您和孩子们保持一定的社交距离。

6. **What are the possible benefits of taking part? 参加这个项目有什么好处吗？**

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will help enhance your understanding of integrating technologies into your pedagogy. Also, you may enjoy sharing your experience and views on technology integration in early years settings.
对于参加者来说可能没有即时的好处出现，但是我们希望这次参与能帮助您加深对于科技融入教学模式的理解。此外，您可能会非常享受这个分享您经历和看法的过程。

7. **Will my taking part in this project be kept confidential? 我的参加将会是保密的吗？**

All the information that we collect about you during the course of the research will be kept strictly confidential and will only be accessible to the researcher. You will not be able to be identified in any reports or publications.
所有我们在研究过程中收集到的您的数据都将会被严格保密，这些数据将只能被研究者本人接触到。在任何报告或者出版物中，您都不会被认出来。

8. **What is the legal basis for processing my personal data? 处理我的个人数据的法律原则是什么？**

According to data protection legislation, we are required to inform you that the legal basis we are applying in order to process your personal data is that 'processing is necessary for the performance of a task carried out in the public interest' (Article 6(1)(e)). Further information can be found in the University's Privacy Notice https://www.sheffield.ac.uk/govern/data-protection/privacy/general.
根据数据保护规定，我们必须要告知您我们在处理您的个人数据时应用的法律原则为"处理是为了完成在公众感兴趣的领域进行的社会研究"。您可以通过谢菲尔德大学的隐私提醒页面获得更多信息：
https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

9. **Will I be recorded, and how will the recorded media be used? 我参与的过程将会被记录吗？采用何种方式？**

You will be audio recorded in the two interview sessions and video recorded by a camera during the observation session (no matter in face-to-face session or video recording session). The audio and video recordings of your activities made during the interviews and observation will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. A transcript will be made of each audio interview. The transcripts will be anonymised.
在访谈过程中，您将会被录音，在观察阶段您将会被录像。所有您的音频和视频记录都将只会被用来做分析研究。在没有您的书面许可的情况下，将不会被移作他用，除了研究者本人之外的其他任何人都不会接触到这些音视频资料。访谈的音频之后将会被转录成文字，这些转录文件也都会是匿名的。

10. What will happen to the data collected, and the results of the research project? 你收集的数据和研究的结果将会被如何处理？

The data collected will be stored in a password protected personal computer which is only accessible to the researcher. Only the researcher will have access to the data, and the data will be treated confidentially.

All audio data will be transcribed by the researcher, and the transcribed data will then be anonymised. The anonymised transcripts will be accessed by the translator, my supervisors as well as the University of Sheffield. The anonymised data will be used in my thesis, potential publications and conference presentations.

The data will be destroyed three years after the completion of my thesis.

收集的所有数据都会被保存在一个由密码保护的个人电脑中，此电脑只能被研究者接触到。只有研究者能看到这些数据，并且数据将会严格保密。

所有的音频数据都将会被研究者转录成文字，转录数据将会是匿名的。匿名的转录文字将会公开给翻译者，我的导师以及谢菲尔德大学。这些匿名数据将会被用在我的毕业论文，可能的出版物和学术会议报告中。

在我的论文完成之后的三年末，所有的数据将会被销毁。

11. Who is organising and funding the research? 谁组织和资助了这个项目？

The research is organised by Ruxue Wang, a PhD student in the University of Sheffield. No one funds this project.
本研究是由谢菲尔德大学的博士生王茹雪组织的。没有任何资助单位。

12. Who is the Data Controller? 谁是数据管理者？

The University of Sheffield will act as the Data Controller for this study. This means that the University is responsible for looking after your information and using it properly.
谢菲尔德大学将会作为本研究的数据管理者。这意味着谢菲尔德大学负责保护您的信息并确保信息的合理使用。

13. Who has ethically reviewed the project? 谁对这个项目进行的伦理审查?

This project has been ethically approved via the University of Sheffield, School of Education's ethics review procedure.

You will be given a copy of the information sheet and a signed consent form to keep.

这个项目已被谢菲尔德大学教育学院伦理审查通过。
此项目的信息表和您签署的知情同意书都将提供给您以便保留。

14. What if something goes wrong and I wish to complain about the research? 如果出现什么差错我想要投诉应该怎么办?

If any problems at all occur in relation to your participation in the project, either during the project or after it, please contact me (contact details are below).

If you have a complaint about the conduct of the project, then please contact the Head of the School of Education, Professor Rebecca Lawthom: r.lawthom@sheffield.ac.uk.

不管是在项目期间还是之后，您有任何关于项目参与的问题，请联系我（联系方式见下面）。

如果您想要就这个项目进行投诉，请联系谢菲尔德大学教育学院院长 Rebecca Lawthom 教授，邮箱如下：r.lawthom@sheffield.ac.uk

15. Contact for further information 联系人

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+86 15726394737

OR

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王茹雪

邮箱: rwang67@sheffield.ac.uk

电话: +44 7529937032/+86 15726394737

或者

Fiona Scott 博士

邮箱：f.scott@sheffield.ac.uk

Thanks for taking part in the project!
感谢您的参与!

Appendix E. Consent Form for Teachers

Teachers' Perceptions and Practices in relation to the Integration of Digital Technologies in Kindergartens in China: A Qualitative Study

中国学前教育教师对于数字科技融合教学的看法和教学实践

Consent Form

知情同意书

Interview and Observation (Teachers)

访谈和观察（教师版）

Please tick the appropriate boxes *请勾出合适的选项*	**Yes** 是	**No** 否
Taking Part in the Project 关于项目参与		
I have read and understood the project information sheet dated 01/10/2021 or the project has been fully explained to me. (If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.) 我已经阅读并理解项目信息表/我已获取关于此项目的详细解释。（如果您的答案是"否"，那么请中止填写这份知情同意书，直到您完全了解此项目信息。）	☐	☐
I have been given the opportunity to ask questions about the project. 我曾有机会对此项目进行提问。	☐	☐
I agree to take part in the project. I understand that taking part in the project will include being interviewed, being observed and being audio and video recorded, as well as providing my lesson plan. 我同意参加此项目。我知道参加此项目包括被采访，被观察，被录音录像以及提供我的备课笔记。	☐	☐
I understand that by choosing to participate as a volunteer in this research, this does not create a legally binding agreement nor is it intended to create an employment relationship with the University of Sheffield. 我知道选择志愿参加此项目并不会建立法律上的捆绑协议也不会构成与谢菲尔德大学的雇佣关系。	☐	☐
I understand that my taking part is voluntary and that I can withdraw from the study at any time. I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw. 我知道参加此项目是自愿的，而且我可以随时退出。我不需要给出退出的理由，也不会因此而承担	☐	☐

任何负面结果。		
How my information will be used during and after the project 在项目进行中和结束之后我的信息将会被如何使用		
I understand my personal details such as name, phone number, address and email address etc. will not be revealed to people outside the project. 我知道诸如我的姓名电话地址和邮箱等个人信息不会被泄露给除研究者之外的任何人。	☐	☐
I understand and agree that my data may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this. 我知道并且同意我的数据将会被引用在出版物，报告，网页和其他研究产出中。我知道我的身份不会被公布在这些研究报告中除非我特别要求这么做。	☐	☐
I understand and agree that other authorised researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form. 我知道并且同意其他的授权研究者将会在承诺保密的前提下接触到这些数据。	☐	☐
I understand and agree that other authorised researchers may use my data in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form. 我知道并且同意其他的授权研究者可能会在承诺保密的前提下将我的数据用在出版物，报告，网页和其他研究产出中。	☐	☐
I give permission for the interview and observation data that I provide to be deposited in the University of Sheffield, so it can be used for future research and learning. 我允许我提供的访谈和观察数据被谢菲尔德大学保存以便未来的研究和学习。	☐	☐
So that the information you provide can be used legally by the researcher 因此您提供的数据可以被研究者合法地使用		
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield. 我同意将本项目所产生的任何材料的版权转让给谢菲尔德大学。	☐	☐

Name of participant [printed] Signature Date

参与者姓名 签名 日期

Name of Researcher [printed] Signature Date

研究者姓名 签名 日期

Project contact details for further information 项目联系方式:

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王茹雪

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Appendix F. Information Sheet for Parents

INFORMATION SHEET: OBSERVATION (PARENTS)

课堂观察信息表（家长版）

Research Project Title:

项目名称

Teachers' Perceptions and Practices in relation to the Integration of Digital Technologies in Kindergartens in China: A Qualitative Study
中国学前教育教师对于数字科技融合教学的看法和教学实践

Your children are being invited to take part in a research project. Before you decide whether or not to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.
家长您好， 我很荣幸地邀请您的孩子参与我们的研究项目。在您决定是否允许您的孩子参加之前， 我会详细地告知您这个项目的研究背景和研究内容。请您抽出您宝贵的时间仔细地阅读以下内容，如果您有任何不清楚的地方或需要更多的信息，欢迎您向我们提问。非常感谢您的阅读和考虑，祝您工作顺利，生活愉快。

1. What is the project's purpose?

Given the increasing use of technologies in early childhood education, this project aims to explore preschool teachers' views and pedagogical practices about integrating technologies into the classroom and to identify barriers to effective technology integration in Chinese early years settings. This project is for a PhD thesis and will last for 3 years.
随着互联网科技的发展，电子科技产品与人们的生活工作学习之间的关系越来越密切。近些年来，电子科技逐渐被应用到学校教育教学中，学前教育领域也不例外。本研究旨在探究中国早期教育教师对于科技融合教学的观点和教学实践， 分析个人、机构和政策因素对于老师态度和实践的影响。本项目将持续三年，数据和结果将应用于研究者的博士论文。

2. Why has my child been chosen?

Your child's kindergarten and one teacher were invited to participate in this research, and they agreed to do so. The researcher need to observe two of classroom sessions in the classroom of your child either in face-to-face way or through video recordings, so your child will get involved.
您孩子所在的幼儿园和班级老师被邀请参与到这个研究中，且他们同意参与。研究者需要通过面对面或者视频记录的方式观察您孩子所在班级的两堂课，因此您的孩子也会参与其中。

3. Does my child have to take part? 我的孩子必须参加吗?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep (and be asked to sign a consent form) and you can still withdraw at any time. You do not have to give a reason. Please note that that by choosing to participate in this research, this will not create a legally binding agreement, nor is it intended to create an employment relationship between you and the University of Sheffield.

参加与否完全取决于您个人的意愿。如果您决定让您的孩子参加，您会通过这份信息表了解到本研究的详细情况，并需要在知情同意书上签字。但是您可以随时选择退出且不需要说明原因。需要说明的是，您选择参加此次研究并不会构成法律上的捆绑协议，也不会存在任何雇佣关系。

4. What will happen to my child if I agree he/she can take part? What does he/she have to do? 如果我的孩子参加这个项目需要做什么?

Your child will be involved in two classroom observations conducted by the researcher, and some actions of your child during the class will be recorded. There are two plans to conduct the observation: in Plan A, the researcher will come to the classroom and observe in face-to-face way; in Plan B, the researcher will post a camera to the teacher to record class process for observation.

您的孩子将会参与到由研究者组织的课堂观察中，因此在课堂活动中您孩子的一些行为将会被记录。课堂观察的组织方案有两种：计划一，研究者将会来到教室进行面对面的观察；计划二，研究者将会邮寄相机给老师，使用相机来记录课堂活动。

5. What are the possible disadvantages and risks of taking part? 参加这个项目有哪些潜在的弊端和风险吗?

There are a risk associated with taking part. Given the current pandemic of COVID-19, you might concern about the safety and health of your child if there will be a face-to-face observation (Plan A), so the researcher will show the health QR code to you before beginning the observation as well as wear masks and keep a social distancing with the children throughout the classroom observation. If the session will be merely video recorded without the presence of the researcher (Plan B), it is unnecessary for you to concern about the safety and health of your child.

参加这个项目有一个风险。由于当前新冠疫情还在持续，如果采用面对面的观察方案，您可能会担心您孩子的安全和健康。因此，在观察开始之前，研究者将会出示健康码，核酸检测阴性证明以及疫苗接种证明给全体家长和老师；此外，研究者将会全程佩戴口罩并与您的孩子保持安全的社交距离。如果采用视频记录的观察方案，也就是说研究者将不会来到教室，因此您无需担心您孩子的安全和健康。

6. What are the possible benefits of taking part? 参加这个项目有什么好处吗?

Your child may enjoy being involved in academic research project, and at the end of classroom observation, your child will get a certificate of participating in academic research.
您的孩子可能会享受参与到学术研究项目的过程，而且在课堂观察的末尾，您的孩子将会获得一个参与学术研究的小小证书。

7. Will my child's part in this project be kept confidential? 我孩子的参加将会是保密的吗？

All the information that we collect about your child during the course of the research will be kept strictly confidential and will only be accessible to the researcher. You child will not be able to be identified in any reports or publications.
所有我们在研究过程中收集到的您孩子的数据都将会被严格保密，这些数据将只能被研究者本人接触到。在任何报告或者出版物中，您的孩子都不会被认出来。

8. What is the legal basis for processing my child's personal data? 处理我孩子的个人数据的法律原则是什么？

According to data protection legislation, we are required to inform you that the legal basis we are applying in order to process your child's personal data is that 'processing is necessary for the performance of a task carried out in the public interest' (Article 6(1)(e)). Further information can be found in the University's Privacy Notice https://www.sheffield.ac.uk/govern/data-protection/privacy/general.
根据数据保护规定，我们必须要告知您我们在处理您孩子的个人数据时应用的法律原则为"处理是为了完成在公众感兴趣的领域进行的社会研究"。您可以通过谢菲尔德大学的隐私提醒页面获得更多信息：
https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

9. Will my child be recorded, and how will the recorded media be used? 我孩子参与的过程将会被记录吗？采用何种方式？

Your child will be video recorded, and the video recordings made during the classroom observation will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings.
您的孩子将会被录像，课堂观察期间的所有视频资料都将只会被用来作分析研究。在没有您的书面许可的情况下，将不会被移作他用，除了研究者本人之外的其他任何人都不会接触到这些音视频资料。

10. What will happen to the data collected, and the results of the research project? 你收集的数据和研究的结果将会被如何处理？

The data collected will be stored in a password protected personal computer which is only accessible to the researcher. Only the researcher will have access to the data, and the data will be treated confidentially.

The data will be destroyed three years after the completion of my thesis.

收集的所有数据都会被保存在一个由密码保护的个人电脑中，此电脑只能被研究者接触到。只有研究者能看到这些数据，并且数据将会严格保密。

在我的论文完成之后的三年末，所有的数据将会被销毁

11. Who is organising and funding the research? 谁组织和资助了这个项目？

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本研究是由谢菲尔德大学的博士生王茹雪组织的。没有任何资助单位。

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谢菲尔德大学将会作为本研究的数据管理者。这意味着谢菲尔德大学负责保护您的信息并确保信息的合理使用。

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You will be given a copy of the information sheet and a signed consent form to keep.

这个项目已被谢菲尔德大学教育学院伦理审查通过。
此项目的信息表和您签署的知情同意书都将提供给您以便保留。

14. What if something goes wrong and I wish to complain about the research? 如果出现什么差错我想要投诉应该怎么办？

If any problems at all occur in relation to your participation in the project, either during the project or after it, please contact me (contact details are below).

If you have a complaint about the conduct of the project, then please contact the Head of the School of Education, Professor Rebecca Lawthom: r.lawthom@sheffield.ac.uk.

不管是在项目期间还是之后，您有任何关于项目参与的问题，请联系我（联系方式见下面）。

如果您想要就这个项目进行投诉，请联系谢菲尔德大学教育学院院长 Rebecca Lawthom 教授，邮箱如下：r.lawthom@sheffield.ac.uk

15. Contact for further information 联系人

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Thanks for taking part in the project!
感谢您的参与!

Appendix G. Consent Form for Parents

Teachers' Perceptions and Practices in relation to the Integration of Digital Technologies in Kindergartens in China: A Qualitative Study

中国学前教育教师对于科技融合教学的看法和教学实践

Consent Form

知情同意书

Observation (Parents)

观察（家长版）

Please tick the appropriate boxes *请勾出合适的选项*	**Yes** 是	**No** 否
Taking Part in the Project 关于项目参与		
I have read and understood the project information sheet dated 01/10/2021 or the project has been fully explained to me. (If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.) 我已经阅读并理解项目信息表/我已获取关于此项目的详细解释。（如果您的答案是"否"，那么请中止填写这份知情同意书，直到您完全了解此项目信息。）	☐	☐
I have been given the opportunity to ask questions about the project. 我曾有机会对此项目进行提问。	☐	☐
I agree my child to take part in the project. I understand that taking part in the project will include my child being being observed and being video recorded. 我同意我的孩子参加此项目。我知道我的孩子参加此项目包括被观察和录像。	☐	☐
I understand that by choosing to participate as a volunteer in this research, this does not create a legally binding agreement nor is it intended to create an employment relationship with the University of Sheffield. 我知道选择志愿参加此项目并不会建立法律上的捆绑协议也不会构成与谢菲尔德大学的雇佣关系。	☐	☐
I understand that my child's taking part is voluntary and that I can withdraw my child from the study at any time. I do not have to give any reasons for why I no longer want my child to take part and there will be no adverse consequences if I choose to withdraw. 我知道我的孩子参加此项目是自愿的，而且我可以随时要求我的孩子退出。我不需要给出退出的理	☐	☐

由，也不会因此而承担任何负面结果。		
How my information will be used during and after the project 在项目进行中和结束之后我的信息将会被如何使用		
I understand my child's personal details such as name, phone number, address and email address etc. will not be revealed to people outside the project. 我知道诸如我和我孩子的姓名电话地址和邮箱等个人信息不会被泄露给除研究者之外的任何人。	☐	☐
I understand and agree that my child's words and actions may be quoted in publications, reports, web pages, and other research outputs. I understand that my child will not be named in these outputs unless I specifically request this. 我知道并且同意我孩子的语言和动作将会被引用在出版物，报告，网页和其他研究产出中。我知道我孩子的身份不会被公布在这些研究报告中除非我特别要求这么做。	☐	☐
I understand and agree that other authorised researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form. 我知道并且同意其他的授权研究者将会在承诺保密的前提下接触到这些数据。	☐	☐
I understand and agree that other authorised researchers may use this data in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form. 我知道并且同意其他的授权研究者可能会在承诺保密的前提下将这些数据用在出版物，报告，网页和其他研究产出中。	☐	☐
I give permission for data that my child provide to be deposited in the University of Sheffield, so it can be used for future research and learning. 我允许我孩子提供的数据被谢菲尔德大学保存以便未来的研究和学习。	☐	☐
So that the information you provide can be used legally by the researcher 因此您提供的数据可以被研究者合法地使用		
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield. 我同意将本项目所产生的任何材料的版权转让给谢菲尔德大学。	☐	☐

Name of participant's parent [printed] Signature Date

参与者家长姓名 签名 日期

Name of Researcher [printed] Signature Date

研究者姓名　　　　　　　　　　　　　签名　　　　　　　　　　　日期

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Appendix H. First Interview Protocol

I. Inform participants:

• The purpose of the interview to acquire a general background information of preschool teachers and their experiences of technology use and get insights into teachers' attitudes, perceptions and beliefs of using technologies with young children;
• The estimated time of 60 minutes;
• The existent of audio recording and field note recording;
• Pseudonym will be used;

• All responses will be used only for research purposes and will not be shared with any others;
• The right of every participant to withdraw at any time without giving a reason.

II. Questioning Route

Part 1. Context data of participants

- Tell me a bit about yourself.

Prompts: Age; Teaching years as an ECE practitioner; Education; Age of current students

- What kind of prior experiences relevant to digital technologies you believe influence your technology integration?

Prompts: Do you know perspectives of other people around you (e.g. principal, colleagues, children, parents, own families and friends)? How do their opinions influence you?

- How far did your educational background and professional development prepare you to integrate technology into your practice?

Prompts: What types of technology training have you been involved in?

What knowledge and skills have you acquired from the training?

What additional training do you think you need?

- What other kinds of support have you received from your setting?

Prompts: Do you think they are useful for your technology integration, or not?

What further support do you need from your setting?

- What are the national and regional policy regarding integrating technologies into early years settings?
Prompts: Is there any curriculum and pedagogy guidelines?

Part 2. Attitudes and perceptions of participants

- What do you think about the role of digital technologies in the everyday activities of your kindergarten?

- Do you feel technologies should or should not be a part of normal activities in early years settings?

- How do you think about the impacts of technologies?

- In your opinion, what's the relationship between digital technologies and children's play, learning and development?

- Do you have any concerns?

Part 3. Practices of participants

- How do you describe the integration of digital technologies in your class?
Prompts: What do you think is your role in such activities?

- Which types of technology do you usually use in your practice?
Prompts: Are these technologies available to your students? (If yes, how? If no, why?)
Is there any other technologies that you have access to but not use in practice? Why?
- How do you decide what technologies to use and when to use them in your classroom? Prompts: Do you think there is a relation between the content area and technology type that should be used?

- Did you use them on your own initiative, or at the request of your setting?

- What kind of activities are organised with the assistance of technologies?

Prompts: What are your purposes when using technologies?

- What specific strategies do you have when you use technologies in the classroom? Do you follow any specific digital curriculum or guidelines to integrate technology into your practices?
Prompts: Which strategies have you found to be most useful?

- Have you had any difficulties with technology integration in your classroom?/What are the barriers standing in the way of using technology in your practices?

- How confident do you feel in using technologies in your classroom?

Appendix I. Observation Protocol

Observation Checklist

Setting: ______ **Teacher: ______** **Grade level: ______**

Date: ______ **Time begin: ______** **Time end: ______**

Location: ______ **Number of students: ______** **Content area: ______**

Themes Checklist	Sample Indicators	Yes	No	Observation
Classroom Environment	Technology is available to teacher (in podium) Technology is available to students (in desk)			
Nature of Technology ----Type	iPad Other tablet Laptop Desktop PC IWB TV Tape recorder Other (specify what)			
Nature of Technology ----Internet	Online Offline			
Instructional Strategies ----Form	Whole class Small group Pairs Individual			
Instructional Strategies ----Purpose of technology use	To present material To communicate To create To access the Internet To assess Others			

Instructional Strategies ----Role of the teacher	Lecturer Moderator/facilitator Cooperator Onlooker Others			
Student engagement ----Activities with technology	Reading Listening/watching Playing Writing Discussing Others			
Student engagement ----Activities without technology	Reading Listening/watching Playing Writing Discussing Others			
Student engagement ----Interaction type	Technology with Teacher Technology with Children Children with Children Teacher with Children Children with Other people outside the classroom			
Student engagement ----Interaction purpose	To transmit knowledge To redirect student thinking To encourage collaboration To encourage questioning To assess To praise student To correct student Others			

Student engagement ---- ability development	Basic skills Subject knowledge Problem solving Creativity Other (state what)			
Duration of technology integration				
Other materials				
Any additional points				

Appendix J. Second Individual Interview Guide

Part 1. Further digging out teachers' beliefs

- Beliefs and practices about children's use of digital technologies at classroom

E.g. Why give/ not give children opportunities to use digital technologies?

How do you support children's use of digital technologies?

Do you think digital technologies could be integrated into children's play or playful curriculum?

Do you intentionally focus on developing children's digital literacies?

How do you think about the relationship between technology use and children's creativity, active learning?

...

Part 2. Understanding specific decision makings of participants

E.g. Did you intentionally arrange children in pairs in small-learning-area activities?

Before the observation day, were children taught about how to voice search with the iPad? Any other ways of using the iPad besides voice searching?

Why do you provide children's camera to children?

What kinds of needs of children have been meet in voice searching activities?

Why did you decide to less intervene in children's use of reading robotics? In what situation, would you intervene in children's use of digital technologies?

In this teacher-led thematic session, how did you promote children's engagement?

In the sharing activity, I observed you presented children's works on the iPad but not the IWB like other classes did, why do you make this decision?

...

Part 3. Investigating teachers' reflections on pedagogical practices

E.g. Do you have any challenges when integrating the iPad into this session?

How do you evaluate this session?

Is this a successful integration of digital technologies?

...

Part 4. Further exploring the influences of contextual factors

E.g. How do you think about the ICT project 2.0?

How did Covid-19 pandemic influence your beliefs and practices?

Have you been encouraged to practise digital technology integration?

Did principal's views influence your practices?

...

Appendix K. Data list

Phase One: Individual Interview			
Participants	**Date**	**Data collection methods**	**Data**
A. Luo	Sat. 15 Jan., 2022	Online interview with Luo	1 36-minute audio file; fieldnotes
B. Ye	Sat. 15 Jan,. 2022	Online interview with Ye	1 36-minute audio file; fieldnotes
C. Shi	Sat .15 Jan., 2022	Online interview with Shi	1 51-minute audio file; fieldnotes
D. Wang	Sun. 23, Jan., 2022	Online interview with Wang	1 45-minute audio file; fieldnotes
E. Zhang	Tues. 18, Jan., 2022	Online interview with Zhang	1 50-minute audio file; fieldnotes
F. Li	Wed. 1, Dec., 2021	Online interview with Li	1 52-minute audio file; fieldnotes
G. Ly	Tues. 4, Jan., 2022	Online interview with Ly	1 52-minute audio file; fieldnotes
H. Bai	Thur. 23, Dec., 2021	Online interview with Bai	1 46-minute audio file; fieldnotes
I. Chen	Sun. 19, Dec., 2021	Online interview with Chen	1 50-minute audio file; fieldnotes
J. Huang	Sat.18, Dec., 2021	Online interview with Huang	1 64-minute audio file; fieldnotes

K. Yang	Sun. 28, Nov., 2021	Online interview with Yang	1 46-minute audio file; fieldnotes
L. Zhou	Sun. 21, Nov., 2021	Online interview with Zhou	1 79-minute audio file; fieldnotes
M. Hu	Sat. 20, Nov., 2021	Online interview with Hu	1 74-minute audio file; fieldnotes
N. Yan	Sat. 20, Nov., 2021	Online interview with Yan	1 94-minute audio file; fieldnotes

Phase Two: Case Studies						
Participants	**Date**	**Data collection methods**	**Data**	**Date**	**Data collection methods**	**Data**
A.Luo	Wed. 8, June, 2022	Observation; document review	10 video files (82 minutes in total); 40 photos; fieldnotes; 1 research diary; 1 lesson plan	13 Nov 2022	Online interview with Luo	1 48-minute audio file; fieldnotes

B.Ye	Tues. 7, June, 2022	Observation; document review	6 video files (83 minutes in total); 20 photos; fieldnotes; 1 research diary; 2 lesson plans	26 Nov 2022	Online interview with Ye	1 37-minute audio file; fieldnotes
C.Shi	Mon. 6, June, 2022	Observation; document review	9 video files (95 minutes in total); 15 photos; fieldnotes; 1 research diary; 2 lesson plans	7 Jan 2023	Online interview with Shi	1 36-minute audio file; fieldnotes
D.Wang	Fri. 10, June, 2022	Observation; document review	5 video files (76 minutes in total); 15 photos; fieldnotes; 1 research diary; 1 lesson plan	6 April 2023	Online interview with Wang	1 56-minute audio file; fieldnotes
E.Zhang	Thur. 9, June, 2022	Observation; document review	5 video files (67 minutes in total); 26 photos; fieldnotes; 1 research diary; 1 lesson plan	4 Feb 2023	Online interview with Zhang	1 42-minute audio file; fieldnotes

Phase Two: Official Document Review	
Data	A Guide to Learning and Development for Children Aged 3-6 Years
	Guidelines for Kindergarten Education (Trial)
	Regulations of Kindergarten Work
	Professional Standards for Kindergarten Teachers (Trial)
	Teacher Education Standards (Trial)
	Ten-Year Development Plan for Education Digitization (2011-2020)
	13th Five-Year Plan for Education Digitization
	Education Digitization 2.0 Action Plan
	ICT Application Ability Standards for Primary and Secondary School Teachers
	ICT Application Ability Training Curriculum Standards for Primary and Secondary School Teachers
	Teachers' Digital Literacy
	The National ICT Application Ability Promotion Project 2.0 for Primary and Secondary School Teachers
	Guide to the implementation of ICT Application Ability Improvement Project 2.0 for Primary and Secondary School Teachers in Guangdong Province

	(Trial)
	A Guide to the evaluation of Digital Teaching Ability of Primary and Secondary Schools in Guangdong Province

Appendix L. Reported Uses of Particular Devices in Phase One

Device	Reporter	Reported practices	Summary
IWB/ projector	Yan	- to present prepared **slides** for **displaying something** (e.g. storytelling, art works), **introducing concepts** (e.g. math) in whole-group educational sessions, which only occupied a small part and worked **with non-digital activities** (usually hands-on) - to search for and present videos or pictures instantly **responding to children's interests** - to be simply touched by **children occasionally**	- present slides, videos, images, micro-lecture, children's photos - to write or draw by teacher or children - whole-class sessions: educational, sharing - informal time - teacher use - children's limited access - a small part, worked with non-digital activities - time and distance controlled
	Ly	- to present educational software in whole-group educational sessions (English, art) - to present both audio and image content for children (music, dance)	
	Lsq	- to present **micro-lecture** in the explaining part of a whole-group educational session (e.g. making steps in art session, knowledge point explanation in science session, introduction part in social session), sometimes **parents**	

		were involved in the micro-lecture recording	
	Yang	- to present slides, videos in whole-group educational sessions (e.g. presenting art works in art sessions, presenting images to explain English words - to **write or draw** on the screen - to be combined with **non-digital playful activities**	
	Bai	- to be used in whole-group session	
	Huang	- to be used in the News Broadcasting by children to present the slides made by family - to present slides, images and videos in whole-group sessions - slides were made or downloaded by teachers - to **set a situation** for children's performance or storytelling	
	Hu	- to present slides, animations in educational sessions - to present works in whole-class session	
	Zhou	- to present slides in whole-class educational	

		sessions - to play music and stories in **pre-lunch, transitional sessions** - cannot be accessed by children	
	Wang	- to present slides for News Broadcasting and Storytelling by children - to delivering music session, presenting videos and searching for materials for educational sessions - to be used in whole-class and small-group sessions - to write or draw by children in spare time	
	Zhang	- to write or draw by children - to present slides, videos in whole-class sessions (e.g. picture book reading, origin of spring festival) - t**ime and distance controlled** by teacher - to be used in teacher-dominated sessions	
	Shi	- to present slides, videos, micro-lecture for educational purposes - only occupied a small part to introduce the theme - cannot be operated by junior-class children	

		- to present children's play and works	
	Ye	- to present slides and videos in whole-class educational sessions across subject areas -to present micro-lecture - time and distance controlled	
	Luo	- to present in whole-class sessions	
Smartphone	Ly	- to record children	- record - family connecting - teachers use and occasionally children use
	Lsq	- to record children	
	Hu	- to be used by children to photograph in Mosaic Approach - to record children by teacher	
	Wang	- to scan QR code by children - to record children and share with parents	
	Zhang	- to record children in small-learning-area activities and shared in whole class, and with parents	
	Shi	- to connect to family - to video record children and edit videos, then shared with parents - to capture children's play and works in small-learning-area activities, then share	
	Ye	- to record children, share with parents - to connect with family: micro-lecture, sharing images	

		of children, sharing early years knowledge and resources, to present home tasks	
	Luo	- to record children	
Tablet	Lsq	- borrowed from the setting not kept in the classroom - to record children which will be shared through screen to whole class - to be shared by several children, which aimed to promote children's cooperation - to use the audio-recording and notebook of tablet in normal sessions (e.g. in a social sessions, children used tablets to record what they spoke to delivery guy) - to use various apps in open class - children's uses were instructed and controlled by teachers in whole-group sessions - occasionally to be operated by children in small-learning-area activities (e.g. science corner to operate the tablet making robot move) - teacher's introduction and guidance first, then followed by children's independent exploration in	Diverse approaches: 1) Access or not 5 of 14 participants reported access 2) Teacher use methods - 3 of 5 reported to record children - 2 of 3 also used it to present images or videos for children with controlled time 3) Children use or not - 3 of 5 reported children use

		small-learning-area sessions	- used the original functions of iPad: camera, audio recording, notebook, online search - small group or individual use - 2 reported children's use of extra apps, one of which just happened in open class - teacher guide first, then observe and intervene - peer cooperation
	Bai	- to be used by children to read, make e-books and digital storytelling - teacher instruction first in the whole-group session, then children's independent use individually - middle class used recording apps and senior class used creating apps - to be used in art, math, emotional activities - children were not completely competent in operating apps limited by their inaccurate speaking and delicate tasks or complicated apps - teacher introduced and set examples for children, then would intervene when problems happened: emotion first, problem-solving second - teacher set rules for children's use - teacher encouraged peer learning around operation	

	Wang	- to scan QR code for watching operational videos of some experiments in science corner - to record children	
	Zhang	- to record children in small-learning-area activities and shared in whole class - time controlled - to display some images or videos for children to imitate for drawing or making	
	Luo	- to be used in small group or individual activities - to be placed in learning corners (e.g. art corner) - to be used by children in cooperation - to voice search, promote children's literacy - to be used in thematic sessions	
Loudspeaker/microphone	Yan	- to be used in performance corner	- play music
	Huang	- to be used by children to do interviews in learning corners	
	Hu	- to play music	
	Wang	- to play music sometimes by children autonomously in outdoor sessions	
	Zhang	- to play music by children themselves for musical performance	
	Ye	- to play music in outdoor	

		activities	
Headphone	Huang	- to listen to stories by children in the language corner	- language corner
	Zhang	- to listen to stories (recorded by parents) in the language corner and music	
Reading Robot	Yan	- to be used in language corner by children autonomously	- language corner
	Bai	- to be used for picture book reading	
	Huang	- to listen to stories by children in the language corner - teacher introduced, set rules and set examples first	
	Ye	- to be independently used by children in the language corner	
Reading pen	Huang		- language corner
	Zhang	- to read in language corner	
Audio recording pen	Shi	- to record children's storytelling in the language corner and teacher made a QR code for peer sharing - introduction first, then observe and intervene	- language corner
Smart speaker	Ly	- to be verbally controlled by children to switch on/off light/ curtains	- social
	Bai	- to be used by children for photography, search, audio recording and timing	
Programming learning tools	Lsq	- special sessions every week delivered by other teacher	- occasionally,

	Yang	- teacher introduction first and then children's operation to learn about the robotics	delivered by particular teacher
	Hu	- to be used by children in the science corner - teacher introduction first, then observe and intervene, support	
	Shi	- to be placed in a particular science room	
Child camera	Huang	- to be used by children to capture moments - teacher set a scale first, followed by children's capturing	- children's independent use across situations
	Zhang	- to be used by children autonomously to capture peers/teachers and any moments in 'a day in life' - to be used in Mosaic Approach - sometimes teacher guided children to use in thematic activities - can be used in any situations, small-learning-area, outdoor, educational session - peer interactions	
Digital microscope	Wang	- to be connected to computer for children to observe and operate	- specific for science
Learning Tablet	Ye	- to be operated by children in math corner for develop	- specific for math

		thinking/mindset	

Appendix M. Summary of Observation Sessions with Digital Technology Use

Case 1: Luo

Sessions:

1. Transitional time

1) Teacher: used IWB to play music

2. Small-learning-area session

1) Children: used iPads to voice search for pictures of tigers, then draw tigers

2) Children: used iPad to search the location of future primary on maps, then make a map from home to primary school

3) Children: used iPad to present the instructions book for Lego construction, then construct a car according to the instructions

4) Children: used learning tablet to do mathematical exercise

3. Sharing time

1) Teacher: used IWB to present the photos of children's works

4. Outdoor time (moving into the indoor construction area because of the rain)

1) Children: used iPad to voice search for "how to construct a castle with blocks"

2) Children: used iPad to voice search for pictures of astronauts and the outer space

3) Children: talked about movies of war, and construct an aircraft carrier

4) Children: pretended phone calling with the arc-shaped clock

Case 2: Ye

Sessions:

1. Transitional time

1) Teacher: used IWB to play music

2. Outdoor activities

1) Children: interacted with Ground Hologram Projection

2) Teacher: used smartphone to take photos and videos

3. Thematic activity -- fish dishes

1) Teacher: used IWB to present slides

2) Children: touched the IWB then a dish of fish appear on the slides

4. Small-learning-area activities

1) Children: used the reading robot to listen to the story

2) Children: used learning tablet

Case 3: Shi

Sessions:

1. Small-learning-area session

1) Teacher: used smartphone to record children

2. Transitional time

1) Teacher: used the IWB to play music

3. Sharing time

1) Teacher: used IWB to share the photos of children's works, and meanwhile introduce the use of 3D pencil and digital drawing board

4. Thematic activity -- our teeth

1) Teacher: drew teeth on IWB

2) Teacher: played a short animation about teeth

Case 4: Zhang

Sessions:

1. Transitional time

1) Teacher: used IWB to play music

2. Morning talk

1) Teacher: used IWB to present photos of children's weekend life, then a child did a presentation

3. Small-learning-area session:

1) Children: used headphone to listen to story

2) Children: used reading pen to learn the letters and numbers

3) Children: used children camera to take photos of peers and their works

4) Teacher: used iPad to take photos of children's works and working time

4. Sharing time

1) Teacher: used iPad to present the photos

Case 5: Wang

Sessions:

1. Lesson -- learning about time and clock

1) Teacher: used IWB to present calendar and time

2. 10-minutes break

1) Children: used camera to capture peers

3. Small-learning-area session

1) Children: used headphone to listen to stories

2) Teacher: used smartphone to search for and play the story

4. Lesson

1) Teacher: used IWB to play music, and children sing along

2) Teacher: used IWB, mouse and keyboard to type the lyrics of the song on MS Office Word, so children could sing reading the lyrics

Appendix N. Multimodal Transcripts

1. Multimodal Transcript of Part of Case 1 Vignette 1

Line No & Time	**Participant**	**Gaze direction**	**Action**	**Language**
(00:04) 1	Bob	Screen	Touched the search box	You should press this first.
2	Alice	Screen	Held the iPad	
3	On screen		Keyboard appeared	
(00:09) 4	Bob	Screen	Pointed to voice typing key	Then press this voice key.
5	Alice	Screen	Pressed the voice key and spoke out	HT Hotel.
(00:20) 6	Bob	Screen	Touched the 'Complete'	
7	On screen		The keyboard appeared again and no words appeared	
8	Alice	Bob		Why is there nothing?
(00:55) 9	Luo	Screen	Crouched down	Have you forgotten how to do voice search?
10	Alice	From Luo to screen	Touched the screen	I searched just now but nothing appeared.
(01:01)	Luo	Screen	Zoomed in the	Did nothing

11			map on screen and touched the search box	appear? What do you think the reason is?
12	Bob	Screen	Shook head and smiled in embarrassment	I don't know.
(01:06) 13	Luo	From screen to Bob	Pointed to the search box	Isn't it your first day to use it, right?
14	Bob	From screen to Luo	Bent	I have iPad at home and I can use it.
(01:10) 15	Luo	Screen	Pushed the iPad a little bit further toward Bob	Then you can try, how to search?
16	Bob	Screen	Sat down	
17	Luo	Bob	Touched the search box	Which primary school will you study at?
18	Bob	Luo		Hua Xing School
19	Luo	Screen	Pressed the voice typing on keyboard and gave a sign for Bob to speak out	You can speak louder.
20	Bob	Screen	Spoke out	Hua Xing School.
(01:25) 21	On screen		Showed some words	
22	Luo	Alice and Bob	laughed	

23	Alice	Screen	Laughed, pointed to the screen and spoke out the words on it	Hua Xin School.
24	Bob	Screen	Smiled shyly and re-touched the search box	
(01:29) 25	Luo	Bob	Gently tapped Bob and laughed	Your pronounce could be more accurate.
(01:36) 26	Bob	Screen	Put the iPad on the desk in front of himself	I know how to do.
27	Alice	Screen		Let me do voice searching, ok?
(01:48) 28	Luo	Screen		Ok, let me do it, let me show you how to do, is it ok?
29	Alice	From screen to Luo	Nodded and smiled	Ok, I want to know where the HT Hotel is.
30	Bob	Luo	Nodded and passed the iPad to Alice	The iPad at my home is much better than this one, as it can easily show the search results.

(02:09) 31	Luo	Screen	Pressed the Home button to Home page and re-entered the safari, touched the map, the voice typing key, and spoke out	Wait a moment. Now , we are in the map app, and then we can touch this (voice typing key) and speak out 'Hua Xing School'.
32	Alice	Screen		
33	Bob	Around room, back to screen		
(02:41) 34	On screen		Map appeared	
35	Alice	Screen	Zoomed out the map until the place searched for was clear	Miss Luo, I just zoomed out then it's done finally!
36	Luo	Screen	Spoke to Alice	How clever you are!
37	Bob	Screen	Tried to take the iPad from Alice, but failed	
(03:00) 38	Luo	Screen	Pointed to the map	Wow, it is so far from here to Hua Xing School.
39	Luo	Bob	Put the iPad back to the desk	Bob, what do you think could influence

				the results of voice search?
40	Bob	Luo	Smiled	It might be the voice
(03:30) 41	Luo	Bob	Smiled	Yes, do you mean the volume?
42	Bob	Luo	Nodded	
(03:45) 43	Luo	Alice	Pointed to the screen	Alright, Alice, you can try to do it. Touch the voice typing key again.
44	Alice	Screen	Touched the voice typing key and spoke out	Hua Xing School
45	Bob	Desk	Fiddled with the white paper on the desk	
(03:55) 46	On screen		The address and the location appeared on screen	
47	Luo	Screen	Pointed to the location on map	You see, you do it!
48	Alice	Screen	Applauded happily	
49	Bob	From paper to screen	Leaned forward to see	Let me see!

			the screen clearly, and then took the iPad away	
(04:02) 50	Luo	Two children	Smiled, stood up and took out her smartphone to take a photo for children	
51	Alice	Screen		Where is HT Hotel?
52	Bob	Screen	Held the iPad, kept gazing	I don't know
(04:10) 53	Luo		Left	

2. Multimodal Transcript of Part of Case 1 Vignette 2

Line No & Time	Participant	Gaze direction	Action	Language
(05:42) 1	Cathy	Screen	Turned on the iPad, and touched an app	
2	On screen		A blank page appeared	
(06:02) 3	Cathy	Luo	Put iPad up	This webpage cannot be opened.
4	Luo	Screen	Walked closer to Cathy	This is not what you need to open, where is the browser?
5	Cathy	Screen	Touched the safari	
6	Luo	Screen	Kept observing, and then walked away	Right! You can search now by yourself.
7	Daisy	Screen		
(06:35)	Cathy	Screen	Kept touching the	

8			screen	
9	On screen		Nothing changed	
(06:54) 10	Cathy	Around the room	Walked into the other group, and looked at their screen	We cannot open the page, and you didn't either.
11	Daisy	Cathy	Followed Cathy to the other group	
(07:10) 12	Cathy	Screen	Continued touching and tried to voice type	Tiger.
13	On screen		Nothing changed	
(08:00) 14	Cathy	Around the room	Came to Luo, and showed the screen to her	
15	Luo	Screen	Took the iPad up and touched while observing	The WiFi was not connected which cannot be solved by you.
(08:29) 16	Luo	Screen	Pulled the other group nearer, crouched down, and touched the screen, then left	I will teach you. You see, this is WiFi, press the connection, and now it joins the WiFi. Solved
(09:04) 17	Cathy	Screen	Started the searching process again	
18	On screen		Returned to the safari page, still blank	
(10:10) 19	Cathy	Around the room	Walked to Luo	Mrs Luo, it still doesn't work, why is it?
20	A boy	Cathy	Passed by	You need to speak louder.
(10:53) 21	Luo	Screen	Took the iPad up, and touched the screen, took her smartphone out for connection check	It is still the connection problem, perhaps you have to draw the tiger without referenced pictures.

(11:20) 22	Cathy	Desk	Settled the paint, brush and paper	
(11:36) 23	Luo	Screen	Bent over suddenly and showed the screen to Cathy	Ah, it's ok now! The pictures are searched out.
24	Cathy	Screen	Put the iPad on the desk, and started drawing	
(11:42) 25	Luo	Screen	Touched the iPad of the other group	Now you can search with it.
(12:00) 26	Luo	Around the room	Left	
27	Daisy	Screen and Luo	Got closer to Cathy and whispered to her	Mrs Luo used to type to search.

3. Multimodal Transcript of Part of Case 2 Vignette 1

Line No & Time	**Participant**	**Gaze direction**	**Action**	**Language**
(04:59) 1	Ye	Children group	Touched the screen	Let's see what kinds of dishes could be made of fish.
2	On screen		Three empty plates appeared	
(05:09) 3	Ye	Children group	Pointed to the screen	What are these on the screen?
4	Children group	Screen		Plates.
5	Ye	Children group	Kept pointing to the screen	Is there any fish dishes in them?
6	Children group	Screen		No.
(05:14) 7	Ye	Children group	Walked from the left side of	Now, I would like to invite a child to conjure the dish.

			IWB to the right	
8	Children group	Ye	Positively Raised their hands	Let me do. / Me.
(05:20) 9	Ye	Children	Pointed at the first plate on the top of the screen	Now, I'll invite a tall child to serve this first dish, alright?
10	A boy called Ellen	Ye	Kept raising right hand	I'm the tallest.
11	Ye	Ellen	Pointed to Ellen	Come, Ellen.
(05:26) 12	Ellen	Screen	Stood up and walked close to IWB	
13	Ye	Screen	Pointed to the first plate	You need to touch this plate to see if the dish will appear or not.
14	Ellen	Screen	Touched the plate	
15	On screen		A picture of the dish with its name appeared	
16	Ellen		Came back to the group	
(05:34) 17	Ye	Children group	Pointed to the screen	Wow, boys and girls please see, anyone knows this dish conjured by Ellen?
18	A girl	Ye	Raised the right hand	It's the Braised Fish with Brown Sauce.
19	Ye	Children	Raised her left	Really? Is it? Any answers?

		group	hand to encourage following answering	Please raise your hands to tell me.
(05:50) 20	Ye	A boy called Frank	Pointed to Frank	Frank, have you ever eaten this?
21	Frank	Ye		I think there are many peppers on it.
22	Ye	From screen to children group	Pointed at the dish on the screen	Yes, there are many peppers. Please see it again, what is this dish made of?
23	Children group	Screen		Peppers.
24	Ye	Screen	Pointed at the dish on the screen and walked back to the left side of IWB	Yes, true, but which part of fish is it?
25	A girl called Gabby			The head.
(06:03) 26	Ye		Pointed at the words ‘Fish Head’ on screen	Yes, so, someone just identified the two words - fish head.
27	Ye	Children group	Pointed to the dish and then pretended to chop with hands	Also, there are many peppers that were chopped by cooks with the kitchen knife, so the name of it is Fish Head with Chopped Peppers

28	Children	Screen	Read out in chorus	Fish head with chopped peppers
(06:25) 29	Ye	Children group		Who has ever eaten it?
30	Children group		Raised hands	
31	Ye	Children group	Pointed to the screen behind her	Is it spicy?
32	Children group	Ye		Yes. / No.
33	Ye	Children group		Dare you to eat it?
34	Children group	Ye	Raised hands	I dare. / I dare to eat it. / I dare to eat spicy food.
(06:35) 35	Ye	Children	Made a gesture of 'stop'	Ok, now we have known the first dish called Fish-Head-With-Chopped-Pepp ers
36	Children	Screen	Repeated	Fish-Head-With-Chopped-Pepp ers
(06:45) 37	Ye	Children group		Alright, now let's invite the second child to serve the next dish.

4. Multimodal Transcript of Part of Case 2 Vignette 2

Line No & Time	**Participant**	**Gaze direction**	**Action**	**Language**
(05:19) 1	Iris	Book 1	Turned the page	
2	Helen	Drawing board	Kept drawing	
3	device		Told the story	
(05:22)	Helen	Drawing board	Turned around to	

4			back to the table	
5	Ye	Table	Walked close and turned the book and device in the direction of facing Iris	
6	Helen	Ye	Turned to face the table	
(05:50) 7	Device		Told the story	...Do you live in a kennel?...
8	Iris	From the book to Helen	Laughed, turned to Helen, and repeated the sentence to Helen	Do you live in a kennel?
9	Helen	From the drawing board to Iris	Laughed	
(06:22) 10	Device		Told the story	...Do you eat fruit?...
11	Helen	From the drawing board to the book, and back to the board	Looked up at the book and then kept drawing	
12	Iris	Around the classroom	Laid her head on the book	
(06:49) 13	Iris	Book 1	Turned the page	
14	Helen	From the drawing board to the book	Stood up, walked up behind Iris and gazed at the book for a while	
(07:00)	Helen	Around the	Left the table area	

15		room		
(07:26) 16	Iris	From the book to around the room	Attracted by somebody's odd noises and tried to locate the source	
17	Helen	Around the room	Attracted by somebody's odd noises and walked around to locate the source	What are they doing?
(07:36) 18	Iris	Book 1	Focused on the book again	
19	Helen		Sat on a sofa behind Iris	
(07:43) 20	Device		Finished the storytelling	
21	Iris	Book 1	Closed the book	
22	Helen	Iris	Spoke to Iris	We need to change a new one, and I'll get it.
(07:50) 23	Helen		Walked to the bookcase, looked around range of books and picked one	
24	Iris		Followed Helen to the bookcase, and returned the previous book	
(08:05) 25	Helen	Drawing board	Passed the second book to Iris, and went back to the	

			sofa continuing drawing	
26	Iris	Book 2	Glanced over the book cover and scanned the title	
(08:30) 27	Iris		Closed the book, walked to Helen and spoke to her	I don't want to read this book.
28	Helen	From drawing board to Iris	Replied to Iris	Then, go there to change a book.
(08:38) 29	Iris		Returned the book 2 and rummaged around the books	
30	Helen	Between drawing board and the direction of Iris	Took a look at Iris now and then	
(9:20) 31	Iris	Helen	Walked to Helen and spoke to her	Which book could be read?
32	Helen	Iris	Replied to Iris	I don't know but maybe the small book on the table could be tried.

5. Multimodal Transcript of Part of Case 3 Vignette 1

Line No & Time	**Participant**	**Gaze Direction**	**Action**	**Language**
(06:21) 1	Shi	Whole group	Raised her left hand	Now, I invite another child to share the work of small-learning-area activities, who want to do?
2	The whole	Shi	Raised right	

	group of children		hands or did noting	
(06:35) 3	Shi	A boy	Pointed to the boy	Jack, you can share.
4	Jack	Shi	Stood up	I have drawn in the art corner.
(06:51) 5	Shi	From Jack to the whole group	Touched the screen, and found out the photo of Jack's work	Well, I have taken photos then, so let's see what Jack has done in the art corner.
6	Screen		Photo appeared	
(07:14) 7	Shi	From the whole group to Jack		Come here, Jack, introduce your work to your peers
8	Jack	The whole group	Walked to the screen, then turned to the group	This is a rabbit which I've made just now.
(07:35) 9	Shi	Jack	Pointed to the photo on the screen	So, could you introduce your rabbit to us? For example, what's this of the rabbit?
10	Jack	Screen		They are the ears of the rabbit.
(07:49) 11	Shi	Screen	Swept around the screen with the hand	What else?
12	Jack	Screen	Tried to touch the screen, standing on the tiptoe, but failed	And eyes and mouth of the rabbit.
(08:05)	Shi	From the	Pointed to the	Well, they are eyes and this is

13		screen to Jack	photo	the mouth, then how about this?
14	Jack	Screen		It’s the tail.
(08:14) 15	Shi	Jack		Could you tell us which colour you use?
16	Jack	Shi		Yellow.
17	Shi	The whole group		Oh, it’s a yellow rabbit, could you tell your peers which tool you use to make it?
18	Jack	The whole group		I used the 3D pen.
(08:41) 19	Shi	The whole group	Gestured to instruct Jack back to the seat, took the 3D pen out and raised it up	This is the 3D pen that Jack has used, and I have told you previously that it was an electric tool and could be heated after used for a while. It is a little dangerous. So, you guys should use it when teachers are present and cannot use alone. Does it make sense?
20	The whole group of children	Shi	Chorused	Yes.
(09:19) 21	Shi	The whole group		Then do you know how to use it?
22	A boy	Shi	Raised his hand	Yes, and I have one at home.
23	A girl	Shi		I have, too.
24	Another boy	Shi		I don’t know.
(09:41) 25	Shi	The whole group	Gestured to keep children quiet, then	Then, this is to adjust the speed, and if you press this, you can start or stop. Finally,

			pointed at the buttons one by one.	the material will go in through this hole and go out from the nib of the pen.
26	The whole group of children	Shi	Watched shi's instructions	
(10:38) 27	Shi	3D pen	Operated the 3D pen	Flip the switch up, and then the light will turn to red. And after a short time of preheating, the light will turn to green, so you can start to use it.

6. Multimodal Transcript of Part of Case 3 Vignette 2

Line No & Time	**Participant**	**Gaze Direction**	**Action**	**Language**
(12:00) 1	Shi	Screen	Touched the screen, and found out the document	Well, now let's see which kind of teeth is the sharpest.
(12:20) 2	Shi	From children to the screen	Walked back to children and watched the animation together	
3	On screen		A cartoon panda appeared	(voiceover) This is QiQi, and he is to have a breakfast.
4	Children group	Screen	Gabbled	- doesn't he brush his teeth? - is this a panda? - ......
5	Shi	From the screen to	Put her index finger at the lip	Shh.

		children		
(12:30) 6	On screen		Several anthropomorphized teeth appeared with brush in hands	Good morning, we are to work! Yoho!
7	On screen		Four incisors lined up	QiQi, start eating! We incisors are the sharpest!
8	Shi	From the screen to children	Pointed to the screen	They are incisors.
(12:41) 9	On screen		Two canine teeth appeared	No, we canine teeth are the coolest.
10	Shi	From the screen to children	Pointed to the screen	What teeth are they?
11	Several children of the group	Screen		Canine teeth.
(12:46) 12	On screen		Two molars appeared	No, we molars are the coolest.
13	Shi	From the screen to children	Pointed to the screen	They are molars.
(12:52) 14	On screen		Eight teeth appeared	Let’s see who the coolest tooth is!
15	Shi	From the screen to children	Put her right hand on the right ear	Listen carefully.
(13:11) 16	On screen		The animation continued, with anthropomorphised teeth singing a rhyme	Strong incisors, cut everything off, crunch, crunch, cut off,

				shining, shining, healthy incisors, are we cool? Pointed canine teeth, Tear everything up, Bite, bite, Tear up, Shining, shining, Healthy canine teeth, Are we cool? Powerful molars, Chew everything up, Chew, chew, Chew up, Shining, shining, Healthy molars, Are we strong?
17	Shi	Screen	Kept watching, with occasionally looking at children	
18	Children	Screen	Kept watching	
(14:03) 19	On screen		Animation continued	What on earth are the coolest teeth? Incisors can cut food off, canine teeth can tear food up, molars can chew food up. Oh, we are all the coolest teeth!
(14:32) 20	On screen		Frame was frozen at the final group photo of	

			three kinds of teeth.	
21	Shi	Children	Walked to the screen, and pointed at each tooth on the screen	Well, this is the canine tooth, this is the incisor, and this is the molar.
22	Children group	Screen	Got excited with some standing up	- Wow, how sharp! - How large teeth!
(14:45) 23	Shi	Children	Walked to children, and gestured to calm children down, asked questions and raised her right hand	You have seen the various types of teeth just now and what are their different functions?
24	Shi		Pretended to cut off with teeth	The incisor is for ...?.
25	A girl	Shi		Cutting stuff off.
26	Shi	Children	Raised her hand	Oh, it is to cut off, then how about the canine tooth?
27	The other girl	Shi	Pretended to tear something up with teeth	Tearing up.
28	Shi	Children	Pretended to tear something up with teeth as well	Yes, tearing up, then how about the molar?
29	A boy	Shi		The molar is to chew the food up.
(15:14) 30	Shi	Children	Gestured	Molars are for chewing up, so the food we eat can be easily absorbed, which could lead to our growth.

(15:24) 31	Shi	Children		Now, I have a task for you to do with parents at home. Please explore how many teeth do you have. Count your own teeth and your parents' teeth and compare the numbers. Share with us tomorrow.

7. Multimodal Transcript of Part of Case 4 Vignette 1

Line No & Time	**Participant**	**Gaze direction**	**Action**	**Language**
(03:13) 1	Zhang	Screen	Pointed to the screen	This is the up-close photo of a cicada captured by Jojo's mom, and please observe how does it look like? What are the features of it?
2	Screen		A photo appeared in which a cicada was lying on the trunk	
3	Jojo	Group	Raised up the glass in which several cicadas existed	The cicada in the photo looked different from these physical ones in this glass, and do you know why? The photoed one seemed golden as it was exposed to some light then.

(03:35) 4	Zhang	From the screen to Jojo	Pointed to the screen and the cicadas in the glass respectively	Oh, Jojo said the colour of the cicada on the screen was different from these caught by her, why? Jojo, you can explain to us again.
5	Jojo	Group		Why do the two cicadas look different? This is because the cicada on the screen was exposed to the sun, while this in the glass wasn't.
(04:25) 6	A boy	Jojo	Questioned	Hey, Jojo, is it right that the cicada needs to hide in somewhere dark in the daytime?
7	Jojo	The boy		It hides under the soil.
(04:33) 8	Zhang	Group	Repeated Jojo's explanation	She said the reason lay in the light. The photo was captured by a smartphone with flash. When the flash lighted on the cicada, what was the colour of its wings?
9	Group	Screen		White.
10	Zhang	Group		Yes, transparent and white. Then, when there isn't light, what is the colour of it?
11	Group	Cicadas in the group		- Orange. - Black.
(05:11) 12	Jojo	Zhang	Eye contacted with Zhang	
13	Zhang	Jojo	Touched the screen to move to the next slide	
14	Screen		A chart	

			appeared, which listed variety of cicadas and their images	
15	Jojo	Group	Pointed to the screen	This slide presented variety of cicadas and there were so many breeds.
(05:20) 16	Zhang	Jojo		Yes, many breeds of cicadas, so do you know which breed are these cicadas in this glass?
17	Jojo	Zhang	Shook her head	Emmm.
18	Group	Screen	Looked blank	
(05:30) 19	Zhang	Group		Then we can compare and explore later to find out the breed of these cicadas.
(05:43) 20	Zhang	Screen	Switched to the next slide, and gestured for Jojo to continue	Now, let's see the next picture.
21	Screen		A picture appeared which showed the sloughing process of a cicada	
22	Jojo	From the screen to group	Gave a question	Do you know why there is an idiom of 'a golden cicada sloughing off its skin' but not 'grey cicada'?
23	Zhang	Group		Anyone knows? What a good question!
24	A boy	Jojo		Because when a cicada

				climbs higher its wings will throw her body up.
25	Zhang	The boy		Oh, so that's what you think.
(06:22) 26	Jojo	Zhang		No, it's because some cicadas were golden.
27	A girl	Jojo	Questioned	But some of what we just watched were blue.
28	Jojo	The girl	Replied	The blue was the colour of wings but its body were a little golden.
(06:43) 29	Jojo	Group		The idiom means that a cicada takes off its out skin. When a line appears on its back, then the taking-off process begins which will last for about one hour. After that, the legs of it could be open, but if not, they might be dead.
30	Group	Jojo	Listened carefully	
(07:26) 31	Zhang	Group	Stressed on the important point	Just now Jojo told us the two states of the cicada. When it's alive, the two legs of it are open, so it can crawl. If it's dead, then what will its legs look like?
(07:39) 32	Group	Zhang		Closed.
33	Zhang	Group	Got the glass	Yes, let's see these cicadas. The states of them show to us that some are alive and some are dead. You can

				observe it.
(08:00) 34	Group	Glass	Stood up to see clearly, and discusses	- All are alive. - All are dead.
35	Jojo	Glass	Pointed to one of these cicadas	Only this looks better.
36	Zhang	Group	Gestured to instruct children to sit down	Everyone, please sit down and I'll raise it higher for you to see.
37	Jojo	Glass	Pointed to the glass	There is a cicada with its feet curled up.
38	Zhang	Glass	Nodded	Yes, we can see its feet became curled up, so the states of them vary.
39	A girl	Glass	Pointed to one cicada	It is alive as its legs were open.
40	A boy	Glass		This is its shell.
41	Zhang	The boy	Nodded	Yes, you are right.

8. Multimodal Transcript of Part of Case 5 Vignette 2

Line No & Time	**Participant**	**Gaze direction**	**Action**	**Language**
(03:12) 1	Zhang	Table	Walked to the role-play corner and raised the iPad to capture children	Hi, chef, what delicacy are you making?
2	Lily	Zhang		It's doughnut.
3	Zhang		Took the 'doughnut' up	Wow, which chef did it?
4	Kevin	Zhang	Raised his right hand	
(03:35) 5	Zhang	Kevin	Spoke to the child, and then left	I would like some dumplings, could you

				do them for me, Kevin? I'll take away them later
6	Kevin		Nodded, and made dumplings	
7	Lily	Kevin	Walked around Kevin, and observed him	
(04:54) 8	Kevin	From the table to Lily		Look! I made dumplings!
9	Lily		Took some Play-Doh up, started to shape it	I can do it also, look at mine! Firstly, shape it into a round one, and squash it into a pie. Then make it like this.
(05:26) 10	Lily	Kevin	Raised her work to Kevin	Look, I finished! Two small dumplings.
11	Kevin		Had a look at Lily's work, and then continued making 'food'	
(05:53) 12	Lily		Picked up the camera from the table and hung it on her neck, then captured Kevin	Hi, Kevin, I'm photographing you.
13	Kevin	From the table to Lily	Raised head and smiled	
(06:35) 14	Lily	Camera screen	Walked around and kept capturing the Play-Doh, 'doughnut',	

			‘dumplings’, and cookers on the table	
(08:21) 15	Zhang	Table	Walked to this corner	Wow, you made dumplings! How did you make them?
16	Kevin	Zhang		I made a ball first and pressed it into a slice, put another ball in and wrapped it.
17	Zhang	Kevin		Are all of these made by you?
18	Kevin	Zhang	Pointed to the ‘dumplings’	No, I made these, and the two were Lily’s.
19	Lily	Zhang	Became excitedly	Miss Zhang, I can do selfie with this camera!
20	Zhang	Lily	Got closer to Lily and the camera	Wow, can you show me how to do it?
21	Lily	Camera screen	Touched the screen of camera, took a selfie	
22	Screen		Switched the back lens view to the front lens view, and Lily’s face appeared	
(08:59) 23	Zhang	Lily	Thumbs up, bent down, and made face come closer to Lily’s face	Good job! We can do it together!
24	Lily		Operated the camera to take a selfie	
25	Screen		Photo was done	
26	Zhang	Screen	Touched Lily’s shoulder, and left	So cute!
27	Lily		Followed Zhang, and	

			captured her back	
(09:42) 28	Kevin	Lily	Spoke to Lily	Can you give it to me? I want to photograph too.
29	Lily	Kevin		No.
30	Kevin		Continued his work	Alright.
31	Lily		Kept walking around the classroom and photographed occasionally	

9. Multimodal Transcript of Part of Case 5 Vignette 1

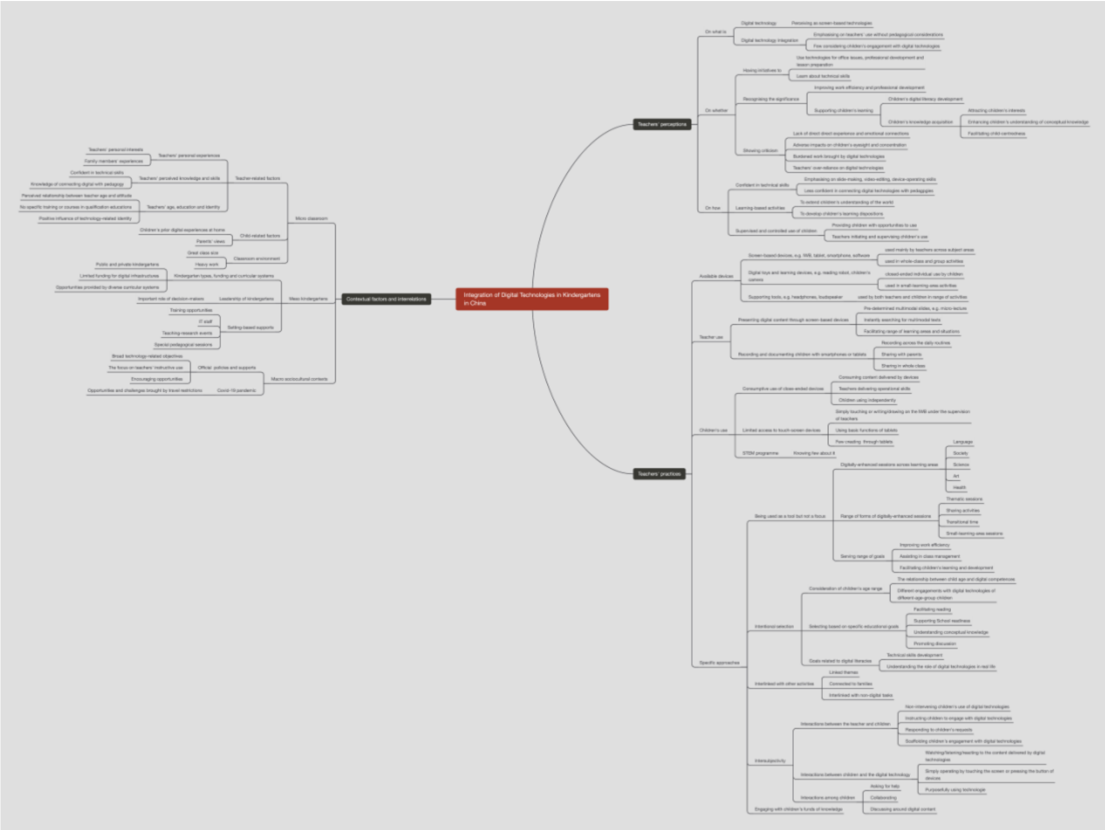
Line No & Time	**Participant**	**Gaze direction**	**Action**	**Language**
(09:50) 1	Wang	Children group	Pointed to one line on the screen	Could you see this sentence? How to pronounce it?
2	Children	Screen		'Zhuang dian feng jing shi jie (decorate the world of scenery)'
3	Wang	Screen	Pointed to the words that children misread	It should be 'Zhuang dian feng jing shi pian (decorate the poem of scenery)'. Now read the right loud. Can you see the words clearly, guys in the background?
4	Some children	Wang		Yes.
(10:14) 5	Wang	Screen	Enlarged the font size and made bold font	Please just read the lyrics but don't sing. Robert, please sit down.

6	Children	Screen	Read out loud but with mismatched voices	'Gan xie qin ai de ba ma wei/gei wo dang feng zhe yu de jia (thank my parents for /giving me a sheltering home).'
(10:30) 7	Wang	Children	Pointed at words one by one and suddenly tapped the character 'gei'	What?
8	Children	Wang	Repeated the word, but still with mismatched pronunciation	'Wei/gei'
9	Wang	A girl		Sophie, speak out this sentence.
10	Sophie	Screen		'gei'
11	Wang	From Sophie to the whole group	nodded	You're right. Please read the lyrics clearly, guys. Now, go on please.
(10:46) 12	Children	Screen	Voices became mismatched	'Wei wo zuo xiang pen pen fan cai (making delicious dishes for me).'
13	Wang	Screen	Kept taking the lead to read out the lyrics	Can you please follow my rhythm? 'Gan xie qin ai de lao shi ...'
(11:09 - 12:35) 14	Children	Screen	Kept shadowing Wang's reading out	
(12:36) 15	Wang	Children	Tapped the screen	Alright, now, please read through these words again together. Just read but don't sing. Follow my

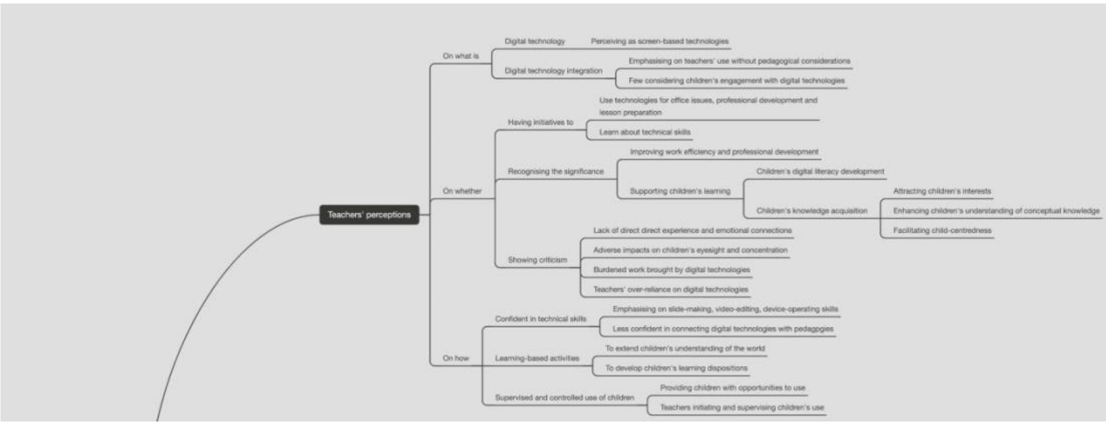
				pointing at. Ready, go!
16	Children	Screen	Started with the first sentence, but still with mismatched pronunciation	'Gan xie qin ai de ba ma wei/gei wo dang feng zhe yu de jia (thank my parents for /giving me a sheltering home).'
17	Wang	Screen	Tapped the character 'gei'	What character is it?
18	Children	Screen		'Gei'
19	Wang			Why did someone speak 'wei'? please listen to me, 'wei wo dang feng zhe yu de jia (for me a sheltering home)', is this phrase idiomatic?
20	Children	Wang	Shook heads	No, it's not idiomatic
(13:11) 21	Wang	Children		Right, it should be 'gei wo dang feng zhe yu de jia (for giving me a sheltering home)'. Then, please go on.
22	Children	Screen	Read the second sentence	'Wei wo zuo xiang pen pen (de) fan cai, pei ban wo zhang da (making delicious dishes for me and accompanying me to grow up)
23	Wang	Screen	Stopped the reading, tapped on the second sentence	Stop, and speak this again.
24	Children	Screen	Repeated	
25	Wang	Screen	Pointed at the	Where does the 'de' go?

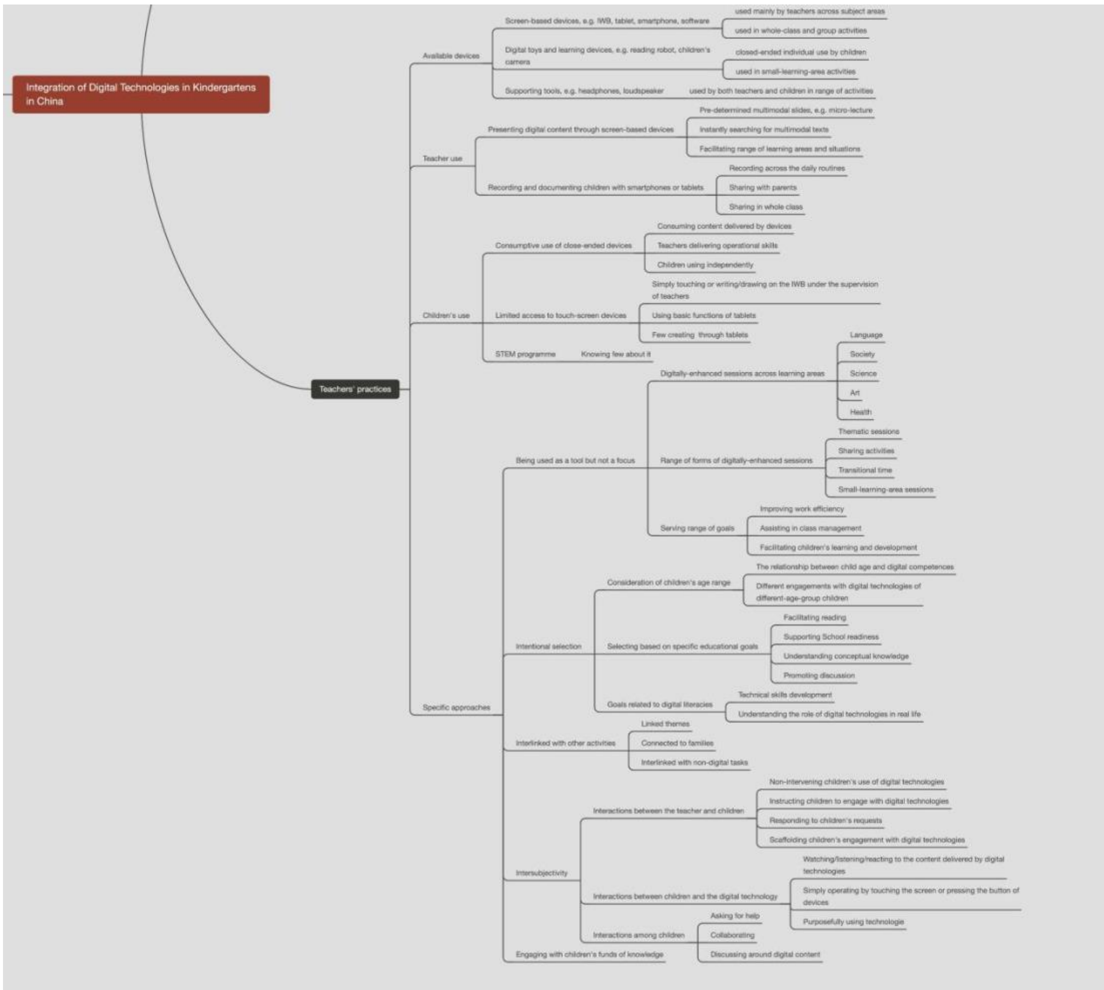
			character ‘de’	
26	Some children	Screen		Miss Wang, you made a mistake. There haven’t been the ‘de’ in the lyrics.
27	Wang	Screen	Corrected the typing fault	Ok, move on.
(14:10) 28	Children	Screen	Kept reading with occasional mismatched voices	
29	Wang		Joined reading again, allowing children to shadow	
(15:19) 30			Pointed to a girl	Ok, Vivian, speak out the last sentence again.
31	Vivian	Screen	Stood up but kept silent	emmm
32	Wang	Vivian		‘Zhuang dian feng jing shi pian (decorate the poem of scenery)’, please speak out.
33	Vivian	Screen	Shadowed	‘Zhuang dian feng jing shi pian’.
(16:00) 34	Wang	Children	Played the back track	Ok, now, let’s sing along the music.

Appendix O. Thematic Map

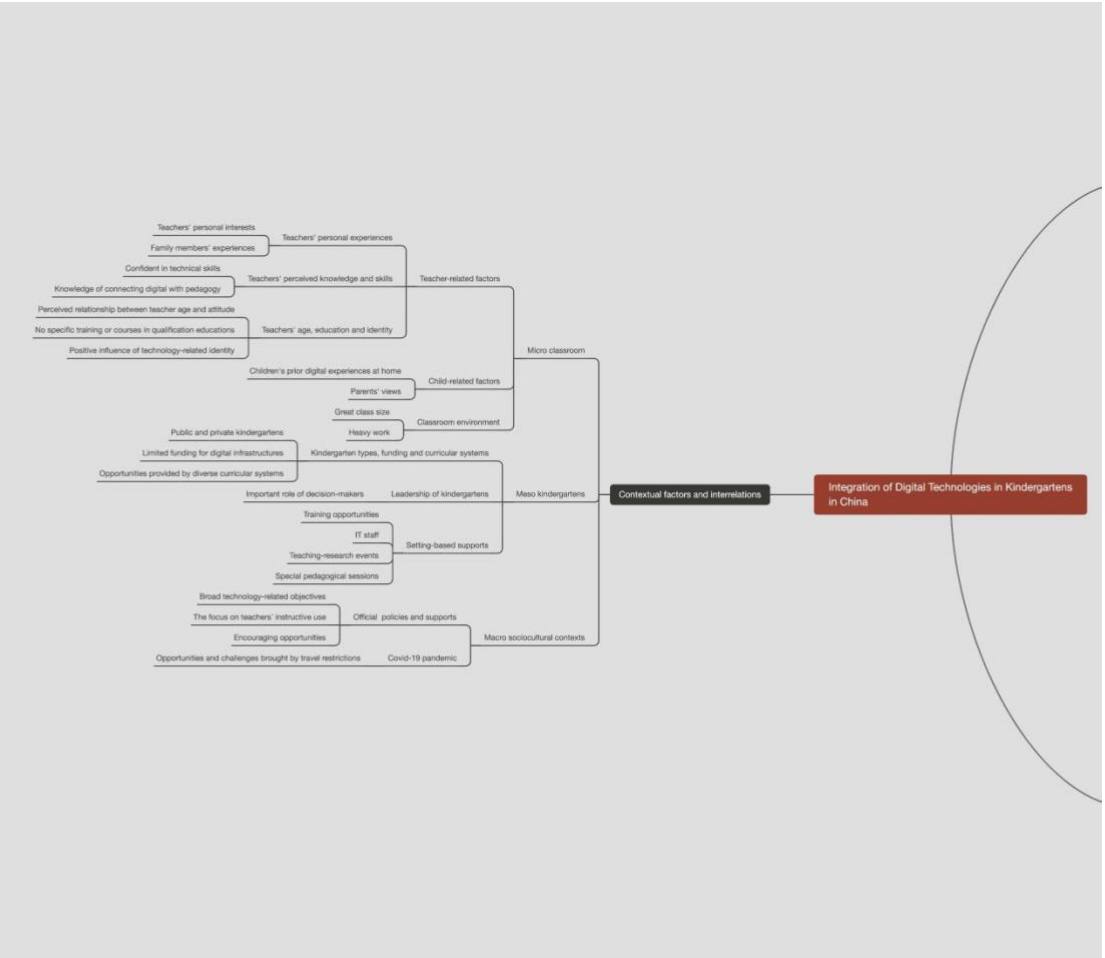


The thematic map was divided into three parts to be presented as follows:





Integration of Digital Technologies in Kindergartens in China
Teachers' practices
Available devices
Screen-based devices, e.g. IWB, tablet, smartphone, software
used mainly by teachers across subject areas
used in whole-class and group activities
Digital toys and learning devices, e.g. reading robot, children's camera
closed-ended individual use by children
used in small-learning-area activities
Supporting tools, e.g. headphones, loudspeaker
used by both teachers and children in range of activities
Teacher use
Presenting digital content through screen-based devices
Pre-determined multimodal slides, e.g. micro-lecture
Instantly searching for multimodal texts
Facilitating range of learning areas and situations
Recording and documenting children with smartphones or tablets
Recording across the daily routines
Sharing with parents
Sharing in whole class
Children's use
Consumptive use of close-ended devices
Consuming content delivered by devices
Teachers delivering operational skills
Children using independently
Limited access to touch-screen devices
Simply touching or writing/drawing on the IWB under the supervision of teachers
Using basic functions of tablets
Few creating through tablets
STEM programme
Knowing few about it
Specific approaches
Being used as a tool but not a focus
Digitally-enhanced sessions across learning areas
Language
Society
Science
Art
Health
Range of forms of digitally-enhanced sessions
Thematic sessions
Sharing activities
Transitional time
Small-learning-area sessions
Serving range of goals
Improving work efficiency
Assisting in class management
Facilitating children's learning and development
Intentional selection
Consideration of children's age range
The relationship between child age and digital competences
Different engagements with digital technologies of different-age-group children
Selecting based on specific educational goals
Facilitating reading
Supporting School readiness
Understanding conceptual knowledge
Promoting discussion
Goals related to digital literacies
Technical skills development
Understanding the role of digital technologies in real life
Interlinked with other activities
Linked themes
Connected to families
Interlinked with non-digital tasks
Intersubjectivity
Interactions between the teacher and children
Non-intervening children's use of digital technologies
Instructing children to engage with digital technologies
Responding to children's requests
Scaffolding children's engagement with digital technologies
Interactions between children and the digital technology
Watching/listening/reacting to the content delivered by digital technologies
Simply operating by touching the screen or pressing the button of devices
Purposefully using technologie
Interactions among children
Asking for help
Collaborating
Discussing around digital content
Engaging with children's funds of knowledge



Integration of Digital Technologies in Kindergartens in China
Contextual factors and interrelations
Micro classroom
Teacher-related factors
Teachers' personal experiences
Teachers' personal interests
Family members' experiences
Teachers' perceived knowledge and skills
Confident in technical skills
Knowledge of connecting digital with pedagogy
Teachers' age, education and identity
Perceived relationship between teacher age and attitude
No specific training or courses in qualification educations
Positive influence of technology-related identity
Child-related factors
Children's prior digital experiences at home
Parents' views
Classroom environment
Great class size
Heavy work
Meso kindergartens
Kindergarten types, funding and curricular systems
Public and private kindergartens
Limited funding for digital infrastructures
Opportunities provided by diverse curricular systems
Leadership of kindergartens
Important role of decision-makers
Setting-based supports
Training opportunities
IT staff
Teaching-research events
Special pedagogical sessions
Macro sociocultural contexts
Official policies and supports
Broad technology-related objectives
The focus on teachers' instructive use
Encouraging opportunities
Covid-19 pandemic
Opportunities and challenges brought by travel restrictions