大妻女子大学紀要 ― 文系 ―　No. 42,　2010年 3 月

E-Teaching and How Interactive Whiteboards Can Enhance the Learning Process

Gordon Liversidge

Abstract

This paper provides an introduction to the potential role of interactive whiteboards (IWB) in enhancing the learning process, and how this can merge or blend the use of the new technologies into lessons: E-teaching. The IWB allows the teacher or lecturer to adapt traditional blackboard techniques and classroom activities, and at the same time create new activities and materials which are not possible without the IWB ― hence the term E-Teaching. The IWB acts as both a whiteboard and a computer screen operated by finger or pen touch. Thus, the IWB provides the teacher the opportunity to access and use all the benefits of the old and new technologies while still remaining in the front of the class. This paper has four parts: first, an explanation of interactive whiteboards and their historical development; second, an outline of the author's initial experiences with IWBs at London University; third, a short summary of interviews with teachers and lecturers; and fourth, an overview of research and frameworks of analysis. This paper finds that IWB usage will continue to increase for several reasons. First, the IWB affords a merging and flexibility in the use of traditional and new technologies. Second, the teacher has greater freedom in choosing when or when not and how to use the materials and the available technologies. Third, platforms and LANs within education institutions, and the Internet allow teachers to store and have access to shared materials prepared for use with the IWB. Fourth, IWBs are used predominantly in educational institutions, and consequently have a much better standard of support and updating of accompanying software. Fifth, and most important, is that teachers and lecturers who have used IWBs report favourably on them. The paper concludes that, as with other technologies, the potential of IWBs is not always maximized because of varying levels of provision for professional development (PD) and support.

Introduction

It is not the purpose of this paper to examine the reasons as to why Japanese educational institutions have been slow to adopt the technology of interactive whiteboards, neither to consider the deeper cultural factors for this. Shimizu (2006) reveals his concern about interactive whiteboards, 'Our country aims to be one of the worlds leading IT nations, but has made little progress in embracing in using IT in education.' (我が国は世界先端の IT 立国を目指してきましたが、教育の情報化についてはなかなか進んでいません (はじめに ii). However, the failure to embrace IWB technology increases the risk of a repetition of the 'Made in Japan but Not Used' scenario (Liversidge, 2006) in which the spread of computers and the Internet,

not only in education, but also in general life, was almost a decade behind that of the US and UK.

In the fifth year of the Meiji Era (1872) the blackboard was introduced to Japan by an American, and within five years every school in Japan had one installed (Shimizu, 2006). This technology is still dominant along with the teacher or lecturer being in front of the class. Since then the idea that the teacher should always be at the centre or the focus of any class or lecture has been challenged. Theories and practices of pedagogy and learning have been adopted, such as child-centred learning or social constructivism, group problem solving, projects in which the teacher does not always have the central role. In the last twenty years, a new challenge to the teacher-centred class has emerged with the new technologies of the computer and the Internet. The effect of these technologies has been a kind of fragmentation both inside and outside the classroom. Students can, and are expected to, do more individual self-study or group work. With E-learning or distance learning some students do not even come to school or university. The best usage which has emerged is that of blended learning where classroom time is devoted to what is best done there — interacting with the teacher and other students; and other activities are best done at home or in self-study rooms.

The success of using computer rooms and computers in the classroom has been varied. A great deal depends on factors such as teacher skills, the physical set-up of the rooms, and the policy of the school or university. The problem with using these new technologies in the classroom is that often they result in a loss of attention while the teacher does something on their computer. This loss of attention has two factors: vision and time. The teacher, in stepping to the side to look at their laptop or computer screen, is no longer in face-to-face communication with students. Sometimes, if behind a control panel, they cannot be seen at all. The result is often that the pace drops and interest decreases. It is sometimes difficult to regain that attention and atmosphere, especially with younger or less-motivated students. At the university level and in industry, these problems have been partially solved by the use of PowerPoint or OHP presentations. However, such a style, while allowing a great deal of information to be presented in an interesting manner, is neither interactive nor face-to-face. There is also a risk of overuse of PowerPoint. The comparison with IWBs, and the visual culture of technology is covered at length in Reedy (2008).

The IWB allows the teacher to place themselves more in the centre while at the same time using the new technologies. This creates a new first phase which could be called E-teaching. However, there are numerous cases where the introduction of technologies into the classroom has failed which is why the IWB needs to be examined closely. Justification for installation and use of such technology should not be based on intuition or desire alone. Such unprincipled eclecticism can result in this E-teaching potential being merely gimmicky and unsuccessful. However, an examination of the pedagogy involved and learning will help academic institutions better assess how where and when these interactive whiteboards are or should be used.

Section 1　Interactive Whiteboards and their Historical Development

What are they?

Interactive whiteboards are more accurately described as electronic or digital whiteboards. Interactive whiteboards (IWB) are no different from the traditional whiteboard or blackboard, in that they allow usage and activities found in the standard teacher-fronted class. However, in addition the IWB allows, by use of a special pen, remote control, or fingers, the teacher to write, sketch, or bring up files, pictures, video clips or a Webpage from the computer. The IWB also allows preparation, storage, and reuse, not only of ones own materials, but also others which can be downloaded and modified. The IWB merges the old technology of writing on the board, with the new technology of the computer and the Internet. It affords the teacher the availability and flexibility of accessing the old and new at anytime. Furthermore, it allows students active participation rather than lessons or lectures using Power Point where students are usually afforded a passive role only.

As such it replicates non-digital technologies.

> Software provided with the board (such as Promethean's ActivStudio), or obtained separately, provides a variety of functions, including those which replicate non-digital technologies such as flipcharts, dry-wipe boards, overhead projectors, slide projectors and video-players. (Kennewell, S.; Higgins, S. 2007 p. 207)

However, it also adds a new dimension by providing access to some of new technologies.

> Software also provides other functions which have not previously been easily manageable when using a large display in the classroom such as: drag-and-drop (objects on the board can be moved around), hide-and-reveal (objects placed over others can be removed), highlighting (transparent colour can be placed over writing or other objects), animation (objects can be rotated, enlarged, and set to move along a specified path), indefinite storage and quick retrieval of material, feedback (when a particular object is touched, a visual or aural response is generated). (Glover, D. *et al.,* 2005)

This merging of digital and non-digital technologies is summarized well by Shimizu (2006, p. 21) shown in Table 1. As mentioned in the introduction, the use of technology can result in a rather rigid class or lecture style such as PowerPoint. IWBs afford the teacher more flexibility, and also enables immediate responses and quick access to extra material.

> Gillen *et al.* (this volume) use Mortimer & Scott's (2003) framework for analysis of pedagogic practice. They identify the potential of IWBs for supporting more interactive and dialogic approaches, for making presentations more imaginative, and also for introducing a degree of spontaneity into what can otherwise be very highly structured lessons

Table 1　Advantages and Disadvantages of Presentation Equipment

◎　Can do very well
○　Can do
△　Possible but not ideal
×　Not possible

1．Blackboard/Whiteboard
2．OHP
3．TV / Video
4．Computer
　a. monitor
　b. screen
5．Electronic whiteboard (interactive whiteboard IWB)
　a. tablet type
　b. standard

a．Can write on
b．Can go back to things wiped from board
c．Students' focus of attention
d．Can present information in any order
e．Displays still images
f．Displays moving images
g．Can operate computer
h．Size of screen / board
i．Can prepare in advance

表1　提示装置のメリットとデメリット

		a手書きができる	b消しても元に戻れる	c注目点への視線の一致度	dランダムな提示	e静止画像の提示	f動画像の提示	gコンピュータの操作	h画面の大きさ	i事前準備
1．黒板		○	×	○	×	×	×		◎	◎
2．OHP		○	△	△	△	○	×		○	○
3．テレビ・ビデオ		×	×	△	×	△	○		△	○
4．コンピュータ	a．モニタ	×	×	×	○	○	○	○	×	△
	b．スクリーン	×	×	△	○	○	○	○	○	△
5．電子黒板	a．（タブレット型）	○	○	△	○	○	○	○	○	△
	b．（標準型）	○	○	○	○	○	○	○	○	△

（Shimizu 2006, p. 21）

based on prepared or purchased resources.（Kennewell, S.; Higgins, S 2007, p. 209）

Types of Interactive Whiteboard

The principle of the whiteboard being a large screen from which you can remotely control the computer with finger or pen is consistent with all models. There are several types of IWB technology, but the two main types are electromagnetic and analogue resistive membrane shown in Table 2.

The interactive-whiteboard industry is an important world education market. The respective companies are competing to sell their systems to schools, universities, and educational authorities.

Table 2　The Two Main Types of Interactive Whiteboard

Type	Analogue resistive membrane technology	Electromagnetic pickup technology
Name	SMART Board	Promethean
Company	Egan Teamboard, Polyvision, Panasonic	Numonics US Promethean UK
	Softboard technology – outer surface and backboard	'Hard board'–electronic gird of sensors embedded into the board
	Finger or stylus pen	Special stylus pen only
Data projector	Ceiling / short arm	Ceiling / short arm
Projection system	Front or back (expensive)	Front only
Mouse over action	Actual click required	Displays automatically
Software	Notebook 9.7 / 10	ActivStudio 3 ActivInspire
Accessories	Voting system–student clickers	
Length of Use	Unclear 7-10 years?	More than 10 years?
Drawbacks	Surface strong but can be damaged-Bulbs are expensive	Cannot be used if pen is lost or stolen. Bulbs are expensive

> The interactive-whiteboard industry is expected to reach sales of $1 billion worldwide by 2008, according to Decision Tree Consulting, a London-based market-research company. The company, which tracks whiteboard sales in 66 countries, predicts that one of every seven classrooms in the world will feature an interactive whiteboard by 2011. (Davis, M. 2007)

However, academic studies or reports have focused on pedagogy and learning. Consequently, in this paper, the author had difficulty in finding information about the different systems. In a review of the literature, Hodge and Anderson state that 'technical problems are discussed to a lesser extent' (2007, p. 273). This difficulty is compounded by the same products having different names in different countries. As with other technologies, such as electricity 100–240 volts, TVs NTSC vs. PAL vs. SECAM, HDD vs. Blue Ray, different ways of creating IWBs have emerged.

> Right from the beginning there was no real coordinated effort to adopt an industry standard for the way IWBs were created. While all the various technological approaches to building an IWB work fine, each has certain pros and cons that ought to be taken into account. These different approaches are not inherently better or worse than each other, but they have given rise to a sort of VHS-versus Beta situation and carry implications for which IWB technology may be the right one for your particular situation. (Betcher and Lee, 2009, p. 25)

Betcher and Lee, 2009 provide a comprehensive analysis can be found in the chapter on 'Setting Up Your Classroom' (pp. 23–46) of their book 'The Interactive Whiteboard Revolution'. They seem to fair in comparing the two main types of IWB and succeed in being 'as agnostic as possible' (p. 34). Wikipedia also has a useful section titled Interactive Whiteboard Technologies. Distributors, for example, Touchboards in the US, have information on the differing products. The other technologies are ultrasonic tracking technology developed by Virtual Ink with products the Mimio board and the eBeam, infrared tracking technology in the Onfinity products made by Ontech (www.onfinity.com), plasma overlay technology (www.nextwindow.com), multi-touch technology (www.perceptivepixel.com), Microsoft surface technology (www.microsoft.com/surface), the SMART Table by the IWB manufacturer SMART technology as above, and Wii Remote IWB.

As interactive whiteboards are still an emerging technology, it is difficult to at this time to predict which of the technologies will become dominant, somehow be merged, or consigned to history. For teachers and lecturers, most important are ease of use of the technical aspects, reliable and learnable software, support from the producers, and access to good materials with an online community. In these points SMART and Promethean products have an advantage. However, Betcher and Lee discussing software state, 'While there is limited compatibility between brands, the value of this online community should be a major factor in any evaluation of an IWB product.' (op. cit., p. 34). Having read twenty or more articles on IWBs from respected journals, this was the first time that the author finally found the important question of compatibility being addressed.

In concluding this section, it is important to be aware that IWBs need to be calibrated: the distance from the projector to the screen must remain the same. As such, all sources are in agreement that portable IWBs cause more problems and should be avoided, unless a short-arm projector is attached. Thus, IWBs should be fixed at the front of the classroom, and if possible have a standard whiteboard at the side.

Historical development

There seems to be some disagreement as to where and when the technology was first used. Greiffenhagen (2000) in a very detailed study claims that the E-board (IWB) was first developed in Xerox Parc in Palo Alto in the early nineties (p. 4), and that it was initially developed for business presentations. Others claim it was first used in higher education (Murphy et al, 1995; Stephens, 2000). However, this statement appears to be directed at refuting the misconception that IWBs, should be or are only used in elementary schools. Lambert claims that in early 1995 in Blackburn College in the UK 'to the best of my knowledge I became the first UK teacher to use a Promethean board in the classroom' (Betcher, C., and Lee. M., 2009, p. iii). They also state that

> 'IWBs are really the first electronic instructional technology designed primarily for use by teachers. All the other electronic technologies, be they film, radio, television or personal computers, were first designed for the general consumer or office markets, and

then adapted for use in education. For all of these products, schools were very much a secondary market. In contrast, the first SMART Board was sold to teachers at a university in 1991, and the first Activboard was sold to a university in the mid 1990s' (p. 5 *op. cit.*)

However, the conception of the idea was much earlier. Shimizu (2006) states first time he encountered an 'electric blackboard' was in the late 1970's when visiting a Bell Research Laboratory near New York (p. 14). The purpose of the research was to enable to send lectures or classes to their various divisions around the United States through the phone lines: a kind of pre-Internet idea.

Whatever the original purpose, in education such technology is now increasingly used and 'interactive whiteboard' is now the accepted terminology. At the present time the widest usage is at the primary school level (Higgins *et al.,* 2007, p. 214). The Third Curriculum Online study in 2005 found that average there were six IWBs in each elementary school and eighteen in each secondary school. UK government studies in 2007 and 2008 showed that the average numbers of interactive whiteboards had risen in elementary schools to nine and in secondary schools to twenty-four (Kitchen *et al.* 2007; Smith *et al.* 2008) as shown in Figure 1.

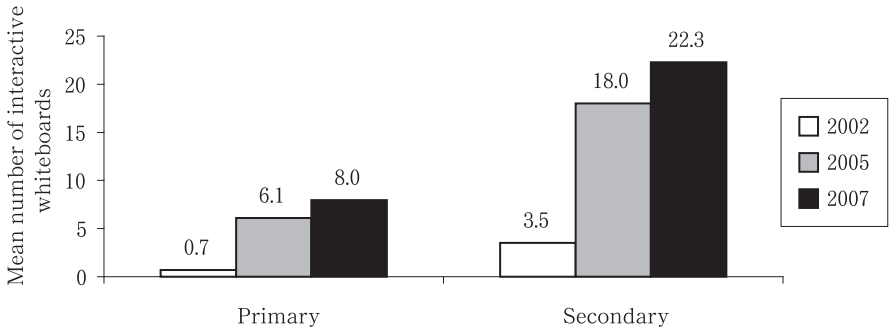

Figure 1 Mean number of interactive whiteboards per school, 2002–07, BECTA 2007

In the United Kingdom, it appears that the widespread adoption of IWB has been for two main reasons.

'…. most teachers do share the pedagogic beliefs held by policymakers—particularly the value of whole-class teaching—and the affordances of the technology match with their beliefs about how they should teach.' (Kennewell, S.; Higgins, S 2007 p. 208).

Consequently government policy and funding has promoted the use of IWBs.

Not all countries have adopted this technology so quickly. Hodge and Anderson state that 'although this technology was launched around 14 years ago [1993], IWBs have only recently gained attention in New Zealand' (2007 p. 272). However, a quick Google search for Interactive Whiteboard produced 1.4 million sites. When using the Advanced Google search, which reduces the possible number by restricting answers to the specific term Interactive

Whiteboard, there were still almost 600,000. A search on Amazon for IWB books, materials, CD-ROMs etc found about sixty products. Amazon Books UK had about one hundred and sixty. Amazon Books Japan had about fifty books English, and six in Japanese (Table 3).

Table 3 Books Available from Amazon on Interactive Whiteboards in Nov 2009

Amazon.co.uk	160
Amazon.com	60
Amazon.co.jp (Books in English)	50
Amazon.co.jp (Books in Japanese) 電子黒板 DenshiKokuban	6

Source: Author

Shimizu (2006) devotes the second chapter to examples from abroad of classes using interactive whiteboards. (電子黒板を活用した授業：海外の事例 (pp. 23-41). Another four chapters contains examples schools in Japan. Nakagawa and Nakahashi (2009) provide, in a very practical book, fifty clear well-structured examples taken from different schools and subjects of how teachers use IWBs in Japan.

Shimizu states that in 2006 there were only 7,832 IWBs in all Japan's primary and secondary schools (p. 152). As Japan has more than thirty thousand schools, this means that there is only only one IWB for every four schools, which compared with the UK indicates a very low usage as shown in Table 4.

Table 4 Interactive Whiteboard Usage: Japan and the UK in 2008

	Japan		UK	
	Per institution	Per classroom	Per institution	Per classroom
Primary	0.25	＞5%	7	80-100%
Secondary			20	60- 90%
University	—	＞1%	—	＞10%

The actual number of IWBs per institution is an accurate estimate for 2007. What is important is the direction of educational policy. In Japan the Mombukagakusho (Ministry of Education in its 2009 Revised Budget Outline (平成21年補正予算の概要) proposed to put at least one IWB in every public primary and junior high school. However, following the change of government in the summer of 2009, the new administration set up new committees to reexamine and reduce allocated budgets (行政刷新会議　事業仕分け). The No. 3 Working Group provided comments on their assessment of Proposed ICT Projects in Schools 3-7 (2) (第3WG評価コメント 事業番号 3-7 (2) 学校ICT活用推進事業). The last comment was, 'Interactive whiteboards are cut'. Concerning IT, only things related to infrastructure are necessary. Training is not needed. If it is necessary do it by E-learning' (電子黒板関係は廃止。ITに関してはインフラとして必要なもののみでいいはず。そのトレーニングは必要なし。必要ならE-Learningで。). Three points of concern arise from this last comment. First, it seems that policy in Japan on IWBs is being reversed. Second, that the government seemed to

missed the chief point of learning: that students cannot do it all alone with E-Learning, but IT needs to be brought into the classroom with the teacher being involved rather than peripheral—hence E-Teaching. Third, it beggars belief that they can say that there is no need for training. Teachers in the UK have found IWBs easier than some technologies, but have also said that they need training. Development does not occur by osmosis.

The same concerns exist for universities. The percentage figures for universities in Japan and the UK are rough estimates, but again the usage in Japan is much lower. In 2008, the author invited manufacturers to give demonstrations of their IWBs. With an eye to go and observe some university classes, he asked which other universities were already using IWBs. Concerning two of the so-called 'big six' famous universities in Tokyo, in 2008 each university had one each. At one university the IWB was in the students' rugby club's clubroom presumably for tactics talks, as the strategies could be diagrammed and easily accessed again from the computer. The second IWB was for an MBA course being taught in English.

At what point the tipping point is reached with each technology is difficult to assess or define. Betcher and Lee state, 'Some have suggested that the year 2014 will be somewhat of a tipping point' (p. 129) but they provide no information as to which country they are referring to, or as to why or how this year was determined. If one takes the case of advanced countries, it is fairly accurate to say people are now at a disadvantage if they do not have a computer and/or access to the Internet. For computers and the Internet probably, it has probably taken fifteen years before they become generally accepted, widespread, cheaper, and easier to use. In the case of interactive whiteboards, the UK and Australia are nearing or have gone beyond this tipping point.

Section 2　Initial Experiences

In 2006 I spent one year at the University of London at the Institute of Education (IOE). IOE has four faculties and eighteen departments. It is rather unusual as it has no undergraduate students. It could better be described as a research centre for education and social research which also offers post-graduate and doctoral programmes. IOE has a great deal of involvement with, and influence upon, government education policy. In addition to department programmes, there are many open lectures, workshops, mini or full conferences, all of which provide a rich environment of educational and culture related events.

One of the fifty post-graduate programmes, the TESOL MA, had an optional Media Technology course. When examining the course syllabus and materials, one thing that was rather interesting was that no one lecturer alone had responsibility. Rather each lecturer introduced how technology contributed to their own field of expertise. Classes were held in small self-study rooms located inside the library. These rooms could also be used for small classes or seminars, and were designed for individual or group work where the lecturer could act as a helper or advisor at each student's computer. Almost all presentations or lectures at IOE used PowerPoint. However, these rooms in the library were also equipped with interactive whiteboards. This gave me an opportunity to observe, not only the course content being

presented, but also an opportunity to examine how lecturers used the IWB.

The Visual Element

Each lecturer was providing a state-of the art version of what was available in English literature, online reading, writing, multimodality, educational software. The post-graduate students possessed a variety of levels of technical knowledge, some surpassing that of the lecturers. However, students did not have the specialist knowledge, for example in the case of corpuses as to what were the different types online and how they could be used. Thus, as most what was being introduced was new, it was much easier to comprehend when guided from a large IWB, before beginning to access these at one's own computer. This was sometimes done in stages, and if a question or problem arose the lecturer was able to respond and every one could see this immediately on the IWB. Where a new concept or information is being introduced for the first time, it is very difficult to understand without a visual element, pictures, film, diagrams etc., whether it be science, literature, language or history (Liversidge 1991). The interactive whiteboard visual input made things more easily accessible.

Time and Location

The interactive whiteboards (IWB) allowed the lecturers to remain in more direct contact with students. Most universities do not have the finances to afford the luxury of a teaching assistant or technical assistant, and the IOE is no different. For those who regularly use computers, and for those who use CALL rooms which have control panels, the time spent operating these can sometimes detract from and interfere with interaction in classes. Therefore, being able to operate the computer, while standing at the IWB, made it possible to demonstrate to students what they needed to do. In other words, the IWB and became a backgrounded or embedded technology, which was less obvious, or intrusive, and enabled the lecturer to focus on the pedagogic purpose.

Cheaper and Simpler

Installing fully-equipped computer / CALL rooms is very expensive. The last project for CALL rooms that this author was involved in cost more than one hundred million yen. Compared with this, the outlay for an IWB is small and the potential gains for pedagogy in giving the lecturer more flexibility appeared to be worth the expenditure. The small computer self- study rooms in the IOE library were no more than rooms with individual computers. To add to this an interactive whiteboard was a simple change which offered the lecturer more variety in class style.

Interactivity

Being able to operate the computer from the IWB allowed lecturers to present from the centre of the rooms. This not only speeded the process of learning but created group cohesiveness. Thus, the sense of fragmentation that often accompanies classes where computer use is involved was reduced. As mentioned previously, questions and comments tended to be

dealt with the whole group involved, and the class developed a good repartee. If this was something cohesive and enjoyable at the university level, it explains the rapid expansion of IWB in the elementary school level, where movement, visuals, and sound are something to which children respond to and need in order to be able to participate and understand. Without IWBs, the shorter attention span of children can result in class disintegration rather than just fragmentation. The IOE classes did not do so, but the IWB enhanced interactivity.

Summary

The IOE course lecturers by using the IWB were able to achieve faster paced, more efficient, and more interactive classes. Given the intensity of the course, with most of the lecturers only giving one class each, the IWB allowed lecturers to present more information more rapidly. However, none of the lectures used the IWB to its full potential. They did not store or save notes written on the IWB, neither did they post notes from the IWB to the university WEB platform so students could access them later. Furthermore, they did not present any materials specifically created for the IWB and take advantage of its unique properties, discussed later in Pedagogy Phase 3. Despite these criticisms, having the option to use the IWB was beneficial for the course.

Section 3　Interviews with Teachers

This section summarizes interviews with teachers and students. Everyone that the author knew, or had met by chance, who was either a student, a teacher or a lecturer at an academic institution outside Japan had used an IWB, or had been in a class when it had been used. With IWBs the majority of research is qualitative. There is a need for quantitative research, and there are issues or problems concerning robustness, validity and reliability and generalisability. However, as Hodge and Anderson argue, one needs to catch individual experiences which are important to all practioners (2007, p. 275), which is the purpose of this section.

Compatibility

Alan is an experienced primary and middle school Australian teacher in his early thirties. He was the first person to mention the issue of compatibility. He is familiar with interactive whiteboards but states, “I should use them more than I do”. He recognized that preparing materials for the IWB takes time. Once they have been created, they are easy to use in class and can be easily modified for future classes. He wishes that there were more professional development training or sharing sessions. However, now he is his second year of teaching at an international school in Mumbai, India. He is not sure how long he will stay in his present position, and is reluctant to spend a large amount of time in preparing materials which he may not be able to use, if or when he moves to another school.

School Platforms

Margaret is a middle-school (9-13 year olds) teacher of music, English and science, with more than thirty years of teaching experience. Her school has interactive whiteboards in every classroom. Although she does not consider herself highly proficient, what she particularly likes about IWBs is that she can access materials from the school platform. By using the LAN, this is possible irrespective of which classroom she is using. Furthermore, she can and does develop and modify materials at home and can post them to the LAN at any time.

Storage and Recall

Katherine was appointed as a lecturer in medical psychology at a British university two years ago. About seventy percent of the lecture theatres and seminar rooms have IWBs. Decisions to install IWBs were made by the technical division. Most courses contain a high level of content and lecturers use the IWBs to store information prepared before lectures, and also to save and record what they have written / drawn on the IWBs. It is not possible to deal with all questions as they arise. However, at the end of the lecture or a part of it, flipping back on the IWB through the stored or saved information enables her to return to the specific area which needs clarification. Lectures notes are saved and stored on the university server so that students can access them later.

Software and Support

Aaron is elementary school teacher in Victoria, Australia and also has an MA in TESOL. For two years, he taught aboriginal children in an Australian government protected area in the Northern Territories. He lived in Japan for ten years and taught all levels: children, community classes, at companies, and at junior high schools, national and private universities. Since his return to Australia, he has used IWBs in several teaching environments. He was given a budget of Aus $ 100,000 and the responsibility to select IWBs for his elementary school where he was the senior teacher. One of the companies that came to the school gave an impressive presentation: that was until Aaron asked about support and updates of software. At that point, the salesman's pitch ended and he could not provide the desired information, simply because that company's product did not have it. Later, the school selected one of the two main IWB types mentioned earlier.

Failure

Phil studied and worked as a computer photography specialist. Now in his early fifties, in the last ten years he has been working in the UK in the IT field of product promotion and sales. He states that IWBs are not used in the business world in the UK. PowerPoint presentations and A 2 paper are the usual medium. However, further questioning revealed that he had recently taken some Italian evening classes.

The teacher was using a 'pseudo-marker pen' which could open a kind of menu and files [toolkit] allowing the teacher to change the colour and other things, but she didn't seem

very familiar with how to operate it. In the end she gave up and used the normal whiteboard at the side.

When questioned further, it seems that she was a university lecturer and that this class was some extra outside work.

General Picture

The above examples are just of glimpse of the variety of experiences and show the importance of interviewing people in the field. Table 5 is data from BECTA 2008 of more than two hundred teachers showing opinions of teachers in the UK. Of all of the technologies covered in the survey, the IWB was rated as the most important, even more than computers.

Table 5 How would you rate the general fitness for purpose of the following types of equipment that are available for use in your school?

	Response	Very good (%)	Quite good (%)	Not very good (%)	Poor (%)	Not available (%)	No response (%)
Primary	Interactive whiteboards	71	21	3	1	2	3
	Laptops	46	42	7	1	1	3
	Desktop computers	43	44	7	2	0	3
	Data loggers	8	25	8	1	40	18
	Tablet PCs	4	4	2	2	68	21
	Handheld computers/PDAs	3	5	1	1	69	22
	N=176						
Secondary	Interactive whiteboards	58	36	4	1	0	1
	Desktop computers	47	44	7	1	0	2
	Laptops	29	54	12	2	1	2
	Data loggers	10	35	15	6	24	10
	Handheld computers/PDAs	7	17	7	3	59	8
	Tablet PCs	4	16	4	2	66	8
	N=184						

Due to rounding, percentages do not sum to 100.
Source: NFER Harnessing Technology School ICT Coordinator Survey 2008.
BECTA 2008, Question 7.

Section 4 Research and a Framework of Analysis

This section looks at pedagogic and learning theories in relation to interactive whiteboards. It may be intuitively correct to say that IWB have a role in pedagogy but neither teachers or lecturers or administrations will be convinced by arguments based on a

hunch. The history of technical installations in schools and universities has many examples of expensive rooms and equipment underused or never used. Kennewell and Beauchamp (2007) in reporting on a study in Australia state,

> The broad purpose of the research was to investigate the impact on teaching and learning of the high levels of ICT but the use of IWBs emerged as the aspect of ICT that was felt to have the most potential impact on learning and raising standards of attainment' (p. 228).

Schuck and Kearney (2007, p. 4.) report that the reasons the led to the use of IWBs in classes observed were

- Facilitation of reflective practice (noted by school executives)
- Ease of use
- Discovery and learning of new skills
- Value as a catalyst for teacher learning
- The visual nature of the board
- Immediacy, flexibility and convenience
- Interactivity
- The match to students' digital culture

While these were the perceived reasons for use, they also report that the researchers saw varying evidence of these outcomes actually occurring. Rather than adopting a success or failure analysis such as the technophile vs. technophobe approach, it is better to consider where and when and why the potential of IWBs has or has not been maximised.

Interactivity

The first question is what is actually meant by interactivity. It is possible to be technically interactive with the computer and the interactive whiteboard while the pedagogy itself or the learning may not be interactive. For example, having children or students coming up and touching the IWB may not always be interactive, because only one can do this at a time. Others students may become bored. However, if the whole class is focused on and interested in what is happening at the IWB, then it may increase motivation and concentration.

An IWB may be technically interactive but may lead to less interactive and more didactic teachings (Smith *et al.,* 2006 in Higgins *et al.,* p. 219). The newer models of IWB have participation systems whereby students can remain in their seats and answer questions by using clickers or Wi-Fi. In the Japanese context where students are notoriously reluctant to answer questions individually in a large class, such systems allow participation while affording anonymity, which traditionally is more culturally acceptable. Concerning interactivity Higgins et al. (2007) state,

> This has two dimensions: first the interaction between pupils and teachers, pupils and pupils, and teachers and teachers as indicated by Birmingham et al. (2002); and second

> the interplay of digital information as elements in the learning process.… Robison (2000) and Jones and Tanner (2002) offer evidence to show that interactivity is most effectively sustained through effective questioning as well as a wider range of activity. (p. 216)

Hence, if first dimension, the interactions between teachers and students, and between students, is reduced by over focusing on the second dimension of the IWBs functions, the pedagogic style will be too didactic.

Learning

There is an assumption that being active results in increased learning. While it is often assumed that more focusing on the IWB may increase participation, the learning outcomes may not occur. Hodge and Anderson (2007), in reflective practice of their own teaching and the students learning, state

> 'Sue learned that it was not the technology but the way that she elected to use it that was important.… She reminded herself of the need to integrate visual material with active learning activities that optimised the power of the IWB to engage the learners yet retained pedagogical approaches that facilitated learning.' (p. 280)

Higgins *et al.* (2007) conclude

> The key issue emerging from this analysis is that although the IWB may alter the way that learning takes place, and that the motivation of teachers and pupils may be increased, yet this may have no significant or measurable impact on achievement. The research literature has yet to demonstrate the direction that teachers need to move to ensure that the proven changes the IWB can bring about in classroom discourse and pedagogy are translated into similar and positive changes in learning. (p. 221)

Hence in the discussion on IWBs and learning, to paraphrase from Kozma (1994) — rather than asking, 'Do media influence learning?' we should be asking, 'How do media influence learning?' and What are the actual and potential relationships between media and learning? More specifically, 'Can we create a strong and compelling influence of media on learning through improved theories, research, and instructional designs?' (p. 1).

In 1979 Salomon proposed an analysis of media in his seminal work The Interaction of Media, Cognition, and Learning. The way that individuals represent and process information relate to three aspects of each medium as shown in Table 6. From the table, learning with media/IWB is a complementary process within which learners, the teacher, and the IWB interact to expand or refine the learner's mental model of a particular phenomenon, for example an event in history, a scientific concept. The question is no longer, Do media enhance learning?, but How do the capabilities of a particular medium (in this case interactive

Table 6　Aspects of Media

Aspect	Capability	Medium
Technology	Physical, mechanical, electronic	Book, TVs, computers, DVDs, interactive whiteboard etc
Symbol System	Expressions: of how information is communicated	Spoken language, printed text, pictures (still and moving－video) numbers, graphs, musical scores
Processing Capabilities	Medium's ability to operate on symbol systems	Displaying, receiving, organizing, transforming, evaluating of whatever information is available

Source: Author

whiteboards) facilitate particular kinds of learning?

The interactive whiteboard affords a large number of symbol systems and processing capabilities which can be combined into a single instructional environment. In examining learning through multimedia, Kozma (1994) looked at the contribution of 'videodiscs' which could equate to present CD-ROMs or DVDs. Some of the findings can be applied to analysis of IWBs. First,

> The capability of the video to use multiple symbol systems to present complex, dynamic social contexts and events might have helped students construct rich, dynamic mental models of the situations. The detailed, dynamic nature of these models might have allowed students to draw more inferences than they could from mental models constructed from text or still pictures.

Second,

> The videodisc contains a great deal of information crucial to the solution of the problem: information about distances, available money, and other relevant conditions is embedded in objects and maps and in what people say, do, and think as the story is enacted. The random access capabilities of the computer-controlled videodisc allow students to pause, review, and search for information they may have missed or forgotten.

Third, and most important,

> The visual and social nature of the story, as presented in this environment, is likely to activate relevant prior knowledge that students can use to solve the problem. Further, because of the scope of detail and relationships the environment provides, students are likely to find many ways to connect their new learning to their existing representations.

There are two major differences between the work of Kozma on videodiscs and interactive whiteboards. The first difference is that, although Kozma recognized the process of the

merging of technologies, the study was conducted in a pre-Internet era. The paradigm shift created by the Internet has changed social interaction of which education is just one part. The second difference is that the teacher or lecturer themself has the opportunity to create and use materials in the same way as was done on the videodiscs. Furthermore, such materials and information are much more quickly and easily accessible, and often at no cost.

This means that the IWBs merging of and advances in technology afford the teacher opportunities to create a better first stage in teaching by taking advantage of the multimedia now available. If this is done well, it well help student learning.

Pedagogy

The IWB affords the technological interactivity, but actually reduces student group or individual activity because it increases the focus of the lesson to the front or centre of the classroom. However, this only refers the first stage. There are three stages or phases of development of IWB pedagogy as shown in Table 7.

Table 7 Developmental Phases of E-Teaching

Phase	
1	Doing old things in old ways
2	Doing old things, but in new ways
3	Doing new things in new ways

Source: Author

These phases are outlined by Betcher and Lee (2007). Typical characteristics of Phase 1 include:

- Notes and diagrams are still handwritten on the board as the lesson is taught.
- Lesson content consists primarily of Word documents or scanned text and diagrams.
- Limited use is made of the IWBs toolset. [software]
- Lessons are not usually prepared in advance.
- Lessons do not take advantage of interactive features.
- Lessons are not saved at the end of the class.
- The teacher works in isolation, not sharing resources with others.

Betcher and Lee continue, 'This phase is painful for the teacher. The amount of effort required to use an IWB in this manner far outweighs the potential benefits.' So they quit [like Phil's Italian teacher] or 'if they do spend time in this phase, most teachers usually get past it quickly, simply because the pain of staying there is too great.' (p. 51).

Phase 2 usages are described by Coghill (2003). She states that teachers characteristically use IWBs to:

- save time scribing.
- provide a large display that students could see and read easily
- attract and retain student's attention

- provide images or text that students could not easily have had access to in other ways
- engage in quizzes or tests within the whole-class environment
- increase class participation by students writing their solutions on the board
- save work so that the teacher and class could access their joint contributions at a later stage
- enable collaborative work

These classroom observations were conducted in 2003. Now with advances in IWB software and other technology, typical characteristics of this second phase include

- Modification of existing paper-based worksheets and activities to work on the IWB.
- Greater use of flipchart-style lessons prepared in advance to work on the IWB.
- Greater use of dragable, layered objects that can be moved around the screen, revealing existing words and objects.
- Greater reliance on resources found in the gallery [IWB database], [the school or university LAN platform], or on the web [Internet] .
- Effective use of software that works well on an IWB.
- All lessons or lectures saved for future use and reused.
- Lessons shared with other teachers to reduce individual workloads.
- Noticeably increased levels of student engagement and interest.

Phase 3 is where teachers 'start to come up with completely new ways to convey concepts to their students.' (p. 52). Some examples include:

- Use of short video clips or animation.…
- High-resolution photo images which that give the ability to zoom in on to inspect finer details.
- Accessing libraries of interactive learning objects.…
- Greater use of software that enables students to manipulate ideas.
- The ability to perform [virtually] impractical or dangerous experiments…
- The ability to engage with virtual worlds [such as Second Life]…
- The use of real-time video communication software to facilitate class-to-class collaboration [web conferencing with classes in other countries], or even to bring in guest speakers over the web [by using Sykpe http://www.skype.com], ...

The activities found in the three phases need to be refined and expanded. By doing this, it will help teachers in reflective practice, and in setting achievable goals. It will also help in those responsible for the introduction and development of E-teaching. Jewitt (2007) states,

> Unlike some other new technologies IWBs have received an overwhelming positive reception from teachers who otherwise struggle to incorporate technology into their classrooms (Kemeny, 2004). At least in part, this may be due to the fact that, unlike

> other new technologies IWBs have the capacity to be absorbed into the space of the classroom without challenging the existing status quo. ....In other words, IWBs have the capacity to mimic other pedagogic technologies. (p. 315)

It is not clear whether Jewitt is promoting a 'Trojan horse' strategy whereby the IWBs capture education institutions by stealth and change the pedagogy, or simply that some teachers will unwittingly remain in a Phase 1 pedagogic style. In fact, her goal is to ensure that in-house and commercially produced texts are based on digital-multimedia design principles of the screen rather than print-based design principles. Thus, she seeks to ensure that materials are designed with Phase 2 and Phase 3 activities in mind.

Mortimer and Scott (2003) suggest a framework with two dimensions: interactive / non-interactive and dialogic/authoritarian (teacher-centered). Smith et al conclude, (2006) 'While our findings support some of the claims being made for IWBs, they do not suggest a fundamental change in teachers' underlying pedagogy' (p. 454). Both of these studies indicate that some of the teachers observed were still using IWBs in a Phase 1 manner: Doing old things in old ways.

Professional Development, Training, and Support

The key thing in maximising the potential of IWBs is for educational institutions to provide a supportive environment so that teachers and lecturers can progress quickly from the Phase 1 where E-teaching is painful and time-consuming to Phase 2. This needs to be ongoing and comprehensive: the school or university has to have a positive commitment to making it a success. It important to offer regular PD opportunities to teachers: workshops, show-and-tell sessions, videoing or observing classes. These do not have to be large-scale events but are better as regularly scheduled short half-hour sessions. If academic institutions are not prepared to do this, and if teachers and lectures are not willing to participate, then the pedagogic potential of IWBs will not be achieved.

Conclusion

The interactive whiteboard allows teachers to present and use materials and activities created with new IT technologies. At the same time IWBs also allow the present whiteboard classroom activities to be retained. As with other emerging new technologies, the incompatibility of software between the main two types of IWB is problematic and needs to be overcome through standardization. However, this weakness has not prevented educational institutions from installing IWBs. Surveys also found teachers' reactions to IWBs were positive and were increasingly using them. The United Kingdom has the highest IWB presence with almost one in every classroom. This is largely because of the government policy of promoting IT usage in education and providing funding. In some other countries, such as Australia and the US, IWB usage is widespread. For other countries, it appears that, it is not a matter of if, but rather when and how they will make use of IWBs. In Japan, there seems

to be little interest in interactive whiteboards, apart from international schools. The situation will or must change, if Japan does not want to once again left behind in using IT in education.

Using the interactive whiteboard as a computer screen allows the teacher to be at the front of the class, while taking full advantage of all the multimedia available. This can enhance the learning process. However, if the teacher does not understand or know how to use the potential of the IWB, there is a danger that they will remain in Phase 1: doing old things in old ways. Gradually moving pedagogic practice to Phase 2 and Phase 3 means that the teacher wishes to enhance the students' learning process by retaining present standard classroom interaction between teacher and student, and student and student, while introducing activities that use the multimedia made accessible through IWBs. The school or university, for their part, must have a policy that understands the educational advantages of IWBs and how this can be achieved. They must create an environment of support (pedagogic and technical) and allow for teacher professional development.

References

Betcher, C. & Lee, M. (2009). *The Interactive Whiteboard Revolution: Teaching with IWBs.* Australian Council for Educational Research Ltd. Victoria, Australia: ACER Press.

Birmingham, P., Davies, C. & Greiffenhagen, C. (2002). Turn to face the Bard: making sense of the three way interactions between teacher, pupils and technology in the classroom. *Education, Communication and Information 2,* (2–3), pp. 139–161.

Coghill, J. (2003). *The use of interactive whiteboards in the primary school: effects on pedagogy.* Becta, Coventry.

Davis, M. (2007). Interactive features fuel demand for modern chalkboards. *Education Week's Digital Directions,* September 12, 2007. Whiteboards Inc. Accessed http://www.edweek.org/dd/articles/2007/09/12/02 board.h 01.html Nov 2009.

Glover, D., Miller, D., Averis, D. & Door, V. (2005). The interactive whiteboard: a literature survey. *Technology, Pedagogy and Education 14,* 2, pp. 155–170.

Greiffenhagen, C. (2002). *Out of the office into the school: Electronic whiteboards for higher education.* Programming Research Group, Centre for Requirements and Foundations, Oxford University Computing Laboratory. Available at http://web.comlab.ox.ac.uk/oucl/work/christian.greiffenhagen/pub/boards

Hewitt, J., Moss, G.., & Cardini, A. (2007). Pace, interactivity and multimodality for interactive whiteboards in the secondary school classroom. *Learning, Media and Technology, 32,* 3, pp. 303–317.

Higgins, S., Beauchamp, G., & Miller, D. (2007). Reviewing the literature on interactive whiteboards. *Learning, Media and Technology, 32,* 3, pp. 213–225.

Hodge, S., & Anderson, B. (2007). Teaching and learning with an interactive whiteboard: a teacher's journey. *Learning, Media and Technology, 32,* 3, pp. 271–282.

Jones, S. & Tanner, H. (2002). Teachers interpretations of effective whole-class interactive teaching in secondary mathematics classrooms. *Educational Studies 28,* 3, pp. 265–274.

Kemeny, H. (2004). Unpublished paper produced for the 'IWB pedagogy and pupil performance project'.

Kennewell, S. & Higgins, S. (2007). Introduction [to special edition on interactive whiteboards]. *Learning, Media and Technology, 32,* 3, pp. 207–212.

Kitchen, S., Finch, S. & Sinclair, R. (2007). *Harnessing Technology Schools Survey 2007.* National Centre for Social Research. Available at http://www.becta.org.uk/

Kozma, R. (1994). The influence of media on learning: the debate continues. *SLMQ, 22,* 4. Available online at: www.ala.org/ala/aasl/aaslpubsandjournals/slmrb/editorschoiceb/infopower/selectkozmahtml.htm (accessed 5 Nov. 2009).

Lambert, P. (2009). In Betcher, C. & Lee, M. (2009). pp. iii-iv. *The Interactive Whiteboard Revolution: Teaching with IWBs.* Australian Council for Educational Research Ltd. Victoria, Australia: ACER Press.

Liversidge, G. (1991). *Visual aids to comprehension: Yugoslavia－A Background to the Conflict.* Internal paper. Temple University Japan: Tokyo.

Liversidge, G. (2007). *Made in Japan, but not Used: Paradoxes and Change in Japanese education.* Lecture March 2007, London University: The Institute of Education.

Mortimer, E. F. & Scott, P. H. (2003). *Meaning making in secondary science classrooms.* UK: Maidenhead. Open University Press.

Moss, G., Hewitt, C., Levaãiç, R., Armstrong, V., Cardini, A., & Castle, F. (2007). *The Interactive Whiteboards, Pedagogy and Pupil Performance Evaluation: An Evaluation of the Schools Whiteboard Expansion* (*SWE*) *Project: London Challenge.* University of London Research Report RR 816. School of Educational Foundations and Policy Studies, Institute of Education.

Murphy, J. F., Jain, N. L. & Spooner, S. A. (1995). Use of an interactive electronic whiteboard to teach clinical cardiology decision analysis to medical students. *Journal of the American College of Cardiology 25,* 2, p. 238.

Nakagawa, K. & Nakahashi, Y. (2009). *Denshikokuban ga tsukuru: manabi no mirai*［電子黒板が創る；学びの未来。Tokyo: Gyosei Kabushiki Kaisha.

O'Neill, G., Moore, S., & McMullin, B. (Eds.). (2005). Observations on the use of Web 2.0 tools for English Language Teaching & Learning. Emerging Issues in the Practice of University Learning and Teaching. *AISHE READINGS,* 1, 2005. All Ireland Society for Higher Education, Office of the Vice President for Learning Innovation, Dublin City University］ http://www.aishe.org/readings/2005-1/collection.pdf

Reedy, G. (2008). PowerPoint, interactive whiteboards, and the visual culture of technology in schools. *Technology, Pedagogy and Education 17,* 2, pp. 143–162.

Robison, S. (2000). Math classes for the 21st century. *Media and Methods 36,* 4, pp. 10–11.

Salomon, G. (1979). *Interaction of media, cognition and learning.* San Francisco, CA. Jossey-Bass.

Shimizu, Y, (2006). *Denshi kokuban de jugyo ga kawaru.* ［電子黒板で授業が変わる］. Tokyo: Koryosha Shoten.

Schuck, S, & Kearney, M. (2007). *Exploring pedagogy with interactive whiteboards.* University of Technology, Sydney.

Smith, H. & Higgins, S. (2006). Opening classroom interaction: the importance of feedback. *Cambridge Journal of Education 36,* 4, pp. 485–502.

Smith, P., Rudd, P., & Coghlan, M. (2008). *Harnessing Technology Schools Survey 2008.* National Foundation for Educational Research. Available at http://www.becta.org.uk/

Stephens, C. D. (2000). Forget the sailboard－let's go whiteboarding!. *Dental Update 27,* 5, pp. 236–240.