

Young Children's Use of ICT in Shanghai Preschools

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Abstract

In the context of ever-increasing presence of information communication technologies (ICT) in young children's living and educational environments, early childhood education (ECE) policies and curriculum have begun to emphasise the importance of integrating ICT into early childhood practices and provide guidelines for the use of ICT in ECE settings. The current study aims to get a clearer picture of young children's use of ICT in preschools and develop a better understanding of their experiences with the use of ICT in the classroom. Data were collected from a survey with 316 teachers in 20 public preschools and observations of young children's ICT activities in two case study classrooms, as part of a larger study. The results show that many children had competences and high interest in using ICT and experienced pleasure and success during their ICT activities, but their overall access to ICT was low, and active and meaningful ICT use was very limited. This paper concludes by suggesting the provision of sufficient reliable hardware and appropriate software for young children to explore the potential of ICT. And EC teachers need to develop effective pedagogies that can support the children's learning with and through the use of ICT.

Keywords: ICT, young children, early childhood teacher, pedagogy

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The use of information and communication technologies (ICT) in particular computers and the internet in early childhood education (ECE) has been a controversial topic for several decades. The rigorous debates have centred on impacts of new technologies on young children and resulted, broadly, in two schools of opinion. One group of scholars (Cordes & Miller, 2000; Elkind, 1998; Healy, 1998; House, 2012) underscored the bad influence and referred to possible threats to young children's learning and development. Their objections to the use of new technologies by young children revolved around the main issues of: abstract or inappropriate learning content, risks to children's health, hazards to children's mental development, reduced social interaction and replacing traditional learning activities. Therefore, this group strongly argued against young children's use of ICT and called for a moratorium on further introduction of computers in early childhood and elementary education.

Negative opinions and claims against young children's use of ICT have raised many responses and disagreements however, and led to more empirical research in this field (e.g. Clements & Sarama, 2003; Morgan & Siraj-Blatchford, 2010; Yelland, 2006). Consequently, ECE organisations and scholars have demonstrated rich and valid research in evidence of ICT potential in the areas of language and communication, creativity, mathematical thinking and problem-solving, cooperation and literacy to refute the oppositions' criticisms (Aubrey & Dahl, 2008; Hsin, Li, & Tsai, 2014; NAEYC, 1996, 2009; Plowman & Stephen, 2006). For instance, Clements and Sarama (2003) thoroughly reviewed research publications on young children and technology and strongly pointed out opposing opinions ignored or misinterpreted most of the current research findings. In their review, they showed that young children's use of technologies contributes to their cognitive, social and emotional development. More recently, Hsin and others (2014) revealed that the technologies had positive effects on children's performance across developmental domains, in particular social development. They also noted differences in the effect of technology use between boys and girls. Sacks, Trundle, and Bell (2011) further pointed out that computer use seems to appeal to boys more than girls, which might lead boys to have better computer skills than girls. In their longitudinal study, these scholars found that girls had a higher developmental rate of computer skills than boys. Notably, the sample population in their study was older than preschool children as they were from kindergarten to third grade.

Despite a growing body of evidence which underlines the positive effects of ICT on early learning and development, young children's use of ICT in ECE settings has not gained much attention from policymakers and teachers (Dong, 2014; Dong & Newman, 2016; Paciga, Lisy, & Teale, 2013). Additionally, how young children interact with ICT and what are their experiences with the use of ICT in educational contexts have, as yet, been understudied (Gronn, Scott, Edwards, & Henderson, 2014; Hsin, Li, & Tsai, 2014). In response to such research gap, this study aims to obtain information about young children's ICT use in preschool environments and gain an understanding of their experiences with ICT use. Young children's use of ICT in preschools is initially dependent on the equipment that their settings provide and the level of access to it. Thus, the study also seeks to collect data about the availability of ICT resources for young children and their access to ICT in the classroom. "Preschool" in this paper to refer to educational institutions for children aged three to six while "early childhood education" is used for educational services for children from birth to age six in China.

Learning and Teaching through the Use of ICT

It is important to consider theories of learning and teaching in this study because the potential of technology to enhance learning can only be realised "if it is based on secure foundation of a robust understanding of learning, teaching and knowledge" (Derry, 2007, p. 503). Over time theories of how children think and learn have evolved in response to new research findings and theoretical assumptions, inevitably shaping definitions of what it means to learn and teach in educational contexts and providing a pedagogical basis for understanding what teaching strategies teachers can offer to support effective learning (Gredler, 2001; Harasim, 2012). Competing views on the nature of learning and human development have been divided into three major main domains: behaviourism, cognitivism and constructivism (Yilmaz, 2011). These three theoretical perspectives have heavily influenced the application of technology in classrooms and its integration into education. Thus, a brief examination of the relationship between these theories and the use of technologies can not only explain the way ICT is used for learning and teaching in ECE

settings, but can also further help gain insights into how changes can be made from the viewpoint of teaching to maximise the potential of technologies for early learning and development.

Behaviourism

From a behaviourist perspective, learning is considered as acquisition of knowledge and skills so instructions focus on very specific and discrete learning steps (Harasim, 2012). It is clear that this view of learning implies that the learner responds to learning materials passively and teachers have dominant roles in classrooms so that the priority in instruction is on transmission of knowledge to the learner. Teachers are responsible for preparing learning resources and setting up learning experiences, but children are often put in passive situations such as seeing, listening, responding to questions and doing what was instructed.

The rise of applying technologies in the educational field occurred within the behaviourist school of thought as learning technologies are designed with specific steps and mechanisation of the learning process to encourage practice and reinforcement of specific tasks (Harasim, 2012). Taylor (1980) made a metaphor of this type of computer use as a tutor. That is, computers present learning material, students respond and computers evaluate the response and decide what to teach, based on the evaluation outcome. Approaches like computer-based tutoring systems, programmed learning and computer-assisted instruction (CAI) were popularly put into practice in some schools (Papert, 1993) and preschools (Paciga, Lisy, & Teale, 2013), teaching children to learn about technology itself or drilling them in the learning of concepts, facts and skills (Dong, 2014; Li, 2006). Deeply influenced by behaviourist learning theory, today's many computer-based educational programs for children are simply designed to set tasks for the learner, achieving learning objectives through raising questions and providing rewards if answers are right (Harasim, 2012). This way of using computers for learning is only supplying a set of stimuli and response while interaction with teachers and collaboration with peers are not recognised.

Cognitivism

Cognitive learning theory emerged as a response to behaviourists' rigid and simple learning theory of 'stimulus and response' and shifted the emphasis from external behaviours to a focus on the internal mental process of behaviours (Bigge & Shermis, 1999). Influenced by this perspective, learning is viewed as an active process involving the acquisition or reorganisation of information (Harasim, 2012). In the late 1970s, social cognitive learning theory as a subset of cognitive theory created by Albert Bandura, expands on behaviourists' imitative learning, reinforcement and operant conditioning by considering naturalistic settings and social environment for learning. This theory contends that by observing others or learning from modelled behaviours, individuals acquire knowledge, skills, attitudes and beliefs (Schunk, 2000). But observation may be not the best way for young children learning to use technologies, because from a cognitivism perspective, learning is an active process so that children "learn better through their own experience, than through passive acceptance of information provided by others or through technical means" (Barak, 2006, p. 123) Barak (2006) suggested that for young children, physical experiences may be necessary for learning because 'hands-on' activities may also mean 'minds-on.'

The technologies influenced from cognitivist learning theories, such as artificial intelligence (AI) and Intelligent Tutoring Systems (ITS), demonstrate a didactic, content-specific instructional pedagogy based on individualised learning (Harasim, 2012).

Constructivism

In the 20th century, two major theorists associated with constructivist approach were: Jean Piaget and Lev Vygotsky. Piaget focused on explaining logical thinking and the reasoning process of the child in terms of biological developmental stages while Vygotsky viewed cognitive development as socially and culturally based and emphasised the social context of human development and learning (Cole & Engeström, 1993). Due to their differences in explaining human thinking and cognitive development, these two major theoretical perspectives are often classified as cognitive-development theory and

sociocultural theories (Gredler, 2001).

Cognitive-development theory. Piaget viewed learning as a process of discovery and knowledge as continuous interactions between the individual and the environment, which is known as the constructivist approach to learning (Ertmer, 2008; Gordon & Browne, 2011). He also believed that children's development goes through a series of stages to reach ability of reasoning, abstract and rational thinking, and intellectual maturity (Piaget, 1955)

Influenced by Piaget's theory of stages of cognitive development, some researchers (e.g. Elkind, 2007; Healy, 1998) argued that young children below a certain age should not use new technologies as learning resources until they reached a required intellectual stage. This argument is based on a belief that children's abstract thinking is developed from experiences with concrete materials and that teaching abstract procedures without taking into account practical, concrete problems would fail. As Yelland (2006) pointed out, one reason for the vigorous debate about the role of technology, especially of computers, is that people think computers are too abstract and only provide children with a two dimensional experience: idea and concept. Therefore young children's learning should be built on natural experience through acting on concrete materials or real-life experiences to develop and reach an appropriate state.

Sociocultural theories. Vygotsky (1962) believed that all human activities exist within social and cultural contexts. From this perspective, learning is understood as the result of complex interactions between multiple agents within a context where cultures and values are shared with other social members and strengthened by the communities, rather than solely as an internal cognitive process (Rivera, Galarza, Entz, & Tharp, 2002).

In contrast to Piaget, Vygotsky viewed instruction as the key to learning and that the potential for learning lay in interactions with more knowledgeable others (Wood, 1998). His very different theoretical orientations from Piaget have led to different images of children's development and teaching strategies, particularly, 'readiness' for learning. Vygotsky defined the Zone of Proximal Development (ZPD) as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in

collaboration with more able peers” (Vygotsky, 1978, p. 86). This concept explained that readiness requires not only children’s existing knowledge but also their capacity to learn with others’ help or assistance (Vygotsky, 1962). It also proposes that children’s development requires guidance from an adult or collaboration with more capable peers for challenge and support (Plowman & Stephen, 2005).

One of the most common ways of describing and presenting provision of assistance to support a learner to achieve potential development is the use of a building metaphor, “scaffolding”, which was developed by Wood, Bruner and Ross (1976). They viewed scaffolding as the “process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond unassisted efforts” (Wood, Bruner, & Ross, 1976, p. 90). This definition suggests if learning is mediated or scaffolded by adults or more capable peers, children are able to accomplish the task at a higher level (Rogoff & Wertsch, 1984; Yelland & Masters, 2007). The concept of scaffolding has been widely accepted in educational settings and used to present a number of different pedagogical approaches or ideas that can support learning. For example, instruction needs to gear the needs of the individual child (Wood, Bruner, & Ross, 1976) and a learning task should be suitable for children’s abilities and sustain learner’s interest, but yet to be managed (Yelland & Masters, 2007).

The role of technologies in the design of early learning environments and construction of knowledge has also been supported by the recognition of sociocultural theories of human development (Loveless, 2011). Using ICT as a tool for communication and interaction (Parette, Blum, & Quesenberry, 2013; Quesenberry, Mustian, Clarke-Bischke, & Blum, 2013) has been widely acknowledged and used as a strategic tool to enable young children and teachers to work together, which provides them with a system to facilitate the construction of their understanding, learning, teaching, and cooperation to solve the authentic tasks in real life situations (Chen & Looi, 1999; Lemon & Finger, 2013).

Inspired by Vygotsky’s view that learning is embedded in social situations and relationships (Fleer, 1995), early learning and development through the use of ICT should not only focus on the outcomes, but also specify the conditions and the learning process, which are provided and supported by teachers and surrounding environments. In this context, sociocultural theories are adopted as a theoretical framework to examine the

process of young children's ICT activities and interactions, and explain how their learning experiences are shaped by the use of ICT in preschool environments.

Research Aim and Methods

This study is one part of a larger study that involved a questionnaire, interviews and classroom observations. The study was guided by the main research question of the larger study, "what are preschool teachers' perceptions and pedagogical practices regarding young children's use of ICT in preschool." The focus of this paper was to address two sub-questions of the larger study, "what ICT resources are available in preschool classrooms" and "what do young children do with ICT when they have access to it in classrooms." The study was undertaken in two phases to achieve the purpose of examining young children's use of ICT in preschools. Phase 1 was a questionnaire study and the results were used to select classrooms for observation. In Phase 2, based on the participant's willingness and the analysis of the data in Phase 1, qualitative data were gained through the observation of young children's ICT activities.

Questionnaire

Questionnaire, a traditional quantitative source of data generation (Creswell & Plano Clark, 2006), with careful planning, can enable the researcher to obtain broad information from a large and widely distributed population within a relatively short amount of time and resources (Dörnyei & Taguchi, 2010). A self-report questionnaire is helpful to answer the research questions like 'what', 'how much' and 'how many' (Yin, 2009) and allows participants to accomplish the questionnaire at their own pace. Therefore, a self-report questionnaire is developed in the study to address a series of quantitative questions. For example, how many ICT resources are available in the preschools? How often or how much time young children use ICT in the classrooms during a week? The measurement of the amount of young children's access to ICT, such as the percentage of children using ICT devices and the type of their ICT activities, helps capture an overall picture of young

children's use of ICT in their classrooms.

Participants

Preschool teachers who were directly involved in teaching young children in an urban district in Shanghai were invited to participate. Geographical sampling was employed to select 20 public preschools in the Pu Tuo district. The selection of the urban district was because preschools in this area generally have relatively more ICT resources in ECE settings than those in suburban and rural places due to social and economic factors (Zhou, Chen, & Jin, 2009). Another reason was that public preschools in urban areas have actively been taking part in various research programmes both internally and externally. As a result, it was anticipated that teachers and young children in this district would be willing to actively participate in the study.

Observation

Different from a questionnaire, observation is one of the most straightforward ways to gain raw data and get a picture on what is going on (Cohen & Manion, 1994) in the preschools studied, which can be then useful to triangulate with questionnaire data for three reasons. First, concerning the authenticity of data collected. Although data collected by a self-reported questionnaire may be considered to be true in the sense that participants can be expected to tell the 'truth' to reflect their perspectives at that time, it is also possible that the participant may "have a conscious and deliberate intention" or unconsciously (Chan, 2010, p. 131) to do otherwise. As a complementary technique observation can be used to double check, contrast and compare participants' responses in the questionnaire through adding another method to triangulate the data. The result of observation can further add, clarify, affirm or challenge the findings in the questionnaire.

Second, children's ICT practices might be found more frequently or be more complex in their classrooms than what was reported in the questionnaire. Merriam (2009) contended that observation is the best technique to use when an activity, event, or situation can be observed firsthand. As a result, observation is commonly used in studying classroom

activities in educational research because it can yield depth and breadth and richness of data.

Finally, observation allows reality to be more directly represented and helps to develop an in-depth understanding of the phenomenon at hand because observation can provide some knowledge of the context or specific behaviours. For example, what is the physical environment like? What objects and ICT resources are in the setting? Are all young children engaged in the use of ICT in the classroom? How do the children interact with ICT and with their peers? Questions like these can be well answered only through systematic and careful field observation.

The conduct of the observation. Based on the questionnaire results and teachers' expression of willingness to participate, two classrooms from the Hongqi and Zhihui preschool (pseudonyms) were invited to take part in observations. Overall, the two selected classrooms were reported to have more ICT resources and young children had a higher access to ICT resources, compared with the other preschools surveyed.

Before conducting the observation, it was planned to spend two hours each day over a week collecting data in the classroom. During a week of observation in each preschool, the researcher noted that no new classroom activities were occurring, in particular, the children's use of ICT were almost the same on the fourth or fifth day, so observations in the fieldwork stopped when the data was 'saturated.' The total of five sessions related to young children's use of ICT was captured in each classroom, which all took place in the morning.

With the permission of both teachers and children's parents, classroom activities were videorecorded to facilitate data analysis. By using the digital video camera in the settings, the focused events were captured, but some notes about their non-verbal features were captured as well. The field notes were also used to describe the physical setting and other contextual features with a focus on children's ICT use, such as the preschool developmental goals related to the use of ICT.

Data Analysis

The quantitative data collected from the questionnaire were analysed using the Statistical Package for Social Sciences (SPSS). Analyses were undertaken to obtain background

information of the participants, the number of ICT resources, the frequency distribution of children's access to ICT resources, and to describe the type of children's ICT activities in 20 preschools.

The collected video footages were first converted into digital form and imported into the qualitative analysis software package NVivo. The videos were watched repeatedly and transcribed to gain an understanding about the children's ICT experiences. The classroom observations were analysed with a view to address the following key aspects:

- The degree of children's agency, participation, competences and engagement in ICT activities
- The way ICT was used by young children
- The children-children interactions in the process of their ICT activities;

Results

A total of 316 early childhood teachers from 20 public preschools in the Pu Tuo district of Shanghai responded to a questionnaire, providing approximately an 87.1% response rate with 98.4% of the teachers being female. Young children in most participants' (69.0%) classrooms were mainly between three and five years old. Approximately 28 children were in each observed class and most of them came from the local communities in the PuTuo district.

The data analysis generated three main data themes: young children's access to ICT resources; young children's ICT experiences; and young children's interaction with their peers during ICT use. The following section details young children's practices and experiences with the use of ICT in the classroom.

Young Children's Access to ICT Resources

Both quantitative and qualitative data reveal that the preschools surveyed had various types of ICT resources in their classrooms, but the numbers of each ICT device was quite small, mainly one or two in each classroom. The most common ICT resources reported by

the teachers in their classrooms were CD/DVD players, TV and computers. Cameras and the internet were also made available, but only a few teachers reported that they had electronic projectors and phones in their classrooms. The percentages of the teachers who reported each ICT device in the classrooms are illustrated in Figure 1.

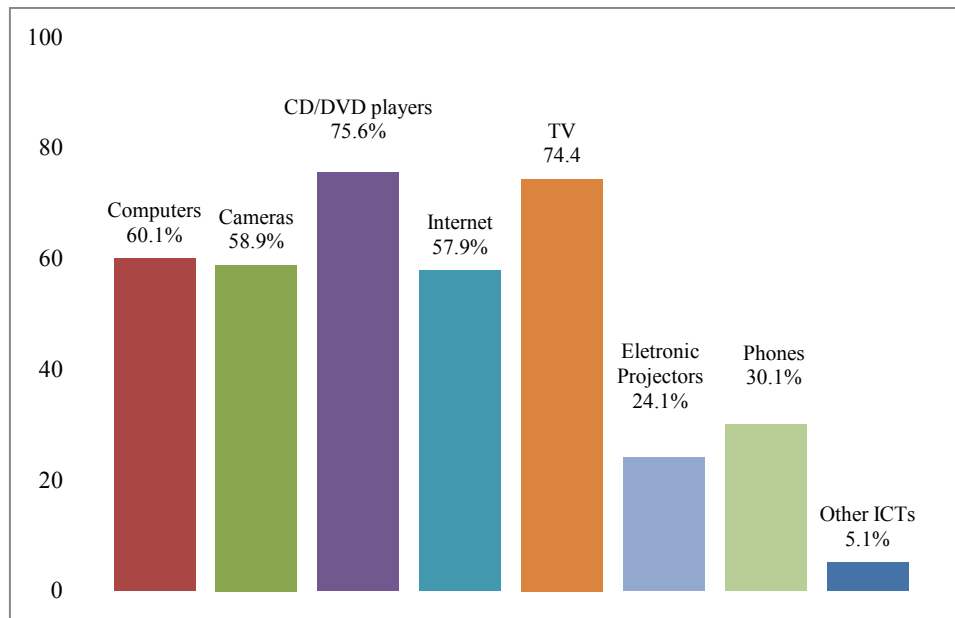


Figure 1. The Percentages of the Teachers who Reported ICT Resources in the Classrooms

The observed classrooms had a wider range of ICT resources, such as TV, CD/DVD players, tape recorders, e-pens, interactive books, headphones, cameras, internet connections, video cameras and desk computers. But the numbers of each device were small when viewed from individual children's usage. For instance, there were only four desk computers in the computer laboratory for a class with about 28 children at Zhihui preschool, thus seven children shared one computer during their play of computer games.

The teachers' responses further demonstrated that computers in the preschools were mainly located in a teacher-only area (e.g. staffroom and teachers' offices) and administration area, whereas about a third of the participants indicated that computers were placed in the children's classrooms. The percentages of the teachers who reported the location of computers in preschools are shown in Table 1.

Table 1. *The Percentages of the Teachers Who Reported Computer Location*

Administration Area	Children's Classroom	Computer Lab	Teacher- Only Area	Another Location
46.0%	37.8%	19.0%	81.0%	4.7%

Most of the teachers reported that principals and the teachers used computers in the preschools. In contrast, only a small number of the teachers answered that young children used computers in their preschools, as shown in Table 2.

Table 2. *The Percentages of the Teachers Who Reported Computer Use*

Principals	Teachers	Children	Administration Staff	Parents	Communities	Others
82.6%	99.4%	11.1%	3.2%	2.2%	0.6%	0.3%

The majority of the teachers (71.4%) indicated that less than a quarter of the children in their classrooms used computers in the previous week, whereas only a small percentage (3.5%) of the teachers reported that more than three quarters of the children had used computers in their classrooms in the last week. Furthermore, about 70.0% of the teachers reported that most children's time spent on computers in the classrooms was less than one hour over a week.

According to the teachers' responses, most computers in the preschools were mainly used for the purpose of teaching and management, instead of as a learning tool for children to explore. A small number of classrooms had computers, but access to them was only available to relatively few individuals for a very short time and the children did not have equal opportunities to use them.

Young Children's ICT Experiences

The teachers were asked to indicate how often most children engaged in ICT activities in

their classrooms over a month. Watching TV/DVD/videos (7.81 times per month) was the most frequent activity that the children engaged in while in their classrooms, followed by taking photos on cameras (4.27 times per month) and using educational software programs (4.05 times per month). The least common ICT activities were playing games and other types of ICT activities. It is interesting to note that the children's active use of ICT in their classrooms, such as making videos and creating their own work or presentations were much less than the above three most frequent ICT activities. About two-thirds of the teachers reported that the children did not engage in five types of ICT activities in their preschools during a month, namely, making videos, searching the internet, creating their own work/presentations and sending and receiving emails, as well as talking on the phones.

The observation data show that the children's hands-on experiences were mainly reading interactive books with e-pens and earphones, and playing computer games. Their most frequent ICT practice was clicking icons to select answers on the screen and pressing buttons on e-pens to read interactive books. During preschool daily group teaching, the children usually sat on chairs and watched digital programs (e.g. pictures, videos and animated cartoon stories) on the screen, which were played by their teachers.

Although the children had a low access to ICT and limited ICT activities, they were very excited about using ICT and were joyful and active in seeking chance to use it. They also experienced success and pleasure in the process of their ICT activities. There were many occasions when their teachers planned to choose children to use ICT devices, such as e-pens, most children raised their hands high to gain the teacher's attention so they could be selected.

At Zhihui preschool, when the whole class went into the computer lab to play computer games, many children immediately ran to computers and some of them quickly grabbed front seats in order to use the mouse and touch the screen. It was observed that the children, especially boys who sat closer to the screen in the first row had many more chances to click on-screen icons than those in the second row. During computer games, almost all the children actively participated in the play as they stood up and concentrated on watching the screen, as well as discussed which icon was the right answer. They often exclaimed for their success and loudly reported their successful results to their teachers with a sense of pride.

Most children were able to connect earphones to e-pens, open software and play programs on computers for play and learning. For instance, in the preschool library, the children could put on earphones and plug them to e-pens. Then they used e-pens to click and read interactive books. However, there were several children who could not use the computer mouse to click on-screen icons.

Young Children's Interaction with Peers during ICT Use

During their ICT activities, the children had frequent interactions and collaboration with their peers. Some of these peer interactions spontaneously took place without their teachers' presence, which had scaffolded their peers' learning. For instance, when the teacher at Hongqi preschool called a girl to select an icon to fill in the water transition circle, the rest of the children reminded her not to forget to click the Chinese characters to get clues for the task. A few children supported their peers by giving their advice and instructions in clicking and dragging icons. Some spoke out their answers directly to help the children who were doing their tasks.

Peer teaching was also evident during their interactions, which had helped the children to achieve the learning tasks as a team. For example, in one session, the whole class came to the computer lab and played computer games. This game requires the children to remember four consecutive locations which a frog had jumped on a map. Then the children needed to memorise the same track and quickly click previous locations on the map for another frog to jump. During the game, a boy as the team leader looked back at his members and asked: "Who should remember the first step?" A boy and a girl immediately raised their hands. This leader loudly said to them "memorise the first step." Both the boy and the girl stood up and pointed to the location that the frog jumped on the screen. The leader repeatedly gave similar instructions to the other team members until all the tasks were distributed.

Notably, their teachers set up the environment for the children's use of ICT and organised physical spaces for them sharing the use of ICT in pairs or groups. During the children's ICT activities, the teachers often stood behind or beside the children and watched their use of ICT devices, but they immediately provided help to the children when technical problems occurred. While the children encountered difficulties in achieving computer game

tasks, the teachers frequently reminded them to collaborate in a team to complete the tasks. Sometimes, they also gave direct instructions to tell individual children what to do or solved problems for the children.

Discussion

Young Children's Low Access to ICT

This study reveals that young children's use of ICT in the preschools was not a common activity in their classrooms. Such finding is consistent with previous literature from China and elsewhere (Guo, Qian, Wang, & Zeng, 2006; Siraj-Blatchford, Sylva, Muttock, Gilden, & Bell, 2002; Xiao, Quan, Bi, & Zhao, 2012; Zevenbergen & Logan, 2008), indicating that technologies have been embraced by early childhood teachers, but young children's access to them, particularly computers, is much less in preschools. However, the study shows that electronic literacy materials (e.g. interactive books, e-pens and e-paper) were relatively rich in terms of varieties and numbers, which infiltrated into the learning environments in both observed classrooms. This is because the two preschools heavily stressed the importance of developing literacy abilities and such emphasis had influenced their provision of interactive literacy resources for the children. It is worth noting that the focus on improving reading was related to a traditional Chinese view that reading is the only effective means of learning. Reading and learning are often taken as synonyms in Chinese (OECD, 2011).

Young children's low access to ICT was related to inadequate ICT resources in the classrooms. Performance of specific behaviours "depends at least to some degree on availability of requisite opportunities and resources," which to some extent determine the likelihood of behaviours and achievement of actions (Ajzen, 1991, p. 182). The availability of ICT resources like hardware numbers, functions and qualities is a critical factor in influencing young children's use of ICT and the outcome of ICT integration for early learning and development. Although ICT had permeated into the preschools, this study shows that the number of ICT devices in the classroom was limited, when considering the number of children in each classroom. Particularly, when approximately one or two

computers in most children's classrooms were available, the children could only use them for short periods of time in turns, limiting the potential for the children working together with the use of ICT to develop problem-solving skills and sustained shared thinking.

With regard to ICT resources, several Shanghai ECE policies (e.g. *Shanghai Early Childhood Education Curriculum Guidelines*) emphasised the need for ICT infrastructure and its use for improving the quality of ECE. The provision of ICT resources in classrooms to extend learning resources and provide young children with opportunities to explore environments is also explicitly advocated in the policy *Early Childhood Education Equipment Regulations* (Shanghai Education Commission, 2006). However, a low or no access to ICT resources for the children in this study conflicts with the statements made in these policies, which reveals challenges in integrating ICT into ECE classrooms and issues in the implementation of these policies.

Young Children's Simple and Passive ICT Use

The children's simple and passive ICT use in the classrooms was linked to their available teaching and learning software. Notably, a feature of the software both the teachers and the children used was coloured by behaviourist views of learning because it was designed with specific steps and a mechanisation of the learning process to encourage the children to practise and memorise learning tasks. As a result, the children were required to remember the content and try out their answers and passively respond to the task set by the software. This way of using technologies from the behaviourist perspectives mirrors traditional classroom practices (Koç, 2005) because the predetermined learning content is focusing on the acquisition of lower-level skills and children as users do not have opportunities to explore authentic and creative learning. While some authors criticised this approach to technology use, especially computer and software use, a lack of meaningful use of computers and software such as drill-and-practices is still common in elementary and childhood education (Finegan & Austin, 2002; Leung, 2010; Paciga, Lisy, & Teale, 2013; Yelland, 2001).

Although the drill-and-practice software programs encourage turn-taking behaviours and competitive spirits, they may limit children's imagination, curiosity and creativity in

exploring possibilities of new learning (Clements & Sarama, 2003). In fact, the US *National Association for the Education of Young Children* (NAEYC) and the UK project *Developmentally Appropriate Technology in Early Childhood* considers the use of drill and practice software less appropriate in early years (Siraj-Blatchford & Siraj-Blatchford, 2006). A key element of the technology that can make a unique contribution to early learning is the availability of developmentally appropriate software (Clements & Sarama, 2003). In early childhood, diverse and open-ended materials could provide children with more ways and more scope to explore the potential in the materials and children can develop their literacy, science, mathematics and creativity joyfully through active play with these materials (Drew & Baji, 2004).

It is worth pointing out that the demand for high quality educational software for Shanghai preschool teachers was noted earlier (Guo, Qian, Wang, & Zeng, 2006), revealing the lack of appropriate software as a barrier for teachers in Shanghai preschools to integrate ICT into the classroom. Evidence from this study suggests this issue has continued to be a concern to this day. Overall, a low or no access to adequate and appropriate ICT resources for this group of children is not consistent with the developmental goals of establishing a learning society supported by ICT resources for every learner made in the *National Medium and Long-term Educational Reform and Development Program (2011-2020)* (Ministry of Education, 2010). It also conflicts with the ambition of equipping the new generation with ICT knowledge and skills for the Information Society as stated in this policy.

Early Childhood Teachers' Lack of Effective Pedagogies

This study reveals that the use of ICT has been limited to teaching children how to use ICT devices, such as opening computer programs and pressing buttons, and mouse skills instead of encouraging learning with and through the use of ICT. Moreover, the children's repeated mouse clicks and touching on-screen icons appeared to be easy for most children, which indicate that the teachers did not provide a higher level of cognitive challenges to motivate them to engage in learning and to achieve their potential development. In fact, the teachers also often acted as observers and technique trouble-shooters during the children's ICT use, instead of using a wide range of pedagogical approach to facilitate and extend

early learning and development within learning communities through using ICT. These results show that the teachers lacked effective pedagogies that can integrate ICT into early learning and development.

Based on the conclusive evidence drawn on the UK project *Researching Effective Pedagogy in the Early Years* (REPEY), effective pedagogy should “assess children’s performance to ensure the provision of challenging yet achievable experiences” (Siraj-Blatchford, 2004, p. 146). In other words, learning tasks and materials should interest and challenge the children and allow them to solve problems through active discovery (MacNaughton, 2003). According to Piaget’s theory of learning process, learning can be triggered when disequilibrium or discrepancies between what children already know and new phenomenon or experience occur (Harrison, Lee, O'Rourke, & Yelland, 2009). In this sense, if the teachers in Shanghai preschools can recognise the children’s current ICT competences and dispositions and provide them with authentic opportunities with appropriate challenges in ICT activities, then they would be better to support young children’s learning in ways that “have implications” for them (Plowman, McPake, & Stephen, 2012, p. 102).

Young Children’s Positive Experiences with ICT

Although the children had a very low access to ICT and simple, passive use in the preschools, they were enthusiastic, joyful and curious when they did have opportunities for ICT based activities. Their achievements and pleasure with ICT, enthusiasm and high interest in using ICT contrast with the findings of Plowman and Stephen (2005). The authors noted that young children seldom used computers in observed free-play sessions and they even ignored them and preferred to play outside or use other materials. They reported boredom, disengagement and frustration were common with young children’s ICT activities in play because of operational difficulties and lack of adult support. There are three possible reasons to explain this difference. First, ease of use might contribute to their positive feelings with ICT. The children’s ICT activities in this study were simple and even repetitive such as doing mouse clicks, which was not challenging for most children. Second, inadequate ICT resources and the limited usage were possible reasons for raised motivation

as the children might be more interested in ‘uncommon’ materials and more curious for rare using opportunities. Third, their studies were conducted in a different cultural context 10 years ago, but there are probably many more new technologies with lower cost now available in Shanghai preschool classrooms. The increasing availability of ICT in their living environment can shape the children’s interest, knowledge and skills in using ICT.

The children’s positive experiences with ICT in this study is consistent with another study (McPake, Stephen, Plowman, Sime, & Downey, 2005), which reveals that most children aged 3-5 were enthusiastic about the use of ICT and had an interest in using the equipment, especially computers. Particularly, boys in the classroom were generally more active in seeking opportunities to play computer games and engaging in activities. This observation supports a view that difference in computer use by genders was emerging at a very early age (Zevenbergen & Logan, 2008), as boys were more frequent users of the computers for different activities and more likely to play computer games than girls.

The observations show that most children had acquired ICT operational skills for learning and play. This result provides evidence for the argument that many children had experiences of using a broad range of technologies and they were already in possession of ICT knowledge and competencies (Marsh, 2005; Plowman, McPake, & Stephen, 2010; Zevenbergen & Logan, 2008). The study has also supported the claim that young children’s social and emotional development was enhanced by their use of ICT as they collaborated and communicated with peers in order to complete the game tasks, and experienced joy and a sense of pride in this process. These data provide evidence for the proposition that engaging with ICT can support the development of learning dispositions such as motivation, concentration, a sense of pride and achievement (O’Hara, 2008). Together these findings of ICT benefits for the children challenge many claims of negative effects of ICT on early learning (e.g. Cordes & Miller, 2004; Healy, 1998) made in opposition to young children’s use of ICT. For example, House (2012) argued screen-based media at an early age can interfere with children’s attention skills, abilities in acquiring literacy skills and children’s capacity to read for pleasure.

Conclusion

This study has identified a strong need for sufficient, reliable hardware and appropriate software for young children in the preschools. Adequate and equitable access to functioning and reliable hardware and high quality software in ECE settings can facilitate teachers and young children to incorporate these resources into their learning programs. With equal access to sufficient and reliable ICT materials, all young children could have opportunities to initiate spontaneous play with ICT or to design their own ICT activities for ongoing, creative and project focused integrated learning.

Young children's increasing competences and experiences with the use of ICT suggests that EC teachers need to develop effective pedagogies that can respond to changes and challenges. For this purpose, it is important for the teachers to discover and pay attention to skills, knowledge and experiences that children have already acquired in their families and communities and incorporate these into their pedagogy so that they can extend greater continuity and connection to children's lived experiences and developmental level.

Limitations and Future Research

Although the scope of this study was broad and the data from the survey were obtained from 20 public preschools, the survey was not distributed to private preschools in urban areas and preschools in rural areas, which also play an important role in the ECE system in Shanghai. The age group of children in the study was mainly between 4 and 5, but young children at 3 and at 6 in the preschools were not included. Thus, this study can be replicated with children in other age groups in private preschools or preschools in suburban and rural areas across China to extend its scope and provide an in-depth understanding of the phenomena of young children's use of ICT.

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