

# How Does the Use of Digital Devices in The Classroom Affect the Learning Outcomes for Literacy in Early Childhood Education

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**Abstract:** Today, digital technology is more and more widely used in learning, whether at home or in the classroom. If digital technology is used properly, it may become a useful tool to support the learning and development of young children. It is now common for preschoolers and kindergarten children to use technology devices, play games on tablets, or surf the Internet. With the widespread use of digital devices in preschool classrooms, we must better understand the process of using digital devices. The development of informatization of early childhood education has made the application of digital equipment more popular at this stage. Therefore, it is necessary to explore how digital devices affect children's learning. In this article, I will review 30 high-impact factor articles and explore how to use digital devices in the classroom to affect the results of children's literacy learning. The article analyzes how digital devices can help children improve their literacy results from multiple perspectives and aspects. The research results show that digital devices affect children's literacy learning effects in three aspects. First, digital devices can increase students' interest and motivation in learning. Second, the use of digital devices in the classroom can increase children's participation. Third, digital devices can act as scaffolding to help children improve their academic performance. Finally, I will make some suggestions on the gaps in my survey and reflect on how the survey results have shaped my thinking and practice.

## 1. Introduction

Today, digital technology is more and more integrated into our lives, and the education industry is also affected. researchers are discussing the impact of digital technology in education on learning (Martin et al., 2019). If digital technology is used appropriately, it may become a useful tool to support the learning and development of young children. It is common for preschoolers and kindergarten to use technology devices now, playing games on tablets or browsing the Internet. As digital devices are widely used in the early childhood classrooms, we must have a better understanding of the process of using digital devices. According to Kalas (2013, as cited in Gjela et al., 2020), digital technology can provide children with new opportunities to participate in attractive and relevant games, learning, communication, exploration and development. Digital media and devices (e.g., e-books, digital games, websites, tablets) have more sensory ranges, which can simultaneously stimulate touch, hearing and vision which might evoke various senses during the construction process (Flewitt et al., 2011). The development of early childhood education informatization has made the application of digital devices more popular in this stage. Therefore, it is necessary to explore how digital devices affect children's learning.

My inquiry question is "How do the use of digital devices in the classroom affect the learning outcomes for literacy in early childhood education"? The reason for choosing this topic is because an increasingly number of digital technologies are integrated into early childhood education, I want to explore What impact does digital devices have on children's learning? In my previous work experience (in an education institution), parents ones questioned the application of digital devices in the field of early childhood education. They do not understand why so many digital devices are used in the classroom, so that they may against using devices in classroom. I know that digital devices will help

children improve their learning outcomes compared to traditional learning. However, further research is needed on how digital devices affect children's learning outcomes. I want to explore further how digital devices can be used in preschool education to help children learn, in which and how they affect the literacy achievement of young children. Also, I think that if teachers have a more comprehensive understanding of the use of digital devices in the classroom, teachers will be more efficient in implementing course content and more flexible teaching methods. Understanding these aspects of information will give me some inspiration for my future teaching work.

In this article, I will explore how digital devices are used in classrooms to affect literacy learning outcome for young children. This is very important for my continued research and works in the future. I will review the relevant literature in the past ten years and explore the answer. First, I will introduce my search approach and analysis of the research methods used in my study, and find out the most suitable research methods for researching this topic. Then I will introduce how digital devices affect children's literacy learning outcomes, including increasing learning interest and motivation, increasing classroom participation and the scaffolding function provided by digital devices. Finally, I will give some advice for future research on gaps in my survey, and reflect on how the survey results shaped my thinking and practice.

## **2. Inquiry approach**

I start with ERIC database search of the advanced search page, using these terms: digital, literacy, China, and choose early childhood age group. I used China as the search term because at the beginning, I would like to narrow the topic of my paper to China context. However, I found that only six articles were investigated in China, and these articles were not enough to support my literature review. So, I expanded the search scope to Asia, but still only searched a few articles. I realized that I had to continue to expand the search scope to the whole world, but narrowed the topics I discussed to the classroom setting. I used the keywords digital, literacy and classroom, and I chose the early childhood age group, and I got 228 articles. I used the filter to select journal articles and got 130 articles. Then I chose the publication date 2010-2020 and peer-reviewed, I got 99 articles. After reading the titles and abstracts of these 99 articles, I found that most of the articles are about what better learning results can be brought by using digital devices, which is not in line with my inquiry question, but some articles can still be used to response my question. After reviewing the impact factor, I selected 13 as my references.

Next, I think I should change my search terms for further searches in the ERIC database. I use the terms device, technology, iPad, computer and tablet, and use the Boolean operator "OR" to connect them, and then add another term "affect OR impact", and then I choose the field of early childhood education. This time, I got 241 articles. I chose peer-reviewed, journal article and selected documents within ten years. I finally got 83 articles. After I reviewed the title and abstract of the articles, I think these articles can answer my inquiry. Finally, after I checked the impact factor and the content of the article, I found 17 articles suitable for use in my literature review. In the end, I identified 30 highly influential articles and 11 peers reviewed articles. Next, I will read these articles to determine the main themes of my literature review.

I use a table to record the articles I read. For each article, I mark its research method, the age of the target group, the number of people and the research results (how digital devices affect children's learning outcomes). After reading the article and making a table, it is clear that some investigations have similar results. There are seven articles mentioning that using electronic devices can increase students' learning interest and motivation; 20 articles mentioning that electronic devices can enable students to have higher classroom participation, including increased attention and more interaction; 5 articles Supporting electronic devices can provide the function of scaffolding to help children improve their learning outcomes.

### **3. Research methods**

Among my 30 high-impact factor articles, nine articles use mixed methods, including collecting qualitative interview information with teachers, observing and asking students, questionnaire surveys, and bringing in ethnography methods for analysis. Eight articles used the randomized controlled trial method to collect research results. In these investigations, the children were divided into two or more control groups and intervention groups, and pre-test and post-test were performed to explore the results. These investigations tested the effect of use of computers, tablet computers, e-books and iRobiQ (Robot companion). Although the digital devices were different, similar results were found. Among the remaining articles, three articles are using the case study method, three articles using the experiment conducted method, five literature reviews and two video observations. In the use of most of the mixed methods, the video observation method is incorporated; this method can directly observe the children's behaviour in the classroom and the degree of influence by using digital devices.

Most of these 30 articles collected qualitative data, and only the randomized controlled trial method collected both qualitative and quantitative data. However, quantitative data has little relevance to my study. Quantitative data collects children's literacy learning outcomes, such as specific improvement data in literacy and reading. I am more concerned about how the children who use the digital device group are affected during the randomized controlled analysis. In general, these analysis methods provide high-quality results for my inquiry question, and they can be used in my subtopics. Among them, the mixed method and video observation are the most suitable research methods for my article. This qualitative research method can intuitively observe and analyze the reaction of children using digital devices in class. Therefore, I suggest that researchers investigating similar topics can consider using the mixed method and video observation method for investigation. I suggest that the survey can be conducted in numerous kindergartens in multiple communities, because the extent to which young children are affected by digital devices may also be affected by other factors, such as family background and how family use of digital devices. This can ensure the diversity and accuracy of the survey data.

### **4. Improve learning interest and motivation**

#### **4.1 Children are passionate about digital devices**

The survey found that young children seem to be particularly fond of digital devices (Flewitt, 2015; Dong & Newman, 2016; Neumann & Neumann, 2014; Haßler et al., 2016), incredibly touchable devices (Lynch, 2014; Flear, 2017; Couse & Chen, 2010). A study by Sulaymani and Flear (2019) found that if children have a positive tendency to use electronic devices, they will be more emotionally engaged. An interview with kindergarten teachers found that digital devices can stimulate children's interest in learning (Dong & Newman, 2016). Moreover, compared with teacher-guided activities, children are more willing to accept interaction with ICT. Flear (2014) believes that motivation is culturally developed due to children's participation in the surrounding environment. Research has established that children's motivation for play and learning seems to be crucial in the way they interact with touch technologies such as the iPad (Flear, 2017).

In terms of reading, many children stated that they tend to use tablets instead of paper materials (Couse & Chen, 2010). Children are very interested in digital storybooks (Ciampa, 2016; Richter & Courage, 2017), and are more involved in reading digital storybooks than reading paper books (Richter & Courage, 2017). De Jong and Bus (2004, as cited as Son, 2020) also believe that digital storybooks are more attractive to young readers, which arouses greater interest and repeats reading. According to Shamir et al. (2012), exposing children to computer text may make them more interested in reading, and it may also make them confident in handling printed materials. However, children do not have the same confidence when reading paper books.

Seemingly, Ipad is very popular in the early childhood classroom (Neumann, 2018; Lynch, 2014; Flear, 2017). In the iPad class, children were observed smiling, laughing, and shaking their bodies with the music. The mobility of the iPad allows children to change their posture at will during class

(Neumann, 2018). In an interview, teachers believe that Ipad-related curriculum activities can stimulate children to learn (Flewitt, 2015). In interviews with children, it was found that in operating applications and maintaining devices (turning them on and off, controlling the volume, putting them away, and charging them), students showed themselves to be highly capable users of these technologies (Lynch, 2014). Tablets remove barriers to complex operations and provide more learning opportunities in the early stages (Merchant, 2015). Students have always been enthusiastic about the use of iPad and are eager to show how they work. When asked about the various technologies used in classrooms, students reported that they prefer iPads over iPod Touch devices, interactive whiteboards and computers (Lynch, 2014). When Martin et al. (2019) implemented a research of observation methods, they also found that children are eager to use iPad. When the children were divided into a tablet group and a paper use control group, all participants in the paper group expressed their desire to use the tablet. For example, children will ask when they can play tablet? Martin et al. (2019). Children like to use tablet and have been observed to gradually increase their awareness of digital printing through the use of tablet for urgent writing (for example, letter and name writing, symbols, typing, and sending emails and messages to family members) (Neumann, 2018). Therefore, it is concluded that the iPad is an active tool that young children can use independently to develop their knowledge and understanding of printing (Neumann, 2018).

## **4.2 From entertainment motivation to learning motivation**

When children were asked about why they like digital devices, all the students interviewed stated that they liked "games" (Lynch, 2014). The children showed some applications, which they thought were called "games", including applications designed to support early literacy learning, and more general games. (Lynch, 2014). Students seem to be able to use the iPad easily, they focus on the functionality of gamified apps, and gaming activities are relatively easy to navigate (Lynch, 2014). Sulaymani (2018) believes that using iPad for enjoyable learning activities may promote the development of children's learning motivation. This learning configuration (using the iPad) began to develop children's motivation from play to learning. A similar finding was found in Flear (2014) research. A student reported that he and other students could not distinguish between casual games and learning applications. For example, this child explained that when he was using the iPad to play games, he did not understand that the learning games on the device and the iPad are not just for entertainment. Also, when this kid uses a learning app to play games, he still thinks that he is using an iPad to play games instead of learning (Flear, 2014). This child's response shows how children think that the iPad is only used for games, so their motivational orientation is to use it for games, even if the content is about learning (Flear, 2014). This also shows that the app creates a learning environment on the iPad. Therefore, when children are developing their entertainment motivation, the role of the teacher should be to encourage the transition from play motivation to learning motivation (Sulaymani, 2018). The motivation of play begins the transition from play to learning, and this situation also reflects the motivational development of teachers (Flear, 2017). Teachers need to create conditions to stimulate learning activities and enhance the motivational development of children in the school environment (Flear, 2017).

## **5. More engage in classroom**

### **5.1 Improve concentration**

Researchers believe that electronic devices can attract students' attention (McEwen & Dubé, 2015; Macaruso & Rodman, 2011), thereby increasing participation in classroom learning (Zhou & Yadav, 2017). In an interview, teachers pointed out, With the help of electronic teaching resources, teaching equipment can be enriched. Due to various dynamic influences such as electronic equipment and animation, the use of digital devices for teaching can better help children focus on learning and improve children's attention (Dong & Newman, 2016). In contrast, a photo alone cannot attract children, while an animated presentation can (Dong & Newman, 2016). Computer applications can stimulate visual effects, including progress bars, which fill up as students complete each unit in the

activity. The program also maximizes the task time for each activity by providing feedback immediately after each response without distraction or delay (Macaruso & Rodman, 2011). This result also shows that no matter what the child's cognitive ability is, a simple application can direct the child's attention to inner and essential content (McEwen & Dubé, 2015). Hsiao (2015) found in a survey on the robot companion iRobiQ to support children's classroom learning that iRobiQ has the function of sound and light effects, and its hands can move, attracting children's attention. Multimedia story reading has also been found to increase reading participation by enhancing the attractiveness of the story format and make the text interesting by using sound or visual effects (Zhou & Yadav, 2017). Moody et al. (2010) compared children participation and enthusiasm in reading e-books and printed text stories. Result shows that compared with participating in traditional story situations, children are more likely to persevere in participating in multimedia story situations and continue to perform tasks. Researchers suggest that electronic devices initially attract the attention of students because they are new devices. Therefore, once students get used to this technique, this attention may disappear (Glover et al., 2007). Martin et al. (2019) research show that technology enhances participants' attention and motivation, but technology should be used appropriately so as not to lose their appeal to children.

### **5.3 More peer interaction**

Some people may think that a significant problem involving the use of digital devices (especially personal computers and tablet) in a early childhood classroom is that it may lead to reduced social activities among children. On the contrary, researchers emphasize that digital devices promote children's social development in various ways (Infante et al., 2010; Martin et al., 2019; Knauf, 2016; Hsiao, 2015). Preschoolers can be relatively relaxed the application of such devices (Hirsh-Pasek et al., 2015) is dealt with carefully, and tablets are described as particularly suitable for young children (Blackwell et al., 2016). Goodreau (2013) observes the use of digital devices in preschool classrooms. It was found that using digital devices can improve students' academic performance, increase participation and motivation, and encourage peer cooperation. Beschoner and Hutchison (2013) conducted a qualitative case study describing the use of digital tablets to promote emergency literacy in the early childhood classrooms of two 4-year-old and 5-year-old children. They pointed out that even if students use the tablet alone, they often start meaningful conversations with the surrounding children and can solve problems together. Since children often use and talk about digital tools together, scholars claim that digital tools can promote social learning (Beschoner & Hutchinson, 2013).

Hsiao (2015) found that children acted as partners who collaborate with classmates (such as telling and understanding stories) when using robot companions (iRobiQ) for reading activities. For example, in each pair, one child explained the meaning of the text to the other, and vice versa; the children in each pair discussed one of the disagreements; they also corrected the partner's mistake in word recognition. These observations indicate that the use of iRobiQ encourages children to learn more actively and interact with peers. When the diversity of leisure activities continues to increase, the participation of children is promoted. Sharing reading on the iPad is an example of reading pleasure. When they are doing reading activities with friends or classmates, sharing reading settings is also fun for them. Some readers showed a high degree of excitement when watching illustrations or animations together. Children seem to prefer a shared environment, and they show more excitement related to activities (Hsiao, 2015). Shamir et al. (2012) emphasize that children in a peer-learning environment paired with peers are better than children who study alone have better phonological awareness, emergency reading and story comprehension.

### **5.4 Interaction with devices**

More classroom interaction means greater participation of children. Some digital devices provide high-interaction functions with learners, such as e-books, tablets and iRobiQ (Hsiao, 2015; Son et al., 2020; McEwen & Dubé, 2015). Besides, the interviewed teachers reported that they compared with guided activities, young children are more willing to accept interaction with devices (Dong, & Newman, 2016). Young children are very enthusiastic about learning with digital devices, allowing them to interact with multimedia and making them feel very happy through hands-on operations

(Dong, & Newman, 2016). There are also significant differences between digital text and traditional text. The digital text has more sensory range than non-digital text because their multimodal features can stimulate visual, auditory, kinesthetic and tactile sensations (Neumann, 2017). For example, a digital storybook contains digital interactive functions embedded in story illustrations and can be activated by the reader's touch (Son et al., 2020; Bus, 2015). Triggering interactive functions to produce a compelling visual or auditory experience may affect children's interest and fun in storybook applications, making them more likely to participate in stories (Son et al., 2020). Therefore, the use of interactive functions in the reading process of the storybook application can improve story comprehension and improve children's entertainment. Research results show that children's initial literacy skills are related to the conditions of interactive applications: after reading interactive applications with a large number of explicit interactive functions, younger children's comprehension scores (especially story recall) are higher (Son et al. al., 2020). Huang et al., (2012) reported that interactive e-books enable students to physically interact and manipulate the text they are reading, allowing them to participate in the reading environment and obtain a better-personalized reading experience. It is also better than traditional books, and it enhances the function of learning words (Korat et al., 2014). The research of Smeets and Bus (2012) shows that interactive e-books with built-in vocabulary explanations and oral reading and narrative text can improve learners' performance and improve their language learning ability (Huang et al., 2012). The applications in Ipad can draw children's attention to inner and essential content. The design of the content in the Apps promote successful users to communicate with the tablet because more educational information is more visually appealing. This attraction makes the interaction between the child and the tablet more successful, and this interaction has nothing to do with the child's cognitive ability. (McEwen & Dubé, 2015).

Therefore, many people report that interactive e-book programs installed on computers or other mobile devices can play interactive functions and increase children's participation (Huang et al., 2012; Korat, 2013; Tseng, Liu and Liu, 2012). However, Hsiao (2015) found in a study that e-books installed on high-interaction tools such as iRobiQ have a more significant positive impact on children's academic performance and motivation than ordinary mobile devices. iRobiQ is a two-way interactive toy and a learning companion that attracts children. It provides them with an experience similar to playing because children can touch the screen, talk with iRobiQ and ask questions. Unlike tablets, iRobiQ has the function of expressing emotions. iRobiQ gives children feedback through nonverbal means, such as hands-on, sound or flashing lights (Hsiao, 2015). Therefore, iRobiQ may be the most interactive digital device. In general, digital devices can provide interactive functions with children, which will increase classroom interaction and increase classroom participation.

## 6. Scaffolding function

Electronic devices provide scaffolding for children's literacy learning (Schmitt, 2018). Vygotsky's sociocultural theory explained that humans use culturally meaningful tools to promote learning, problem solving, and other problematic behaviors (Vygotskii & Cole, 1978). Digital devices and some applications have become a tool today, like a compassionate teacher or caregiver, educational digital devices and applications can extend their existing knowledge by guiding children through more challenging learning (Wartella et al. 2016). Alternatively, from a sociocultural perspective, support children through their "proximal development zone" to support their learning (Wartella et al. 2016). The applications start the process of building scaffolding by showing kids that things are much more complicated than they can do, and it becomes more challenging (McManis and Gunnewig, 2012). This process may make learning more interesting and encourage children to continue learning. Also, the applications can provide corrective feedback, prompt and/or emotional encouragement as other means of supporting children's learning (McManis and Gunnewig, 2012). As another means of scaffolding, if the child is confused, the applications may be necessary to demonstrate the solution to the problem, or if the child's first answer is incorrect, the child should be allowed to try to answer the question multiple times (Yelland & Masters, 2007). Providing the possibility of personalizing the learning process and the ability of digital devices to respond immediately to any student's behaviour, which

helps to detect and correct errors early (Cicconi, 2014). However, as the child's competence for target skills improves, the applications will reduce the level of scaffolding over time (Yelland & Masters, 2007). However, students should also get more learning outcomes for the scaffolding function provided by digital devices (McManis and Gunnewig, 2012).

## 7. Conclusion

In conclusion, digital devices affect children's literacy learning outcomes in three aspects. Firstly, digital devices can improve students' learning interest and motivation. Due to children's active tendency towards digital devices, especially touch devices, digital devices can stimulate children's interest in learning. In addition, the children showed proficiency in the operation and maintenance of the equipment. Children think all applications are "games", so their interest in games is an entertainment motivation. However, these "games" seem to have created a new learning environment on the iPad. Therefore, electronic devices and applications that are highly attractive to children provide children with learning motivation. Secondly, the use of digital devices in the classroom can increase children's participation. Electronic equipment can display more visual effects, such as animation and other dynamic effects, which can attract children's attention and increase participation. In the process of using digital devices, peer interaction becomes more frequent, and children will discuss device-related dialogues and solve problems together. The interactive features in some application enable more interaction between children and the devices. These features make children attracted by the course content and increase participation. Thirdly, digital devices can play the role of scaffolding to help children improve their learning achievement. Digital device applications can guide students through more challenging learning content to expand their knowledge. The applications also provide error correction feedback, hints and encouragement to help children better complete their learning content. In general, the use of digital devices in the classroom can increase children's learning interest, motivation and enhance children's classroom participation. The devices also play a scaffolding function to support learning.

In my study I found that most articles are about how iPad, computer, and e-books affect children's learning. The use of some other digital devices is rarely studied, such as interactive whiteboards and PowerPoint. These devices seem to be often used in children's classrooms, but they are rarely studied. Future research can explore how the use of other devices affects the literacy learning outcomes of young children. Furthermore, in these 30 articles, there is no mention of whether there is a gap between the short-term and long-term effects of using the same digital device or applications for learning. For example, if children use an application on the iPad for a long time to learn, will they lose interest? I suggest that researchers can consider further research in this area, which is very helpful to teachers' practice and curriculum design.

After reviewed articles, I learned how digital devices affect and support children's literacy learning outcomes. I think digital devices need stimulation and help in many aspects to affect learners' learning outcomes. First of all, the entertainment of digital devices can increase children's interest and participation, which may make children more active in learning. However, the scaffolding function of digital devices is also very important, which may determine how children can improve their learning outcomes. The function of helping children correct errors and encouragement in the application is very important. Moreover, I think that because digital devices can play the role of scaffolding, it can help teachers correct errors, give prompts and encouragement to children, like an assistant teacher, so as to improve classroom efficiency and improve students' learning achievements.

Therefore, in future research, I may focus on the scaffolding function by digital devices. I think this kind of help is not only reflected in the digital devices to the students but also the scaffolding help between peers may also be provided because of the digital equipment. Moreover, how the teacher plays the scaffolding function in the classroom using digital devices. In my future practice, I will also study how to use digital devices more effectively in the classroom. For example, when or under what circumstances in the classroom can use digital devices to their best effect.

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