Let's Draw: Utilizing Interactive White Board to Support Kindergarten Children's Visual Art Learning Practice

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(Submitted June 7, 2016; Revised September 10, 2016; Accepted November 2, 2016)

ABSTRACT

Compared to other academic disciplines, interactive white board (IWB) research in early childhood education is still in its infancy. To add more knowledge base regarding the instructional effectiveness of IWB for young children, this study aimed to investigate educational phenomenon of using an IWB to teach visual art to kindergarten students. The study adopted a qualitative case study to fulfill the research purpose. The research participants were 25 children aged 5 to 6 years old from a public kindergarten in Taiwan. The qualitative study lasted for four months of one semester. Multiple qualitative data sources were collected from students, teachers, and parents. A qualitative analysis method identified seven major themes. The results indicate that the IWB is an effective learning tool for enhancing students' learning interest and motivation during visual art instruction. The IWB may facilitate discussion about learning process, resulting in more diverse elements in children's paper-based drawings. Schoolteachers and parents both witnessed the positive effect of IWB use on children's drawing instruction. In particular, IWB integration strongly supports students with special learning needs. Based on IWB implementation experiences, several instructional implications for early childhood educators who are interested in IWB adoption in classrooms are proposed.

Keywords

Information technology in kindergarten, Visual art learning, Interactive white board use, Interactive learning environment, Drawing instruction

Introduction and problem statement

Problems of Information and Communication Technology (ICT) use in Taiwanese kindergartens

The Ministry of Education in Taiwan outlined the importance of ICT applications in classrooms for K-12 teachers. To foster the development of digital citizens, the Taiwanese government strongly encouraged teachers to embrace the concept of curriculum integration with ICT by holding several workshops on ICT applications in education (Ministry of Education, 2008). However, similar to the status and development in Western countries (e.g., Hsin, Li, & Tsai, 2014; Yelland, 2005), many early childhood educators in Taiwan remain skeptical about ICT use in kindergartens. Those who were unwilling to adopt ICT in the curriculum often expressed that ICT use might lead to impaired eye development, poor social interaction, and computer addiction (Chen & Huang, 2007). Chen and Huang (2007) further explored the factors influencing kindergarten teachers' ICT use and found that teachers who resisted using ICT in the classroom often lacked professional knowledge regarding ICT use for curriculum reform and personal experience in utilizing ICT in their teaching practice. In addition, according to a recent survey report (Chen, 2011), from the preschool teachers' perspectives, the largest barrier for ICT integration in kindergartens is administrational support.

Emphasis on traditional drawing instruction in Taiwanese kindergartens

Because young children in kindergartens have not received literacy training yet, they often draw symbolic images to express their ideas. According to Piaget's (1956) constructive learning theory, children use symbols in drawings to construct their imaginary worlds. Kress and Van Leeuwen (2001) considered children's visual artworks to be "image grammar" that communicates their conceptual knowledge to adults. Therefore, most kindergartens in Taiwan emphasize drawing instruction in the curriculum design (Shen, 2003). Several kindergarten teachers even examined the content of drawings as a benchmark of cognitive development (Ehrlén, 2009).

Drawing instruction is a subcategory of visual art education. Traditionally, kindergarten children's drawings are created using pencils, pens, and crayons because schoolteachers emphasize on traditional teaching methods. For instance, according to learning resources listed in the Association of Taiwan Art Education (2015), most preschool teachers still employ traditional teaching methods without the need of technology tools in drawing instruction. Integrating ICT into visual art education is uncommon in Taiwanese kindergartens. This phenomenon echoed Terreni's (2010) observations in worldwide early childhood settings, and also became a driving force in completing the current study.

Unpopularity of interactive white board use in Taiwanese kindergartens

An interactive white board (IWB) is a large touch screen display mounted on a wall. When used in classrooms, it is often combined with a digital projector that displays electronic signals from a desktop or laptop computer. Teachers or children can easily use electronic pens to annotate texts and move learning objects (e.g., images or animation) on the IWB (Preston & Mowbray, 2008). These interactive features situate young children in a joy-based learning environment (Morgan, 2010), where students' learning interest and motivation are higher than they are in traditional learning environments (Terreni, 2010). Despite the claimed benefits of IWB use, according to Tsai's (2013) survey report, the installation rate of IWBs in Taiwanese kindergartens was extremely low. Furthermore, based on the researchers' long-term observation, a combination of IWB instruction and drawing instruction for young kids was also rarely seen in the kindergartens.

Theoretical discussion and research purpose

Foundations of IWB use in Kindergartens

According to a new position statement of the National Association for the Education of Young Children (2012), when used wisely, ICTs are effective learning tools that may support learning in young children. Similarly, the International Society for Technology in Education (2007) described the necessity of technological literacy standards for young children and emphasized ICT use in learning activities. Being as one of emerging ICT tools, therefore, IWB use in current kindergarten curriculum, particularly for visual art learning, perhaps presents a new instructional option in early childhood education.

According to the cognitive theory of multimedia learning (Clark & Mayer, 2011), IWB adoption in visual art learning might function as an effective learning tool that enables young children to systematically organize received information with prior knowledge. Furthermore, IWB use may serve as a scaffolding tool (Donohue, 2015; Jonassen, 1999) for helping children construct knowledge about drawings. IWB teaching practice, as a new instructional technology, perhaps can support and facilitate children's paper-based drawing in traditional visual art learning.

IWB use with visual art learning in Kindergartens

Because the IWB is a relatively new ICT application, IWB research in early childhood education is still in its infancy, influencing the number of scholarly studies. In the relevant literature, most past research has focused on IWB integration with science-related subjects and reported positive findings. For example, Preston and Mowbray (2008) found that IWB adoption enhanced children's science learning experiences. Linder (2012) indicated that IWB use was an effective learning tool for supporting children's mathematics skills. Wong, Goh, and Osman (2013) revealed that IWB integration into the science curriculum improved the teaching and learning process. However, whether IWB integrated into visual art curriculum may yield similar outcomes remains further exploration in the current study.

Regarding a combination of IWB and visual art learning, after interviewing several UK kindergarten teachers about IWB use and observing young children behaviors during IWB integration in class, Morgan (2010) was the among the first to identify that IWB was a perfect tool to capture students' visual ideas. Furthermore, Terreni (2011) integrated IWB use into a visual art curriculum in a New Zealand kindergarten, and reported that IWB use supported young children's visual art learning experiences. However, because there have been few past studies on IWB use with visual art learning in early childhood education, the effect of IWB instruction on young children remains uncertain. Therefore, the implementation of the current study perhaps provides other new insights to IWB application in visual art curriculum.

Based on the previously discussed problem identification and theoretical background, one overarching goal of the study was to use a qualitative case study method to investigate the educational phenomenon of integrating IWB into visual art instruction in a public kindergarten in Taiwan. Specially, under the goal, the research objectives were:

- What were young kids' responses to IWB application in drawing instruction?
- Compared to the previous semester, what kinds of new elements might appear in students' drawings after IWB use?
- What instructional scenarios (or problems) might happen during IWB implementation?
- What were teachers' and parents' perceptions of IWB use in the visual art curriculum?

Research method

Research design

The current study involved long-term observation in one educational setting. A qualitative approach was the most appropriate research method for fulfilling the research purpose (Hatch, 2002). Of the varied qualitative paradigms, this study adopted a case study methodology to collect the required data because case study research enables researchers to fully concentrate on one specific case in a school (Creswell, 2007). According to Yin (2003), a case study can have a simple single-case or complex multi-case design depending on the unit of analysis. In this study, the main focus was how IWB integration affected children's learning process and drawing learning whereby the single-case design fits this research's scenario.

Research participant

The participants in the study were 25 children aged 5 to 6 years old. These children were students at a public kindergarten in a metropolitan city in Taiwan. One school teacher and two childcare workers who assisted the schoolteacher were assigned to the class. The school was located in a downtown area where the students' parental backgrounds were more diverse than those in countryside areas. Before the implementation of the study, research consent forms were obtained from the students' parents. To confirm with ethical standards, the names of the students and settings were assigned codes.

The schoolteacher had six years of experience of working in kindergarten where she often taught visual art classes. She obtained her bachelor's degree of early childhood education and master's degree of curriculum and instruction. Prior to the study, the schoolteacher had already received professional training regarding IWB use in class.

Prior to the study, the ICT infrastructure in the classroom contained a desktop computer and a digital projector. The students' ICT exposure was limited to PowerPoint instruction models, where teachers used to introduce health issues and promote school policies to students. No learning opportunities regarding ICT manipulation in the school were provided to the students. Because the IWB was newly introduced in the kindergarten, the students had no previous experiences with using an IWB.

Curriculum design

To enable the IWB to be successfully integrated into the existing visual art curriculum, the researchers and the schoolteacher collaboratively designed eight learning units about drawing practice by modifying the official curriculum current used in the kindergarten. Two learning units were taught each month. Each learning unit lasted 2.5 hours. Prior to the study, the teacher introduced the IWB into the classroom, enabling the students to understand the technological functions embedded in the IWB. Table 1 lists the curriculum design of the study.

The curriculum design listed in Table 1 was coordinated with other learning activities. For example, before the start of Unit 1, the schoolteacher took the students to stroll around the kindergarten neighborhood. The activity enabled the students to observe the neighborhood so that they could have a reference to draw for their visual art class. Furthermore, the schoolteacher chose specific picture books related to the unit titles. This storytelling activity enabled the students to learn how to organize what they observed in their drawings. During the learning unit, the schoolteacher employed the IWB to demonstrate basic drawing knowledge and skills. Several students were also encouraged to draw their imaginary objects on the IWB. After 1.5 hours of IWB use, the students used

crayons to complete their artworks on a work sheet and share their stories with classmates. Upon completion of drawing instruction, homework (paper-based drawing) related to the learning unit was assigned to the students. Students were asked to practice their visual art learning on a piece of paper.

Table 1. Curriculum design

Unit title*	Description (Learning goal)
What is neighborhood?	Children observe something in the neighborhood
Symbol	Children understand shop symbols
Billboard	Children discover interesting billboard
Where are you going?	Children understand several routes in the neighborhood
Little receptionist	Children take a role of a receptionist
Little hair designer	Children take a role of a hair designer
Little cloth designer	Children take a role of cloth designer for Halloween
Shopping fun	Children buy something in a supermarket

Note. *Learning units were coordinated with other two learning activities (field trips and storytelling with picture books)

Interactive White Board in the classroom

In the study, the IWB served as a scaffold for supporting teaching and learning in the class (Donohue, 2015; Jonassen, 1999) rather than replacing traditional teaching methods. The research assumption was that IWB use in the classroom might stimulate the students' learning interest and inspire them to draw visual objects. When integrating the IWB into teaching practice, the schoolteacher employed IWB software to prepare learning materials, which contained several animations, static images, and Internet learning resources. Overall, IWB (a commercial tool in the market) establishment in the classroom provided a digital drawing function for the students. Figure 1 shows a student who drew objects on the IWB.

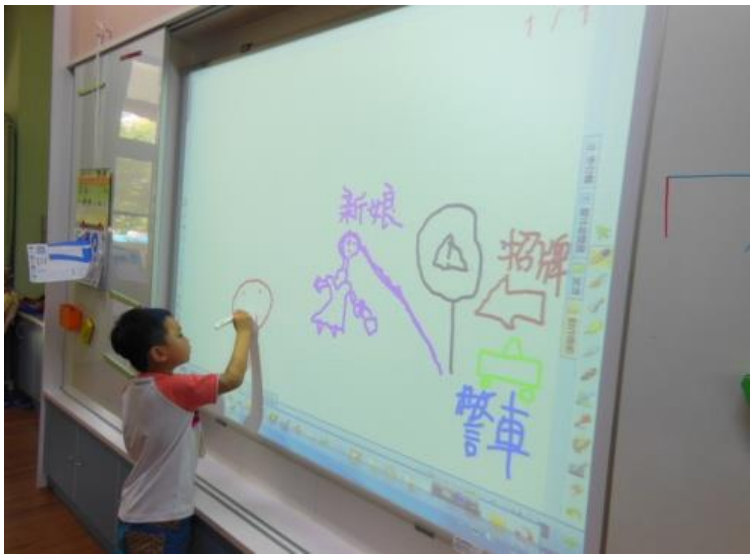

Figure 1. Student drawing objects on the IWB

Data collection

Yin (2003) suggested that a case study should involve collecting data from multiple sources. This study adopted seven data sources:

- Recorded instruction videos: During each learning unit, a digital camera recorded all learning scenarios. The researcher used these data to examine the instructional process of each learning unit.
- Teacher's teaching notes: The schoolteacher wrote a self-reflection in her teaching notes after the completion of each learning unit. From a teaching perspective, the notes presented what the teacher saw in the class.
- Learning materials: All learning materials presented on the IWB were collected. These data were used to ensure consistency between the instruction videos and teaching notes.

- Peer feedback: Two schoolteachers in other classes were invited to observe the learning units by providing written peer feedback. These data offer an objective viewpoint on students' learning process.
- Students' work sheets and homework: Students' in-class and assigned homework drawings were collected after the completion of the study. These drawings were compared with the students' drawings in the previous semester (without IWB intervention).
- Parent survey: After all learning units were finished, a questionnaire was sent to the students' parents. The survey consisted of five open-ended questions on the parents' perceptions of visual art learning. The questions are listed in Table 2.
- Interviews with parents and students: After each learning unit, the schoolteacher conducted an informal interview (no semi-structured guidelines) with several parents and students. The style of the informal interview was a conversation focusing on drawing practice between the schoolteacher and different parents (without children) and students (without parents), which created a low-pressure environment. The informal interview was conducted within 15 minutes. The teacher summarized the interview results in interview notes.

Table 2. Open-Ended Questions in the Survey

Item	Question
Q1	How often did your kid draw at home?
Q2*	How creative was your child's drawing?
Q3	How did you perceive the role of IWB instruction in visual art learning?
Q4	After examining your child's working sheets, how did you perceive his (her) visual art learning?
Q5	Any feedback regarding IWB adoption in the classroom?

Note. *The creative elements were based on parents' judgment compared to the drawings created in the previous semester.

Data trustworthiness, coding and analysis

The study adopted a data triangulation method proposed by Patton (2002) to ensure qualitative data trustworthiness. Figure 2 illustrates the data triangulation method. Furthermore, the study employed a coding strategy to ensure information privacy. Table 3 summarizes the coding principle for each data source.

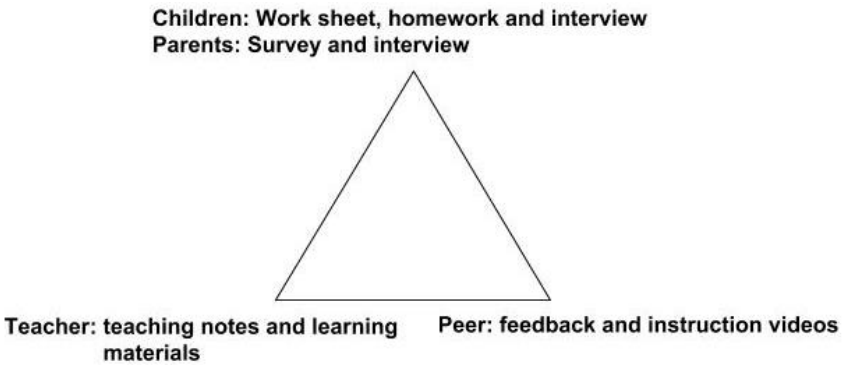

Figure 2. Data triangulation method

Because Teaching Note, Peer Feedback, Parent Survey, and Interview with Parents and Children were qualitative-based text information, the researchers recruited three graduate students majoring in education to transcribe original paper-based data and assigned coding name to each category of documents. Totally, more than 300 copies of A4-size documents (transcripts) were retrieved. The Recorded Video, Learning Material and Work Sheet and Homework were used for corroborating the transcripts.

Table 3. Coding strategy

Data source	Coding name
Recorded Video	RV
Teaching Note	TN
Learning Material	LM
Peer Feedback	PF
Work Sheet and Homework	WS and WH
Parent Survey	PS
Interview with Parents and Children	IP and IC

After all data sources were obtained, the researchers employed Moustakas's (1994) four-stage analysis method to interpret qualitative transcripts. First, crucial phrases were identified. Second, similar phrases were grouped to form meanings. Third, the formulated meanings created several themes. Finally, a detailed text description with representative quotations for each theme was provided. During the process of data analysis, three researchers collaboratively analyzed the results from the four-stage analysis and discussed the data triangulation among seven data sources. Overall, seven themes related to research content were selected for further discussion.

Research results

Seven major qualitative themes with representative supporting data are presented in this section.

Theme 1: Joyful learning environment activated learning motivation

When the IWB was introduced into the classroom, the students showed their excitement toward drawing instruction. In each recorded video clip (from RV-Unit1 to RV-Unit8), excited sounds and expressions from students were captured during class. For example, "Wow! IWB again" and "Yeah! I love IWB" were common phrases that the students used to describe their feelings of excitement. In the teacher's teaching notes, the teacher also observed similar situations. The teacher wrote one note: "Sounds of excitement filled the class. Each child was eager to see what the teacher would introduce by using the IWB" (TN-Unit1). Such joyful learning experiences might linger for a long period of time. Several interviewed parents recalled that their children would actively share how they used the IWB during class at home. For instance, one mother said, "My son often brought the IWB into conversation and told me that the IWB was very interesting stuff. He drew something on it" (IP-S6).

Once a joyful atmosphere was created in the learning environment, students' learning motivation and interest were aroused (observation from RV-Unit1 to RV-Unit8). Compared with a traditional teaching method, the students focused more on learning activities designed by the teacher. IWB integration into drawing instruction enabled the students to experience new learning opportunities. The IWB acted as a learning hub that focused each student's attention. The most intriguing finding was that some students who performed inactively in regular classes became interested after IWB integration. Changing attitudes enabled those students to actively respond to the teacher's questions. Figure 3 shows the student's active involvement in IWB instruction.

Figure 3. Students' active participation during IWB instruction (Screenshot from RV-Unit2)

Theme 2: IWB integration arousing learning interests

When the IWB served as a learning tool in the classroom, the students always showed interests in using the IWB. However, because only one IWB was installed in the class, learning opportunities were limited for all students. Several video clips demonstrated that to attain learning opportunities to practice drawing on the IWB, the students were willing to stick to instructional rules established by the teacher. One feedback comment from a peer teacher stated, "The kids quietly raised their hands. No other noises were made. They wanted the teacher to call their names" (PF-Unit3). While selected students drew on the IWB, other students not only watched their drawing demonstration but also provided several drawing suggestions. One teaching note stated, "When the kids

drew their works in front of the IWB, other children enthusiastically discussed what their peers drew" (TN-Unit2).

During the IWB intervention, the students had to follow one rule: peers' drawings cannot be criticized. After volunteers drew on the IWB, learning discussion was open to all students. First, the teacher praised the volunteers' active participation and encouraged them to share the meaning of their drawings on the IWB. Second, other students discussed the volunteer's drawings. Finally, other students who had drawn on the IWB expressed their viewpoints. Overall, from each recorded instruction video (from RV1 to RV8), students were engaged in a lively learning discussion. Figure 4 shows a student who volunteered to draw on the IWB.

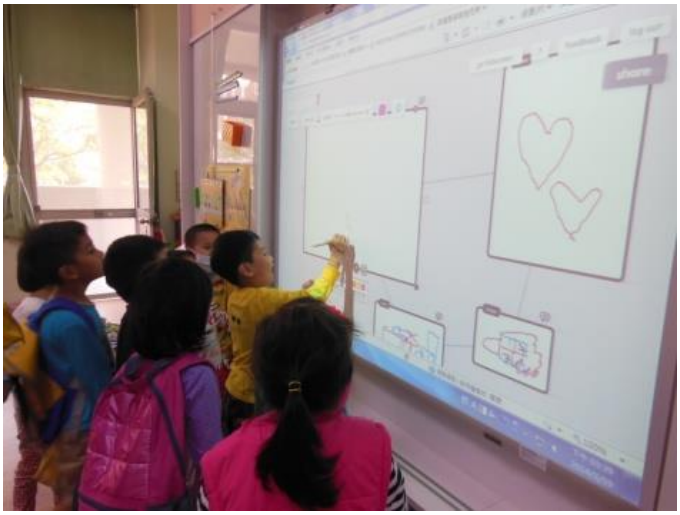

Figure 4. One volunteer for IWB drawing (Screenshot from RV-Unit3)

Theme 3: New art learning process

The students were attracted to the IWB and thus students attempted to obtain the teacher's permission to use it. The content of the video clips often indicated that specific students actively expressed their learning desires. To ensure that all students to have an opportunity to demonstrate their drawings on the IWB, the schoolteacher often self-reflected her choices. One teacher's note also stated, "While some kids wanted to show something on the IWB, other students quietly listened to my lesson. I should remind myself to pick inactive students" (TN-Unit2).

To enable the students to understand the technological functions of the IWB, the teacher introduced the IWB into the classrooms several times prior to the study. However, during the IWB learning intervention, some students still showed awkward behaviors when standing in front of the IWB. For example, one peer feedback comment stated, "Even though the kids already learned to operate the IWB, some still hesitated when it was their turn to show something" (PF-Unit2). The teacher provided those students with learning scaffolding and helped them become familiar with IWB operation and confident to draw pictures.

Several interviewed students reported that the IWB was an easy-to-learn and fun tool. Compared with traditional teaching, they expressed enthusiastic feelings regarding using the IWB for drawing. For example, one boy said, "I do not like to use a plastic eraser to remove something on paper, but the IWB provides an easy function for erasing objects" (IC-S9). One girl stated, "I can easily choose any size of a pencil for drawing pictures. It is difficult to achieve this purpose for traditional drawing" (IC-S14). In addition, a few students extremely enjoyed IWB drawing practice. They asked the teacher if they could use the IWB to complete drawings for work sheets and assignments.

Theme 4: IWB integration strongly supporting students who need more learning attention

Prior to the study, three participants were identified as special care students who need more learning attention because several kindergarten teachers observed their inactive learning behaviors in classes. Table 4 lists the profiles of those students, who are denoted using codes. However, against expectations, during the IWB learning intervention, those three students performed better than they did during activities in traditional teaching environments. In general, the IWB aroused their learning interest to engage more in learning activities.

Table 4. Profiles of students who need more learning attention

Pseudo name	Learning behaviors*
S1	Shyness and few interaction with classmates
S2	Low learning confidence
S3	Low Learning achievement

Note. *These behaviors were not identified illnesses.

S1 demonstrated shyness in all classes. She seldom talked with other children in the classroom. After 3 weeks of the IWB intervention, S1 showed her interest in IWB operation. The teacher recorded this exciting moment in one note that stated, "I have taught this class for one and half years. This was the first time I saw S1 raise her hand" (TN-Unit4). Although S1 spoke quietly in front of the classroom, she shared ideas about her drawing with the other students. When interviewed about her changed attitude, S1 responded that she had already practiced a similar learning activity several times at home.

S2 often showed low confidence during learning activities. When the teacher asked if he had any ideas about drawings, he always said "No." During drawing creation, S2 often sat quietly and gazed at his white work sheet for a long period of time. After a few weeks of the IWB intervention, S2 became more interested in classmates' drawings. According to the teacher's observation in one note, "S2 fully paid attention to other children's drawings shown on the IWB" (TN-Unit5). When provided a copy of a work sheet, S2 quickly completed his drawing. When asked about his feelings about drawing, he responded that the IWB learning activity inspired his thinking and gave him more ideas.

S3 was active in sports activities outside the classroom. When learning occurred in the classroom, S3 often showed restless behaviors and did not pay attention to the teacher. At the beginning of the IWB intervention, S3 became interested in the new technology. When interviewed about his learning attitudes, he responded that he had experience playing with new technology at home because his parents bought a lot of technology products, such as a tablet computer, for him. Therefore, the teacher allowed him to play the role of "helper." S3 demonstrated his excitement to assist other students in becoming familiar with IWB operation during the study.

Theme 5: Diverse ideas expressed through drawings

After the completion of the study, the teacher and other peer teachers compared the students' paper drawings during the IWB intervention with those drawn without the IWB intervention. Regardless of drawing quality, on average, more diverse elements appeared in the students' drawings with the IWB intervention. The teacher used peer imitation to describe this finding. One teaching note stated, "The IWB learning activities probably enabled the students to incorporate other students' ideas in their drawings. Students use similar concepts to create their personal style drawings" (TN-Unit6). Other teachers perceived that a joyful learning environment played an important role. One peer feedback comment stated, "During IWB instruction, the learning environment inspired the students to think. More ideas popped up when the children demonstrated their works on the IWB" (PF-Unit4).

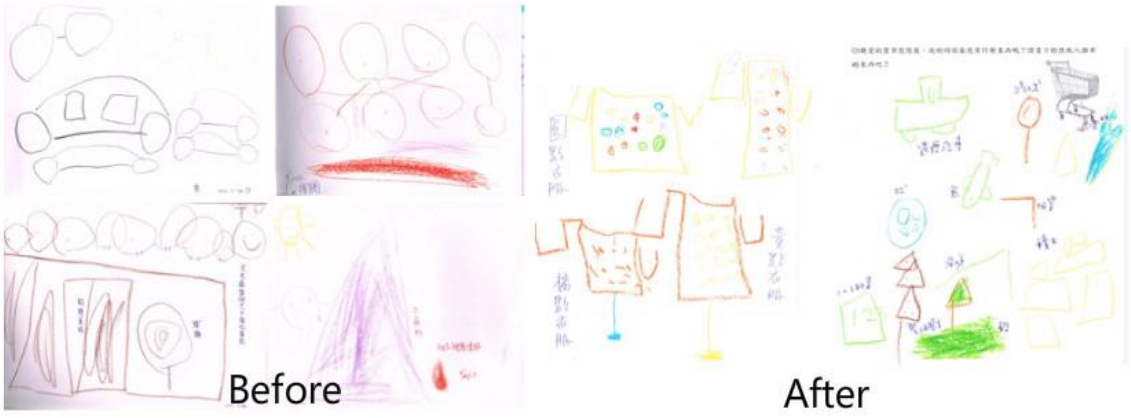

Figure 5. One child created more colorful elements after the IWB intervention

When asked about the students' drawing habits at home, several parents stated that the IWB learning activities facilitated the drawing development process, enabling the students to introduce diverse elements into their visual works. One mother responded in the survey, "I observed that my son began to try different visual elements to

express his drawings. The drawings did not look very boring" (PS-S11). Another mother said, "Usually, my kid's drawings only contained one or two colors, but his drawing style became more colorful" (IP-S13). Although the IWB strengthened the students' drawing content, many parents reported that their children's drawing frequency at home did not substantially increase. Figure 5 shows one representative student's (WS-S9) drawings before and after the IWB intervention.

Theme 6: IWB integration as a focus in the kindergarten

In this study, eight learning units designed in the visual art class were combined with other learning activities. Drawing instruction practice became a showcase in which the students demonstrated knowledge they received in the other two learning activities. Such theme-based learning enabled the students to focus on learning activities. One teaching note stated, "The kids knew that other activities were their idea inputs. They paid attention to the learning content. They did not want to miss something important" (TN-Unit8). Teachers of other classes in charge of learning activities expressed similar observations. One peer feedback comment stated, "The kids seriously observed things and listened to picture stories" (PF-Unit7).

Because IWB adoption occurred only in one classroom, teachers of other class in the kindergarten showed their interest in IWB integration into drawing instruction. Instruction with an IWB became a popular topic for discussion in the school. High levels of curiosity caused the teacher's colleagues to observe the IWB's practical impact on learning in children. The teacher recalled this phenomenon in one teaching note, which stated, "Everyone was curious about new things. My colleagues wanted to know if the IWB affected student learning" (TN-Unit6). Once colleagues witnessed the students' learning during drawing instruction using the IWB, their skepticism regarding ICT use disappeared. They began to consider the possibility of technology integration into the existing curriculum.

Theme 7: New problems during IWB instruction

Although the new instruction method created a positive learning environment, some new problems occurred during the IWB intervention. First, the students' emotions fluctuated throughout the school day. After the completion of a 2.5-hr learning unit, the students were ready to take other classes. However, the students' joyful learning feelings suddenly disappeared when they faced a traditional teaching method. According to one teaching note, the teacher wrote, "My colleagues told me that the children obviously showed a sad feeling after the visual art class. It's difficult to motivate them again" (TN-Unit8). Other teachers in the kindergarten even called those students "deflated balloons."

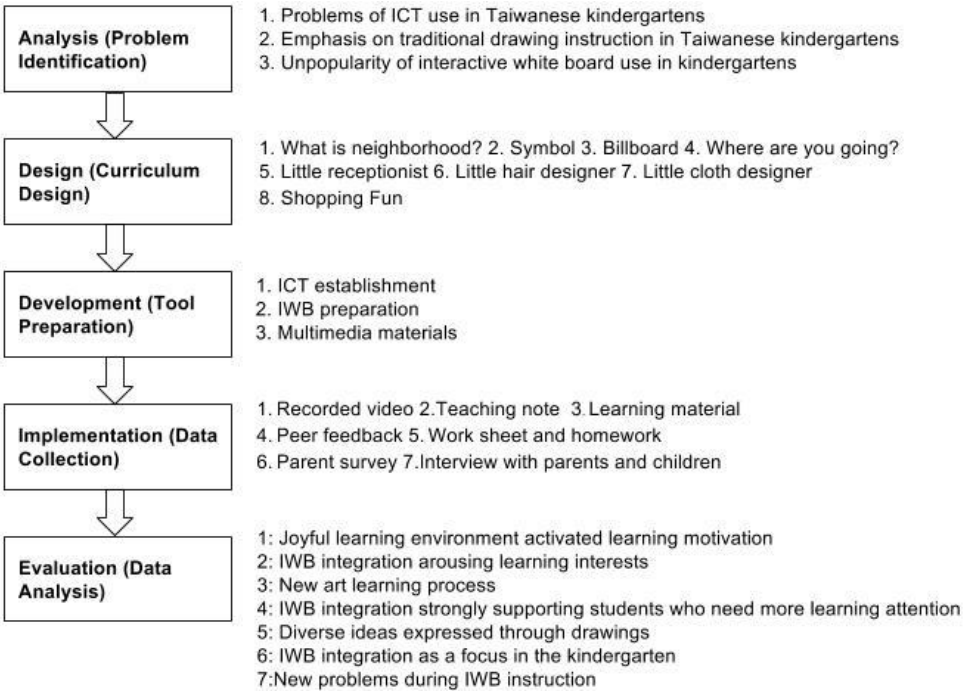

Figure 6. Roadmap of the study from analysis to evaluation

Second, the IWB platform in the classroom was installed at one specific height. From a human and computer interaction perspective, the height enabled the teacher to easily access objects on the IWB. However, the fixed height was not suitable for children aged 5 to 6 years, causing several students to have difficulties in operating the IWB. Therefore, the teacher should have prepared a standing platform for shorter children. The teacher self-reflected in one teaching note, stating "If the IWB could be vertically adjusted to a certain height, that would be perfect for all kids" (TN-Unit3).

Last, compared with a traditional teaching method, a curriculum that involves computer use and technology tools requires more learning resources. Learning materials contained several multimedia elements (from LM-Unit1 to LM-Unit8). However, such a learning atmosphere created a teaching burden for the teacher, who had to spend a lot of time preparing learning materials by using computer software. Furthermore, to avoid spontaneous technical problems in the classroom, the teacher should demonstrate materials on the IWB and be familiar with tool manipulation before the beginning of the learning unit. One teaching note stated, "Extra effort should be put into IWB teaching preparation. Maybe we can create an IWB team in the future so that learning materials can be shared" (TN-Unit4).

Figure 6 is a roadmap that provides a scientific overview from analysis (problem identification) to evaluation (seven qualitative themes).

Discussion

Over the course of the eight learning units implemented in this study, the students were interested in IWB instruction, which directly influenced their learning motivation. This finding was consistent with past research that integrated the IWB into science learning in kindergartens (Linder, 2012; Preston & Mowbray, 2008; Wong et al., 2013). Regarding visual art learning, the finding also supported a previous study that indicated that the IWB might strongly arouse children's learning interest and motivate students to participate in IWB-related learning activities (Terreni, 2011). According to Keller's (1983) motivation theory, stimulating students' curiosity is a critical step in instructional design. In the study, therefore, the IWB served as a novel learning tool for increasing the students' curiosity during the IWB intervention.

In the current study, the joyful learning environment created by IWB instruction obviously facilitated peer discussion and interaction. While volunteers shared their drawings on the IWB, other classmates enthusiastically discussed objects in the drawings and responded to the teacher's queries. Furthermore, after school, the majority of students were eager to share IWB learning scenarios that occurred in their classrooms with their parents, which in turn facilitated social interaction at home. Therefore, the findings in the study echoed the analytical report by Hsin et al. (2014), which stated that ICT positively benefited children's social development when used wisely.

In the study, the IWB enabled students with varied drawing capabilities to construct their individual-based drawings by socially interacting with peers and the teacher in a highly motivated manner. Under such a learning environment, the IWB use in the classroom indeed served as a useful scaffolding tool (Jonassen, 1999; Donohue, 2015) to support learning interaction. In addition, although the quality of the students' drawings did not improve markedly, more diverse and colorful elements appeared in the drawings compared to visual art works in the previous semester. This finding can be attributed to social learning (Bandura, 1977) in children's discussions. The students perhaps observed other styles of visual art and incorporated new elements into their works, which became unique drawings with personal styles.

According to a report from the United Nations Educational, Scientific, and Cultural Organization (UNESCO, 2006), ICT use in schools may support students with special learning needs. For example, ICT can "unlock hidden potential for those with communication difficulties … [and] enable students to demonstrate achievement in ways which might not be possible with traditional methods" (p. 30). In this study, IWB integration in the visual art curriculum played a critical role in supporting three students who needed more learning attention. Adopting the IWB in the classroom enabled one student with an introverted personality to overcome communication problems, one student with low learning confidence to develop more diverse ideas, and one student with low learning achievement to demonstrate potential learning abilities not shown in a traditional teaching environment. This finding supported a finding from Terreni's (2011) study, which showed that IWB use benefited students with special learning needs in a visual art class.

User experiences reflected the value of technology adoption (Carr-Chellman, 2006). In this study, an IWB mounted on the wall seemed to be a large tablet computer screen on which the students could enjoy working on their drawings. Easy-to-use features in the IWB enabled the students to have new art learning experiences. Some students even perceived the possibility of IWB drawing replacing traditional drawing methods. Although unfamiliar feelings at the initial implementation stage were reported by some students, the user-friendly interface of the IWB still triggered students' learning desire for drawing practice. Therefore, from a practitioner's perspective, IWB adoption in the classroom fitted well with the visual art curriculum. In accordance with Morgan's (2010) observation in UK schools, the IWB was perfectly used to capture students' visual ideas.

Most previous studies tended to focus only on students' learning performances. The role of parents was always a missing component of ICT integration in classrooms. In this study, parents' perceptions were obtained to construct a multi-faceted perspective of ICT adoption (Ravasco et al., 2014). According to the analysis of qualitative themes, several parents identified their children's changed drawing styles. More diverse and colorful elements appeared in the drawings. If IWB instruction is implemented during a school day, children might be eager to share classroom learning stories with their parents after school. Although IWB practice in school might not increase children's drawing frequency at home, most parents appreciated the positive effect of the IWB on children.

From a pedagogical perspective, the IWB was an effective tool for facilitating the teaching process (Wong et al., 2013). However, because the IWB intervention was implemented only in the visual art related curriculum, the visual art teacher was fully responsible for technical preparation of multimedia learning materials. The extra effort required increasing the teaching load for the teacher. This finding was consistent with prior research that indicated that IWB integration in the classroom required an investment of time and effort for the instructors (Smith et al., 2005). Furthermore, when IWB instruction yielded learning benefits for the students, other teachers in the kindergarten began to consider the possibility of technology adoption in their classes. Thus, IWB instruction elicited a relative learning advantage that prompted teachers of other classes to accept ICT adoption (Rogers, 2003).

Conclusion

Response to research goal

The overarching purpose of this study was to explore the educational phenomenon of using an IWB to teach visual art in kindergarten. The analysis of qualitative themes revealed that the IWB effectively aroused the students' learning motivation and facilitated the students' learning discussion during visual art instruction, resulting in more diverse elements in their paper-based drawings. In particular, IWB integration unlocked latent capabilities for students who need more learning attention. Furthermore, the students enjoyed using technological interfaces in the IWB to demonstrate their drawing. Schoolteachers and parents both perceived that the IWB had learning benefits on the students' drawing learning.

Research limitations and recommendation for future work

Because of the unique nature of a qualitative case study, several research limitations existed in the study. First, research design in the study emphasized on qualitative scenarios rather than an experimental comparison. Future studies may investigate the comparison between IWB integration and traditional instruction through a quasi-experiment. Second, the duration of IWB instruction in the study was 4 months. Future studies can extend the intervention scope to examine whether children still enjoy IWB instruction over a long period of time. Third, the learning content in the study was drawing practice. Future studies can introduce the IWB into other types of visual art learning, such as clay creation. Different learning responses to IWB instruction may be obtained. Forth, drawing instruction in the study was coordinated with other learning activities. Future studies can verify the effect of sole IWB instruction on children's learning. Fifth, the tablet computers such as I-Pad provide a similar function for digital drawing. Future studies may evaluate if different tools may yield similar results. Last, the limited opportunity for using IWB and the novel effect of IWB may lead to the joy feeling of the students in class. Future studies may explore those two factors during IWB integration.

Instructional implications

IWB integration into the kindergarten curriculum is an innovative pedagogy. Based on implementation experiences identified in the study, some instructional implications are proposed for early childhood educators who are interested in IWB instruction. First, IWB adoption in classrooms requires professional training. Inadequate technical support may influence the usage intention of teachers. Second, to avoid additional teaching problems, a suitable height for installing the IWB for children should be established. Third, because most children enjoy using IWB to create drawings, the instructor may allow students to submit their digital works as assignments rather than paper-based drawings. Finally, during IWB integration, several students may attempt to obtain permission to use IWB. Each student should be given an equal opportunity for technology use.

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