AFFORDANCES OF INTERACTIVE WHITEBOARDS AND ASSOCIATED PEDAGOGICAL PRACTICES: PERSPECTIVES OF TEACHERS OF SCIENCE WITH CHILDREN AGED FIVE TO SIX YEARS

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ABSTRACT
The integration of information and communication technology into early year's classrooms is increasingly important for engaging and motivating digital learners. One of the more promising recent revolutions in educational technology that encourages learner's involvement is interactive whiteboard (IWB). Many schools have accepted IWB as core teaching technology for teaching young children. Yet there has been little research that looks into it especially for teaching science in early year's education. This paper reports on selected preliminary findings from a recent study which highlighted a number of affordances, practices and challenges related to teaching science for children aged five to six years using IWBs. A phenomenological perspective was adopted in this study. In-depth interviews with teachers to explore their individual experiences and perspectives about the uses of IWBs were recorded. Data were collected and analysed according to a qualitative approach. The preliminary analysis of the data summary across the seven case studies revealed that the teachers used IWBs in a wide range of ways with the intention of bringing contemporary content into the classroom and leading to the learning of investigative science. Promoting authenticity and connectedness, multimodality and versatility, and efficiency were the most frequently mentioned by participating teachers. This study also illustrates the disruptive effects of conventional classrooms setting, low technical support and insufficient training towards the process of implementation of IWBs.

INTRODUCTION

Technologies are widely used in a world of education today, both in higher education through to preschool education. Forms of technology resourcing in the classroom have been revolutionized since the use of personal computers. In the second revolutionary teaching tool, interactive whiteboards (IWBs) are becoming increasingly more prevalent in primary classrooms. Across the world, 750,000 IWBs had been installed in classrooms by 2007 and over three million were forecast to be installed by 2010 (White, 2007). In the late 1990's, primary schools in United Kingdom began using this technology (Higgins, Beauchamp, & Miller 2007). There is a growing amount of research that suggests that the use of IWBs improves teaching and learning for science (Hennessy, Deaney, Ruthven, & Winterbottom, 2007; Higgins, Beachamp & Miller, 2007; Murcia & Sheffield, 2010; Preston & Mowbrary 2008). According to Becta, in its role as an advisory body in educational technologies for British schools, there are four identified advantages for students: increased enjoyment and motivation, greater opportunities for participation and collaboration, decreased need for note-taking through the capacity to print from the screen, and the potential to cater for different learning styles (Becta, 2004). Furthermore, teachers using IWBs in the classrooms believe that the learner is able to retain the concepts rapidly and provide an apprehensive approach towards science. Multimodal representation styles are essential when explaining specific scientific concepts and ideas.

According to Clarke (2004), the United Kingdom government has already invested heavily (approximately 50 million pounds) in the installation of IWBs in schools with the purpose of imparting an impact on teaching and learning. Somekh et al. (2007) noted that IWBs are well adapted to whole-class teaching, particularly in terms of enlivening formal expositions, including demonstrations of practical procedures and explanations of complex concepts. Teachers and students can use IWBs to bring together information communication and technology (ICT) tools that support learners' production of drawings, tables, graphs, written text, and verbal and video accounts.

Since 2003, IWBs have made a rapid penetration into Australian schools. The Australia Government has come to an understanding that ICT permeates most students' daily lives and social milieu. Prior to the extensive encouragement from Government's Department of Education, Employment and Workplace Relation (DEEWR) and related ICT organization, many preschools and primary schools in Australia have replaced conventional classroom tools with IWBs. In 2009, the push to incorporate and integrate technology in classroom teaching from all levels became much stronger in the Australian education system after the introduction of the Strategic ICT Advisory Service (SICTAS) project. In 2010, the Prime Minister Julia Gillard announced that the Federal Government had allocated forty million dollars for teachers' professional development in ICT, as part of the Australian Government's $2.2 billion *Digital Education Revolution* (Gillard, 2010).

THE STUDY

No doubt, many international researchers have noted that the use of IWBs is growing rapidly and becoming one of the most important educational technology tools in the digital generation. They believe that IWBs can contribute positive effects on learning and are presenting many opportunities for teachers (Hennessy et al., 2007; Murcia & Sheffield, 2010; White, 2007; Preston & Mowbrary 2008). However, there is little Australian research that looks into their use and explores pedagogical approaches needed to enhance young children learning in science classrooms where interactivity requires a new approach to pedagogy. In response to this situation, a research study was conducted to observe the affordances of IWBs and their initial practices for young learners. Given current recognition of the value of IWBs, as well as the investment costs that IWBs represent for schools, it seems a worthwhile topic of enquiry and fruitful to explore.

This study contributes to the literature in a number of ways. Firstly, although contemporary research contains many claims about the value of IWBs and its pedagogical practises, little of this research has been with early childhood education. Yet IWBs have many features that seem to have important synergies for teachers dealing with young children, especially for teaching science. Secondly, although studies have been conducted on the use of IWBs in the UK, the use of this technology is just beginning in Australia especially for teaching Science for children aged five and six years, therefore, the findings derived from those analyses might not adequately reflect Australian schools environments. Furthermore, some findings were anecdotal, inconclusive and, at times, contradictory. Thus, it is vital to address this gap and to have empirical evidence which clarifies the issues pertaining to the use of IWBs in early childhood classrooms.

The study was focused on a single academic subject, science as not only is science providing authentic contexts and meaningful purposes for literacy learning, it is also providing opportunities to develop a wider range of literacies such as using science as a tool for discovery and contributing to problem solving. Furthermore, based on the South Australian Curriculum, Standards and Accountability (SACSA) Framework, science subject in which educational technologies are frequently employed. Yet studies that focus specifically on IWBs use in science are currently limited in Australian context.

The lack of information regarding IWB's pedagogy and pedagogical practices could lead to teachers of science delivering knowledge insufficiently and ineffectively enough to encourage teachers to use IWBs in teaching and learning. Individuals in DEEWR, especially curriculum designers and teacher educators need to gear up their action towards *digital native* as they are expected to include IWB technologies in their daily lessons (Harlow, Cowie & Heazlewood., 2010). It has been researched and studied that the mere introduction of the IWBs does not in itself have a transformative effect on classroom teaching and learning and may indeed reinforce familiar patterns of teacher-pupil interaction in whole class teaching (Smith, Hardman & Higgins, 2006; Underwood et al., 2010).

RESEARCH CONTEXT AND METHODOLOGY

As mentioned above, IWBs are a relatively new teaching tool in Australian preschools and junior primary schools. In order to ascertain the affordances of IWBs, and the pedagogical practices and drawbacks of using IWBs in science classrooms for children aged five and six years, a small-scale case study approach drawing on a phenomenological perspective was taken. Drawing on multiple recommendations from academic colleagues, subject advisors and Department of Education and Children's Services (DECS), the researchers identified seven teachers who were considered to be successful in terms of the quality of their teaching and who had knowledge of the South Australian Curriculum Standards and Accountability Framework (SACSA).

The researchers carried out the in-depth interviews with those teachers in five junior primary schools located in metropolitan Adelaide from February to June 2011. All participating teachers are female and their teaching ranged from 10 to 25 years. They had IWBs in their classrooms, had taught Science for children aged five to six years and have been using IWBs for more than 3 years. Thus, they were believed to have some familiarity and skills with IWBs use. All participating teachers used either SMART Board™ or ACTIVboards™ in their teaching and learning.

In this study, the researchers conducted interviews with some predetermined questions that aimed to explore affordances, pedagogical practices and barriers related to teaching science for children aged five to six years using IWBs. However, the exact wording of the questions was flexible as there were follow-up questions to interesting statements from the subjects. The semi-structured interview questions developed were based largely on, and supported by, a review of the literature in the similar field. All relevant data was transcribed, using conventions of standard spelling and punctuation to represent interpreted speech. Some follow-up interviews were carried out to ensure the depth of the data.

Discussion of common themes and overall findings

Pedagogical Practices

In the SACSA Framework, science is organised into four conceptual strands (earth, space, energy systems, life systems and matter), each with its characteristic scientific knowledge and ideas and based on earth and space science, physics, biology and chemistry respectively. All participating teachers noted that IWBs were suitable for all four conceptual strands underlying SACSA Framework. The PrimaryConnections 5Es teaching and learning model (Engage, Explore, Explain, Elaborate and Evaluate) can be engaged by using IWBs. Based on the participating teachers' use of IWBs, the researchers have summarised the way of pedagogic practices among teachers: *Supported Didactic, Integrated Interactive Activities* and *Guided Assessment.*

Supported Didactic

Participating teachers noted that they use IWBs to capture and spark children's interest, stimulate their curiosity, and elicit children's existing beliefs about the topic or scientific concepts. With the good size and visual capacity of IWBs, it provides clear explanations for younger children. In this stage, conceptual development and scaffolding activities were very limited. This accorded with the research literature offered by Glover, Miller and Averis (2007). Teachers treated IWBs as ordinary screen or whiteboard substitute. IWBs merely present standard information, such as a pre-prepared sequence of slides or pages on IWBs which were "presented" to the class. The use of other presentational software such as *PowerPoint* was common during this stage. This was more about teacher centredness of IWBs use. Any interaction was internal and remained under the control of the teachers. IWBs can be used for presenting slides, pre-loaded web pages and scanned materials for explanation purposes. Virtual demonstrations, documentaries and real life action, such as the recent earthquake in Japan could attract children's attention. One teacher argued that, *"…diagrams, images, photos and other related materials can be imported or captured using the interactive software camera tool and… presented it as lesson introduction to young children…IWBs are really awesome"*.

Integrated Interactive Activities

This is the most frequently mentioned way related to the use of IWBs. This pedagogic practice usually marks progression from the *supported didactic* stage where IWBs are used to challenge children to think by using a variety of stimuli such as verbal, visual and kinaesthetic. Young children have the opportunity to interact with the board, by writing on it or drag and drop, or responding to discussion centred on the material shown on the board. Participating teachers reported that the rate of interaction between teacher and children tends to increase when an IWB is used, although this does not necessarily lead to improvements in attainment.

Teachers normally employ authoritative interactivity practice in their integrated interactive activities. *"Authoritative interaction with ICT is characterised by the incorporation into the teachers' planning of fixed questions with specific answers*" (Beauchamp and Kennewell, 2010, p.763). A teacher pointed out that *"…I'm always asking my children to move prepared images to the suggested answers on IWB to complete matching, sorting or labelling activities"*.

Teachers also noted that having explanations via IWBs was very different from projecting lessons to the ordinary screen or board. They have the opportunity to interact with children while conducting lessons via technology. A teacher shared her views by commenting that "*…losing contact with the young children while teaching always occur when we are using other ICT teaching tools, but …with IWBs, I still can navigate and conduct activities via interactive board without going to the desktop computer that is placed far away from the front of the classroom…and sure, this provides opportunities to have more interaction with kids …IWBs definitely quicken the pace of the lessons"*.

Guided Assessment

In most Australian education for young children, the IWBs are a very new phenomenon. Underlying these stages, teachers are often categorised in the infusion stage (Burden, 2002). Thus, opportunity to develop complete assessment procedures that use the IWBs could be limited. But overall, the interviewed teachers showed their enthusiasm in many ways to incorporate assessment with the IWBs as they believed that the affordances of IWBs could provide a good channel to assess their children easily and effectively either in the form of diagnostic, formative or summative procedures. They noted that assessment via engagement, exploration, explanation and elaboration can be done with IWBs.

Moreover, IWBs can contribute hugely to plenaries. With the help from teachers, young children can present their art work in front of the classroom by scanning the images or taking photos and projecting them on the interactive board for further discussions. This will encourage them to review and reflect on what they have done. Comment and correction can be done on the spot and any noted comments on the entire art work can be saved for future references. A teacher shared her views by commenting that, *"…when doing group work, I will take a photograph or talk to children…or do a mind-map with them, and I will scan and discuss it on the board"*.

Practical Pedagogical Benefits

Promoting authenticity and connectedness

Studies have proven that authentic tasks can provide real world relevance and high impact towards effective learning among young children (Betcher & Lee, 2009). IWBs can promote task authenticity especially when teachers connect IWBs with online news sites, *You Tube*, *Google Maps,* and so on. These practices enable fluid access to online real life science contexts which could be annotated at the board with the interactive tools. One enthusiastic adopter of the IWBs said, *"…my job as a teacher…is to prepare children for the world to be"*. This accorded with the findings by Hennessy *et al*. (2007). Hennessy *et al*. (2007) revealed that the IWBs created a fluid space where interactive communication allowed the teacher and students to explore science with the latest information and knowledge.

Virtual demonstrations, documentaries and real life action are definitely able to provide huge learning space. One of the teacher commented, *"…I can look for information easily, with a range of resources, it brings the science classroom to life and it enriches the classroom discussions and scientific language used"*. Her view was echoed by another teacher who explained *"…I can minimise the slides and can go to the video that interested children instantly"*. For example, a science teacher did a lesson on "*Weather Symbol Detectives*", and a child asked her, *"What's the symbol for today's weather?"* With the authenticity and connectedness feature in IWBs, she instantly linked it with the current weather forecast websites (such as *www.weather.com.au*) and by having that, her young children are able to understand it easily. She said; *"…evidence-based explanations are very vital in teaching science for young children"*.

One respondent made the following comment, *"before having IWBs, I had to go to the library to find the resources and spend my own money… it was lots of hard work"*. *"Google Earth and You Tube work really well with IWBs and this is an activity that I often start the lesson with. From the world map, I can zoom down till very specific places such as the Sydney Harbour Bridge or Eiffel Tower. I then elicit the children's understanding by asking them to guess where we are."* In such ways, IWBs have clearly facilitated whole-class discussion, which has led to the sharing of ideas and generation of new learning through spin-out questions.

Multimodality and Versatility

Interviewed teachers were also conscious of the opportunity to use multimedia facilities such as video clips, scanning of images, and sound effects for their teaching. Learning is much more powerful if it has a range of multimodality and versatility facilities across the curriculum.

IWBs allow science teachers to teach multi-sensory lessons, seamlessly changing from one type of media to another. Text, sound, video and graphics can be operated at the same time to provide better scientific ideas and concepts explanation to young children. A teacher pointed out and said, *"…children are really easy to get focused. The minute I turn on the IWB, it can be a basic interactive game, they are so engaged. I can create sequences linking sound files, web pages and images to gain young children's attention.…"*

Versatility of IWBs supports several different learning styles such as visual-spatial, auditory and kinaesthetic. One teacher shared her views that: *"Children not only can watch and listen to the video via IWBs, it also provides physical involvement by touching and moving objects to show its effect…"* Kinaesthetic learning for example would occur when young children were asked to click and drag the images on the board.

Efficiency and Effectiveness

It is worthwhile considering that one of the most obvious distinctions between IWBs and other technology teaching tools is the facility to control the computer at the touch of the screen. This enables teachers to stay in the front of the class and still be interacting with the technology. Interviewed teachers revealed that having a touch screen enabled them to explain and teach with more focus. Young children need to be shown and pointed out while explaining certain concepts to ensure that they can follow the lesson. By having touch screen facilities, teachers can perform explanation without neglecting them. The touch-sensitive nature of IWBs facilitates a more efficient presentation and more professional delivery of multimedia resources. One of the teachers said *"I can have more attention to my children's expressions rather than just focusing on clicking and searching icons on the computer screen…"* Another teacher also noted that with that affordance, she could scan pages out from previous materials to use in class discussions, where she could point out the important point visually to young children in order to ensure that they focused on the entire sentences or images while the explanation was going on.

Teaching materials can be saved to hard disk or USB stick or software galleries and subsequently be reused and edited for additional use in future teaching and learning activities. In IWBs, there is a feature that can capture work that has been done in the *work place* (screen). Revisiting previous lessons is easy. Teachers of science can return to earlier pages or screen to help a child who needs extra explanation or for reinforcement purposes. Saved information can be recalled for review and discussion at the end of the lesson. A teacher mentioned how she could easily bring the previously saved diagrams and pictures into her lesson again by using IWBs. *"SMART notebook galleries are fantastic; I can drag and drop the saved images easily from the galleries"*. Similarly a teacher reflecting on her own practices noted "*…with IWBs and its backup feature… I will never have to rewrite on the board, it just takes minutes for me to revisit the information that has been discussed before..."*

Pedagogical Challenges

Few pedagogical challenges were noted for using IWBs in teaching and learning for children aged five and six years, apart from the obvious initial expenditure to purchase them.

Classroom setting

Integrating IWBs into classrooms can pose some serious challenges and problems. This issue became a common topic when participating teachers were asked about the challenges of using the entire technology. Full class visibility can be problematic when initial conventional classroom settings are not designed for technology viewing especially when a huge light is shining directly towards the classrooms. Blinds have to be installed to solve this problem. A disappointed teacher revealed that, *"one of the classrooms here, the projector is not bright enough and there is so much light coming in to the room, no blind has been installed"*. Teachers also complained that some IWBs were not placed in the front centre of the classroom due to the practical necessity of finding convenient power outlets. This resulted in difficulties for some children in the classroom to have a comfortable view of the board.

The height at which IWBs are placed can be an issue, particularly where boards are permanently fixed. Many participating teachers revealed that some IWBs have been installed without considering the children's height. *"In my class, many children are having difficulty to touch the top of the board as it fixed too high"*. Teachers need to prepare accessories that can help make it easy for the smaller students, such as stylus pens in the form of long wands that give the children a greater reach on the boards.

Technical Support

Interviews revealed that, at least in the initial stage of introduction, teachers were hesitant about changing pedagogy as they are let down by their ineptitude with the technical aspect of use of IWBs. If teachers are working with a technology infrastructure that realistically cannot support their work, they will turn back to the conventional teaching tools. Statements that showed this concern were *"having technical support is really important. When we have got 25 children in front, we can't stop the lesson. And also if I spend 10 or 15 minutes to solve the problem, tomorrow, I need to catch-up"*. And *"Some IWBs are not working properly. We get frustrated trying to fix it, and we are just about to start to use it. At the end we prefer not using it and give up"*.

Teachers also must have access to on-site technical support personnel who are responsible for troubleshooting and assistance after the technology and lessons are in place. A statement that showed this concern was *"We just have one day a week from a part-time technician. That is Wednesday. When IWBs break down on Thursday, we need to wait for next week"*.

From the interviews, researchers found that all participating teachers noted that they do not like technical problems, which from their perspective cause disruption, delay and frustration. One of the very experienced teachers prompted that "*… we know that technical problems are many times unavoidable and unforeseeable, but setting up routine technology maintenance is vital, and by that, it may be avoided*". Another concerned teacher said, "*My previous school was in the countryside. It's about 100 kilometres from Adelaide. If the computer breaks down, I need to go to Adelaide to fix it"*.

Teachers' Knowledge and Skills

Having an IWB in the classroom, however, does not necessarily open a lesson to higher levels of children's interaction. IWBs require an investment of time, and some degree of training. Low confidence in use of IWBs could hinder teachers to use IWBs in their daily teaching activities. Training in the technical and pedagogical aspects of IWBs should be viewed as a continuous process. Glover and Miller (2001) claimed that the interactive nature of IWBs requires new approaches to both pedagogy and professional development for teachers. Successful integration of any technology into the classroom requires more than simply acquiring that technology. *Closing the digital divide requires much more than buying equipment, it requires the knowledge and skills of teachers using the technology, and access to digital tools in the community* (Riel, Schwarz & Hitt, 2002, p.147). Indeed, the introduction of an IWB does not in itself transform existing pedagogies (Moss, Jewitt, Levaaic, Armstrong, Cardini & Castle, 2007). For teachers who may not be confident or lack basic technology skills, the IWBs can be a hindrance to their teaching and learning process during the lessons.

Although the participating teachers have high enthusiasm towards their developmental needs, they revealed that they want more training development programs. A desperate teacher commented, *"We can go to our colleagues or websites for extra information, but we need more…more training"*. Whilst others said; *"We had training during the day of the installation, but it is not enough"*. But, one statement proved that teachers were taking prompt actions to have more sharing of resources among colleagues. One of the interviewed teachers said *"in fact, yesterday, in the staff meeting, we have discussed having 10-15 minute use of IWBs in every session"*. These actions could provide ideas for broader usage and generally offer additional techniques for teaching science using IWBs among young children. Advanced skills were needed by some participating teachers. One enthusiastic adopter of IWBs commented that: *"…I need more advanced knowledge and skills, such as layering, sequencing, converting and inserting video or sound…all these are very crucial for me to create interactive lessons for my kids"*.

CONCLUSIONS

This paper has described the results of a study that was designed to understand the perspective of Australian teachers of science using IWBs with children aged five to six years. In particular, this paper has tried to determine the pedagogical practices, benefits and challenges of using IWBs in teaching and learning for young children specifically for the science learning area. Despite findings reported in the literature to date about the use of IWBs for teaching and learning, much of the data gathered during this study had proven the merit of the affordances of IWBs in science classroom for children aged five and six years. There was evidence from interviews that participating teachers had changed both preparation and style of teaching in order to be fully engaged with IWBs, compared with conventional classroom teaching tools. This was because they believed that IWBs could lead to the learning of investigative science, critique in science and responsible actions in science.

And although not mentioned as a major theme in previous studies, findings from this study revealed that participating teachers did use IWBs for supported didactic, integrated interactive activities and guided assessment. These summarised that, in teaching science for younger children, IWBs could be used to improve whole class teaching and learning processes, especially in lesson introduction, children-teachers' interaction and promoting group or individual evaluation. The findings also highlighted the affordances of IWBs in science classrooms. Promoting authenticity and connectedness, multimodality and versatility, and efficiency were the factors that most frequently mentioned by participating teachers. These characteristics encourage children to be engaged actively in the learning process and to develop investigation skills relating to the nature of science.

An important outcome stemming from these findings is the need to be mindful of the potential drawbacks of technology evolution in educational technology. Teachers need time and properly designed professional development. This study illustrates the disruptive effects when conventional classroom settings were used for IWBs implementation and teachers were having limited skills to develop the lessons.

Consideration should now be given to teachers' professional development in IWBs. The Australian national priority on ICT integration in education acknowledges that children need greater access to appropriate resources, but well-trained teachers are essential to gear up the progress to achieve a high level of integration of IWBs in the teaching and learning for young children. Education authorities need to understand the importance of training to encourage positive use of IWBs in the early years education. It must be noted that the IWB itself does not enhance teaching and learning. Rather, it is the way that it is used as a new teaching and learning tool that does so. Good teaching remains good teaching with or without IWBs; it enhances the pedagogy only if teachers understand it as another pedagogical means to achieve teaching and learning goals.

Many international researchers have noted that the use of IWBs is growing rapidly and becoming one of the most important educational technology tools in the digital generation. However, in Australia, there is little Australian research looking into their use and exploring pedagogical practices to enhance young children's learning in science classrooms. Therefore, more studies of this kind, especially at a larger scale, need to be conducted so that the findings can adequately reflect the perspective of the whole population of teachers teaching science using IWBs for children aged five and six years. This could be in the form of a comparative study across several states , to determine whether there are differences especially regarding the use of IWBs for different curriculum that have been implemented in various states. We suggest that a comparative study could be conducted across different states to determine whether there are different findings especially regarding the use of IWBs for different curriculum that have been implemented in different states. Since technology especially interactive software, will continue to grow and develop rapidly, a replication of this study might be conducted periodically in order to examine its trends and its wider contributions remain to be seen.

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