A study of teachers' integration of interactive whiteboards into four Australian primary school classrooms

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Abstract

Interactive whiteboards (IWBs) have become increasingly available in Australian primary schools, however little is known about how they are being integrated by teachers. This paper reports on a study of the introduction of IWBs into an Australian public primary school. Data was collected during one day per week over two school terms, involving four classroom teachers. Data collected included a log of time allocation, lesson observations and a series of interviews with the teachers. The study found that participants used IWBs to a varying extent over the course of a teaching week, with lessons that integrated the use of IWBs tending to focus on literacy and numeracy. The technology was readily incorporated into the classroom environment by teachers and considered easy to use. Teachers adopted a range of pedagogical approaches when using the IWBs and these approaches were consistent with those they usually employed in their teaching.

Introduction

Although interactive whiteboards (IWBs) are a relatively new technology to education, they have become the focus of considerable interest, particularly in the United Kingdom where there has been a massive influx of IWBs into schools supported by significant government funds. Enthusiasm for IWBs is also gaining momentum in Australia, with education authorities pledging to invest in this new technology. For instance, the New South Wales state government recently pledged to "provide every NSW public school with interactive whiteboards and video conferencing facilities by 2011 to connect classrooms around the state" (Iemma, 2007, p. 5). Despite such interest, IWBs are yet to become commonplace in Australian classrooms.

Interactive whiteboards are large touch-sensitive screens that allow teachers and students to view, manipulate, create and distribute electronic teaching and learning resources using familiar computer applications. The whiteboards connect to desktop and networked computers, combining the functionality of audio-visual presentation and computer-based interactivity. In classrooms, interactive whiteboards have potential to encourage collaboration by creating a shared learning environment suitable for teaching strategies involving whole classes or small groups.

Until recently much of the literature available on IWBs has been limited to descriptions of 'good' practice and teaching experience in teacher-oriented journals, newspapers and magazines and to "small-scale research projects undertaken by individual teachers, schools and higher education institutions" (Smith, Hardman & Higgins, 2006, p. 445). As noted in several reviews of the IWB literature (Glover, Miller, Averis, & Door, 2005; Higgins, Beauchamp & Miller, 2007; Smith, Higgins, Wall, & Miller, 2005), there has been relatively little academic empirical research investigating interactive whiteboards in education. This is beginning to change with the publication of research reports (e.g., Moss, Jewitt, Levaãiç, Armstrong, Cardini & Castle, 2007) and peer-reviewed journal articles (e.g., Kennewell & Higgins, 2007).

The key findings from this emerging research literature indicate that the integration of interactive whiteboards into the classroom can create new opportunities for student learning, through multimedia or interactive resources, and can enable more rapid transitions between lessons, but that it does not necessarily have a transformative effect on pedagogy (Gillen, Staarman, Littleton, Mercer & Twiner, 2007; Glover, Miller, Averis & Door, 2007; Wall, Higgins & Smith, 2005). To date, no evidence has emerged of significant impacts on student achievement (Higgins, Falzon, Hall, *et al.*, 2005; Moss *et al.*, 2007). However, there is a recognition of the teacher's central role in determining how IWBs are used and arguments that teachers may need to adapt their classroom practices to make most effective use of the technology (Glover & Miller, 2002; Kennwell & Beauchamp, 2007; Schuck & Kearney, 2007), especially for example in the design of multimodal 'texts' (Jewitt, Moss & Cardini, 2007) and the integration of resources (Armstrong, Barnes, Sutherland, Curran, Mills & Thompson, 2005). These early results suggest that there is still much to learn about the impact of IWBs on teachers' practices in the classroom and on student learning.

This paper presents findings from a study of the introduction of IWBs into a primary school in Canberra, Australia. The study was conducted over the two school terms in which IWBs were installed in the classrooms of four teachers who volunteered to take part in an initial implementation. The main focus of the study was on the teachers' perspectives and the types of activities they undertook with their students. The paper begins with a description of the methodology, presents the results and, discusses the key findings and their implications.

Methods

The research used a predominately qualitative approach to explore the context from the perspectives of the participants (Creswell, 1998). Such an approach is most appropriate for investigating phenomena in the complexity of a natural setting (Bogdan & Biklen, 1992; Marshall & Rossman, 1989) and, as such, allows the investigation of a range of issues that may impact on the use of a particular technology in a particular classroom environment. This sustained investigation became a collaboration with the school that aimed to develop an understanding of the range of issues and experiences, and the contexts in which they are relevant. The overall aim of the research was to discover how teachers experienced a new technology in their classrooms not through the lens of what the technology could supposedly offer them, but in terms of their actual experiences. Table 1 summarises the forms of data was collected.

Table 1: Summary of data collection

Method	Detail
Initial interview	An initial interview was conducted with each teacher to collect background information about each teacher's professional experience, IT skills and initial impressions of the IWBs.
Classroom observations	Over the two school terms, classroom observations provided examples of how the teachers and students used the IWBs. A member of the research team sat unobtrusively in the classroom and recorded field notes according to a semi-structured protocol, which were later transcribed. The classroom visits were impromptu and not scheduled ahead of time.
Activity	An in-depth 'activity' interview was conducted with each teacher during the study

interview	in which the researchers collected teachers' explanations of some of the specific IWB-supported activities observed.
Use log	An extent of use log instrument was used to track each teacher's IWB use over a two-week period. Using this instrument, teachers recorded the subject they were teaching, the length of the lessons and the tools and resources they used. The log was analysed to understand the overall pattern of IWB use across a typical school week.
Final interview	A final interview was conducted with each participant at the end of the school year to collect their reflections on their use of the IWBs over the previous two terms.

Data reduction and display techniques derived from Miles & Huberman (1994) were used to develop coding schemes for each of the qualitative data sources based on emergent themes and on the research questions. Aggregation of codes and iterative examination of categories was then used to identify patterns in the data. This process allowed the identification of key findings (Creswell, 1998).

Context

The study school was located in the outer suburbs of a major Australian city in an area of relatively high socio-economic status. At the time of the study IWB were very new in Australian schools and, with no targeted government funding available for their purchase, the school community had raised the money to buy the IWBs. The IWBs were installed into the classrooms of the four study participants during the break in the middle of school year. These teachers represented a range of both teaching and technology experience (see Table 2).

Table 2: Research participants

Name (pseudonym)	Class	Teaching experience	Self-described IT experience or attitude
Belinda	K/1	7 years	Reasonably competent and confident Limited ability to solve problems
Leonie	5/6	4 years	Began teaching career with very basic IT skills Experienced a steep learning curve Now rates skills as average and feels confident
Jude	5/6	3 years	High level of computer skill Took major in IT at university
Rob	5/6	First year of teaching	High level of computer skill Studied at high school and university level Uses computers at home a lot

Results

Extent of use

The use logs completed by the participants provides evidence of the extent of use over the study period. Table 3 shows the IWB use according to each of the teachers, showing the total minutes used across the two-week period, the percentage of total class time and the number of lessons in which the IWB was used.

Table 3: IWB use for each teacher

Teacher	Class	Minutes	% Total teaching time[1]	Number of lessons
Rob	Year 5/6	625	28%	18
Leonie	Year 5/6	690	31%	19
Belinda	Kindergarten/Year 1	280	13%	13
Jude	Year 5/6	1035	47%	25
Total		2630		75

One of the Year 5/6 teachers, the participant with the most teaching experience and the highest self-reported level of technology competence and confidence used the IWB most. Belinda, teaching a composite K/Y1, used the IWB less than the other participants and her lessons were, on average, of shorter duration. When participants did use the IWB, an analysis of the IWB lesson time according to subject area showed they used it mostly when teaching English and Maths, and to a lesser extent when teaching other subject areas or lessons that related to multiple subject areas (see Figure 1). Activities that were unrelated to a particular subject area, such as general games or information sites, were categorised under 'other'.
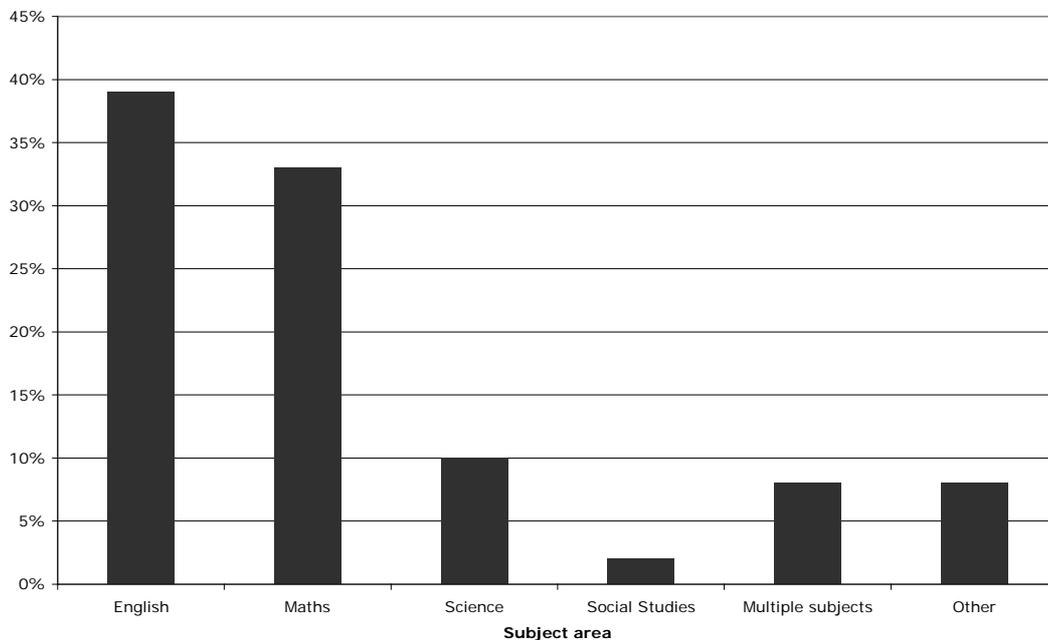

Figure 1: Percentage of IWB lesson time per subject area

Participants reported using a software tool in 70% of lessons in which the IWB was used. During these lessons, the tool used most was *Smart Notebook*, while tools used less often included productivity tools such as *Word* or *Excel*, student portfolios for Year 5/6 students only, search engines and other tools, including games (see Figure 2).

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[1] Excludes the time allocated to weekly sport activities, school assemblies and regular relief time.
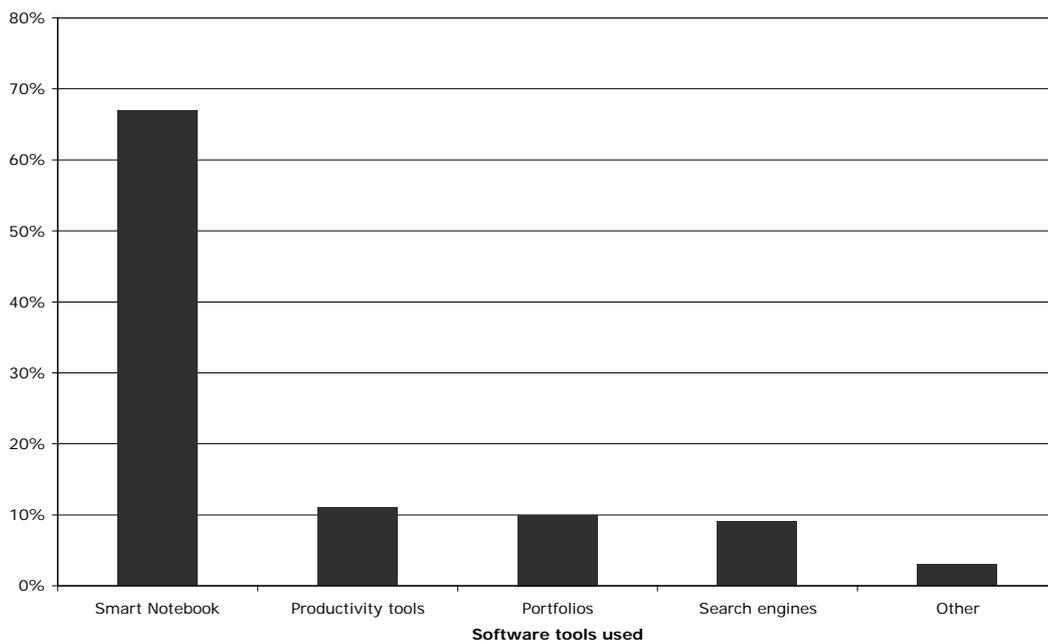
Figure 2: Percentage of IWB lesson time per software tool used

Additional hardware, such as scanners or videos, was rarely used, reflecting the limited availability of these devices at the time the study was conducted. Resources on Internet or CD-ROM were used in 35% of total IWB lesson time. Internet sites was the most popular type of resource, with Web sites used during 24% of all IWB lesson time and CD-ROMs used during 7% of all IWB lesson time.

Classroom observations

A total of 28 full lessons were observed, comprising lessons on English (11), Mathematics (12), Science and Technology (3) and Social Studies (2). The minimum numbers of lessons observed for each participant was 5 and the maximum number of lesson observations for a single participant was 10.

Analysis of the observation field notes indicated patterns of IWB control. In 11 lessons the teacher was in sole control of the IWB, while in one lesson the students were in sole control. In the majority of lessons (16) teachers shared control of the IWB with the students, though still controlling the lesson and facilitating student turn-taking. The strategies employed by teachers to manage students' use of the IWB included: selecting from students who volunteered (most common); inviting students in turn for equity of access; and, allowing students access as a reward for good behaviour (least common). In two classrooms, students were most often asked to sit on the floor in front of the board from where they moved up to use the board. In the two other classrooms, students remained at their desks when the IWB was being used, moving to and from their desks when it was their turn to use the board. Teachers usually responded to off-task talking and lack of attention by either coaching students on the skills of turn-taking, or by eliciting suggestions from the rest of the class to assist the student at the board.

Analysis of field notes from classroom observations also provided indicators about the tools and resources used in IWB-facilitated lessons. As revealed in the use logs discussed in the previous section, *SmartNotebook* was the software tool used

most often, followed by Internet browsers and *Word*. *SmartNotebook* software provides functionality for teachers and students to create resources that combine text and a range of media types. This software was used for both presenting and recording information during the lesson, while *Word* was used for presentation only. Text and images that had been pre-prepared by teachers were used in most lessons. Teachers also returned to IWB work saved in earlier lessons.

Participants adopted a range of teaching strategies when using the IWB. The most common lesson pattern involved the teacher first demonstrating or modelling a concept, which was followed by individual student activities, often exercises completed in their books. Feedback was usually given to the whole class. Sometimes the teacher gave the answers to the exercises without discussion, but more often the teacher provided the answers while facilitating discussion around the topic. Less often, students were called upon to write their answers on the board. This situation more frequently incorporated discussion about the answers than when the answers were provided by the teacher. Other types of IWB-facilitated teaching strategies included using the IWB to: provide stimulus or instructions for a lesson; record student ideas or brainstorming; facilitate whole class discussion about a topic; support open-ended individual activities such as Internet searching; or using Internet-based educational games.

Few practical and technical issues using the IWB were observed. The main practical issue was in students developing skills in operating the board, such as selecting and dragging objects or text, and using special pens to write. Students became involved in supporting use of the IWB by closing blinds to darken the room and 'waking the computer up' if the screen saver came on. Few technical problems were observed and those that were encountered caused minimal disruption to the lessons.

Activity interviews
In-depth interviews with participants during the term were used to elicit the teachers' reflections on particular observed lessons.

Literacy rotation – Internet research (Year 5/6)
In this daily literacy rotation Jude's students used the IWB to support Internet research, which was one of five small group activities through which students rotated each day. The activity was focussed on locating and selecting information using Internet search engines.

Prior to the lesson, the class had been taught Internet research skills in the computer lab, including strategies to use when searching for information and assessing the quality of the information found. When reflecting on the rotation activity with the researcher, Jude explained, "[the IWB] has made a big difference because we don't have to have a special time in the lab to do that." Students completed a worksheet in which they described the Web sites they found including the URL, author and description. This type of lesson was the first in which students had the opportunity to use the IWB by themselves.

Observations indicated that students had no difficulty using the IWB, and were focused on their task. Furthermore the students using the IWB were unconcerned about rest of class, and rest of class were not distracted by IWB. He felt accessing the Internet on the IWB was a benefit, explaining that:

> The Internet has added another dimension to teaching in the classroom that everyone can
> see from everywhere in the room and interact with it. It's another reference source
> straight away in the classroom and if some asks a questions that I don't know the answer
> to I can show them or give them some multimedia experience to enhance their learning.

For Jude, having the IWB in the classroom also meant he approached the development of computer literacy differently:

> It's transformed the way we use the lab as well. I don't actually have to explicitly teach a
> lot of IT skills. They pick it up through watching me on the SmartBoard every day and
> then using it themselves. Simple things like saving a file into a folder or scanning an
> image they pick up.

Maths timetables and exercises (Year 5/6)

For this, and many other lessons, Rob used an Internet site containing tests on multiplication, addition and subtraction to provide students will opportunities to practice mathematics skills.

Rob explained that he wanted to use "something interactive" for maths with his students and particularly liked this site because it included timed and un-timed multiple choice tests which were automatically randomised and provided feedback. He felt this type of activity was more "fun" for students and provided a change from the usual maths activity of completing a worksheet.

Rob also felt using this site improved his productivity by reducing his preparation time because the tests could be quickly assembled online using the options available on the site and projecting the tests on the IWB meant that no photocopying was required. Being able to display the correct answers immediately on the screen also enabled students to mark their own work more quickly.

Isometric drawing (Year 5/6)

For this lesson on isometric drawing Leonie scanned a grid and copied it into a page on *SmartNotebook* to display on the IWB. She felt using the IWB in this way would be "a lot easier than trying to manage a piece of paper on an easel". Leonie first demonstrated the process by drawing a shape on the grid, explaining the procedure as she went and pausing occasionally to ask students to come up to the board to help or offer advice on what to draw next.

Reflecting on the lesson, Leonie explained that she particularly liked the fact that the image on the IWB was large and clear, and that she could easily undo the last step when, as a class, they had made a mistake. This, she felt, engaged the students in her demonstration of the concept. Leonie felt that because of this "[the students] were more confident to go back and replicate the model we'd made and drawn, and then create their own model and draw that." She also felt there was value in the way the students helped each other, explaining it as a pattern she had observed in all of her IWB lessons:

> The ones sitting on the floor aren't just thinking 'oh I want a turn next'. They'd say 'no
> that's not in the right place, no you've got to go down'. So they were helping each
> other."

Leonie also felt that her use of the board improved the efficiency of teaching this particular lesson:

> Comparing it to a similar lesson with my class last year, I was sitting with groups of
> students on the floor, showing them over and over, and starting them off drawing, but I
> didn't have to do that with any of the students this time because they saw it all the first
> time.

Reading – Storybook (K/1)

Belinda had prepared for this lesson by scanning the pages of an out-of-print storybook at home and inserting them into a PowerPoint presentation. The book was old, small and falling apart, but by displaying the book on the IWB Belinda was able to read the book to her class. Belinda read through the story, controlling the pace of reading, but also allowing for discussion and pausing to point out words that contained the 'feature letter of the week' around which she organised literacy lessons. Belinda reflected on her students' reactions to the lesson:

> [They] love the SmartBoard. They love the idea that they can just sit and see it. They don't have to worry about a book falling over. They like the brightness of it and they can read the words. They can follow along.

Final interviews

When reflecting their use of the IWB over the two terms since their installation, the participants confirmed using the IWB, in the main, for literacy and numeracy lessons. Whether for English, Maths or other subject areas, participants also revealed that they and their students used the IWB for research, particularly for Internet resources. This was felt to be a particular strength by one participant who found that it was not always easy to send students to the library for such tasks.

Overwhelmingly the teachers felt that the IWB offered efficiencies in terms of planning and lesson preparation. They believed because of the IWB it was quicker to prepare lessons, that uploading prepared lessons eliminated the need to write instruction on the board, that time was saved by moving between screens without rubbing out and re-writing, and that photocopying was significantly reduced. They had also found the transition between lessons to be quicker. Using *SMARTnotebook* also enabled the teachers to record what the class had accomplished and save the outcomes on the school's intranet.

The teachers also perceived that use of the IWB facilitated student engagement. One participant explained, "everyone wants to have a go, use it and show me what they could do. They're sharing knowledge." Another recounted the high levels of student engagement in his class when they had used interactive games on the IWB:

> Kids obviously enjoy games and stuff like that. Sometimes some of them ask me to put the maths up if they've nothing to do so they enjoy doing that rather than just doing them in their books.

Another participant felt the students picked up technology skills by using the IWB:

> It's helped them with computer skills. They've got the lingo. IT. More than I could have got with the stand-alone small computers. I've noticed they are talking about computer stuff and they're then able to explain to each other and new students who come into the class what they need to do.

The teachers also mentioned technical and classroom management challenges in using the IWB. Initial concerns about the IWB were associated with both teacher and students becoming comfortable with using the board and finding strategies for equitable turn taking.

One participant explained the impact of the IWB on her classroom practice saying, "it forces me to think about doing things differently. Sometimes it's worked. Sometimes it hasn't. I've learnt from that. Lots of trial and error." Another expressed his confidence in the IWB as a classroom tool by saying, "I'd like to see one on every

classroom obviously… I wouldn't know what to do without one. I would but I wouldn't like to work without one."

Discussion

These results reveal the early impact of interactive whiteboards in the four classrooms studied. The interactive whiteboards were used to a varying extent by the four classroom teachers, with IWB use being interspersed with other types of classroom activity, particularly for the K/1 students who were engaged in a high level of hands-on activity appropriate to their developmental stage. The IWBs were mainly used during literacy and numeracy lessons. While this is unsurprising because these are the two main subject areas in which teaching occurs in the school, these results suggest that the teachers readily integrated the IWBs into their usual classrooms routines. This contrasts with the pattern for many earlier classroom technologies whose use remained peripheral to normal classroom activities (Cuban, 1986).

Teachers experienced IWBs as having immediate practical benefits for them, such as those identified in previous research (e.g., Glover *et al*, 2007; Smith *et al*., 2006). The teachers were particularly enthusiastic about how the IWBs had assisted them in routine teaching tasks, such as preparation and presentation of resources. All commented on the time they had saved in being able to use existing electronic resources, such as Web sites and CD-ROMs, and on how they planned to reuse materials they had created themselves, thus saving themselves preparation time in the future. The ability to display exercises or instructions on the board saved further time previously spent on photocopying materials for each student. The preparation of electronic materials that could be quickly called up on screen also meant that teachers no longer needed to write on the board, making the pace of lessons faster and the transition between lessons quicker and smoother. It is likely that these benefits in part led to the high level of acceptance of this new technology expressed by the teachers in this study.

Observations of lessons and comments from the teachers indicated that although some aspects of their practice might have changed, the IWBs were integrated into existing practices and had not changed the focus of teaching and learning activities. Further, there was no evidence that the teachers changed their overall pedagogical approaches in response to having an IWB. The IWBs were integrated into the ways that teachers taught already. For example, if a teacher used a directed approach for a particular type of lesson, the IWB was used to support that approach. This was particularly obvious in the maths lessons observed, which followed a familiar pattern of students completing a series of exercises. If the teacher used facilitative approach, for example using discussion activities to support essay writing or in small group literacy activities, then the IWB was used to support that process. It should be noted also that individual teachers were observed to adopt a range of strategies, both teacher-directed and student-centred, during the study, but the IWB was usually integrated into whole class teaching directed by the teacher. All of the participants commented on how they felt using the IWB improved their ability to present material to students, so perhaps this pattern in part reflects another key benefit as seen by the teachers. That is, they found the IWB helpful in presenting material and this became the main focus for its use as a result. Previous studies have also noted that IWBs were used to support established teaching styles rather than to 'transform' teaching, suggesting that IWBs fit well with the status quo (e.g., Gillen *et al*, 2007; Jewitt *et al*., 2007). Such findings challenge assumptions that the

introduction of a new technology either must or should in and of itself promote pedagogical reform.

For the participants in this study it was clear that the lesson content and learning objectives determined the use of the IWB rather than the teachers looking for opportunities to exploit the IWB's potential. In this context, there was no incentive for teachers to change pedagogy they considered appropriate for their learners simply because of the introduction of the new technology. Further none of the teachers expressed views that suggested resistance to change, with all acknowledging in interviews that there is always scope for improvement in teaching practice. So it appears that in this study, teachers adopted the IWBs in ways that supported the pedagogical approaches they had already deemed successful, although the appeared to remain open to continued improvement as a general part of their professional philosophy. This suggests that once adopted there may be potential for the gradual introduction of new pedagogical approaches as part of an evolutionary rather than revolutionary development of teachers' skills. Thus the findings of this study support class for ongoing and appropriate professional support for teachers (Armstrong *et al*., 2005; *Jewitt et al*, 2007).

The IWB did, however, prompt some changes to classroom practice worthy of further investigation. Firstly, all participants felt that the IWB brought technology into the classroom in a way that other technologies had not. Though usually controlled by the teacher, the IWBs had become a technology tool used by the class as a whole. Even in the K/1 class, students participated in routine tasks to operate the IWB and computer. Students took turns at the board, often with technical advice and guidance provided by classmates. The IWB was often the focus of class attention and interaction, complementing the more individual computer activities undertaken on the few classroom desktop computers or in the computer lab. All of the teachers commented on the benefits of being able to demonstrate IT skills via the IWB, and the Year 5/6 teachers also modelled information literacy skills by consulting Internet sources via the IWB to answer questions spontaneously as they arose during class activities. The IWB also enabled teachers to integrate a range of online and CD-based resources into whole class teaching. It is true that similar activities could be supported using a computer and projector with a normal screen or board, but the ability to operate the computer via the touch-sensitive IWB offered both teacher and student a different type of interaction.

Conclusion

The teachers who participated in this study integrated the IWBs into their existing teaching practices with the IWBs used primarily to support whole class teaching, particularly to present content or model activities. The main impacts on lessons were an increased use of the Internet, software and visual resources as part of lessons; modelling and discussion of IT skills; and modelling of Internet research skills. The main changes for teachers were a reduction in preparation time and increased ability to prepare lessons at home, the ability to record lesson content for later reuse, and faster pacing within and between lessons. In this study control over structure, pace and interaction within the classroom remained with the teacher, but students did have opportunities to use the IWBs. In many lessons the IWB became the focus of class discussion rather than teacher-led instruction. These findings suggest high levels of integration and acceptance of this technology which may come from the early

advantages that teachers experience in using IWBs in their classrooms, and from which it may be possible to leverage the future development of pedagogy.

This study is significant in investigating teaching and learning practices using IWBs a number of classrooms by collecting in depth data over a sustained period. This article provides some insight into the understandings about practice that can be obtained with sustained investigation and suggests the need for more research of this nature. The practicality of research in the real world setting of school classrooms necessitated a multi-faceted approached to data collection. The combination of researcher observation and teacher self-report and reflection provided a comprehensive understanding of the ways in which the technology used and can be used by teachers and learners. Thus, this study also contributes to the further development of research methodologies that can be effectively used in naturalistic environments.

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