

Children's Interactions with Digital Devices

by

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Abstract

The role of digital devices such as touch screens in children's lives at home and at school has increased at an accelerated pace during the past eight years. Parents and teachers act as children's main monitors, instructors, and guides for interacting with digital devices. This project reviews parental influence on children's digital usage via parents' attitudes, their own usage, their support, and mediation. Results show that children's experiences of using digital devices is affected by the diversity of parental influential factors. The positive effects of parental usage, support, and mediation possibly promote children's experiences with digital devices. Furthermore, the use of digital devices in school are also found to improve children's writing, drawing, foreign language learning, and social collaboration under some conditions. However, the review of children's use of digital devices in classrooms reveals conflicting results on the development of intellectual and social aspects, which calls for more communication among teachers on instruction and guidance.

Introduction

Children born in the last decade are growing up with digital technologies. A large number of children are exposed to digital technologies such as touch screens at home long before entering pre-school (Cohen, Hadley, & Frank, 2011; Ebbeck, Yim, Chan, & Goh, 2016). Accordingly, the family environment is the first environment in which children encounter digital devices, making parents the gatekeepers of children's digital device usage (Nikken & Schols, 2015). Much literature has been devoted to exploring the influence of various parental attitudes towards children's use of digital technologies (Genc, 2014; Plowman, Stevenson, McPake, Stephen, & Adey, 2011; Plowman, Stevenson, Stephen, & McPake, 2012; Mikelic Preradovic, Lesin, & Sagud, 2016). Children spend significantly more time on touch screens if their parents agree that digital technologies provide them with a moment of rest (Nikken & Schols, 2015). The literature has also shown that the majority of parents agree there are benefits to the use of digital devices and therefore support their children's use of digital devices; even those who have concerns about digital play also conditionally allow their children's usage (Baek, Lee, & Kim, 2013; Genc, 2014; Nevski & Siibak, 2016). Accordingly, the amount of time spent on digital devices by children has attracted researchers' attention. Therefore, it is timely and appropriate to explore the parental influence on children's digital play and the effects of children's digital device usage on their development. I begin by contextualizing this study in my personal interest, followed by the research questions, and then the research path.

Parental Influence on Children's Interaction with Digital Devices and their Influence

My interest in children's use of digital devices developed recently, when I last visited my family in China over summer vacation. From the moment I landed at Guangzhou Baiyun airport, I was overwhelmed by the prevalent usage of digital devices. Surprisingly, I noticed there was a large number of children, including children as young as 2 and 3 years old, playing on their parents' mobile phones or touch screen tablets in subways, on the bus, in restaurants, and almost every public place. More surprisingly, every child in my family not only played on their parents' mobile phones or touch screen tablets but played with them daily and more frequently on weekends. However, this is not the first time I noticed young children playing with digital technologies. While I was working part-time for an after-school care program in North Saanich, I sometimes overheard children talking about how they are allowed to play on touch screen devices for a short amount of time at home, sometimes for a longer amount of time as a special encouragement when they behave well at school.

It is obvious that the phenomenon of children using and playing on mobile technologies does not only happen in China or Canada, but worldwide, based on the literature. In Europe, Northern Europe, the United States, Australia, Israel, Thailand, and China Taiwan, children have easy access to diverse mobile devices and they are allowed to spend quite a bit of time playing with these devices. For example, the majority of children spend half an hour per day interacting with smartphones on weekdays and more than half of children spend about 1 or 2 hours on weekends when their parents believe there are positive outcomes to smartphone use (Genc, 2014). It is also reported that children play on touch screen tablets as well as smartphones for at least half an hour per day since more than half of the parent respondents consider digital device

usage by their children to be beneficial (Ebbeck et al., 2016). Whereas some parents hold positive attitudes towards their children's digital device use, some parents have concerns about it. For example, more than half of parent respondents reported children should use digital devices under their supervision and that they mediate the amount of time and content when their children are playing with digital devices (Nevski & Siibak, 2016). One study found that parents' own use of digital devices is linked to their children's use (Nikken & Schols, 2015).

Despite the mediations parents adopt to supervise and restrict their children's digital device use, it is rarely reported that parents prohibit their children from playing with digital devices. For example, although a large percentage of parents (87%) in one study worried about the various negative impacts of using digital devices on children, such as negatively affecting physical and social development, addiction to touch screens, exposure to inappropriate content, etc., they did not prohibit their children from using digital devices, but limited their use to 20 to 30 minutes at most per day (O'Connor & Fotakopoulou, 2016). However, although 20 minutes per day does not seem like much, the accumulated time in a year and in years to come throughout their childhood would pop people's eyeballs.

As a result, the effects of digital device use on children is a realistic interest to parents and education researchers. Researchers have explored children's development through digital device usage, which refers to various skills needed in education. Since many children begin to play with touch screen before starting kindergarten, their earliest experiences of literacies on screen play a significant role in developing their reading and writing skills (Korat, Shamir, & Chen, 2012; Neumann, 2014; Prieto et al., 2016; Wong, 2015). Therefore, emergent literacy is reported as being the main educational skill developed through digital play by children

(Beschorner & Hutchison, 2013; Clarke & Abbott, 2016; Ihmeideh, 2014; Levy, 2009; Neumann, 2016; Wong, 2015). Besides emergent literacy, research has examined the differences of digital technological skills, drawing, and math abilities on children after digital technology use. For example, children demonstrated significant learning gains in math curriculum knowledge and math concepts after an intervention with a tablet math application (Outhwaite, Gulliford, & Pitchford, 2017). Likewise, it has been found that elementary children improved their performance significantly in placing values in decimals, comparing and ordering decimals, and two digit by one-digit multiplication after using math apps on tablets (Zhang, Trussell, Gallegos, & Asam, 2015).

Some studies have also reported social gains from using touch screens by children including peer collaboration and high engagement (Clarke & Abbott, 2016; Couse & Chen, 2010; Crescenzi, Jewitt, & Price, 2014; Flewitt, Messer, & Kucirkova, 2015). For example, digital device use is found to have the potential to help to elongate children's attention spans and ability to concentrate, due to an iPad app can make children touch the screen in continuous sequences (Crescenzi et al., 2014). Thus, the use of digital devices plays a role in influencing children's social learning.

Research Questions

Therefore, there are two focal points examined in the literature reviewed: (a) parental influence on different aspects of children's interaction with digital devices and (b) the development shown due to children interacting with digital devices. Two research questions are based on the two fo-

cal points: (a) how do parents affect children's interactions with digital devices and (b) what relationships exist between children's use of digital devices and their development?

Research Path

To locate the literature, I used advanced search on the Web of Science and Uvic's library search through the University of Victoria's database, combining the search terms "children" and "parents" with "digital technologies" and "mobile devices" respectively, in an attempt to locate literature on how parental factors affect children's use of digital technologies and how children's digital play influences their development. There are only a few studies searched with each combination such as "children," "parents" with "digital technologies" or "children," "parents" with "mobile devices" after refinement. After the initial search, I felt it was necessary to expand the three core search terms which were "children," "parents," and "digital technologies". I expanded "children" into "young children," "pre-schoolers," "kindergarteners," "primary school," and "elementary school," added "parental" as a synonym of "parents" whilst I added "digital devices," "mobile technologies," "touch screen tablets," "tablet computers," "smart or mobile phones," "iPad," and "e-books" as the synonyms of "digital technologies" and "mobile devices." However, there were still not enough studies in the database since the first mass-market tablet computer (the iPad) was released in 2010 and it has only been seven years since it achieved ubiquitous popularity (<https://en.wikipedia.org/wiki/IPad>). To further locate more research studies on my topic, I scanned the 27 studies located, scrutinized their references, and thus located eight more papers. In total, I located 35 empirical studies on my topic.

The literature that was located in total includes both quantitative and qualitative studies to explore the effects of parental factors on children's digital device usage and the relationship between children's digital playing and their development. Most studies conducted qualitative research through observation and interviews, but some studies employed quantitative research methods such as questionnaires. The target participants in every study were children aged from about 27 months old up to fourth-grade students (app. 9 years of age) in elementary schools. Sixteen journal articles were examined to explore the effects of parental factors on digital device usage by children while nineteen journal articles examined the relationship between children's use of digital devices and their educational development and growth including impacts on literacy, math knowledge, drawing skills, etc. Only recent research studies are included because touch screens entered our lives after 2010. For example, touch screen tablets achieved worldwide popularity after iPad was invented in 2010, while iPhones as the first worldwide touch screen phones started to sell outside of North America after 2011. Although they have been employed to improve children's phonological awareness, emergent literacy, and writing abilities in educational settings since 2000, electronic books only received more attention and were widely used by children in daily life after being combined with touch screen products (Chera & Wood, 2003; Korat, Shamir, & Arbiv, 2011; Shamir, 2009). Therefore, all studies were published after 2000 and most reviewed studies were published between 2010 and 2017. Each study was conducted to focus on a particular digital device—the touch screen tablet, the mobile phone, and e-books. These 35 journal articles consist of the best database to explore the association between parental influence and children's use of digital technologies; and the relationship between children's use of digital devices and their educational and social development.

Review of the Literature

Much literature has been conducted on parental influence on children's interaction with digital devices. Some studies examined how positive parental attitudes supported children's use of digital devices, while other studies explored how negative parental attitudes restrict children's use (Baek et al., 2013; Ebbeck et al., 2016; Neumann, 2015; Nevski & Siibak, 2016; Nikken & Schols, 2015; Plowman et al., 2012; Yilmaz Genc & Fidan, 2017). Owing to parents holding different attitudes towards digital play by children, children's interactions with digital devices vary in duration, frequency, main activities performed, and contents presented in the various apps they play with. Considering the large number of children spending short or long amounts of time on digital devices regularly, it is worth looking closely at the influence digital technology products have on them, especially compared to non-users. Studies have shown there are significant differences on children's literacy, drawing, mathematics, and digital technological skills after intervening with digital play (Beschoner & Hutchison, 2013; Clarke & Abbott, 2016; Ihmeideh, 2014; Korat et al., 2011; Levy, 2009; Neumann, 2016; Shamir, 2009; Wong, 2015). In the following section, I will illustrate the findings from each study on the influence of parental factors on digital device use by their children, and the relationship between digital device usage by children and their development, intelligence, and social learning.

Parental Influence on Digital Device Use by Children

The first question is, "How do parents affect children's interactions with digital devices?" Parents are the gatekeepers of their children's digital technology use; therefore, exploring the influence of parental factors would allow us to clearly understand the different effects of digital device use by children. There are four general areas in which parents would affect their children's interactions with digital technologies: (a) parents' attitudes towards children's use; (b) parents' own use; (c) parental support and its influence; (d) parental mediation and its influence.

Parents attitudes towards children's use. Studies reported that parents hold both positive and negative attitudes towards children using digital technologies, and parents' supporting and disapproving attitudes affect children's digital use time.

Review. All studies showed children spend a certain amount of time on digital devices regularly in different countries. Parental attitudes towards children's use of digital devices is significantly associated with their use time and frequency (Lauricella, Wartella, & Rideout, 2015). For example, the majority of children spent one hour and one third of them spent two hours per day on digital devices since more parents hold positive than negative attitudes toward digital device use (Baek et al., 2013). Another study reported that children spend half the time on digital devices than those in the above-mentioned study, as there were more parents with negative perceptions on children interacting with smart devices than parents with positive perceptions (Genc, 2014). It indicates that the more positive the parents' attitudes toward digital device use, the more time children spend on digital devices, and vice versa.

In contrast, one study reported the contradictory result that children only spend 0.25 hours per day using digital devices, with the majority of parents considering digital technologies

to be beneficial to children and almost all parents considering children's digital use to not be risky (Mikelic Preradovic, Lesin, & Sagud, 2016). A similar result was found in another study claiming children spent a small amount of time on smart devices and a large proportion of parents approved of their children's use of digital devices (Palaiologou, 2016). Therefore, a contradiction exists within studies on parental attitudes affecting children's digital device use. Surprisingly, the two studies that found positive parental attitudes increased children's digital device use were conducted in South Korea and Singapore. South Korea and Singapore are Asian countries under the influence of Confucius culture, and therefore parents in these countries have more power in disciplining their children. Thus, this may suggest that the extent of parental attitudes towards their children's digital device use may be influenced by social and cultural differences.

However, studies that found parents' positive perceptions toward digital device use not increasing children's use have one similarity. These parents not only considered it necessary for children in the 21st century to have access to digital devices, their negative attitudes focused on how to instruct children in order to increase the benefits of digital device use, but not from whether or not they should allow children to use them (Palaiologou, 2016; Mikelic Preradovic et al., 2016). A large proportion of parents in these studies felt they lacked the knowledge to guide their children to benefit from digital device use, so they accordingly controlled their children's digital device use. Thus, parental attitudes encompass more than approving or disapproving of their children's smart device use. More precise variables besides general positive or negative attitudes should be created to find out the impact of parental attitudes on children's interaction with digital technologies.

Discussion. Although studies showed parents expressed different proportions of positive and negative attitudes towards children interacting with digital technologies, some studies claimed that parental support is associated with children using digital devices for longer amounts of time, whereas others claimed these two variables are not closely connected. For example, some studies found children spend long amounts of time using smart devices with higher rates of parental approval and spend less time with higher rates of parental disapproval—in these studies, parents and children were from a culture where parents have more disciplining power. If parents have more disciplining power over their children, children's digital device use is affected more by parents' desires. In such a culture, parents' attitudes have a greater influence on children. Thus, cultural difference is involved in the impact of parental attitudes towards children's digital use time.

Several studies found that the main reason parents' perceptions decreased the amount of time children used digital devices was that they feel they lack the knowledge to instruct their children on digital device use. It suggests that parental perception toward their children's digital device use is more complicated than being merely positive or negative. This leads to the gaps in studies examining the impact of parental attitudes on children's digital device use time. For example, when parents hold positive attitudes toward children using digital technologies, but they feel they do not have the knowledge to instruct them on the positive impact of digital technologies, and therefore reduce the amount of time they allow their children to use digital devices (Mikelic Preradovic et al., 2016). These parental attitudes toward children's digital device use cannot be categorized as either positive or negative. It is partially in line with another study that concluded that parents' views on the influence of digital technologies on children is complicated

and practical (Nikken & Schols, 2015). Therefore, more precise variables about parents' views should be created in order to understand parents' perceptions of children interacting with digital technologies, so parents can adjust their attitudes to ensure children use smart devices appropriately.

Parents' own use. Parents' own use plays a significant role in affecting children's digital device use. Parents' occupations, entertainment habits, and their socio-economic status are discussed as related to their use of digital technologies.

Review. Parents' own use of smart devices has a significant impact on their children's use. The more time parents spend using digital technologies, the more time their children will spend using these technologies (Lauricella et al., 2015). Parents' use of various digital devices at home sets them up as examples for their children to imitate (Neumann, 2015). This suggests that the more parents use smart devices, the more their children will use these devices (Nikken & Schols, 2015). Parents' own use of digital devices is proven to be closely associated with their own occupations, their use habits, and their socio-economic status.

Parents' occupation was reported to be a factor in their frequent usage and higher ownership of digital technologies in many studies, and parents' digital use habits were proven to be related to their children's digital device use. For example, one study found that parents used digital devices 54% of the time for work-related purposes and about 20.7% of the time for entertainment purposes (Nevski & Siibak, 2016). Therefore, if a parent worked as a software developer, as reported in one qualitative study (Yilmaz Genc & Fidan, 2017), they are more likely than other

parents to use tablets and touch screens at home. Besides the occupation of software developer, jobs that require parents to send emails from home were also found to increase children's exposure to digital devices at home. In addition to work-related reasons, parents' own entertainment habits have an influence on children's engagement in digital activities. For instance, two thirds of parents in one study claimed they search for information on Google and use social media daily at home (Neumann, 2015). Children who frequently see their parents using digital technologies want to use these technologies more frequently. Children whose parents often work on smart devices and who usually entertain themselves with digital devices thus are more likely to model their parents' behavior and spend a lot of time on digital devices.

Parents' socio-economic status is found to make a difference in children's digital usage. Parents with a higher income said their children spend more time on touch screens than did parents with a lower income (Nikken & Schols, 2015). It could be because digital devices are still rather expensive, financially disadvantaged parents have fewer opportunities to purchase the latest version of high-end mobile devices, and therefore their children have fewer opportunities to acquire the skills to use these products and consequently use them less. However, this contradicts the results of one study that found financially advantaged parents are more likely to acquire expensive and up-to-date smart devices, but that financially disadvantaged parents have the same amount of digital products that are older models or second-hand (Plowman et al., 2011). It indicates that parents with lower economic status might allow their children to use digital devices more often, as their devices are less expensive and less valuable. Such contradictory findings in terms of the impact of parents' socio-economic status on children's use of digital devices makes it hard to come to a conclusion.

It has to be noted that in one study that compared the ownership of digital technologies in the families of four countries: England, Luxembourg, Greece, and Malta, the ownership of digital technologies and Internet access were clearly higher in England and Luxembourg than in Greece and Malta (Palaiologou, 2016). Children's access to mobile technologies in England and Luxembourg were twice as high as compared to children in Greece and Malta. England and Luxembourg are more financially advantaged countries and the average families in these two countries naturally have more income than the average families in Greece and Malta. It suggests that families with a higher income are more likely to purchase more than one digital device, to buy the apps that children like to use, and to have Internet access at home. These factors all create more opportunities for children to spend time on digital devices.

Discussion. Parents' own use of digital devices is significantly associated with children's use. The preceding review has showed that the more time parents engage with digital technologies, the more time children are likely to spend using digital technologies. Whereas some studies reported that parents' occupation and use habits influence the frequency of their use, other studies paid attention to the impact of parents' socio-economic status on their use.

Parents' occupations have an impact on how strongly digital devices influence the home environment for children. If parents frequently work on smart devices at home, children will see parents spending a lot of time on them. Such a heavy influence of digital devices in the home environment is a concern because children will model their parents' behaviour. In addition to parents' occupations, parents' frequent use of mobile devices for entertainment around children is

a bad influence for children. Thus, parents cutting down their use of digital devices around children can decrease children's exposure to these devices.

Parent's socio-economic status has been discussed as a factor affecting their ownership of smart devices. Some studies claimed that parents with higher socio-economic status are likely to purchase expensive, high-end digital technologies and their children would therefore have more opportunities to acquire digital skills and use digital devices more frequently. Other studies stated that parents with lower socio-economic status are likely to buy the same amount of older model or second-hand products, leading their children to use digital devices more frequently, because they are less valuable. These arguments are both reasonable, but these studies failed to address that parents' financial status is not only associated with money spent on digital devices, but also with how many digital products they can afford to purchase, whether they have Internet access at home, and how much they would pay for applications their children can use.

Parental support and its influences. Studies reported on how different rates of support parents had for their children's interaction with digital technologies affected the different types of activities these children took part in. It is significant for parents to understand the influence of their support on different digital activities children take part in, so parents can adjust their support rates to better nurture their children's development.

Review. Parents generally support their children's use of digital devices for many reasons: to help children develop intellectually, improve their motor and cognitive skills, promote digital technological skills, occupy children when tending to adult tasks, entertain children, promote

academic performance, and to keep up with their peers. These reasons can be classified into two categories: (a) positive support—to promote children's intelligence and skills; (b) negative support—to occupy, entertain, and follow trends.

Studies have shown that parents support their children's interactions with digital devices for various reasons. In most of these studies, parents support their children's use of digital devices in order to develop children's intelligence and skills. For example, 72% of parents agreed that using digital technologies can benefit children in learning new skills (O'Connor & Fotakopoulou, 2016). It corresponds with the belief many parents hold that children can gain valuable digital technological skills by interacting with digital technologies (Ebbeck et al., 2016; Mikelic Preradovic et al., 2016). Therefore, parents have installed applications for their children with the intention of promoting children's learning or intelligence.

Many studies also found that parents support children's smart device use for reasons deemed "negative." One study found a majority of parents found occupying their children to be a key benefit of allowing children to use these devices (Nevski & Siibak, 2016). That is to say, there was a high percentage of support for occupying children for the convenience of parents who need to attend something else. It may lead to parents encouraging their children to use digital technologies in some cases and generally not paying much attention to the digital activities children are engaged in. As one study found (Baek et al., 2013), 42.2% and 27.3% of parents supported children's use of smart devices to follow trends and to occupy them while parents are busy. The digital activities these parents' children took part in were mostly cartoons, shooting pictures and games, but very few were applications with educational content. Therefore, these parents were responsible for their children spending a lot of time watching videos and gaming on

smart devices. This is in line with results stating that playing games and watching videos are the two most common activities children took part in when their parents stated that keeping children occupied was one significant benefit of their children's use of touch screens (O'Connor & Fotakopoulou, 2016; Yilmaz Genc & Fidan, 2017).

Interestingly, one study found that children spent a relatively comparable amount of time on fun and educational digital activities when their parents did not see the "negative" reasons such as occupying children as advantages to children's digital device use (Genc, 2014). The reason for this could be that parents turn on cartoons and fun games for children when they are busy and need digital devices as a pacifier (Chiong & Shuler, 2010; Nevski & Siibak, 2016). But this is not always the case. Another study found that children spent twice as much time watching cartoons than using educational applications when their parents didn't use any of the "negative" reasons for supporting children's use of digital devices (Mikelic Preradovic et al., 2016). It has to be noted that the total time children spent using digital technologies in this study was limited to about 0.5 hours per day, so the time difference spent on watching cartoons and educational applications was very small. This study thus is not a sufficient contradictory result.

Unemployment status is considered as a factor influencing parents to use digital devices to occupy children. For example, one study found that unemployed parents reported to use smart devices to occupy children more frequently than employed parents (Vittrup, Snider, Rose, & Rippy, 2016). This goes against the traditional recognition that working parents are more likely to use digital devices to occupy children because of their busy work schedule. It may indicate that stay-at-home parents have a greater need to use digital technologies to occupy children since they have heavy housework to do. This corresponds with one study in which parents—only 20%

of the sample being housewives—did not express any of the “negative” reasons for the benefits of children’s digital device use (Genc, 2014). Although more research is needed, the variable of employment status should be a factor in further studies since it affects parents’ “negative” support for children’s smart device usage.

Discussion. The preceding review shows that parents support children interacting with digital technologies for different reasons. The majority of studies indicate that parents support children’s use in order to develop their intelligence and skills. This is significant because these parents would download digital activities with educational value for their children to use. Some studies also claimed that parents encourage children to use digital technologies because of their own needs. These “negative” reasons for support, such as occupying children, are harmful as when parents attend to adult tasks children spend time on digital devices watching cartoons and playing games for fun. Thus, increasing “positive” reasons for parental support and decreasing the “negative” reasons for support, such as using digital technologies as a babysitter, would be beneficial for children’s intelligence and development. Moreover, parents’ working status is associated with parents’ “negative” reasons for support. Stay-at-home parents surprisingly have higher support for “negative” reasons, thus encouraging children to engage in watching cartoons and playing fun games on digital devices. Some studies reported that parents’ employment status is marginally related to parents using digital technologies to entertain children when parents were employed, but few studies attend to parents’ increased use of digital technologies to occupy children when unemployed. Therefore, parents’ employment status (both employed and unemployed parents) should be considered in future studies.

Parental mediation and its influence. Most studies associated parental mediation on children's digital device use with the restrictive, the technical, and the active mediation. Children's gender and sense of achievement were also found to be associated with parents' mediation on children's digital device use.

Review. Parents use various approaches to mediate children's use of digital technologies so children can use digital devices appropriately and safely. Restrictive mediation is reported as one common form of parental mediation in digital device use by children. For example, parents put limits of between 20 and 30 minutes on their children's digital device use per day (O'Connor & Fotakopoulou, 2016). Time limits were also reported in another study, though the length of the time limits varied. For instance, parents only allow their 5 and 6-year-old children to play with tablets for about 1 to 2 hours daily (Yilmaz Genc & Fidan, 2017). One might assume that when parents limit children's use time, children will use digital technologies less. But this is in contrast to a finding that children's digital device use was more frequent in families where parents restrict use time (Nevski & Siibak, 2016). This was probably because there were small conflicts between parents and children when parents limited children's use time (Yilmaz Genc & Fidan, 2017).

Besides limiting children's use time, parents were also found to restrict the content that children interact with on digital devices. For example, parents would read the applications' description in order to protect children from inappropriate content such as violence or sexual content (Nevski & Siibak, 2016). If parents don't allow their children to use dangerous content, they won't worry about their children being damaged by said content, and accordingly, will be more

likely to allow children to use digital devices for longer periods of time. This corresponds with the claim in a study that 0- to 3-year-old children's smart device use is higher in families where parents restrict device content (Nevski & Siibak, 2016). This may indicate that parents' restrictive mediation surprisingly increases the frequency and length of time children use digital devices.

Some studies also claimed that parents implemented technical methods to mediate their children's use of digital technologies. For instance, some parents set up passwords, cut off internet access or disabled built-in apps (Nevski & Siibak, 2016). One study reported that a father installed parent control software on the devices his children use (Shahbazyan, Hajdinjak, & Kumanova, 2016). The software enables the parent to view his child's online activity. This is a relatively complicated technical mediation as compared to cutting off children's access to smart devices. Therefore, how parents mediate children's interaction with digital devices depends on their technical skills in operating these devices.

One study found that half of parents actively mediated by talking to their child, staying close by while their children used digital devices, or providing feedback during the child's digital device use (Nevski & Siibak, 2016). In contrast, another study reported that only a small number of parents used active mediation, such as co-using and instruction (Wu et al., 2014). The reason for the difference is that, in both studies, the mothers' education levels were different. In the study that found more active mediation by parents, the majority of mothers had higher education levels, while in the study that found less active mediation use by parents, most mothers were secondary school graduates. Although there is a claim that parents' education levels have no effect on parental mediation strategies (Nevski & Siibak, 2016), the results of these studies show

that mothers' education levels do affect their strategies in mediating children's digital device use. Therefore, mothers play a key role in actively mediating their children's interaction with digital technologies.

Gender is pointed out as one factor parents refer to in mediating children's interaction with digital technologies (Nikken & Jansz, 2014). For example, one study found that parents downloaded applications with content that is stereotypically suitable for girls, such as decoration, baking, coloring, putting clothes on characters, etc when these parents' children are girls. (Yilmaz Genc & Fidan, 2017). The study also stated that parents would give priority to digital activities that provided their children with a sense of achievement. This is because on one hand, children get bored, sad, or furious, and want to change the application, or tend to ask for help from parents when they lose a game; on the other hand, they enjoy the digital application and become happy when they finally win. This is interesting, because compared to restrictive mediation and technical mediation, these parents mediate by choosing digital activities that are more stereotypically suitable for girls and provide them with a sense of achievement in order to benefit their children and increase their enjoyment of digital technologies rather than worrying about children's use of digital devices being harmful.

Discussion. The majority of studies identified parents use forms of restrictive mediation and technical mediation when their children are interacting with digital technologies. Few studies attend to parents who actively mediate and focus on improving the positive experience of their children's digital device use.

In terms of parents' restrictive mediation, some studies reported parents set up either time limits or restrict content, while other studies claimed parents limit both time and content while their children use digital technologies. The main goal of applying restrictive mediation is to control children's use time to an appropriate amount and to protect children from dangerous content. But children's use of smart devices conversely increased after parents applied restrictive mediation. Thus, restrictive mediation is not very effective, and parents who simply set up time restrictions and read application descriptions cannot appropriately mediate their children's use of digital technologies.

The preceding review shows that whereas some studies claimed that parents cut off children's access to digital devices, to the Internet, or to applications technically, other studies stated that parents use software to remotely monitor children's online activities. This indicates that whether or not parents use more advanced mediation techniques to control their children's digital device use depends on their own skills in operating digital technologies.

As for active mediation, although some studies found no relation between parents' mediation strategies and their education levels, it was found that mother's education level is associated with which active mediation strategies were applied on children's interaction with digital devices. Thus, mothers who have higher education levels were more likely to apply active strategies to ensure children receive feedback and instructions.

Parents' restrictive and technical forms of mediation focus on the negative experience of children interacting with digital devices so as to restrict their digital usage. Gender difference and giving children a sense of achievement are two variables that promote children's enjoyment in using digital technologies to serve their developmental needs. Few studies focus on how parents

mediate to promote children's positive experiences with digital device use and their developmental needs. Thus, future studies could pay more attention on mediating to encourage children's positive experiences of digital device use.

The Influence of Children's Interaction with Digital Devices on their Development

The second question guiding this review is "What relationships exist between children's usage of digital devices and their development?" This section will review two main aspects of children's development after intervening with digital device use from three aspects: (a) the two main aspects of development, (b) the relationship between children's use of digital devices and their writing and drawing, (c) the relationship between children's use of digital devices and their peer collaboration.

The two main aspects of development after interacting with digital devices. Results of studies showed that children improved at least one aspect of development after interacting with digital devices. Generally, two aspects of children's development are discussed: intellectual development and social development. The review demonstrated that children's development in these two aspects is very unbalanced. Whereas the majority of studies report children's improvement on intelligence, only some report on their social development.

Review. The majority of studies found that children's use of digital devices was associated with their intellectual development. For instance, one study collecting statistics from 109

children from 11 pre-schools reported that children's access to tablets was positively related to their emergent literacy (Neumann, 2014). This is because, due to tablets' touch-based features, children who have not fully developed their fine motor skills can easily print names and letters with their fingers on screens (Huang, Liang, Su, & Chen, 2012; Neumann, 2016). Another study stated that children who used digital literacy apps such as *Blobblewrite*, which demonstrate to children how to write letters, had much better handwriting as compared to the year previous to the study, prior to using iPads (Clarke & Abbott, 2016). Aside from writing skills, children's printing knowledge and reading skills were identified as having improved after their use of smart devices (Ihmeideh, 2014; Levy, 2009; Mioduser, Tur-Kaspa, & Leitner, 2000).

Many studies also reported digital devices helped children to develop other aspects of intellectual learning in mathematics, drawing, and language skills (Picard, Martin, & Tsao, 2014; Plowman et al., 2012). Children in the experimental group who used a math tablet intervention demonstrated significant gains in math ability assessment (Outhwaite et al., 2017; Zhang et al., 2015). Another study claimed that children who are from a non-English speaking country learned the English meaning of colors, animals, and shapes, etc., through using applications in English (Yilmaz Genc & Fidan, 2017). It is common practice in China to use English applications to develop children's English language skills. Nowadays Chinese parents not only allow children to use digital devices for the purpose of learning English, but also purchase applications and expensive digital technology products for that purpose, since learning English is widely considered a competitive skill in children's future education and development. However, few studies touched on the topic of children's digital device use for promoting language learning in non-English speaking countries. Therefore, the efficiency of using digital technologies to promote children's

foreign language acquisition becomes significant to educators and parents who use digital devices to develop children's foreign language skills.

Some studies reported that digital devices are useful tools to promote children's communication and information sharing. For example, children are found to actively engage in conversation with peers around them when working on iPads individually (Beschoner & Hutchison, 2013). It is consistent with a study reporting that touch screens improved children's knowledge sharing and peer support (Clarke & Abbott, 2016). The reason for this could be touch screens' portability and shared screen make it easier to take turns and share in collaborative activities and to evaluate each other's work; in addition, carrying tablets was found to encourage children to seek assistance and help from more capable peers (Alhinty, 2015). Therefore, the tablets provide children with many communication opportunities. This might especially benefit shy children, as one study claimed that quiet children spoke more during group activities involving use of tablets (Clarke & Abbott, 2016; Flewitt et al., 2015). It suggests that digital devices offer more opportunities and possibilities to engage children in social learning. The focus of their benefits for shy children is significant as digital devices might create new opportunities to engage these children in active peer collaboration.

When children actively share knowledge and are involved in group collaboration during iPad use, they are more likely to feel a sense of belonging and connected to their peers. It is found that iPads play a key role in satisfying children's needs for relatedness in collaborative learning (Alhinty, 2015). Such relatedness makes children feel relaxed and enjoy collaboration with peers, and therefore to be motivated to learn. Two other studies also reported that children's motivation for learning was promoted during iPad use (Clarke & Abbott, 2016; Flewitt et al.,

2015). It is interesting to note that the use of iPads themselves is a powerful motivator for children—one study found that children were motivated to complete a traditional task when promised they could use an iPad afterward (Clarke & Abbott, 2016). It thus indicates that digital technologies can play a significant role in improving children's motivation for learning.

Gender is discussed as being associated with children's intellectual development but studies have showed contradictory results. While some studies showed that girls display more improvement in emergent literacy scores after using digital technologies, others showed boys to achieve greater improvement than girls on emergent literacy after using digital devices (Clarke & Abbott, 2016; Ihmeideh, 2014; Shamir, 2009). On the other hand, some studies reported girls to improve more than boys after using math applications, while another study that compared the results of boys and girls using iTunes math applications claimed that boys achieved greater progress than girls after the intervention (Clarke & Abbott, 2016; Schacter et. al, 2016). It indicates that the traditional stereotype that boys have lower literacy performance and thus should improve more than girls do with literacy apps and girls have lower math ability thus should improve more than boys do after using mathematics apps does not apply, which is inconsistent to the finding that agrees with the traditional stereotyping.

Discussion. The preceding review shows that there is an increasing number of studies researching the impact of using digital technologies on children's intellectual development; some also study the influence of digital device use on children's communication and peer sharing. Most studies of children's intellectual development mainly focussed on children's emergent literacy, drawing, and mathematics skills, and few attend to children's foreign language learning im-

provement when interacting with digital technologies, especially English. The reason could be that many studies were conducted in English-speaking countries. As reviewed above, the study that reported on children's progress with English language acquisition through using English digital applications was from a non-English speaking country (Yilmaz Genc & Fidan, 2017). Using a variety of digital products to learn English has become more popular in China in the last few years, particularly in bigger cities. Thus, the effects of learning English through digital technologies in non-English speaking countries is becoming more important. It suggests that children's cultural differences should be considered when studying the influence of digital device use on intellectual development. In addition, gender differences are discussed as being related to the different degrees of improvement on intellectual development. The contradictory results make it hard to conclude whether girls or boys achieved more progress on different intellectual aspects. It suggests that improvement in literacy or math skills for children of all genders can be varied when using different literacy or math apps. Therefore, more variables should be created to explore children's views on different intellectual apps, so children with different genders can gain the most intellectual benefits from using digital devices.

The relationship between children's use of digital devices and their writing and drawing. Writing and drawing are the two most popular activities children take part in when using digital devices. The existing studies showed that children's interactions with digital technologies was related to their writing and drawing performance. This section is to review the difference between children writing and drawing in a digital environment and when using paper, pens, and paint in a traditional environment.

Review. Many studies indicated that children who used digital devices displayed better writing performance. For example, children who used tablets more often for writing had greater print knowledge such as upper and lower case letter name, numeral name, letter writing than children who used them less frequently (Neumann, 2014, 2016). This is because with tablets' touch-based features, children who have not fully developed their fine motor skills can easily print names and letters with their fingers on screens (Beschoner & Hutchison, 2013). Additionally, it has been found that digital literacy apps, such as Blobblewrite, demonstrate for children how to write letters and can correct children's writing mistakes (Clarke & Abbott, 2016). Interestingly, in all of these studies, children gained writing experience due to the smoothness of the digital screen and because children could use their fingers to write rather than a stylus. This is in line with the study that reported children wrote the same number of letters using a stylus on an iPad as they did when writing on paper with a pencil, but wrote more letters correctly using their fingers on an iPad (Patchan & Puranik, 2016). It suggests that, compared with writing with a pencil on paper, children improve their writing knowledge and skills more from using their fingers on tablets.

In contrast to the preceding findings, one study claimed that when testing children in a traditional writing environment, children who used tablets to write regardless of using fingers or a stylus did not have inferior performance to those using pencil and paper, whereas when tested in a digital tablet environment, children who used tablets to write had significantly better performance than those using traditional pencil and paper (Wollscheid, Sjaastad, Tømte, & Løver, 2016). It may indicate that digital devices are at least comparable to traditional writing materials

in helping children to learn to write and the assessment environment plays a role in the final results.

Many studies indicated the differences found between children drawing on traditional materials (paper and pen/paint) and drawing on touch screens in the early stages of drawing. Children made more straight and circular strokes and significantly more repeated and continuous touch sequences with their fingers on iPads than they did with pen and paper (Price, Jewitt, & Crescenzi, 2015). Similar findings appeared in other studies, reporting that significant changes were detected on horizontal arc, vertical arc, and push-pull movements made by very young children on tablet computers (Matthews & Seow, 2007; Price et al., 2015). The horizontal arc and vertical arc movements in concert with children's straight and circular strokes and the push-pull movements (repeated and alternatively pushing the finger away from and pulling towards the child's body), resembles children's repeated and continued touch sequences on the tablet. It suggests that digital devices elicit more various and repeated strokes from young children as compared to children drawing on standard paper materials. But it should be noted that one study found fewer drawing movements with an iPad colour palette by children (Crescenzi et al., 2014). This indicates that the frictionless screen offered by digital technologies can be both advantageous and disadvantageous in developing children's sense of touch while drawing. As discussed in the study, digital technologies do not provide children with the properties of touch that paper and paint can provide (Crescenzi et al., 2014).

When it comes to comparing drawing scores in a digital versus traditional environment, studies do not report consistent results. This is probably because the existing studies of children drawing on digital devices exhibit results from "replication" drawing and "memory" drawing.

The scores from children's "replication" drawing on touch screens, however, were consistently higher than their scores from "replication" drawing on paper with pen and paint (Couse & Chen, 2010; Ho, Lin, Chen, & Lee, 2017). The reason for their better performance could be that presenting a copy of the piece in front of children to draw or a mirror in front of children is an easier task than drawing from memory; at the same time, it could be that children were given direct instructions on how to use tablet ink, pen selection, and color pallet features (Ho et al., 2017).

As for "memory" drawing, some studies reported children had higher scores when drawing on tablets, whereas others reported the opposite findings. For example, children's scores on the originality of brushwork for creative vase drawings (when "memory" drawing) were significantly higher when they used iPads than when they drew on paper (Ho et al., 2017). In contrast, another study found children's performance on tablet "memory" drawing decreased but their performance on paper was unchanged (Martin & Velay, 2012). The contrasting findings might be accounted for by whether children used fingers or a stylus to draw on tablets. This is interesting because the above-noted children who used fingers on iPads wrote more letters and had fewer writing mistakes than those who used an iPad stylus. These findings suggest that using fingers to write or draw on digital devices could make a difference to the impact of digital devices on children's writing and drawing development.

Discussion. Many studies claimed that children's use of digital technologies is associated with their writing and drawing performance. Children achieved better writing and drawing results after interacting with digital technologies (Henderson & Yeow, 2012; Ho et al., 2017; Neumann, 2014, 2016). This might be due to the tactile screen provided by digital devices that min-

minizes friction for children when writing or drawing. This improvement in writing skills is not consistent, however, children were not found to perform better with digital instruction than they did with paper and pen when tested with paper and pen or with a stylus on digital devices (Wollscheid et al., 2016). The inconsistency suggests to us that the use of digital technologies to improve children's writing might be restricted to children's early stages of writing and different testing methods.

Children's negative experiences with drawing was found in many studies. Although children enjoy drawing on the smooth surface of digital devices, thus making more touching and drawing movements, they used the colour pallet less on digital devices than with real paint. This indicates that digital devices make children want to draw, but they lose the sensory feel of paint on paper in a digital environment. Therefore, when a task involves more complex drawing such as with "memory" drawing, that requires recalling details from memory, digital devices might not help to develop children's drawing skills. As reported in one study, children's graphic scores were slightly lower in the iPad condition than in the standard condition as children's drawing on digital devices lacked detail (Picard et al., 2014). Therefore, most studies did not note the importance of sensory detail to children when drawing in a digital environment. It leads us to conclude that digital devices can be used to assist children in developing drawing skills.

The relationship between children's use of digital devices and peer collaboration.

Most studies associated children's use of digital technologies with their motivation to engage in collaboration and communication. Their findings suggest that with the implementation of digital technologies, children are motivated to engage in collaboration and communication with peers.

However, some studies also indicated that challenges and difficulties arise when using digital devices to encourage children to participate in peer collaboration.

Review. Digital devices have the power to encourage communication and collaboration (Chiong & Shuler, 2010). Before digital devices were invented, handheld computers similar to today's digital devices were used to facilitate overcoming weak communication among children and to engage children in collaborative activities (Zurita & Nussbaum, 2004). Many studies suggest that children helped each other spontaneously and the more knowledgeable children often helped their peers during iPad use during class activities (Clarke & Abbott, 2016; Flewitt et al., 2015). This is probably due to the portability of digital technologies and children's different levels of technological competence, as one study found when digital technologies were used to complete an activity, children were observed carrying their devices around to seek help from peers and naturally engaged in communication (Alhinty, 2015).

One study found that children using digital devices had a high interest in class participation since digital devices are multi-functional (Alhinty, 2015). For instance, when children write or draw on an iPad, they can use different writing tools and various colours, and add stamps or photographs (Beschoner & Hutchison, 2013). Another study also claimed that children do not tire of their work because the bright colours and music used on digital devices are appealing (Clarke & Abbott, 2016). The increased interest in participation is linked to children's communication with their peers, as one study reported that digital devices, by providing pictures, icons, etc., enriched children's communicative possibilities (Flewitt et al., 2015). As reported in one study, the multiple functions provided by smart devices, such as drawing pictures, taking photos,

recording videos, etc., motivated children to discuss and share their final productions with peers (Alhinty, 2015). Therefore, the digital devices' multi functionality positively influences children's engagement in communication and collaboration.

As discussed above, children, when using digital devices during class activities, can benefit from engaging in collaborative communication and sharing. The implementation of digital technologies can be significant for children in Chinese classrooms. This is because, due to Chinese teacher-centered methodology, Chinese children need to be provided with more opportunities to gain knowledge through collaboration. This suggests that digital devices can be used as a tool to create more collaborative opportunities in Chinese classrooms.

Whereas many studies reported children were observed taking turns with iPads, patiently sharing in activities, and frequently supporting their peers' learning, other studies explored the challenges and difficulties that impair children's engagement in collaboration when using digital technologies. For instance, some children complained of group members using Youtube or downloading pictures, which distracted from their studies (Alhinty, 2015). In addition, children encountered technological challenges in operating digital devices, which led to frustration with school work (Flewitt et al., 2015). Another challenge was in selecting appropriate educational apps, updating, and installing apps for children to use (Clarke & Abbott, 2016). These difficulties and challenges with using iPads in collaborative activities can potentially disrupt children's learning and thus have a negative impact on children's participation in collaborative and communicative learning.

Lastly, one study found that girls were motivated to engage in collaboration when using iPads but boys were more attracted to completing an activity if use of an iPad was offered as a

reward for task completion (Clarke & Abbott, 2016). This points to a negative side of using digital devices in motivating children to communicate and collaborate in the classroom, because boys may only want to use digital devices for fun. In that case, as boys' curiosity for using digital technologies fades, the motivation to use the technologies to collaborate might decrease. Therefore, children of different genders using digital technologies might be motivated to communicate and collaborate for different reasons. Most studies failed to comment on incentives for boys to collaborate when using digital technologies, so the topic of gender difference is worth studying more.

Discussion. The preceding review shows that the use of digital technologies is related to children's participation in peer communication and collaboration. The majority of studies claimed that use of digital devices creates more opportunities for children to communicate and collaborate. The positive influence of digital device use involves children sharing their work with other children, seeking help from each other, solving problems together, and even sharing information inside and outside of the classroom (e.g., Alhinty, 2015). A few studies also noted problems and challenges existed in the process of using digital devices for collaborative activities. Technological difficulties and issues with fair-use when using digital technologies for class activities would break children's learning flow and have a harmful effect on motivating children to interact and collaborate with peers. This indicates that digital device use can be a valuable tool in promoting children to engage in collaborative learning if technological difficulties and fair-use challenges are properly addressed. Among the challenges, one study found that boys are less motivated to engage in collaboration when using digital devices for class activities as compared to girls, as they might be only encouraged to use digital devices as a reward for finishing school

work (Clarke & Abbott, 2016). This finding questions the efficacy of using digital devices to encourage children's communication and collaboration in the long term as boys might be only motivated to use digital devices based on their curiosity. However, few studies have noticed the difference of the impact of digital devices on boys and girls. Thus, more variables with regards to gender differences should be studied in order for teachers to benefit the most from using digital devices for children's collaborative learning.

Implications

Introduction

Last summer, when I went back to China to visit, I was surprised by the extensive use of smart devices by people in public places in China. What surprised me most was the prevalence of digital device use by children both in public places and at home. Many of my friends who have become parents are eager to know how to guide and influence their children in using digital devices properly. Considering that digital media such as videos, PowerPoint presentations, etc. have been widely used in schools, it is only a matter of time before the introduction of digital technologies to assist children in classroom learning. Therefore, it appears very significant for parents to know how to support and mediate in children's interaction with digital devices and for teachers and educators to understand how to promote children's development through digital device use in class. In this section, I first review findings on the parental impact on children using digital technologies and the relationship between children's digital device use and their development from research performed mostly in Europe, and some from Asia and North America.

The previous review section showed that children's use of digital devices is mostly influenced by parents' attitudes and parents' own use at home. In terms of parental impact, the research findings revealed that (a) parents' support of children's use for educational purposes encourages their development while parents' reliance on digital devices as babysitters encourages children's use for undesirable purposes; (b) parents' restrictions on children's digital device use tends to be inefficient and parents' mediation is not associated with children's positive use expe-

riences; and (c) parents' inappropriate use of digital devices creates an unhealthy model for children's digital device use. As for the impact of children's digital device use on their development, the findings indicate that (a) interaction with digital technologies significantly improved children's writing and drawing interest and skills but also had negative effects on their writing and drawing experience and (b) when using digital technologies children are encouraged to communicate and collaborate with peers but teachers face challenges and difficulties when engaging classrooms with digital technologies.

Based on the preceding review, the main focus of the implications is to provide suggestions: (a) for parents on how to better support children's positive experiences using digital technologies at home and (b) for teachers to promote children's intellectual and social development through their use of digital devices in school.

Children Using Digital Devices at Home

The first research question is aimed at parental support and mediation for children using digital technologies. The literature review in this area reveals that children's use of digital technologies is highly affected by parents' positive support and positive mediation. In addition, children's undesirable use of digital devices is associated with parents' own negative modelling with digital devices. I provide suggestions in this section to help parents to improve their positive involvement in children's digital device use from selecting safe digital content and suitable digital apps to building healthy use habits. In this section, three types of interventions are recommended: (a) trial use, (b) monitoring and feedback, and (c) co-use.

Trial use. The previous review indicates that parents' positive support can develop children's intelligence and skills by encouraging them to use digital applications for educational purposes, but the "negative" side of parents' support (using digital devices to occupy children) encouraged children's undesirable use of digital devices, such as watching cartoons and playing games (Nevski & Siibak, 2016; O'Connor & Fotakopoulou, 2016). As some studies claim, many parents are aware that letting children use educational apps can benefit their intelligence but inevitably allow children to play games and watch cartoons when they have to attend adult tasks (Baek et al., 2013). The key issue is that parents are unsure of the type and content of the digital apps their children use, which leads to children spending too much time using digital devices for entertainment. Thus, one approach is to get to know and filter the digital content before offering them to children.

I suggest parents use each application by filtering digital content and understanding the function buttons in the app. This trial use method allows parents to exclude inappropriate digital apps and locate appropriate and safe educational apps for their children.

There is a method called "Three steps filter," which consists of three levels in filtering digital content. Three files are created, labeled as Strawberry (red colour), Banana (yellow colour), and Cucumber (green colour). These categories for sorting apps originates from the colours of traffic lights—red, yellow, and green signal "stop", "prepare to stop," and "go". In this way, the Strawberry file represents apps that are inappropriate for children, the Banana file includes apps that require parents' monitoring, and the Cucumber file contains safe apps for children to use.

The first level is to filter out dangerous content including aggressive behaviors, sexual information, presence of smoking, drug or alcohol use, tantrum, and horror scenes. The range of dangerous content identified is inspired by parents' concerns about their children interacting with digital technologies from the studies in my literature review (Nevski & Siibak, 2016; O'Connor & Fotakopoulou, 2016; Wu et al., 2014). When parents encounter any of the inappropriate content mentioned above, the digital app is put in the file named Strawberry. Digital apps in the Strawberry file are strongly suggested to not be offered to children, as the dangerous behaviors and information are a negative influence, which can be detrimental to children's growth and development. It needs to be noted that some digital apps contain inappropriate commercials with content such as sexual information, which is as damaging as the dangerous content of some apps. Customers can pay to remove commercials on some apps while on others, they cannot. Second, the factor of unrealistic expectations is commonly seen in digital content. For example, the search term "Barbie" at the Apple Store will bring up many Barbie dress-up and emulation apps, such as Barbie Magical Fashion, Barbie Fashion Closet, and Princess Salon—Perfect Bride. The unrealistic content can stimulate children's diverse thinking and creativity on one hand, but may lead them to form biased views on the other hand. As a parent in one study stated, their daughter emulates everything about Barbie, from her clothing to saying she wants to dye her hair blond when she grows up because Barbie's hair is blond (Yilmaz Genc & Fidan, 2017). This could lead children to hold Barbie as their standard of beauty. If parents come across such unrealistic content in trial use, they should put the app in the Banana file, which represents apps that require parents' careful guidance and direction while children use them. Unfortunately, only a few studies have addressed that content encouraging unrealistic expectations should draw parents' atten-

tion. Third, on the basis of the former two levels of filters, apps with no inappropriate content and that are used for educational purposes are deemed safe apps, and are therefore put in the Cucumber file. In addition, apps that serve educational purposes can be located by using search terms such as literacy, drawing, colouring, numbers, shapes, foreign languages (English), jigsaw puzzles, board games, storytelling, sing-songs, origami, etc. in the Apple Store (IOS system) or in Application Market/Google Play (Android system) on digital devices. It has to be noted that app resources in the Cucumber file are safe for children but are not necessarily of high quality. To search the apps that are appropriate and high-quality, two more approaches that parents could use to enhance children's positive experiences with digital devices are introduced in the following section.

The previous review has noted that parents' own digital technology skills are positively associated with their support and mediation in their children's digital technology use. The trial use method can help parents to become familiar with app functions and use, further increasing their own knowledge of the apps. For instance, the app 幼儿英语启蒙ABC is equipped with a timer function, allowing the downloader to set up the time period that they want children to spend using the app. By trial using each digital app, parents not only filter out poor-quality apps, they also learn the functions of the apps so they are capable of better supporting their children when using them.

Monitoring and feedback. Based on the previous review, many studies reveal that parents put too much emphasis on negative mediation on children's digital use via restriction and control (Nevski & Siibak, 2016; O'Connor & Fotakopoulou, 2016). This leads us to believe that

parents pay little attention to enhancing the quality of their children's digital use experience. To improve the quality of children's experiences using digital devices and their positive feelings towards use of digital devices, parents need to judge which digital apps or activities can achieve this goal. Since each child is different, I suggest parents monitor their children closely while they use digital devices to acquire feedback that assists them in matching suitable apps and content to their children's intelligence level and preferences.

First, I suggest that parents choose a few apps from the Cucumber and Banana files recommended above, but not too many, especially when children are first beginning to interact with digital devices. Once the apps are set up on the digital devices, parents should let children use them independently but stay close, observing their responses to the apps and taking detailed notes of their responses. No interruption is suggested during the process as frequent guidance would break the flow of children's use experience. It is important to note children's facial, physical, and vocal expression, since children are honest with their feelings and preferences at that age level. In other words, children's reactions towards digital apps represent their true feelings while using them. Having said this, children should trial use an app a few times before parents come to a conclusion about it in order to account for interference due to children's curiosity and unfamiliarity. For instance, if the child taps one app more frequently than others, he/she prefers using that app over others. Parents should pay special attention to the content type and the other features of that app. For example, an app might be about mathematics and shapes. If a child rarely taps it after trying it once and does not pay much attention while using it, this may indicate the app is too easy or too difficult for that child. One of the jigsaw puzzle apps, Puzzle Adventure, has three levels of difficulty: easy, medium, and hard. The easy level of jigsaw puzzle is designed

for preschool children and toddlers, so it would probably be hard to interest and develop intelligence in children who are already familiar with jigsaw puzzles. Different levels of app difficulty can meet children's intellectual needs at different ages and stages of development. There is no universal standard for all children, which highlights the significance of selecting suitable apps for different children by careful observation. The essence of the approach is to locate the type and the difficulty of digital apps that correspond with children's abilities and preferences. The idea of looking for digital apps according to children's skill levels is inspired from the parents in one study who considered a sense of achievement as a standard to use when downloading apps for their children (Yilmaz Genc & Fidan, 2017). Therefore, a moderately challenging app is preferred because it is more likely to inspire children to think deeply to solve challenges.

It has to be noted that casual communication with children after playing with an app can provide further clues as to whether parents are making the right judgements regarding their reactions towards the app. I would suggest parents use this "casual talk" method along with trial use. For instance, "The elephant jigsaw puzzle looks fun, do you like it?" and, "The dinosaur jigsaw puzzle is a little difficult for mom, do you think you can do it?" The use of these questions in assisting communication is especially helpful for children who often like to share ideas with parents but may not be efficient with quiet and shy children.

There may be situations in which children say they are enthusiastic about a digital app but have unenthusiastic reactions or vice versa. In such contradictory situations, parents can allow children to use the digital app for a short time, e.g., one week, in order to observe children's reactions continually before deciding on digital apps for their children. Moreover, parents should repeat this method every few months in order to select new and more challenging digital apps, as

children are continually growing and learning more skills and naturally require more from the digital apps they use. Older and lower levels of digital apps cease to inspire their interest and no longer develop their intelligence. Therefore, the repetition of careful observation and feedback is a key element in the suggestion.

Co-use. Research has shown that parents' occupation and their entertainment habits related to digital technologies increase their children's interaction with digital technologies (Nevski & Siibak, 2016). Regardless of whether it is related to work or leisure, parents spend a lot of attention and time on digital technologies while with their children. Children naturally want to use digital technologies when they see their parents using them for large quantities of time. Furthermore, one study found that children five to six years of age engaged in conflict with their parents when they were told their allotted time for using digital devices was up (Yilmaz Genc & Fidan, 2017). This reveals that parents are not allowing their children to use digital devices when they themselves are, or that when parents allow children to use digital devices on their own, this can lead to children's inappropriate use of digital devices. Some findings have revealed that there are more opportunities for parents to co-use media such as television and computers with younger children since younger children tend to spend more time with their parents (Connell, Lauricella, & Wartella, 2015). Here, I suggest that parents co-use digital technologies with their young children. The parents and children co-use method can contribute to the proper use of digital devices.

During the co-use process, parents may ask their children questions related to the content in digital apps to help them to think about what they find useful and learn from the apps. Parents can also make connections for their children between what they are learning from digital devices and what they already know. For instance, when their children watch the popular marine expedi-

tion cartoon "Octonauts," parents could ask them about the sea animals, such as, "what sea animals in this show are the same as ones you've read about in books," "What sea animals do you see in the aquarium," or, "Does the octopus look the same as in the aquarium?" Parents' co-use of digital devices with children also creates opportunities to express and share feelings. For example, when children use a digital app called Children Dentist (translated from 儿童牙医), parents can talk to their children about why going to the dentist is important, why it is important to brush their teeth, and maybe why children are usually afraid of seeing the dentist, and how to maintain oral hygiene. When parents share their feelings, this provides children with opportunities to learn, thus making children's digital device use more meaningful and active. The co-use approach enhances the connections children make between what they learn through digital apps and what they learn in real life, and also with positive and negative situations they will encounter in their future education and life.

It is worth mentioning that when children use digital devices with their parents, it makes it easier for parents to track the amount of time children spend on devices, instead of letting children's use go unchecked. For instance, children could agree to use digital devices for about 30 minutes per day with their parents; it would be difficult to abide by the agreement if parents usually let their children use digital devices for longer periods of time because they lose track of time due to attending adult tasks. Therefore, parents should use digital devices with their children so as to help them to build a healthy and regular digital device use habit.

Children Using Digital Devices at School

The reviewed studies show that there is a relationship between children using digital devices and their development. Children were found to exhibit strong interests in learning to write, draw, etc., and even peer sharing and communication after interacting with digital devices in class. Although the intervention of digital technologies in a class environment has its limitations, it possesses potential advantages in motivating children to learn and collaborate. Based on the research findings, two types of approaches are suggested so that teachers can implement digital device use in their curriculum in order to enhance children's intellectual and social development: (a) motivating children's interest in learning and (b) promoting children's peer collaboration.

Motivating children's interest in learning. Many studies revealed that the use of digital technologies increased children's interest in learning to write and draw. Evidence shows that the pressure-sensitive touch screens of digital devices can encourage children to make more straight lines, circles, and other movements with their fingers than when they hold pen or pencils to write or draw on paper (Matthews & Seow, 2007; Price et al., 2015). Additionally, one study from a non-English speaking country explicitly expressed one benefit of children using digital devices is that they helped with learning English (Yilmaz Genc & Fidan, 2017). Based on these findings, two types of suggestions are proposed to motivate children's intellectual development with the assistance of digital devices: (a) Chinese character writing and (b) English clip dubbing.

Chinese characters writing. Chinese characters are a type of hieroglyphic, in which each character has at least several strokes and most characters have many strokes. For example, characters 春, 夏, 秋, 冬 representing spring, summer, autumn, and winter are four commonly

seen characters in a first-grade textbook in Chinese. It is not easy for children to learn to write the above four characters as they respectively have 9, 10, 9, and 5 strokes including complex strokes such as left-falling stroke, right-falling stroke, and cross-cutting stroke, etc. As noted above, the use of digital technologies can promote children's interest in making marks, which inspired me to suggest an approach to motivate children to write Chinese characters by combining the use of digital technologies with traditional Chinese character writing.

The activity is named "Fun writing." The general point of the approach is to encourage children to sketch their ideas with their fingers on a digital device and practice the sketched ideas using pens on traditional paper materials later. The sketching on a digital device is the warm-up exercise, encouraging children to become familiar with various strokes that construct a character. The main focus of the method is to let children use their fingers to sketch on digital screens rather than using a stylus, since one study reported that the benefits of writing with touch screens for children did not include use of a stylus on digital technologies (Patchan & Puranik, 2016). Studies also show that digital devices offer many functions such as various colours, different forms of tools including thick brush, thin marker, spray paint, and writing glitter (e.g., Beschorner & Hutchison, 2013). These functions all help to transform the mechanical and repetitive activity of character writing on a grid paper notebook into a fun, active, and self-motivated writing activity. Using digital devices, children could write and design the characters with different colours and tools they can choose along with the other features of the digital device. Teachers should set a time limit for the warm-up exercise since it is possible that children might get carried away with the various features the digital devices offer and ignore the next task of writing characters on paper.

The second step of this approach is that teachers should ensure children write the characters they “designed” with digital devices onto their paper notebook. Sketching on the digital screens aims to motivate children's interest in writing characters, so as to lay a solid foundation for writing on paper. Children would be welcome to use coloured markers to decorate the characters they write in their paper notebooks to make them as colourful as those they created on the digital devices, but it is suggested they finish this up after class considering in-class time is limited. The use of digital devices for writing Chinese characters would motivate children's interest in and increase their confidence in writing Chinese characters.

English clip dubbing. To learn English well is the prevalent hope parents hold for their children today in China. Although few studies explored the association between children's digital device use to their English language learning, many research results showed that digital devices use promotes children's interest in intellectual learning. I therefore recommend teachers to combine the interaction with digital devices in a fun way—English dubbing with the traditional English teaching curriculum together in the school environment.

English dubbing is the act of replacing the original speech in English films with another person's voice. Dubbing English short clips with the help of digital apps is an easy-to-use method for children. It helps them to practice pronunciation, common expressions, and also inspires their enthusiasm for English learning. This method has been gradually used in English Competition Galas at some schools and for extracurricular activities outside of school during the past five years in China. This new combined curriculum consists of two sections. First, the teacher would select and prepare the English clips on topics associated with the units of study in

English textbooks. For example, five units in a common third-grade English textbook from People's Education Press (different provinces may use different versions of textbooks) are "My family," "At the zoo," "Where is my car?," "Do you like pears?," and "How many?" The five units suggest five topics, which are family, animals, transportation, fruits, and numbers. There are many digital dubbing apps offering a bevy of English clips varieties on the Apple Store (IOS systems) or Google Play (Android systems) through digital technologies such as Children Fun Dubbing (translated from 儿童趣配音). An English film dubbing clip on Children Fun Dubbing is from the film *Fantastic Mr. Fox*, and is about Mr. Fox forgetting the blueberries. The dubbing script is as follows:

— Give me a blueberry.

— What? Blueberry. You didn't say...

— You forgot the blueberries?

— I did say it! I wrote it on your paw!

— Yeah, it's written..." (Film clip from *Fantastic Mr. Fox* on Children Fun Dubbing)

The second step is to let children dub either the English songs, cartoon video clips, or film clips that relate to the content they are learning about in the traditional curriculum. I strongly suggest that teachers match the English dubbing content with curriculum topics, since English dubbing is a method of helping children to realize that learning words, phrases, and sentences in order to encourage their curiosity to learn further, and of transforming the children from passive acceptors of information into active learners. This suggestion is influenced by my own experience studying at the University of Victoria (UVic) and my volunteer experience at Mackenzie Elemen-

tary School. In my classes at UVic or at Mackenzie Elementary, I observed that students are the center of the learning process. This may increase the difficulty of learning for students in the short term, as they transition from being a knowledge acceptor, but will develop one's thinking on a deeper and wider level in the long term.

It needs to be noted that dubbing English short clips could be difficult for children to do initially, so the teacher's repeated demonstration and positive encouragement is required. As children gradually become familiar with the activity, the elaboration of some uncommon phrases and expressions is still needed. For instance, a dubbing material on the topic of numbers is called Ten Little Fingers. Some vocabulary in the dubbing material, such as finger and clap will need to be elaborated on and demonstrated before letting children dub the song themselves. This dubbing activity not only enhances children's English knowledge learning but also promotes children's interest in English and transforms the learning from being centred around the teacher to being centred around the children.

Promoting children's peer collaboration. Children are overtly motivated to participate in peer collaboration and communication when digital technologies are used in class (Clarke & Abbott, 2016; Flewitt et al., 2015). Other studies have shown that teachers' appropriate guidance and their own proficiency with digital devices are two key considerations that would affect children's communication when digital devices are used in class (Alhinty, 2015). These two factors—the teacher's opportune guidance and skilled digital device use play a key role in facilitating children's communication and collaboration. Therefore, suggestions are made in this section

to promote children's collaboration and sharing through digital technology: (a) organizing effective grouping and (b) establishing official account communication platforms.

Organizing effective grouping. What is interesting to note from previous review findings is that children's intelligence development, learning motivation, and collaboration are not independent from one another, for some features of digital devices such as multi-functionalities not only increase children's interest in learning, they also encourage children to communicate and share in collaborative activities (Beschoner & Hutchison, 2013; Clarke & Abbott, 2016). This suggests that fun activities, such as Chinese character writing and English dubbing could help children to acquire knowledge through collaboration if under the appropriate guidance of teachers. In China, there are 50-60 students in a normal size of a class. Considering the large size of a normal class in China, I recommend organizing students into smaller groups and guiding the groups of students to practice the above-mentioned suggestions. Research has also identified that knowledgeable children spontaneously help other children in groups during iPad use (Flewitt et al., 2015), which suggests that having children with different levels of mastery of academics and digital technology skills in each group may provide more opportunities for children to communicate.

The principle of grouping is otherness. For example, teachers could organize a group competition for writing Chinese characters and dubbing English clips using digital technologies, the results of which would demonstrate the students' varying levels of mastery over writing Chinese characters and the English language. For instance, the goal of a group competition could be to select different types of digital tools to write these characters: “春”, “夏”, “秋”, “冬” on

screens. With regards to English clip dubbing, pronunciation, fluency with digital operation, and understandability could be used as criteria in a group competition. Students' performances in these group competitions should be noted. The collected information would be used as the data to assess students' differing levels of mastery and fluency. With this information, teachers can group students in order to maximize the effect of collaborating and communicating with other peers in a group.

I believe that knowledgeable children influencing other children because they are willing to share, talk with, and help others in a group is likely to create a positive atmosphere for communication. Each group should be "equipped" with at least one such child. Their positive sharing and friendly helpfulness are contagious and will engage shy and less talkative children in the collaborative activities, so that shy students are more likely to enjoy learning through collaboration more than they usually do. The enthusiastic communicators in the group would feel a sense of satisfaction from sharing and helping peer students. Their sharing can motivate them to learn at a deeper level. Therefore, this conscious grouping would contribute to children's learning how to effectively communicate with peers and collaborate. It would be beneficial to both enthusiastic student learners and less enthusiastic ones.

Establishing official account communication platforms. The use of digital technologies can develop peer collaboration and communication. But the reviewed studies also found that teachers face the challenge of selecting appropriate educational apps, and updating and installing apps for children to use (e.g., Clarke & Abbott, 2016). Therefore, children's communication and sharing skills would be impaired if their teachers lack digital technical skills and the ability to

locate appropriate digital study materials and media when experimenting with new technology in the curriculum. This indicates that the improvement of teachers' digital technical skills is a significant factor in guaranteeing this form of peer collaboration goes smoothly.

Since digital technologies are not yet widely used in classrooms, there may not be many instructive materials on the market to guide teachers. However, with the prevalence of mobile devices, the free instant communication service app "WeChat" made for digital devices has increased in popularity since its creation in 2011. Therefore, I suggest establishing an official account related to the implementation of digital devices on WeChat, to build a free platform for teachers to learn to use digital devices and improve their digital technical skills through actual instructing experiences. The approach is feasible since WeChat's estimated number of users reached 1 billion in 2018 and its users can send text, pictures, audio, and video clips instantly.

Teachers in the same school district could share an official account on WeChat called "Teachers' Second Classroom" and by clicking the button "follow," teachers could then read, comment, and "like" articles. "Teachers' Second Classroom" could be updated once a week and at least three articles or topics would be uploaded each time. For instance, the three articles could be "Two easy-to-use English dubbing apps," "How to better lead students to use digital devices fairly in groups," and "Talk about your favourite methods of guiding boys who want to spend longer amounts of time on digital devices." In the following weeks, one of the updated articles could be on the topic of teachers' experience and their observed effects of the two easy-to-use English dubbing apps. Those teachers who regularly insert digital device use into their curriculum will learn more digital technical skills and can communicate to other teachers the effects of classroom use without limits on their time. As has been found in research studies, children are

challenged technically during use of digital devices (Flewitt et al., 2015) and it is the teacher's responsibility to provide help and instruction to ensure the implementation of new curriculum.

I have followed an official account on WeChat, and therefore know that official accounts can add more than one administrator. I therefore recommend a shifting of the administrators of "Teachers' Second Classrooms" after a period of time. This way, teachers from each school in the same school district will have the opportunity to share their digital technical wisdom and also post their queries regarding instructing children to use digital devices. The official account will allow teachers to let each other know about high-quality digital apps they can use, and offer an instant and free platform to exchange reflections on instructing children using digital devices.

Concluding Reflections

For this researcher, the current study had a few drawbacks. The lack of research on the gender demographics of parents is a substantial limitation. Mothers and fathers might have distinct levels of influence on children's digital device use through the four aspects discussed in the literature review—their attitudes, their own usage, support rates, and mediation. The majority of research did not report on parents' gender demographics, and the percentage of female and male parent participants in the rest of the studies were varied, and so did not differentiate perspectives of parents' influence on children's digital use by gender. Furthermore, a large number of studies involved only the qualitative research method of observation and interviews by teachers and researchers regarding the influence of digital device use by children on their writing, drawing, and peer collaboration. I believe the data would have been more balanced if there were some studies that used quantitative research methods. Moreover, the recommendation of establishing an official account on WeChat to enhance communication among teachers regarding digital technology use in the classroom could be somewhat constrained geographically, especially in the countryside, in mountainous areas, or at high altitudes, because the network has not yet been covered in those places.

Although there are several limitations, I have gained precious knowledge while completing this project, which has been a “painful” but incredible academic writing experience. During the process, I changed my topic once only to find that I faced the same challenges of struggling with a hazy range of search topics and entangled result findings from the searched journal articles. One valuable lesson I learned about choosing a topic is to follow my heart and select the

topic that attracts my interest and passion. One precious research method I learned is to create a table and fill it with results related to the focal points of my topic, which then presented me with results approaching the project's research questions, thus allowing me to compare and contrast. Under my supervisor Dr. Roth's instruction, I became gradually aware of how to synthesize the data and complete the literature review.

From reviewing the literature, I have also learned the valuable implications of this literature. Children in current times are born in the fast-developing era of mobile devices and they naturally deserve to use mobile devices in their lives and studies. However, parents' perceptions towards children's digital device use focuses on restriction. Parents should increase positive support and mediation in order to enhance children's experience of interacting with digital devices at home. Teachers and educators could purposely focus on a few aspects of children's intellectual improvement when introducing the use of digital technologies to children in class. This would not only motivate children's interest in learning but would help children to acquire collaboration skills. Lastly, I acknowledge that children's digital device use, either at home or in the school environment, should emphasize children's pleasure and development rather than entertainment. Parents and teachers appear to be the guides who can make digital devices efficient media tools for children.

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