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

Sue Bennett* and Lori Lockyer

Cognition and Learning Design Laboratory, Information and Communication Technology Research Institute, Faculty of Education, University of Wollongong, Wollongong, Australia

(Received 4 November 2007; final version received 16 September 2008)

Interactive whiteboards (IWBs) have become increasingly available in Australian primary schools. However, little is known about how they are being integrated by teachers into their teaching practices. This paper reports on a study of the introduction of IWBs into an Australian public primary school. Data were collected for 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.

**Keywords:** interactive whiteboards; K-12; primary schools; pedagogical approaches; technology integration

**Introduction**

Although interactive whiteboards (IWBs) are a relatively new technology to education, they have become the focus of considerable interest, particularly in the UK 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 IWBs and video conferencing facilities by 2011 to connect classrooms around the state’ (Iemma 2007, 5). Despite such interest, IWBs are yet to become commonplace in Australian classrooms.

Interactive whiteboards are large touch-sensitive boards 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, IWBs have the 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 experiences in teacher-oriented journals, newspapers and magazines and to ‘small-scale research projects undertaken by individual teachers, schools

*Corresponding author. Email: sbennett@uow.edu.au
and higher education institutions’ (Smith, Hardman, and Higgins 2006, 445). As noted in
several reviews of the IWB literature (Glover et al. 2005; Smith et al. 2005; Higgins, Beau-
champ, and Miller 2007), there has been relatively little academic empirical research investigat-
ing IWBs in education. However, this is beginning to change with the publication of
research reports (e.g. Moss et al. 2007) and peer-reviewed journal articles (e.g. Kennewell
and Higgins 2007).

The key findings from this emerging research literature indicate that the integration of
IWBs into the classroom can create new opportunities for student learning, through multi-
media or interactive resources, and can enable more rapid transitions between lessons, but
that it does not necessarily have a transformative effect on pedagogy (Wall, Higgins, and
Smith 2005; Gillen et al. 2007; Glover et al. 2007). 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 and Miller 2002; Kennewell and
Beauchamp 2007; Schuck and Kearney 2007), especially, for example, in the design of
multimodal ‘texts’ (Jewitt, Moss, and Cardini 2007) and the integration of resources
(Armstrong et al. 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.
Moreover, in order to provide accounts of practice, much of this research takes a ‘snapshot’
perspective; longitudinal studies that might explain how teachers’ practices change as they
start to use IWBs are harder to find.

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.

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 (Marshall and Rossman 1989;
Bogdan and Biklen 1992) 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 rele-
vant. It also allowed the way in which teachers’ practices changed to be explored. Table 1
summarises the forms of data that were collected.

Data reduction and display techniques derived from Miles and 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 identifi-
cation 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 IWBs 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). Note that K/1 children are around 5–7 years old, and grade 5/6 children are around 10–11 years old.

**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

<table>
<thead>
<tr>
<th>Name (pseudonym)</th>
<th>Class</th>
<th>Teaching experience</th>
<th>Self-described IT experience or attitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belinda</td>
<td>K/1</td>
<td>7 years</td>
<td>Reasonably competent and confident; Limited ability to solve problems</td>
</tr>
<tr>
<td>Leonie</td>
<td>5/6</td>
<td>4 years</td>
<td>Began teaching career with very basic IT skills; Experienced a steep learning curve; Now rates skills as average and feels confident</td>
</tr>
<tr>
<td>Jude</td>
<td>5/6</td>
<td>3 years</td>
<td>High level of computer skill; Took major in IT at university</td>
</tr>
<tr>
<td>Rob</td>
<td>5/6</td>
<td>First year of teaching</td>
<td>High level of computer skill; Studied at high school and university level; Uses computers at home a lot</td>
</tr>
</tbody>
</table>
of lessons in which the IWB was used. (Note that ‘total teaching time’ excludes the time allocated to weekly sport activities, school assemblies and regular relief time.)

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’.

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

Table 3. IWB use for each teacher.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Class</th>
<th>Minutes</th>
<th>Total teaching time (%)</th>
<th>Number of lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rob</td>
<td>Year 5/6</td>
<td>625</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Leonie</td>
<td>Year 5/6</td>
<td>690</td>
<td>31</td>
<td>19</td>
</tr>
<tr>
<td>Belinda</td>
<td>Kindergarten/Year 1</td>
<td>280</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Jude</td>
<td>Year 5/6</td>
<td>1035</td>
<td>47</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2630</td>
<td></td>
<td>75</td>
</tr>
</tbody>
</table>

Figure 1. Percentage of IWB lesson time per subject area.
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 the Internet or CD-ROM were used in 35% of total IWB lesson time. Internet sites were 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 focused 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 Websites 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. Jude 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 someone asks a question 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 with 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 in *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 instructions 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 of 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 IWBs in the four classrooms studied. The IWBs 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. Smith, Hardman, and Higgins 2006; Glover et al. 2007). 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 Websites 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 a 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: 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, Moss, and Cardini 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 they 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 calls for ongoing and appropriate professional support for teachers (Armstrong et al. 2005; Jewitt, Moss, and Cardini 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 may come from the early advantages that teachers experience in using IWBs in their classrooms, from which it may be possible to leverage the future development of pedagogy.

This study is unique in investigating teaching and learning practices using IWBs in a number of classrooms 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 fulsome understanding of the ways in which the technology is 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.

Acknowledgements
The authors wish to thank Claire Krnavek, Jacqueline Millard and Martin Olmos, all of whom provide research assistance for this project. We would also like to acknowledge Louise Thake and Marie Bolton for their support throughout the project.

Notes on contributors
Sue Bennett is a Senior Lecturer in the Faculty of Education at the University of Wollongong and the Deputy Coordinator of the Centre for Research in Interactive Learning Environments. Sue’s research is concerned with understanding the role of information and communications technologies in education. Her body of work encompasses a wide range of research questions relevant to school and university education.

Lori Lockyer is an Associate Dean, Research in the Faculty of Education at the University of Wollongong and teaches and researches in the ICTs for Teaching and Learning programme. Lori is an Apple Distinguished Educator (Class of 2006–08) and is on the editorial boards for the International Journal for Learning Technology and the Journal of Interactive Learning Research.

References

Kennewell, S., and S. Higgins, eds. 2007. *Learning, Media and Technology* 32, no. 3. (Special issue).


Copyright of Learning, Media, & Technology is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.