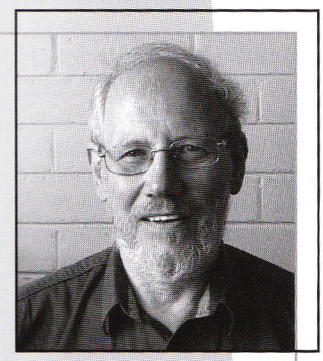
Using models for understanding pedagogical change in a technology environment: A case study of IWB implementation in a secondary school



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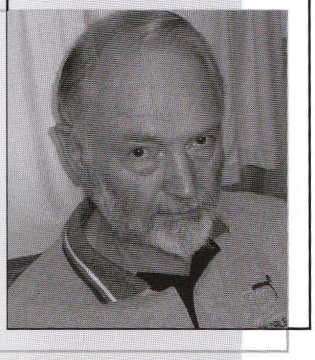
ABSTRACT

Effective integration of learning technologies into classrooms is a continuing issue, with many instances of new technologies making minimal impacts on classroom practice. Reports on the introduction of interactive whiteboards into UK schools over the past decade have revealed that their impact on both pedagogy and learning is at best neutral. Interactive whiteboards have become common in Australian schools in the past three years, and in that time the authors have been involved in studies investigating professional development models to help integration of interactive whiteboards into classrooms. Video-recordings were analysed using two coding schemes, a modification of a pedagogical hierarchy developed by Beauchamp which was christened HoPS (Hierarchy of Pedagogical Stages), and the other developed from Bernstein's model of pedagogical framing. Using the two models it was possible to analyse shades of pedagogical behaviour. It became clear that peer non-expert mentoring was highly effective in helping teachers develop modified teaching behaviours that exploited the affordances of the technology. In this paper we will report on the application of the two models to the understanding of the impact of professional development on classroom pedagogy in a Victorian secondary school.



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INTRODUCTION

Many early studies of interactive whiteboards' (IWBs') use in schools were very positive about the possibilities for increased interactivity involving students, and about the role that the special affordances of the boards could play in the altering of pedagogies from instructive / didactic to constructive / interactive (BECTA, 2004). Indeed much of the driving force to introduce IWBs in England came from the UK Government agencies, especially the then DfEE, and their National Literacy Strategy (DfEE 1998) and National Numeracy Strategy (DfEE 1999), both of which espoused the philosophy of "interactive whole class teaching" as the dominant pedagogical strategy. IWBs were seen as a way to help teachers both successfully manage whole class teaching in a teacher-centred pedagogy, and to increase interactive exchanges. As a result, in English and Welsh schools, Government money financed a huge investment in IWBs

Growing doubts

recent work in the United Kingdom has begun to question the effectiveness of the interactivity being promoted by IWBs in classrooms. Even in 2002, Cogill reported that only a few teachers used the interactive features of the boards, while others absorbed the technology into their standard pedagogical repertoire and used it as a display tool only. Kennewell, Tanner, Jones & Beauchamp (2008), concerned about quality of interaction arising from use of the interactive whiteboards, developed a hierarchical interactivity tool based on one developed by Tanner et al. in 2005. Using the tool in case studies, Kennewell et al. (2008) concluded that "the advent of the IWB may be seen as a backward step, in that it gives a new impetus to traditional, teacher-centred, approaches". The reasons lie in the low level of interactivity used by the teachers, with high level of teacher control, rigid scaffolding and closed questioning with stylized teacher responses.

Pedagogical analyses

as a response to the unease at the pedagogical uses of technologies a number of researchers have developed models to analyse pedagogical strategies and skills. In a UK advisory document (Becta (2004) the authors suggested the use of a progression of teacher practice model based on a five stage progression in how technology is adopted in classrooms, first proposed by Hooper & Rieber (1995). The TIMMS lesson events framework (Clarke 2006) used stages of pedagogy to examine mathematics teaching. Beauchamp (2004), in response to a need to classify pedagogies from school observational data, proposed a 'transition framework' in a rubric of teacher actions with IWBs, to place the teacher into one of five categories of teaching strategy use: substitution user, apprentice user, initiate user, advanced user and synergistic user.

Most of these tools that have been proposed to analyse pedagogies when teachers are using technologies have a built-in value judgment. The Becta (2004) authors write of a progression of teacher practice, implying a range from low to high value. Beauchamp's stages also imply progression from low to high.

Developing models for an australian iwb study

In a study reported in this paper it became clear from the data collection that a less judgmental analysis tool would be required. In addition, no model so far examined would give us a complete picture of transformations as the teachers

worked with the technology. Most models were skills based, and while teacher technology-use skills give a partial picture of the way that pedagogical activity is undertaken, knowledge of skills fails to understand or observe pedagogical thinking and change. The Tanner et al. (2005) model of levels of interactivity on the other hand, while seeking to understand the relationship of interactivity to technology use, fails to take into account other aspects of pedagogy, in cluding task making, pace and questioning.

For the current study discussed here, two models have been adopted, both new, but both drawing upon previous insights. Two frameworks, those of the TIMMS study (Clarke 2006) and Beauchamp's (2004) transition framework proved to be the most useful in informing a new tool which has been called a "Hierarchy of Pedagogical Strategies", or HoPS (Figure 1). The HoPS borrows Beauchamp's 'substitutional' and 'synergistic' categories as the outer extremes of a range of styles, but introduces other headings (experimental, interactional) that reduce the judgmental nature of labels. The actual instrument examines teachers' skills, ICT usage and management. As a single instrument it becomes too unwieldy to incorporate pedagogical strategies such as questioning, task making and student action. A second instrument has therefore been developed, based on the pedagogical framing concepts (Figure 2) introduced by Bernstein (1990). This framing model adopts Bernstein's concept of teaching strategies that range from highly controlled ('strongly framed') to ones that closely involve the students (weakly framed), with intermediate framing levels in between. The model interprets some of Bernstein's criteria to create a rubric by which to test the framing strength of lessons. This has similarities to the Tanner et al. interactivity model, but the framing model deals not only with obvious interactivity, but also with teacher task making, teacher questioning, and student actions. Of itself it is not judgmental, although in its original form there was an element of judgment in Bernstein's use of the framing concept.

Thus by use of the HoPS and the framing tool, the researchers were able to investigate whether a finer-grained picture could be developed of the way that a teacher employed pedagogical strategies in lessons using the IWB technology.

School case study

A rural secondary college in Victoria installed interactive whiteboards (IWBs) in each faculty area of the school, the library, and in a multipurpose room. The technology was almost unknown to the teaching staff, and the decision to install the technology was a school management one. This is a standard situation with expensive ICT equipment. However, ownership was given to the teachers through a mentor professional development programme. Two teachers, neither technology experts, were appointed to establish a peer mentoring scheme. The two mentors, one from visual arts and the other from mathematics, did not have responsibility positions, and were allocated 50% of their school time to mentoring. Teachers who wanted to experiment with incorporating the technology into their teaching could work alongside a mentor for a while, including working as a team for one or more lessons.

Take-up

During the first year of the scheme 60% (n = 36) of teachers investigated using the technology by teaching at least one lesson and most of those went on to use the IWBs multiple times. The researchers visited the school fortnightly throughout the year and used a naturalistic data

Figure 1: Hierarchy of Pedogogical Stages (HoPS) near here

Elements of practice

Stages	Teacher skills	ICT usage	Classroom management and pedagogy
Substitution	Little file use	Mainly text and drawing, some learning objects.	Teacher only; presentation takes precedence over student interaction.
Experimental	Frequent loading of files. Pre-prepared lessons. Some downloading from internet	Wide use of pre-prepared resources. Occasional downloads of resources. Often many PowerPoint linear presentations	Students use the board under teacher direction: mainly dragging. Mainly whole class teaching of lesson topic Students write and manipulate text for a defined purpose under teacher direction
Interactional	Uses stored sequences of files. Captures image from various sources, including cameras and non-IWB inputs such as sound from microphones, document cameras etc. Uses hyperlinks.	Different programs for different purposes. Using native navigation to flip pages. Internet links for "if and when" use. Students build linear presentations for sharing with peers	Frequent student use of teacher materials needing manipulation (eg changing drawings, texts etc). Teacher revises and builds on previous ideas. Student choices built in. Expectations of students include informal and unplanned use of board. Students encouraged to build linear presentations (eg. PowerPoints).
Synergistic	Wide range of both teacher and student skills, including screen capture; digitized and recorded speech; animations. Students widely use both native and other software, including complex nonlinear manipulative software such as graphics manipulations, dynamic geometry, multimedia, Excel manipulatable macros etc.	IWB use embedded into most lessons without constraints. Teacher, with student help, may create complex learning objects (such as a game with embedded curriculum material). Student build cooperative texts/ graphics, critical literacies, cooperative proof construction events etc.	Both teachers and students able to construct meaning, and control direction and step lengths of lessons. Students able, and encouraged, to prepare presentations, lessons and assessments. Development encouraged of socially constructed products (e.g. shared narrative). Students encouraged to insert their own structure into the learning.

Figure 2: Framing analysis tool for pedagogical strategies near here

Strong ↓ Weak	Rules/ Task making	A	Questions	B	Student action	C
	States rules of task prohibits modifier **1**		Closed question **1**		Students engaged in fully defined task with no freedom to experiment, single pathway 1	
	Make rules but accepts some modifiers **2**		Question open but does not accept open answers 2		Students engaged in well-defined task with some freedom to experiment 2	
	Makes rules but invites modifiers 3		Question closed but accepts alternative answers 3		Students engaged in defined task with mult. solutions or possible pathways 3	
	Involves students in rule making 4		Open question 4		Students engaged in planned but open task with loose framing 4	
	Two-way rule modification 5		Negotiated open question 5		Students design own task 5	

Figure 3. Framing analysis, Esther, year 8 mathematics near here

Time	Framing strength (1=strong, 5= weak)			
	Task making	Questions	Student action	Lesson event
00:00	1	1	1	Defines task (decimal recognition) Revises decimal matching with fractions from self-prepared set of slides. Specifies activities
06:20	1	1	1	Uploaded decimal recognition game
07:54	1	1	1	Appoints students to respond to matching pairs. Poses closed questions
18:36	1	1	1	Sets paper tasks, insists on uniform presentation.
28:36	1	1	1	Defines new task (BOMDAS). Use a self-prepared visual slide set to revise order of operations. Questions and responses closed
31:02 43:45	1	1	1	Introduces and activates an order of operations quiz game (uploaded) in which teacher controls the game (and uses the possible interactions herself) while the students write answers on paper.

Figure 4: HoPS analysis Esther, Year 8 mathematics near here

Time	Elements of practice			
	Teacher skills	ICT usage	Classroom management	Lesson event
00:00	Interactional (stored prepared materials)	Experimental	Substitutional	Defines task (decimal recognition) Revises decimal matching with fractions from self-prepared set of slides. Specifies activities
06:20				Uploaded decimal recognition game
07:54	Experimental	experimental	Substitutional	Appoints students to respond to matching pairs. Poses closed questions
18:36				Sets paper tasks, insists on uniform presentation.
28:36	Interactional (stored self-prepared material	Interactional	Substitutional	Defines new task (BODMAS). Use a self-prepared visual slide set to revise order of operations. Questions and responses closed
31:02 43:45	Experimental	Experimental	Substitional	Introduces and activates an order of operations quiz game (uploaded) in which teacher controls the game (and uses the possible interactions herself) while the students write answers on paper.

Figure 5 Framing analysis, Debbie, Year 8 Indonesian LOTE lesson.

Time	Framing strength (1=strong, 5= weak)			
Task making	Questions	Student action	Lesson event	Lesson event
00:00	1	1	1	Defines time task (matching) Does not accept floor comments and question
04:34	1	1	1	Uploaded train times games: interactive response through IWB
10.53	1 2	2	1	Matching quarter hour statements with clocks: board manipulation. Allows student to correct teacher error
18:21	1	1	1	Time matching through IWB, wholly controlled
20:36	2	3	2	Matching time task. Questions open ("Tell me what is going through your mind as you think about it") although final task is closed.
23:05 28:35	3	3	2	Matching time and words with arrows. Introduces making arrows, and suggests student chooses a question and arrow style. Students given some choice of action and establishment of criteria

Figure 6 HoPS analysis, Debbie, Year 8 Indonesian LOTE lesson.

Time	Elements of practice			
Teacher skills	ICT Usage	Classroom management	Lesson event	Lesson event
00:00	interactional (stored pre-prepared activities)	interactional	experimental (students use board under direction)	Defines time task (matching) Does not accept floor comments and question
04:34	experimental (internet loaded)	experimental	experimental	Uploaded train times games: interactive response through IWB
10.53	experimental - interactional	experimental	experimental	Matching quarter hour statements with clocks: board manipulation. Allows student to correct teacher error
18:21	experimental	experimental	experimental	Time matching through IWB, wholly controlled
20:36	experimental	experimental	2	Matching time task. Questions open ("Tell me what is going through your mind as you think about it") although final task is closed.
23:05 28:35	interactional	experimental - interactional	interactional	Matching time and words with arrows. Introduces making arrows, and suggests student chooses a question and arrow style. Students given some choice of action and establishment of criteria

collection technique in many of these lessons, by setting up a video camera focussed on the IWB and letting it run for the length of the lesson. As little intrusion into the lessons as possible was aimed for. The researchers are confident that measures they took to ensure the observations came close to being naturalistic were effective.

Selection

Early selection of research subjects was random: teachers using the IWBs on the days that the researchers visited were video-recorded. Later, there was an attempt to follow some of the teachers as their usage developed, in order to make longitudinal observations. Fourteen teachers in all were video-recorded, of which 10 were then recorded multiple times, allowing changes to be recorded.

Pedagogical changes

In this study, of those teachers observed teaching, few lessons using the boards displayed common characteristics on both models. An example of this disparity is Esther, a mathematics teacher. Esther received mentoring for preparation of a mathematics lesson on decimals and order of operations with a Year 8 class, and by using the framing model, which only considers pedagogical strategies and not skills, it was observed that Esther remained very clearly at level 1 (strong framing) throughout for all three criteria (teacher controlled tasks, closed questions and student action).

By using the HoPs model it was therefore hardly surprising that her classroom management did not stray from a substitutional strategy, using the IWB as a conventional whiteboard substitute in which teacher presentation took precedence over student interaction at all times.

What the HoPS did demonstrate, however, was that Teacher Skills and ICT usage were both beyond the substitutional level because they used pre-prepared files, and other stored resources, as well as some of the multimedia affordances of the IWBs, albeit within the framework of complete teacher control of the lesson events.

Ten of the teachers were filmed using the IWB multiple times, and they therefore provided data to analyse for change. Almost all demonstrated radical change in teaching styles during the course of the year. All were closely monitored and aided by one of the peer mentors, and in the early stages relied on them for both technical and intellectual support for the first few lessons. Analysis with the two tools gave a wide picture of the changes taking place.

An example is Debbie. Early in her usage of the board, Debbie taught part of a LOTE Indonesian lesson on the topic of time. The lesson was captured on Video. Its framing analysis (Figure 5) shows that for most of this part of the lesson her pedagogical framing was very strong, weakening towards the end as she began to open the questioning and allow some students to experiment with a drawing idea on the board.

By using the HoPS analysis (Figure 6) to overlay meaning onto the pedagogical strategies there is a deeper understanding of the teacher's use of the technology. HoPs shows a considerable use of experimental and interactional ICT skills and usage. By the HoPS definitions for classroom management, the analysis shows that this aspect was not wholly at the substitutional level. At the start of the lesson, for example, all interactions were at the direction of the teacher, and no variation to the plan was allowed, making this strongly framed in the Framing analysis, but Debbie did allow students to come to the board and operate it under her direction, an experimental level in the HoPS instrument. Later, this developed into interactional management.

Comments on the case study

the use of two instruments for the analysis of the pedagogies employed by teachers at this school has given a greater insight to the changes associated with the technology than the use of a single tool. In the case of Esther, the framing analysis shows that her strategies are teacher-centric, that she has controlled the entire lesson and its discourses and dialogues. It could be assumed that the technology has made no discernable difference to either the teaching or the learning that has taken place compared with a non-IWB classroom. The HoPS instrument tells a slightly richer tale. It does not analyse the criteria that determine pedagogical strategies, and gives a substitutional result to classroom management, but it shows that in *teacher skills,* and in *ICT usage* there has been a shift from the substitutional level. Esther is not using the IWB as a conventional board or screen. She has adopted affordances of the IWB, not to alter her pedagogical stance, but to enhance the way her material is presented to the students. In post-lesson interview, Esther claimed that this was a direct result of what she had learned from her mentor.

In similar fashion, although Debbie is shown as strongly framing her pedagogy for much of the LOTE lesson, HoPS reveals experimental use of ICT skills and usage, and sometimes beyond that to interactional use (involving the students). Later in the lesson, she continues to use these techniques, but the framing instrument indicates she weakens the framework, and begins to use open questions and accept open answers. Thus each instrument has given additional information about the ways that the technology is interacting with the teaching.

As the year progressed, the researchers analysed many lessons where framing was weakened. Debbie, for example, set a project for a Year 8 class in which she invited them to prepare a multimodal product for use on the IWB by the class, incorporating an Indonesian spoken narrative. This involved activities which were both synergistic in the HoPS instrument, and weakly framed level 5 on the criteria for the framing instrument.

However, there were several other important observations that arose from working with both instruments.

(1) It became clear with many teachers that as they matured with their use of the IWB technology they regularly changed framing levels within one lesson. However the HoPS analysis of those same lessons often revealed that the episodes with strong framing often displayed expert use of the technology and high level teacher technology skills when the teacher used the multimodal affordances of the IWB software such as image manipulation, spotlight tools, image capture, sound video and animation to enhance a section of the lesson that was wholly instructionist. For example Vincent & Jones, (2007) described Nicolas who began an art lesson on PopArt with a multimodal display of art works, spoken commentary and animation devices as he instructed a passive audience about the art genre. In the framing analysis this appeared as strongly framed with a teacher dominated task and closed questions. In the HoPS it appeared as high level teacher skills and ICT usage. Later in the same lesson, students were invited to use the technology to transform their own photographs into pop-art style pictures, a weakly framed activity handing control to the students. From such observations the conclusion was drawn that as teachers become aware of the affordances with IWB technologies, they can use them flexibly and differently according to the pedagogical needs of the moment in the lesson. In this study the key to rapid change to making skilful use of the IWB affordances within a weakly framed pedagogy appeared to be the constant support from the two peer mentors

(2) Use of the mentors followed a pattern. It began with pre-lesson planning; encouraged experimental use of techniques; and extended to accepting mentors as team teaching members or merely safety-net back-up in early lessons. Finally, the teachers cast off from the mentor support as they became confident enough to dare to use the boards in innovative ways.

(3) Early lessons were almost always mirrors of largely instructionist non-IWB lessons but using the affordance to enhance presentation. In nearly every case of multiple use following mentoring, the teachers changed their pedagogical stances to weaken their framing, sometimes very substantially, just as Debbie did. These changes were able to be recorded and understood through both tools.

CONCLUSION

The use of effective analysis instruments is a key part of understanding the rich tapestry of action and interaction in the natural classroom, and must be so if we are to understand the complex relationships between technology and pedagogy. There has been much disquiet about this relationship, including the use of interactive whiteboards. Unlike many UK studies, the researchers in the current study found a positive relationship and complex

changes in the way teachers employed strategies as the IWBs were introduced. There were very few lessons in which substitutional use of the boards was observed, and many cases where teachers moved to synergistic use involving student development, and weakening of the pedagogical framing to allow student engagement. The only significant difference between this school and most others in the introduction of the technology was the use of peer mentors throughout the year at a high enough time-release level to be thoroughly effective as a teacher support mechanism. Teachers in interviews and surveys constantly referred to the support system taking fear of the technology and its unexpected consequences out of the classroom. What the researchers also observed was that the two mentors rapidly assumed that flexible uses and attitudes to pedagogic strategies were as important as skills, and mentored those attitudes into their work with teachers. Understandably, the teachers were reluctant in interview to admit this. It might have given the impression that their standard teaching was rigid.

It became very apparent during this study that no one analysis instrument was going to allow a full understanding of the pedagogical changes taking place. This observation indicates that it is dangerous to draw firm conclusions about ICT impact without using a range of analysis tools. Hence the development of two tools, one emphasising teacher skills and ICT usage with classroom management (HoPS) and the other emphasizing pedagogical framing features from strong to weak. This has given a greater insight to the understanding of technology's interaction with pedagogy.

BIOGRAPHY

JOHN VINCENT, *is a Teaching Fellow and Clinical Specialist in the Melbourne Graduate School of Education's Master of Teaching Program.*

Throughout his 40 year teaching career he was interested in how technologies impacted on pedagogical practice, and in the past three years has worked with Tony Jones on several University of Melbourne research projects to monitor pedagogical change as interactive whiteboards have been introduced into the classroom. John can be contacted at jtv@unimelb.edu.au

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