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## Abstract

With the ever-diversifying digital landscape of the 21st century, terms such as 'information and communication technologies' (ICT), 'digital media' and 'technologies' are often used to refer to a broad set of digital devices and applications. However, the use of these umbrella-concepts in educational contexts has caused issues when used in conjunction with concepts such as affordances and integration. In this paper, eight Chinese preservice early childhood teachers' perceptions of ICT and its affordances are explored through online interviews. The participants conceptualised 'ICT' as screen-based technologies such as interactive whiteboards and computers. These technologies were perceived to afford efficiency and assistance, particularly for teacher-centred practice, but to constrain children's tactile and direct hands-on experience. The results highlight the importance of sociocultural contexts (e.g. practicum places and educational traditions) in shaping preservice teachers' perceptions of technology and technology use. Implications for future technology integration research and teacher education are discussed.

## Keywords

Preservice teachers, early childhood education, technology, ICT and affordances

## Abbreviations:

ICT: Information and communication technology; ECE: early childhood education; EC: early childhood; PSTs: Preservice early childhood teachers

## INTRODUCTION

Already more than a decade ago Plowman and Stephen (2006) were encouraging early childhood (EC) practitioners to expand their definition of information and communication technologies (ICT) 'to include digital still and video cameras, mobile phones, electronic keyboards' (p. 3), rather than referring to ICT just as computers. Due to the introduction of touch-screen technologies and -more recently- the internet of things and educational robotics, the technological landscape is now more diverse than ever. But is it so in EC practitioners' minds?

In this paper, we explore what ICT Chinese preservice early childhood teachers (PSTs) think when they are asked about ICT use in early childhood education (ECE). Our second research interest is to investigate the kinds of benefits and constraints preservice teachers read from these technologies by using affordance theory (Norman 1988) as our theoretical base. Third, and last, we will explore the contextual factors behind

PSTs' perceptions of ICT and its affordances. The following three research questions have guided the research process.

- (1) Which ICTs do preservice teachers refer to when they discuss ICT use in ECE? (2)
- (2) What kinds of affordances do preservice teachers perceive ICT to provide/not to provide?
- (3) What (contextual) factors have influenced their perceptions of ICT and ICT use?

By providing answers to these questions, the present study contributes to the theoretical development of technology integration research, which has been criticized as under-theorised (Costa, Hammond, and Younie 2017). PSTs are an under-represented group of informants in early childhood technology integration research and by having China as the research context this study diversifies the cultural and geographical reserve in teacher research in the early years technology integration context, which currently is dominated by studies conducted in Western countries. In this study, early childhood education refers to institutional education for children from 0 to 8 years old whereas perceptions are about individual understanding and views.

## **THEORETICAL AND CONTEXTUAL BACKGROUND**

### **ICT integration and affordance theory**

The field of educational technology research is conceptually scattered. A review of recent research reveals that in the ECE context alone, concepts such as 'technology', 'digital technologies', 'ICT', 'digital media' are used interchangeably to refer to a broad set of digital devices and applications (Stephen and Edwards 2018; Dong 2018; Mertala 2017a). In this paper, we have chosen to use the term 'ICT', that being the one used in Chinese pedagogical documents and curriculum guidelines (Ministry of Education 2012a).

Similar vagueness exists in discourses around the concept of ICT integration which is often used synonymously with ICT use (Lloyd 2005). Such a straightforward alignment is problematic as ICT integration is a more complicated phenomenon than the mere use of digital devices and software. To integrate, as defined by Merriam Webster online dictionary is 'to form, coordinate, or blend into a functioning or unified whole'. To put this definition in context, ICT integration refers to organizing the goals of curriculum and ICT into a complex but coordinated and harmonious entity (Robertson, Webb, and Fluck 2007; Lloyd 2005). In other words, integration is possible only if the (particular) ICT includes features that are in correspondence with teachers' pedagogical values. As put by Ottenbreit-Leftwich et al. (2010)

when a new pedagogical approach or tool is presented, teachers make value judgments about whether that approach or tool is relevant to their goals. The more valuable they judge an approach or tool to be, the more likely they are to use it. (1322).

The value of the new tool can be conceptualized as an affordance, a term which originated from Gibson's theory of ecological perception (Gibson 1979) and was further defined by Norman in his seminal work 'The Psychology of Everyday Things' (1988, 9) as referring 'to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used'. Norman's ideas have been influential for human-computer- interaction research and technology integration research, and a more specific term of 'technology affordances' has been coined to approach the perceived functions and properties of digital technologies (Hutchby 2001; Mao 2014). However, the use of umbrella-concept such as ICT, technology, or digital media causes notable issues when used in conjunction with concepts such as affordances and integration. This problem is pertinently captured in Palaiologou's (2016) definition of digital devices as

a collective term for all equipment that contains a computer or microcontroller and to which adults and children might have access, a list which now includes toys, games consoles, digital cameras, media players and smartphones as well as handheld, laptop or desktop computers (p. 305).

Many of the items listed in the above quote have more differences than similarities. Some of them enable mobility (i.e. smartphones and media players) while others are stand-alone devices (desktop computers). Some of them are screen-based (i.e. laptops) whereas others are tangible objects (i.e. toys). In other words, each of these technologies evokes different kinds of affordances, some more and others less in line with teachers' pedagogical values. For example, it has been argued that the difficulties of integrating desktop computers into ECE can be largely explained by the mismatch between the tactile and embodied tradition of ECE and the affordances of desktops (Lindahl and Folkesson 2012). Children can manipulate digital objectives only via mouse or keyboard and they must sit in one place to be able to use the computers while teachers appreciate exploratory learning, direct and physical interaction with materials and learning activities which involve movement (Abu-Jaber, Al-Shawareb, and Gheith 2010; Mertala 2017b).

By using the term 'tradition' this study acknowledges that teachers' pedagogical values are always constructed within historical, cultural, and social conditions (Rogoff 2003). The role of the sociocultural environment for the variety of affordances subjects are able to read from artifacts is also emphasized in Norman's (1988) original work as well as in more recent literature (Mao 2014) of affordance theory. In the most evident and simple form, this means that the social environment influences the kind of affordances one can perceive from given artifacts. An example to illustrate this point is that research has identified that the ways teachers use technology are often copied from colleagues they consider more competent than them (Mertala 2017b).

### **Traditions of Chinese early childhood education**

Dong and Newman (2018) studied Chinese EC teachers and found that many teachers thought that the whole class should do the same technology mediated activities at the same time. According to the authors, such a view was likely inherited from Chinese culture and communist ideology, which value unity, order, collectivism and control and it has influenced Chinese early years curricula, as well as teacher education and professional training (see also Liu and Elicker 2005; Wang and Mao 1996). In the Chinese educational tradition, organisation, administration and detailed lesson plans are viewed as good preparation for teaching and the basis for good professional performance (Wang and Mao 1996). The focus on planning lessons has a pedagogical root in following the former Soviet Union Model of curriculum, which came to China in the 1950s and advised that teachers instruct children in purposeful and planned activities. Influenced by this model, early childhood programs specified unified content and schedules and required teachers to teach individual subjects (Zhu and Zhang 2008).

Another main influencer has been Confucianism, which played a dominant role in shaping traditional Chinese culture and the social system for over two thousand years. As Tobin, Wu, and Davidson (1989, 122) noted, Chinese early childhood education is 'the product of a fusion of political ideology and cultural tradition,' and daily routines are characterised by an emphasis on 'peace', 'good order' and 'harmony' with a purpose of shaping and fitting every individual into a harmonious society.

To conclude, members of the current generation of PSTs have been encultured to these traditions and values from the day they first entered an ECE center as a child. To cite Barak (2006) they are passing on educational culture unconsciously in their practices as 'the way teachers teach relates strongly to the way they have been taught.' (Barak 2006, 131). Since ICT integration is a rather new phenomenon in Chinese ECE (Ministry of Education 2012a), PSTs do not have prior experience of it as and teaching practicums can therefore be influential for what preservice teachers think ICT integration should (or should not) be like (Hu and Yelland 2017).

### **ICT in Chinese early childhood education**

In Western contexts, the debate around the role of ICT in ECE has changed in focus, from whether or not young children should use it, to how best ICT can be used to support early learning and development (Mertala 2017a). It has been suggested, that ICT can contribute to several areas of learning including extending knowledge and understanding of the world, and acquiring operational skills (Plowman, McPake, and Stephen 2012). Consequently, western educational policies and curricula (Stephen and Edwards 2018) have emphasised the importance of effectively integrating ICT into ECE contexts in order to harness ICT's power to enhance learning and teaching.

In China, the government has been actively facilitating educational modernisation through the use of ICT to enhance children's competitive knowledge and skills in the technological world (State Council 2001; Ministry of Education 2012b). The government issued the Ten-Year Development Plan on ICT in Education (2011–2020) to harness the power of ICT for developing creative citizens for the future and increasing national competitiveness (Ministry of Education 2012b). This plan stipulates developing ICT infrastructure for different kinds of educational institutions including ECE settings and suggests that all teachers should basically meet the standards of ICT competency by 2020. According to the ICT Competency Standards for Primary and High School Teachers (Ministry of Education 2004), school teachers are required to effectively integrate ICT into their curriculum being able to efficiently and effectively use ICT to support and manage teaching and learning activities, and to communicate and collaborate with children and their families (Ministry of Education 2004).

A review of the Chinese educational policy documents suggests that the development of ICT infrastructure and teacher training prioritizes school settings and school teachers over EC centers and EC teachers. There is no specific national ICT policy for the ECE system and ICT professional development for EC teachers is scarcely mentioned. The National Guidelines for Learning and Development of Children Aged 3–6 (Ministry of Education 2012a) states that children should develop a preliminary understanding about the relationship between technologies and their own lives and understand the positive and negative effects of technologies. For this purpose, teachers are required to 'lead and guide children to understand the relationship between technological products and people's lives, and discuss the effects of technologies' (Ministry of Education 2001, Science, para 2), without explicit reference to pedagogical practices.

Additionally, some regional guidelines have been produced especially in major cities like Beijing and Shanghai. For instance, the Shanghai Education Commission (2006) explicitly states that the availability and application of ICT should meet the needs of teaching and promote communication between preschools, parents and communities. To sum up, even though some general-level suggestions exist, it can be argued that policy documents or curricula have not provided specific guidance, examples and support for EC teachers to integrate ICT into everyday work with children, which means that teachers have to 'make their own decisions about the nature and extent of ICT use in children's learning' (Bolstad 2004, ix).

## **METHODS**

### **Participants**

This study is one part of a broader mixed methods study that involved a questionnaire and interviews. In phase one of the questionnaire study (in review), a total of 21 participants expressed their willingness to

participate in the interviews which – to cite Merriam (2009, 88) – are the ‘best technique to use when conducting intensive case studies’ of several selected individual cases. Eight PSTs were chosen for online Skype interviews via purposeful sampling, which here meant that that age and gender-wise the participants should represent the majority of Chinese EC PSTs. Additionally, it was thought that final-year PSTs would be the most information-rich cases as they have completed their required practicum in various childhood educational settings and gained relevant professional learning and practical experience over their four years of study. Table 1 summarizes the background information of the participants.

Table 1. Background information of the participants

Background information	Participants	Notes
<b>Gender</b>	All female	Representative as the most preservice and in-service EC teachers in China are female (Xu and Wangangayake 2017).
<b>Age</b>	20–22	Representative as the vast majority of PSTs attend to their initial training straight after high school (Zhu 2008).
<b>Stage of studies</b>	Final year in a 4-year bachelors-degree program	Informant rich cases as they had completed their required practicums and were close to obtaining their degree
<b>ICT training</b>	As part of their early childhood degree program, the participants were required to complete foundational technology courses in their teacher education institution to learn basic computer skills. No pedagogical themes and aspects were included in these courses.	Representative as the common approach to developing teachers’ technology competency in Chinese teacher education institutions is to offer foundational computer training courses which teach the basic computer knowledge and skills such as using Word and Excel (Hang and Wang 2010)
<b>Personal ICT use</b>	All owned a personal laptop and mobile phone. All used social media, and some played digital games	Representative as the national survey reveals most teenagers and young adolescents own PCs and mobile phones, as well as having internet access (Li and Ranieri 2009).
<b>Geographical location</b>	North-western regions	Socioeconomic status and high technology infrastructure in this region are lower than that of other coastal areas (Sun 2013)

### Interview procedure

The first author, who was responsible for conducting the interviews, was located in Australia and the interviewees were in China. The interviews were therefore conducted via Skype™, a telecommunications application for video conferences and voice calls. The participants were given the opportunity to choose their preferred place, day and time for their interviews which were conducted in December 2017. The interviews were guided by a list of questions which is provided in Figure 1. Translations into the participants’ mother tongue, Mandarin, were carefully prepared in advance and piloted with four PSTs to avoid errors or misinterpretation of translation. Drawing from the feedback, the interview questions were re-read, discussed and modified in collaboration with a local ECE lecturer.

### **Interview Questions**

1. What are important learning experiences or activities for young children in ECE settings?
2. How do you see the place of ICT in these important experiences or activities?
3. What are the effects of young children's use of ICT?
4. What is your opinion on young children's use of ICT at home?
5. From your point of view, what is the appropriate use of ICT in early childhood education?
6. In your opinion, how can ICT be used effectively for supporting children's learning and development?
7. What are your experiences with the use of ICT in your daily life or professional practices?

Figure 1. Early childhood preservice teachers' experience with ICT.

Whilst the interviews were conducted online, we adhered to ethical norms in research and considered ethical issues as for face-to-face interviews. The participants were informed about the nature of the study and what would be expected of them. They were clearly advised that participation in this study was voluntary and they could withdraw from the study at any time without giving any reasons. Additionally, the participants were made aware that online interview data might be accessed and stored by a third party (in China, Skype's Terms of Use state that personal information is subject to government use), therefore all the interviews were strictly centred on the research topic without revealing any privacy information or discussing any sensitive topics. All the interviews were audio recorded with the permission of the participants to facilitate data transcription and analysis. The length of the interviews ranged from 50 to 65 minutes.

### **Data and analysis**

The data were fully transcribed in Chinese and consisted of 72 pages. Since the participants and the first author spoke the same language, the initial coding – which usually stays close to the data (Nes et al. 2010)- was done by using the Chinese. The codes and selections of data were then translated from Mandarin to English, involving a process of checks and reviews, which involved the assistance of a native Chinese-speaking lecturer at an Australian university and a professional translator. The original audio recordings and transcription were often re-examined to increase understanding of the participants' intended meanings and culture-specific words and their meanings were reviewed many times to avoid potential loss of meaning.

The initial codes for the data analysis were mainly descriptive, which summarises the data segments and in turn provides the basis for high-order coding and searching for themes and patterns (Punch 2000). Using NVivo software, the interview data were coded into several meaningful broad categories, based on the interview questions and the participants' responses. The process of constructing categories and coding the interviews was cyclical and iterative, and was continued until all the codes were sufficiently comprehensive to capture all the important perspectives of the PSTs. For instance, PSTs' narratives of children's ICT use – watching videos revealing that they viewed ICT as screen-based technologies. Further, they were concerned about watching videos resulting in a lack of direct learning experience for young children, which was coded under a broader theme 'ICT constraints,' as exemplified in Table 2.

Table 2. Examples of data analysis.

	<b>Example 1</b>	<b>Example 2</b>
<b>Data extract</b>	I think children watching digital videos is not a direct learning experience	I think electronic whiteboards are very necessary. For instance, when I teach science to young children such as the growth of a butterfly which is a long process for children to experience this, using PPT and videos probably can let children understand this
<b>Technology</b>	Screen-based technologies (watching videos)	Screen-based technologies (showing videos and PPT-shows on electronic whiteboards)
<b>Affordances and Constraints</b>	Constrain: Screen-based technologies do not afford desirable learning experiences	Affords efficiency: using PPT and videos help children to understand the long and complicated process of transformation of butterfly in a short time.
<b>Abstraction</b>	Screen-based technologies were mainly used by teachers to display teaching to children, although they believed that children would not acquire hands-on experience, revealing a strong tradition of teacher-centred approach.	When PSTs discussed their use of electronic whiteboard with the feature of touch screen, they did not think of possibilities for children to explore and use and the touch-operating feature of such technology was not discussed at all.

In total, there were three main themes generated from the data: ICT is screen-based technology; ICT affords efficiency and assistance, and ICT Constrain direct learning experiences.

## **FINDINGS AND DISCUSSION**

The findings of the study are provided in two main sections. The first one focuses on participating PSTs' perceptions of ICT as well as on the roots of these perceptions. The second one discusses the kinds of pedagogical affordances and constraints the participants saw in these ICTs

### **ICT is screen-based technology**



The first research question this study sought to answer was which ICTs do preservice teachers refer to when they discuss ICT use? Based on the data, preservice teachers conceptualize ICT as screen-based technologies such as interactive whiteboards, desktop and laptop computers, e-projectors and smartphones, as well as educational software and applications that can be used on these devices. These resources are similar to those used in various settings in the Shanghai area (Dong 2016b) and with respect to the third research question – what (contextual) factors have influenced their perceptions of ICT and ICT use we noticed that the participating PSTs often referred to the digital resources of their teaching practicum places.

First, we have computers, digital screens and electronic whiteboards, as well as surveillance cameras, which is also a type of ICT. We also have an e-projector but we do not use it. We only use electronic whiteboards. [Yi].

Notably, the PSTs seldom mentioned portable touch screen tablets such as iPad and programmable robotic toys (e.g. BeeBots, Cubetto), which are increasingly present in many children’s everyday life (Ofcom 2017; Chaudron 2015). Globally, the number of families who own digital technologies continues to rise and the proportion of young children who access digital media on mobile technologies and own their own tablet or smartphone is growing (Stephen and Edwards 2018). It is thus important for educators to consider technology use from a sociocultural perspective and reflect on home and community environments surrounding the children they teach. In doing so, educators need to broaden their understanding of the range of technologies and provide technology environments that can make connections to, and extend, their existing technology experience.

### **Affordances and constraints of ICT**

The second question this study sought to answer was what kinds of affordances do preservice teachers perceive these ICTs to provide/not to provide? As a result, we found that the participating PSTs thought ICT affords efficiency and assistance, but -at the same time- constrains tactile ‘hands-on’ learning opportunities. Common to all the views was that ICT was understood as a teachers’ resource. Such reading of affordances appears to be shaped by the Chinese teaching tradition that emphasizes lecturing and demonstration (Wang and Mao 1996). This statement is perhaps best illustrated by the fact, that even though some centres had robots, they were used only for display purposes, and children were not allowed to use them:

My practicum centre has recently introduced robots, which can interact and dialogue . . .  
Teachers do not give them to children to use. They are for displaying. [Ai].

Next, we will discuss the perceived affordances and constraints in more detail in their own subsections.

#### ***ICT affords efficiency***

Several participants described ICT as a necessity for 21st-century early childhood education. Often, these views were based on the idea that ICT mediated teaching would be more effective than the use of traditional methods. In other words, ICT was not read to have pedagogical transformative power, but it was merely considered as a new tool to carry out traditional teacher-centred and teacher-initiated practices in a more efficient manner. As explained by Yang:

In my view, technology has brought convenience to teachers. This is because teachers in the past did not have power points and e-projectors. They all had to use chalk to write and draw on the blackboard for children to watch and observe. It is just a change of the media [for teaching].

Two different lines of perceptions were recognized: According to the first one, ICT mediated practices were thought to intensify children's learning processes. This perception is well illustrated in the following extract in which Ji explained the benefits of using multimedia presentations to study the metamorphosis of a butterfly.

I think electronic whiteboards are very necessary. For instance, when I teach science to young children, such as the growth of a butterfly, which is a long process for children to experience, using PPT [Power Point] and videos probably can let children understand this process in a short time. (Ji).

Second, ICT use was believed to provide better means for whole class instruction than the use of traditional materials.

The effect of using digital teaching resources or Power Points is better than traditional items. It also makes it easier for children to understand or learn. This is a good side. In group teaching activities, using digital devices to replace previous blackboards is fine and necessary, which allows many children to draw at the same time. (Du).

These notions are similar to those noted by Dong and Newman (2018) who identified that in-service preschool teachers in Shanghai believed that children do not need to use ICT during group teaching, but only to watch teachers' demonstrations on screens. Their perceived ICT affordances, replacing old teaching facilities, have suited the purposes (demonstrating teaching and instructing learning content to children) they have in mind. In contrast, the PSTs valued the use of ICT to transmit knowledge to children to enhance their memorisation of learning content, which has been considered as a criterion to assess the appropriate use of technology.

The quality – teaching result after using ICT is the most direct way [to judge appropriate ICT use]. If ICT is used, the result is not good. Then I think it doesn't make much sense to use it. If

you don't use ICT, this class is very successful and children also perform well. After a while, children can recall and remember the content of this lesson. I think lessons without using ICT are fine. The appropriateness is finally judged based on the results presented . . . .In a lesson, children watched a video about a scientific experiment with oxygen. After a few days they were asked what is oxygen and the importance of oxygen in our life. Children were only focused on watching the video and did not remember much. This is a failure. The feedback you receive from children after a few days or months is the most important. Using this as a criterion to judge I think is relatively fair. (Yi).

First, the appropriateness needs to be judged based on the purpose of activities or your aim of using technologies. For example, If they are used to deliver and teach knowledge, I think it is fine. (Ji)

Wang and Mao (1996) have pointed out that Chinese early childhood traditional teaching is mainly done by lecture and demonstration so using ICT as a display tool in these E participating PSTs' teaching has reinforced their traditional teacher-centred pedagogical practices. The data also contained some interesting insights on how ICT can be used to intensify daily routines, other than supporting teaching and learning. Fan, for example, described how ICT could be used to play relaxing music to help the children calm down when needed, which interlinks with the traditional organization of daily routines, characterised by an emphasis on "peace' and 'good order' (Liu and Elicker 2005; Tobin, Wu, and Davidson 1989).

As a student teacher in the centre, the use of ICT in daily activities, not in teaching, can regulate children's whole or half day emotions and mood. For example, teachers playing soft music on a computer can help children calm down after outdoor activities or help them get to sleep calmly after lunch. (Fan).

Tobin and others (1989, 122) noted that Chinese culture values 'unity, collectivism and control' and the use of ICT in the PST practicum settings has assisted both in-service and preservice teachers in achieving their culturally specific educational aim of shaping and fitting young children into a harmonious learning environment. This reflects a deep impact of sociocultural traditions on PSTs' perceived ICT affordances and the way they used ICT.

### ***ICT affords assistance***

The PSTs expressed a highly consistent view on the role of ICT in ECE and emphasised that ICT can only play an assisting role, despite its importance in supporting their teaching. In other words, digital solutions were thought to have a supplementary role in classroom activities, to be used alongside traditional materials and

methods. For example, the following quote from Zhang exemplifies how she thinks technology can enhance children's learning but only within limits.

ICT is a teaching tool and means used in the classroom . . . I think it is supplementary. In children's learning, it is a tool, but not a 'must.' It can support children's better learning and understanding to a certain extent. (Zhang).

In the contemporary age, I think ICT should assist in teaching . . . From my point of view, ICT should support teaching activities. (Yang)

Similar to the earlier quotes, they mainly used ICT to benefit their own teaching practices, particularly when they were short of resources for group teaching and therefore they placed a great value on the convenience brought by ICT. Again, ICT was used to support their teacher-centred practices to transmit knowledge to children.

When our resources are not sufficient, it is very convenient to use it for display . . . Sometimes it is very necessary to have ICT when we do not have enough teaching materials and we have to do group teaching. (Ai).

Fan's following comment further offers evidence that, for the sake of teachers' benefits (convenience and simplicity), young children were naturally 'constructed' as passive observers in ICT mediated teaching activities. This result is in line with earlier studies, in which young children were not encouraged to explore ICT resources and their active roles in constructing their own knowledge through using ICT was not recognised (Dong 2016a).

Using power points in my teaching is indeed more convenient and simpler than the use of real objects. Children can watch it clearly. This is its convenience. I think e-whiteboards and power points are very convenient. It allows all the children to see [screens] in group teaching clearly. Using real objects can't achieve this effect. (Fan).

Despite the PSTs' concerns over the negative effect of screen-based technology for young children (discussed in the next section), Fan's comments that children could learn skills and knowledge by watching screens clearly helped justify the use of screen-based technologies to teach young children. However, it reveals a limited understanding of the value of ICT for young children, not considering children's active roles in constructing their learning.

Influenced by the Chinese traditional subject teaching, ICT was used to support PSTs' teaching of discrete subjects such as language class.

I think ICT is a facilitating role. Facilitating means it is used in every aspect [of daily practices]. There is no detailed description of its role, but it is related to everything. Thus we feel it important. However, ICT does not have specific functions [for educational practices]. For instance, it is used in some parts of our society and language class. Its main role is supporting teachers' teaching. (Yi).

Due to the lack of explicit curriculum guidance on ICT integration for early years education, Chinese EC teachers including these PSTs were falling back on their traditional training and practices (Dong and Newman 2018). As a consequence, instead of integrating ICT into the curriculum, these PSTs tended to limit the role and the scope of ICT use in ECE, which is strongly related to their conceptions of ICT constraints as detailed in the following section.

### ***ICT constrains direct learning experiences***

When discussing their practicum experiences, the PSTs reported that besides teacher-led presentations, they had also witnessed children using apps on computers to learn how a caterpillar turns into a butterfly through clicking icons as well as learning to draw on screens through software. Even though in such practices the children could be understood to have a more active role in using the ICT, the participants expressed that the use of such technologies would be more of a constraint than a resource for children's learning. Terms such as 'direct', 'hands-on', and 'real' were commonly used in participants' descriptions of how the use of screen-based technologies can constrain pedagogical practices. The following extracts provide pertinent examples of such perceptions:

I think children watching digital videos is not a direct learning experience, which is different from their hands-on experience. They probably just gain an understanding of the process, but no profound experience. They might forget it as they grow old, unlike their own hands-on experience which can leave a deep impression. It is better for children to use their hands to manipulate . . . .The screens are often changing and flashing which can distract children's concentration. (Du).

My own feeling is that it is better to give children real experience if possible, hands-on physical objects and real feelings. (Ji).

It is difficult to teach abstract concepts because children learn through senses particularly for 5–6 years old children. It is easy [for them] to understand concrete things. (Yi).

These extracts highlight the importance of learning-by-doing and tactile experience in children's learning. According to the PSTs, virtual representations, such as images, can provide only a pale reflection of the phenomenon under investigation. Physical manipulation of tangible objects, in turn, was thought to allow

children to interact with the 'real world' without digital filters. As put by Du, they will gain understanding but not personal and profound experience. These notions echo the findings of previous research (Palaiologou 2016; Starčič et al. 2016), which also has identified that many preservice and in-service teachers consider traditional materials to be more effective than digital ones because they provide tactile experiences and allow children to have a more active role in their learning.

That being said, there was some diversity in participants' perceptions. Fan, for example, stated that she found the use of digital materials superior to the use of tangible objects (see extract in 'ICT Affords Assistance' section).

## **CONCLUSIONS**

This qualitative study explored which ICTs Chinese preservice early childhood teachers think of when they are asked about ICT use in ECE. The second research interest was to investigate the kinds of benefits and constraints preservice teachers read from these technologies. The kinds of ICT the participants typically referred to were screen-based technologies such as interactive whiteboards, and desktop and laptop computers. These technologies were read as affording efficiency and assistance but as constraining children's direct and tactile hands-on learning experiences. The ICT resources available in the teaching practicum places were influential for what PSTs understood by ICT in the context of ECE – a notion supported by previous research (Hu and Yelland 2017). Perceptions of affordances and constraints of these particular ICTs, in turn, were deeply interlinked with the pedagogical traditions and values of Chinese ECE.

To conclude, the study contributes to the theoretical development of technology integration research by applying affordance theory to study preservice teachers' perceptions. By having Chinese preservice teachers as participants this study has brought urgently needed geographical and cultural diversity to the Western-centric state of current knowledge. Whilst this study has provided novel and valuable knowledge, it is not without limitations. One issue worth considering is the terminology used in the interviews. The term 'ICT' was used, being the term used in Chinese pedagogical documents and curriculum guidelines (Ministry of Education 2012a, 2010). We are aware that the concept of ICT is linked with connotations that may have had a role in shaping the participant's perceptions. For example, Plowman (2016) has argued that terms such as 'ICT' and 'educational technology' are not well suited to ECE as they guide our attention towards traditional classroom technologies such as computers and interactive whiteboards. The findings of the present study support her claim and we agree with Buckingham's (2015) argument that the contemporary digital landscape

can no longer be regarded simply as a matter of ‘information’ or of ‘technology’. This is particularly the case if we are seeking to develop more effective connections between children’s experiences of technology outside school and their experiences in the classroom.

These limitations aside, our findings have several implications for future research. First, as the participants of this study were referring to a narrow segment of the everdiversifying digital landscape of 21st century societies, the findings suggest that future research should pay more attention to identifying which technologies the informants are actually referring to. Being skeptical towards interactive whiteboards is not the same as being skeptical towards ICT per se. Such notions may indicate limited understanding of what ICT can be. Second, our findings highlight the importance of immediate (practicum places) and structural (pedagogical traditions) socio-cultural environments in shaping pre-service teachers’ perceptions of ICT and ICT use in the context of ECE. Questions related to the interaction and power relations between ICT and ECE remain to be studied and answered by future empirical research.

The findings offer implications for educational policy and teacher training as well as suggesting, that policy and research development in China have not kept pace with the fast advance of ICT in terms of technological development and ICT’s role in children’s lives. Chinese policy-makers urgently need to develop more specific ICT policies and curriculum guidelines for ECE that can reflect the role of ICT in the early years and support EC teachers’ ICT professional training and development to enable them to harness the potential of ICT for young children. Specifically, teacher education should broaden preservice teachers’ perceptions of the range of technologies and putting an extra emphasis on experiences which combine technology use with the tactile and hands-on traditions of ECE – cherished by both our participants and EC educators in general (Mertala 2017b). The trending makerspace ideology (Marsh, Arnseth, and Kumpulainen 2018) which positions children as designers and creators of technology instead of mere users, provides one possible way to bring the valued hands-on -element to technology related practices in initial teacher education as well. This notion is not limited to the Chinese context only but also applies globally.

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