Use of *SMART* Boards for teaching, learning and assessment in kindergarten science

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This article presents the findings from classroom based research into the use of SMART Boards (interactive whiteboards) with kindergarten children. SMART Boards have been used successfully over the past 8years at Abbotsleigh Junior School innovative ways to enhance teaching and learning and facilitate assessment in primary Science. Key research findings are discussed along with some practical examples (including photographs) of ways the SMART Board has been used in Science.

Introduction

Teaching science to beginning primary school (infants / preparatory) level students presents some unique challenges. Children of age 5 or 6 attend school with well developed ideas about science concepts, are able to make detailed observations and demonstrate considerable thinking skills. Unlike older children who are able to read, write and express ideas coherently, teachers face the problem of eliciting prior understanding, providing experiences to challenge and extend existing ideas, and assess the understanding of students whose literacy skills are still developing.

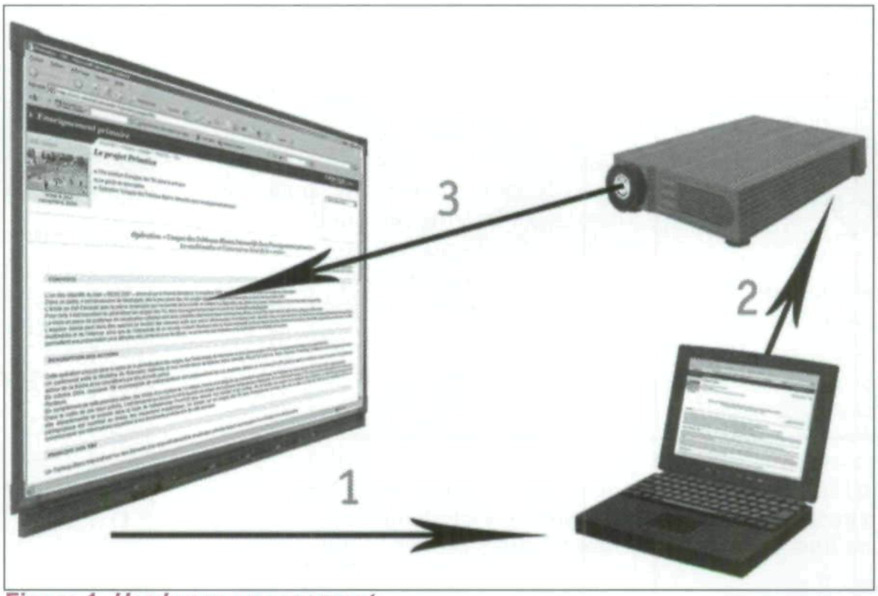

Figure 1. ***Hardware arrangement***

SMART Boards have been used successfully with kindergarten children at Abbotsleigh Junior School over the past 5 years in innovative ways to enhance teaching and learning and facilitate assessment in Science. Findings from classroom based research will be discussed along with some practical examples of ways the *SMART* Board has been used in Science.

What are *SMART* Boards?

SMART Boards (*SMART*-Technologies, 2003) are a brand of interactive whiteboard (IWB). Simply speaking, it can be described as a whiteboard displaying the image from the computer monitor with the surface operating as a giant touch screen. They vary in size and can be mobile or wall mounted. The set up can consist of a desk or ceiling mounted data projector and computer or can work on a totally integrated system as is the case for rear projection *SMART* Boards. The computer can then be controlled from the board itself by touching the *SMART* Board screen, either directly with your finger or one of the incorporated electronic pens. Figure 1 shows a wall mounted IWB and a roof mounted data projector.

Figure 2 shows the technology configuration in the Primary Science Room at Abbotsleigh.

SMART Board technology enables the teacher and/or student to perform a range of functions. The user can:
write on the interactive whiteboard's large touch-sensitive surface with the electronic pen, drag-and-drop images or text,

- interact in many ways such as pressing icons to hear pre-recorded sounds,
- engage with educational multimedia activities,
- watch simulations and view graphics,
- capture text or areas of screen and annotate with the pen,
- save notes, drawings or annotations for future use.

Saved information can be recalled for review and discussion at the end of the unit. It could also be loaded to the school website for student reference at home or to share the data with teacher colleagues.

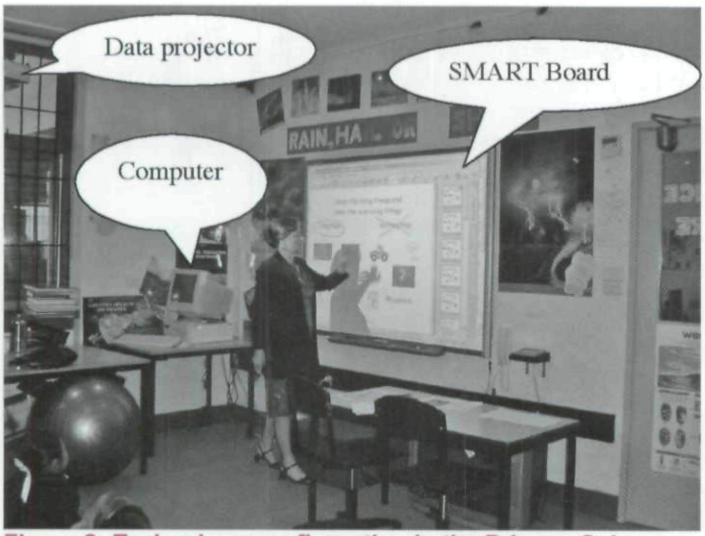

Figure 2. ***Technology configuration in the Primary Science Room***

Research literature reveals other uses of IWBs including:

- 'using web-based resources in whole-class teaching,
- showing video clips to help explain concepts
- presenting students' work to the rest of the class
- creating digital flip charts
- quick and seamless revision' (Becta, 2003).

Availability and cost

IWBs were originally marketed to the business sector and used in boardrooms and conference settings. In the last couple of years, due to reductions in pricing, the possibility of utilising this technology has become a realistic option for schools. A data projector and *SMART* Board installation could cost under $5000, depending on size and features. Installation labour costs and computer hardware also have to be factored in. The software to run the *SMART* Board is free and can be installed on any computer, either in the school or at home.

Why use *SMART* Boards with kindergarten students?

The *SMART* Board provides teachers and students with a whole new interactive learning environment to share ideas, information, images, animations, audio or video. Learning is much more powerful if it is multimodal and the *SMART* Board supports several different learning styles - visual-spatial, auditory and kinaesthetic (*SMART*-Technologies, 2004). Young students are highly motivated when content is presented on a *SMART* Board. It increases their enjoyment by being physically involved touching and moving objects and by the size of the screen which makes images large enough for everyone to see. The engagement and knowledge building of young children is fostered when they are given the opportunity to interact in a physical and mental way in the learning environment (Harlen & Rivkin, 2000). Further, children's excitement in demonstrating a skill or 'operating' the *SMART* Board boosts their self-esteem and builds confidence in science and technology and aids them to work independently at a later time.

Kindergarten children have a short attention span and need to be kept actively involved to promote learning. The collaborative nature of using the *SMART* Board in the learning environment, where the teacher and students are grouped in front of the board engaging in an activity is highly effective for whole group instruction, active discussion and questioning.

Kindergarten students are incredibly inquisitive and highly motivated towards science but lack the skills and ability to deal with multiple relations compared to older students. This can present challenges especially when trying to record the results of investigations. Kindergarteners are able to predict what might happen in an experiment and can verbally describe their observations, having them record the results is more challenging. 5-6 year olds require considerable scaffolding and teacher modelling which is where the *SMART* Board becomes effective. Whilst the aim of the science specialist teacher is to develop children's understanding in ways consistent with the scientists' views and begin to instil an evidence based way of thinking, one has to ensure that the children are 'with you' as you do this. Working collaboratively with the classroom teacher and the students recording what happened and trying to explain and understand why becomes more effective through interacting with the *SMART* Board and using its computer based features. We are always 'pushing the envelope' to see just what kindergarten children are capable of and constantly looking for ways that help us to communicate our teaching goals to the children and to be sure that they are 'really getting' the ideas behind what we are teaching.

Our work with IWBs have assisted us to guide children's investigation and recording of results of practical activities as well as to reinforce the concepts underpinning these. *SMART* Boards also provide a means of promoting visual observation skills, the development and practice of skills being an important outcome of science learning (Feasy, 2004).

Lesson introductions

SMART Boards are ideal for introducing a lesson and to determine children's prior knowledge and understanding. Figure 3 shows a hands on activity where children are sorting Living and Non Living Things into groups.

In this activity meant that the children were able to use concrete items; however, not all concepts in science enable this. In other lessons involving energy, for example, this kind of hands on task would not be possible. In this case a *SMART* Board activity was used to elicit prior understanding. Figure 4 shows a task where children are asked to group the pictures into those objects that need electricity and those that do not (*SMART* Education, 2007). As an extension children were asked to separate those needing electricity into those that use batteries and those that require power points.

Figure 3. ***Hands on activity where children are sorting Living and Non Living Things into groups***

Integrated activities in teaching and learning sequences

Making predictions

In this example children were asked to predict what would happen to the plant pictured on the *SMART* Board if it was not watered. Children were selected to draw what would happen to the plant. This included instruction on how to do simple scientific drawings rather than do artistic sketches.

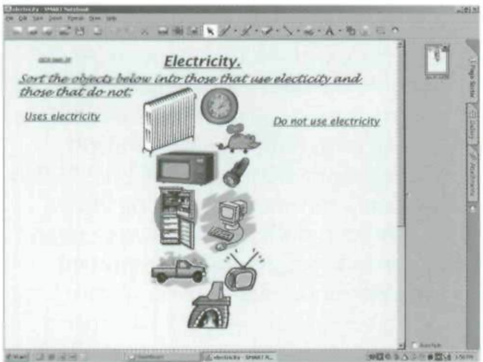

Figure 4. *Electricity grouping activity*

Building up instructions for practical tasks

Young children are not able to take in several instructions at once; they require clear, step-by-step instructions. A PowerPoint presentation or Flash animation can be used with the *SMART* Board whereby instructions are gradually revealed to children. This approach provides children with visual and verbal cues to help them assimilate the procedure. An example of this application was used to guide children in the construction of mini worm farms.

Recording results

After several frustrating attempts at guiding kindergarten in the recording of results of investigations the *SMART* Board worked effortlessly. Children conducted an investigation to see how far Lego cars travel on different surfaces. The teachers modelled recording of results using the *SMART* Board file.

Children dragged paddle pop sticks from the box to show how far the car went and how they measured it. This level of guided instruction enabled the children to use their Lego cars in pairs to conduct and record the results of their own investigation.

Reinforcement of key ideas

The BBC Schools Science Clips from the UK are fantastic resources that we found could readily be incorporated into our unit of work about forces — Push Me Pull You. In this unit of work children experiment with Lego cars to see what happens if you give them a big push and a little push. Results are recorded by asking children to draw a picture to show what happens and to verbally explain their observations (the science specialist and classroom teacher annotate drawings with their explanations). To consolidate their understanding the Push-Pull interactive activity shown in figure 6 is used (BBC, 2007).

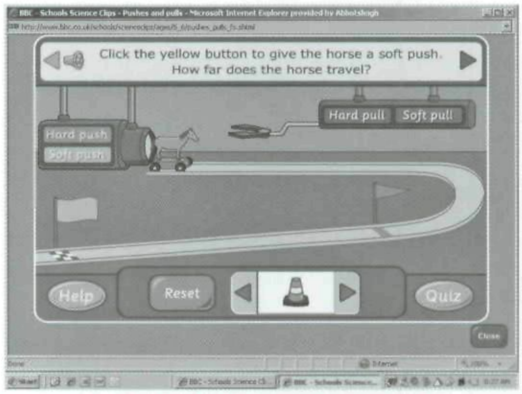

Figure 6. Push-Pull interactive activity

Concluding lessons

Conclusions are a vital part of effective lessons but are frequently bypassed due to running out of time or lack of adequate planning. The *SMART* Board can be used effectively to conduct, short, focussed conclusions which result in ending the lesson on a 'high point' in the children's minds.

Assessment

Our action research with kindergarten highlights the effectiveness of the *SMART* Board in assessing young children. We have designed interactive activities that enable children to show their understanding of concepts and recall of experimental procedures without the need for highly developed reading and writing skills. ESL students are able to complete such tasks whereas they previously would have struggled with pen and paper text based tasks.

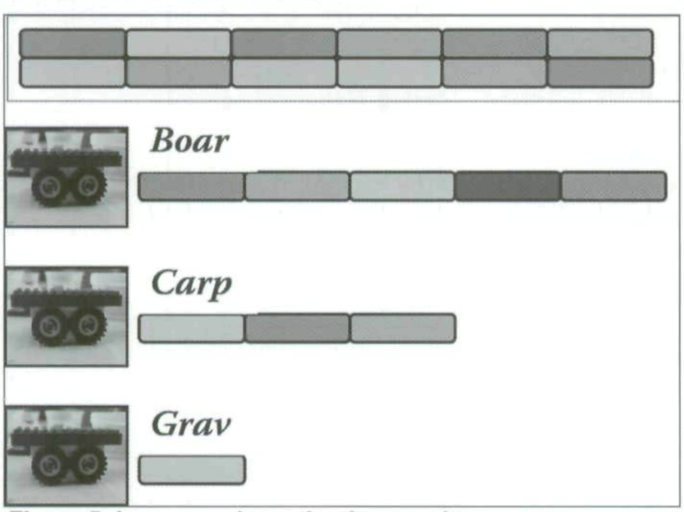

Figure 5. Lego cars investigation results

Formative

In figure 7 a child is dragging an image of a rain cloud over the plant which was to be watered to demonstrate her recall of an experimental procedure. Previously students had conducted an experiment to see what happens when plants are deprived of water, they had 2 sunflower seedlings in small pots, the one marked with a cross was not watered and the other plant was watered.

Summative

Figure 8 shows a child completing a summative assessment activity where they are asked to circle the living things and put a cross over the non-living things

Further, Figure 9 shows the teacher simultaneously engaging in one-to-one questioning with one child while another is completing the *SMART* Board activity (described above) the time saving advantages are obvious.

Evaluation of *SMART* Boards

Whilst a range of uses have been found for the *SMART* Boards in kindergarten Science lessons, research at Abbotsleigh Junior School has revealed the following beneficial purposes and limitations.

Figure 7. Child recalling experimental procedure

Beneficial purposes

Many beneficial purposes of *SMART* Boards were perceived by teachers often relating to opportunities to elicit children's ideas and gain evidence for their level of conceptual or skills development. For example:

> *'Allows children to classify visual images to show if they understand the similarities and differences between them or if they can relate what they have learnt in science to everyday experiences (see push/pull example)'.*

> *'Focus children's attention on the practical task being explained, due to the increased stimulus of visual, auditory and the ability to physically interact with the IWB'.*

Young children require little instruction to learn how to operate the *SMART* Board which may be a result of the technological age where children are now growing up surrounded by technology and are familiar with high-tech gadgets.

Further *SMART* Boards are seen as fun.

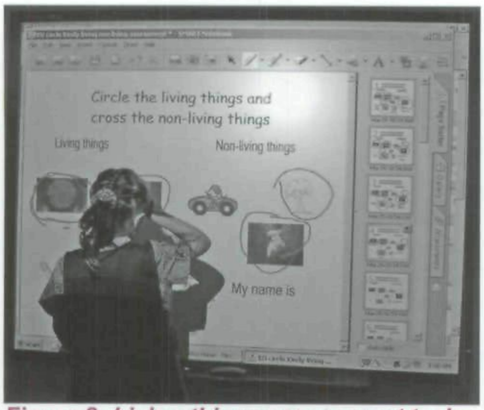

Figure 8. *Living things assessment tasks*

For example:

'Students enjoy using the SMART Board and they encourage very young students to be scientists'.

'The SMART Boards engages the child with what they are learning about and makes it both a personal and shared learning experience for them'.

'Kindergarten students love to look at photos of themselves. They will go back to the same photo galleries and activity pages over and over again, never ceasing to enjoy viewing themselves at work. This makes it a wonderful basis for the consolidation of learning'.

A major benefit has been adapting the *SMART* Board for assessing kindergarten students with whom traditional pen and paper based tests are neither appropriate nor feasible.

'Chris used to spend 2 hours per class interviewing the girls for their term 1 assessment. Now it can be done in a single science lesson by having 3 tasks occurring simultaneously: one where girls interact with the SMART Board individually'.

The pace of lessons has also been increased with the ability to incorporate short, focussed interactive segments before, during or after hands on practical activities.

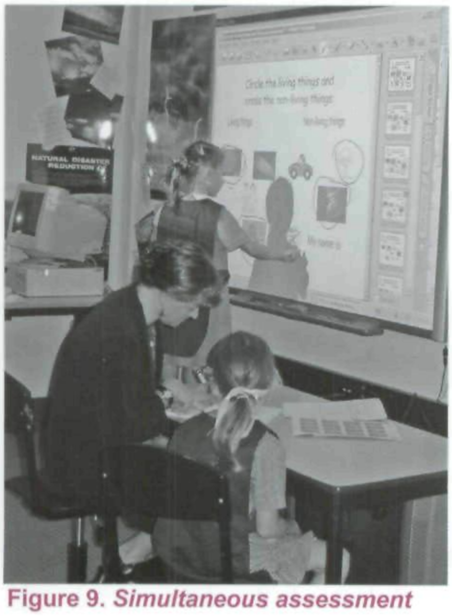

Figure 9. *Simultaneous assessment*

Limitations

Few limitations were noted for *SMART* Boards apart from the obvious initial expenditure to purchase them. The most commonly cited problem is the technical setting up in a classroom. Classrooms which have fixed, permanent installations and the teacher just needs to turn it on, have little technical issues and therefore a greater level of teacher satisfaction and implementation.

One teacher noted that *SMART* Boards can also 'be a distraction as the students focus on it as soon as they enter the room', which can easily be overcome by positioning students away from the *SMART* Board until it is to be used. The fact that *SMART* Boards can only be used by one person at once means that others may be sitting, watching and not directly involved.

Kindergarten students who said they didn't like using the *SMART* Board explained that this was 'when I don't get a turn to use it'.

Selecting activities that allow brief interaction of multiple students ensures that everyone gets to have a turn which keeps children focused for longer.

It must be noted that the *SMART* Board itself does not enhance teaching and learning, it is the way that it is used, being another tool teachers can use to increase interactivity in science classes (Earle, 2004). The real advantages of the *SMART* Board are being seen as teachers explore ways to use this new technology with students mutually developing new teaching and learning strategies resulting in changes in pedagogy (Beauchamp & Parkinson, 2005).

When new innovations are adopted in the classroom there is a danger that they will be used to replace rather than enhance existing teaching practices. The *SMART* Board is an effective tool for facilitating a 'minds on' approach in science. Most importantly this technology should be used to enhance *not* replace hands on investigations and other practical activities in Science (the value of hands-on learning experiences in science are well reported). Indeed *SMART* Boards can be used to integrate experiential activities with discussion and reflection to encourage the growth of coherent understanding (Osborne, 1994; Skamp, 2004).

Implications of research

The majority of exemplary examples presented at ICT conferences that showcase the use of IWBs suggest that years 5 and 6 benefit most from this technology at primary level.

'Most of the available research focuses on older children. Part of this is because IWBs are not typically found in Early Childhood settings - the youngest classes are often the last to get resources and there is an historical reluctance amongst Early Childhood educators to use technology' (Goodwin, 2007).

The Abbotsleigh experience will hopefully encourage more schools to explore the use of this innovative technology with young children. Further development of interactive learning materials for young children could also lead to more fulfilling, productive science learning experiences with beginning primary school children.

The potential for enhanced teaching, learning and assessment with beginning primary school students revealed by this classroom based research suggests that the trend in Australian schools towards the introduction of IWBs into secondary schools more so than primary schools should be reversed. Investing in our youngest minds and stimulating them to develop a strong interest in and love of science could well translate into more people choosing science based careers in the future.

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