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Abstract

This paper reports findings from a case study in one UK University of innovative teaching practices using Interactive Whiteboards (IWBs). The study involved observations and interviews with teachers at the University who were using them in particularly interesting or innovative ways. Findings report wide ranging pedagogies in practice. These are categorised against Haldane and Somekh's (2005) typology of IWB pedagogies. Findings suggest that the pedagogies demonstrated span the typology according to the learning need perceived by the teachers and contexts of use. An adapted typology of pedagogy in Higher Education is proposed.

Literature Review: In Context

Teaching technologies are updating faster than academics can write about them. As UK policy currently acknowledges, in Higher Education "...further research in the field is essential to make the most of ICT in teaching.. teaching staff need to be encouraged to experiment..innovative research is needed into pedagogy" (DfES 2005 p32) The vast majority of research is based on schools and there is little literature examining the pedagogic benefits of using IWBs in Higher education. This research project was designed to capture the innovative ways whiteboards are being used in teaching in several departments in one University.

Identifying Good Practice

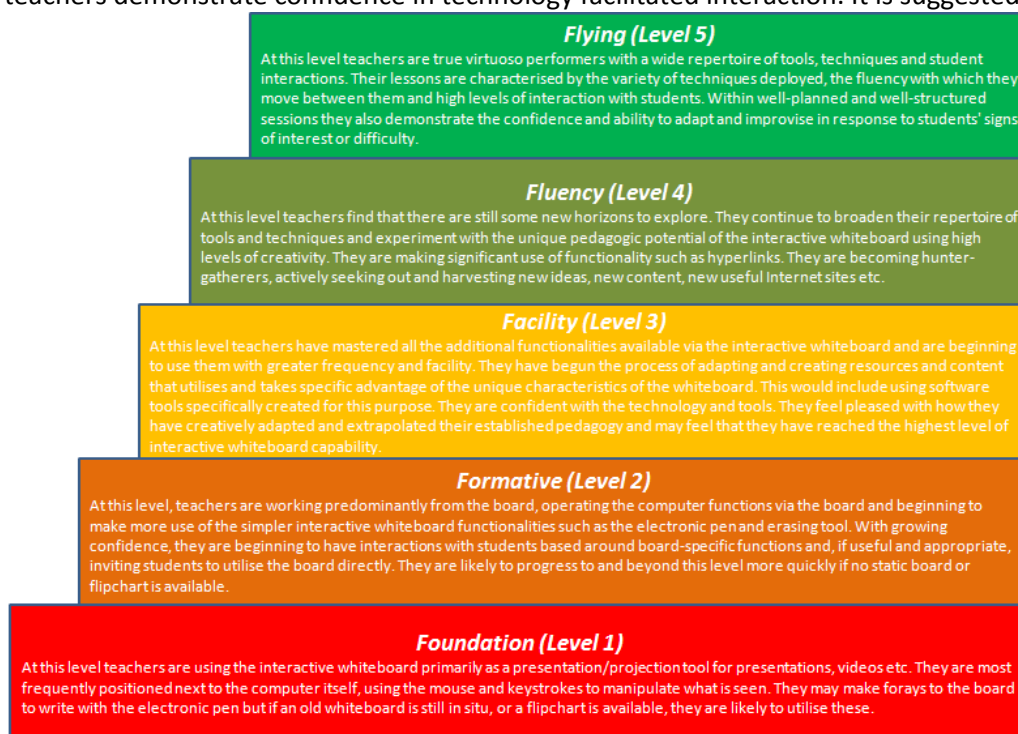
In order to identify good practice, it is important to identify scales of usage. There are two significant papers which offer a scale of use specific to interactive whiteboard technology. The first paper (Kennewell 2006) is a synthesis of research in the field categorised into the associated pedagogies reported when using IWBs. He does not report any new empirical evidence but attempts to classify the current evidence published in the field. He categorises the pedagogies into lower level and higher level uses.

By contrast, Haldane and Somekh (2005) describe an five-tiered model scaling teaching practice. These scales were derived from group discussions based on observations in practical settings by trainee teachers and tested by subsequent research projects. The model classifies teaching from low-level 'foundation' use, where practice replicates what is already possible with display technologies, to best practice full integrated 'flying' use, where teachers demonstrate confidence in technology facilitated interaction. It is suggested that at the highest level

a new pedagogy emerges where lesson design is constructed with interactive technology fully embedded. (see Figure 1)

Figure 1: Haldane and Somekh (2005) Typology of interactive whiteboard pedagogies

Lower Level Use



At the lowest level of Haldane and Somekh's (2005) typology 'Foundation' where the lecturer replicates uses of the data projector and screen. However there is evidence that even at this low level there are significant affordances offered by the IWB technology over other technologies.

Kennewell (2006) sub-categorises the literature relating to low-level functionality of the IWB. The role of described at this level are 'Consultant' – providing information, 'Organiser' – providing tight structure, 'Facilitator' - providing looser structure and 'Repository' – enabling student ideas to be stored and recalled.

In this first 'consultant' role described by Kennewell (2006) the whiteboard is a tool to 'provide information'. The unique benefit of technology is the way it can be used to visually supplement presentation and interaction. There is significant literature around the benefits of digital visualisation in education broadly and at the level of Higher Education. "The incursions of the digital add a mutable new dimension to decades of theorising of the visible and visual in culture" Bayne 2008 pp52

Wall et al (2005) suggest from their evidence that visualisation of any concepts aid the learning process and reports a number of positive comments from students about the way you can see movement rather than imagine it, see demonstrations rather than listen to descriptions and understand by seeing 3d models. Olive (2002) suggests from schools-based research and Beeland (2003) concurs at the higher level that pedagogy is specific to context in which it occurs. Lincoln and Guba (1984) argue that in order for qualitative research to be useful it is important to acknowledge the difficulties in generalisability and aim for transferability between contexts through thick descriptions.

Higher education students of the future are currently being exposed to more technologies than ever before much earlier than ever before (Oblinger and Oblinger 2007) Prensky (2009) argues that as a direct result of their early digital engagement students will be actively seeking engagement through technology. There are positive findings from a wide range of studies (Moss et al 2007, Burke and Ray 2008, Beeland 2003) to suggest IWBs can promote engagement; however there are arguments against this generalisation. Moss et al (2007) acknowledge that increases in pupil engagement reported were limited to the 'novelty period' p235 immediately after the technology was implemented.

Smart (2004) suggests that the biggest benefit of using IWBs is the chance to integrate a wide range of resources to meet a wide range of learning styles and needs. The report refers to learning styles as visual, auditory and kinaesthetic. It is broadly accepted that using a range of teaching approaches and resources reaches a wider range of learning needs.

These affordances can broadly be categorised as visual representation of concepts, increasing engagement and motivation and appealing to a wide range of learning styles.

The Kennewell (2006) model distinguishes between the board's role as organiser, providing a tight structure, and facilitator, providing a loose structure. There is opportunity within both roles to use the board to stimulate interaction with the learners. The findings from Miller et al's (2004) evaluation of IWB use in primary schools are in parallel with Kennewell's 'organiser' role for the board finding that effective interactivity requires structured lesson planning, with stepped conceptual learning, pace in activities and a cognitive review. There are also parallels with the 'facilitator' role as they observed tight structure complemented by the ability to move backwards or forward spontaneously in the learning to recap where necessary or answer questions. Their conclusion, as with Bayne (2008) and Beeland (2008), is that the quality of interaction with the board or resources is dependent on the teacher as expert facilitator.

Personalisation is a hotly prophesized benefit of the new digital era in education (DfES 2005) the board allows direct through use of a pointing device allowing live and dynamic interaction between the teacher or student and IWB. The evidence of the dynamic interaction is stored and can be recalled later as a personalized learning resource. This is equivalent to the second and third level of the Haldane and Somekh (2005) typology where the lecturer is making increased use of the interactive functions of the board. At the second level teachers are

working from the board using the pen and eraser and inviting students to contribute where appropriate. At the third level teachers are adapting and creating resources to take advantage of these interactive potentials.

Higher Level Use

At the fourth level of the Haldane and Somekh (2005) typology of use, 'Fluency', teachers are 'becoming hunter-gatherers, actively seeking out and harvesting new ideas, new content' and into the fifth level of the model the practitioner builds confidence and 'a repertoire of skills to exploit the benefits of the technology and begin thinking about them in innovative ways'. Some of the specific pedagogies which may meet these descriptions are presented here.

At the highest level of the typology, teachers using the technology must be responsive '...lessons are characterized by the variety of techniques deployed, the fluency with which they move between them and high levels of interaction with students.' p12

The benefit of personalisation suggested by Kennewell (2006) was suggested as low-level use. However at this level Haldane and Somekh (2005) suggest that the teacher should use expertise interacting skills to stimulate as well as facilitate beneficial personalisation during class teaching.

Hennessey et al (2007) identify top-level use of technology to facilitate deeper learning. They suggest that 'Expert teachers create, collect, adapt and use (or construct with students) dynamic, manipulable objects of joint reference on the IWB which thereby offers new forms of support for intersubjectivity' pp26 The findings of their study indicate that these interactions may include setting challenges, building representations, evaluation of ideas and speculation. The learning objects created have a range of benefits and can facilitate student independence. This suggests that the lecturer operating at the higher level will construct dynamic teaching resources both before and during the session which facilitate independent and therefore deeper learning but will also respond to students needs. Moss et al (2007) propose that to embed IWB use and fully reap the benefits will require changes to whole approaches in teaching.

In order for technology to gain maximum benefit, it should meet an already established need. (Slay et al 2008) One particular need highlighted in the HE sector is preparing students to be ready for the workplace. Many courses which are very visual may also be very practical. Rich multimedia material available can provide an excellent link between theory and practice. This can, where delivered well, contribute to a more 'situated learning experience' (Brown et al 1989) and through engagement and interaction offer the opportunity for the 'active construction of knowledge' (Lave and Wenger 1991)

Therefore at the reconceptualisation level specific pedagogies are likely to be subject-specific learning experiences. However they are likely to involve collaborating (with students, colleagues or both) to redesign lessons stimulated by pedagogic need. Sessions would be planned to include active learning with the teacher as facilitator and IWB as focus. Most importantly reconceptualisation involves bringing together expert subject, pedagogic and technological knowledge to enhance the teaching and learning experience.

Research Approach

This report was conducted as the original research for a dissertation award as part of an MA in Educational Research Methods sponsored by the Visual Learning Lab Centre for Excellence in Teaching and Learning at the University of Nottingham.

Methodology

The project sought to identify 'exemplars of good practice teaching in IWB use'. Glover et al's paper reports on the notion of missionaries who innovate in good practice use of technologies in teaching hence this sample are 'missionaries' and their stories represent teaching from 'the missionary position'.

A gatekeeper in each department was contacted to ask them to identify any practitioners using Interactive Whiteboards, and in particular those using them in 'exemplary teaching'. Six academics were identified in different subjects, all based in Science Faculties (as opposed to Arts). They were interviewed about their teaching practice, skills development and motivations for using the Interactive Whiteboard. Two were also observed teaching in practice. The interview was conversational and data was audio-recorded, transcribed, coded and thematised.

Findings

The findings report on the motivation for teachers in each case to use the IWBs and their perceptions of the potential affordances for teaching and learning. In each case the IWB is sought as a tool to meet a pedagogic need.

The analysis considers how each teacher perceives their use of the IWB in terms of the typology of use proposed by Haldane and Somekh (2005) Findings show exemplary practice in using IWBs in HE span the full range of the typology proposed and is wholly dependent on meeting learning needs. Examples are given, in rich description, as to the exact nature of IWB use in a range of teaching scenarios providing potential impact on practice as a useful grounding for staff development activities and further research. Removing the information from detailed contexts of use to categories can sometimes reduce the impact of the phenomena studied (Bryman 2004) A brief contextual description is therefore necessary to support understanding of the ways in which the technology is used and benefit perceived within *each individual setting*.

Lecturer A (Vet School) has developed IWB resources for small group clinical teaching sessions and has school-owned facilities in each SGTR. Lecturer B (Physics) uses a mobile device for cross-site teaching and meetings. Lecturer C (Engineering) has adapted existing resources to use innovatively with a mobile whiteboard in the unusual setting of a lab environment. Lecturer D (Pharmacy) has a wide range of devices to use and uses in a range of contexts including whole class teaching. (100+ students) Lecturer E (Biomechanics) uses a portable IWB to promote interaction during off-site outreach sessions.

The emergent interview data has been categorised for analysis and presentation to reflect against earlier identified themes.

Pedagogies

The interview data is thematised against the earlier pedagogic categories proposed from the two models in the research (Kennewell 2006 and Haldane and Somekh 2005). These categories are redefined according to their relevance in HE.

Representation.

Lecturer C cites the benefit of visualisation in the lab environment 'the students can't visualise how it all comes together'. He suggests the IWB can display visually complicated technical concepts. Lecturer A also finds the IWB useful for small groups to engage with visual concepts such as x-rays. Lecturers B and C both report on the benefits of writing live on the board to offer visual demonstrations of mathematical concepts, as proposed by Beeland (2005) 'I think that is the best way to teach maths, to produce stuff in real time and to make mistakes on the fly because students follow it and engage with it. So it's good to use an IWB for that because you can capture it then put it on the web so students can access it later'

Lecturer E suggests she uses the IWB since the visualisation of concepts is imperative to science learning. She further argues that visual stimulation can stimulate and engage those with a wide range of learning preferences. Lecturer E explains how she believes using the IWB can especially engage learners with text-based learning deficiencies (such as Dyslexia).

Therefore there is evidence that practitioners use the IWB with intended benefits of visualisation, engagement and meeting a range of learning needs.

Route and Recap.

Building on the concepts introduced by Kennewell (2006), Glover et al (2005) and Smith et al (2005) this section of the typology refers to the benefits of providing learning structure (route) and opens up semantic movement through resources (recap).

Lecturer C confirms the findings of Smith et al (2005) that a benefit of using the IWB in lectures is 'it's a fairly good way to control the pace and flow of the lesson' and the other respondents agree. Lecturer D uses the IWB in conjunction with software to control the flow of whole group teaching to 100+ students. Lecturer E reports that for small group teaching the IWB materials structure both facilitated and unfacilitated sessions. Furthermore lecturer E suggests that the students benefit as the material is available for recall later when required to facilitate problem solving both during the session and after. This links with the benefits identified in the literature review and links to the net session of the typology – using the whiteboard as a repository.

Repository.

All participants, without prompting, cited the functionality and benefit of the using the IWB to personalise class resources to be saved and retrieved later. Participants B and C both cited the benefit of handwritten Maths concepts. This is particularly important for participant B who delivers lectures cross-campus via video link.

In the literature review the benefits of the repository were considered as a reflective tool for use by students. However Participant D introduces an interesting perspective by describing the way he uses the IWB repository to aid reflective practice amongst teaching colleagues 'I've got a complete record of the session when one of the staff saves the files back for me ...so that when I come back to revise the module, next year's classes can benefit as well by saying ... 'well last year that was an area which we needed to concentrate on' and perhaps that would otherwise have been lost in 12 months in academia.

Participant D suggests that the IWB can gather data about teaching to feed into a reflective cycle which might otherwise have been lost. Kennewell (2006) reports that teachers share more materials when sharing the challenge of implementing new technologies and do not use the exact same materials year after year because using ICT they easily improve their presentations and activities as they learned more about the features and techniques if using the IWB.

Therefore it seems there are significant potential benefits for reflective learning both about the learning process and the teaching process.

These sections of the findings have reported on pedagogies associated with lower level use of the typology proposed by Haldane and Somekh (2005). Pedagogic practice has been identified which can be build hoping to develop deeper learning at the higher level of the typology and these are summarised in the following sections.

Responsiveness.

At the top end of the typology responsiveness relates to the use of a range of techniques, pace and interactions to stimulate learning and the role of the teacher in responding to student needs by improvising on demand.

Participant B describes using the portable device to respond to needs in a range of scenarios. He promotes the benefits of the device in use with large groups to magnify written diagrams explaining concepts which may arise during the lecture from student questioning rather than planned into the lesson. He also describes its usefulness with tutees in a 1-2-1 or small group scenarios to respond to the need for explanation which can be recorded for later reflection.

Participant C also highlights the benefit of using the IWB to respond to particular student needs. In his lab he needs to work with students on a low ratio (1-2-1 or 2-2-1) to demonstrate certain equipment and therefore these are on a rotation throughout the year. As a result the students' conceptual understanding varies and the mobile IWB allows the teacher to recall, personalise and explain resources as required according to their knowledge in context.

Haldane and Somekh (2005) suggest well-planned lessons incorporate the opportunity to stimulate reflection and reaction. As Burke and Ray (2008) suggest this may include the use of particular questioning techniques. These were seen in practice in the observation of Participants A and E in small group teaching and demonstrate the level of cognitive reflection described by Laurillard (1995) as strategies to promote deeper learning.

Although these interactions may seem hard to incorporate in larger group practice, both Participants A and D described using keypads to stimulate questioning and reflection, in this context.

Reconceptualising.

At the highest level of the Haldane and Somekh (2005) typology is the teacher has built one experiences of responsiveness to positively improve their practice. The technology becomes embedded into the teaching and learning process to benefit from maximum pedagogic gain and facilitate deep learning.

As Maor and Zirski (2003) propose, at this level the focus may move from the teacher to the board. Participant D is convinced that board can become the focus of the teaching with support from the teacher. He feels this is an efficient way of developing deep learning, especially where sessions are often repeated to multiple small groups. Participant A agrees that this is a reconceptual focus which enables greater sharing of good reflective teaching practice and facilitates consistency. Participants specifically describe the way they are reconceptualising teaching using the board to focus on the IWB with teacher as facilitator.

As Olive (2002) proposes specific pedagogies in practice observed are subject-specific. Participant C describes the way he has redesigned the way he teaches a very subject-specific process around using the IWB to link theory to practice in the lab setting. He confirms this is a new way of addressing this learning problem, "It's a completely different way of conceptualising".

Participant B believes the IWB allows the reconceptualisation of single location teaching. He shares lectures over videoconferences with the IWB offering the opportunity for shared explanation and reflection. The learning materials and adaptations are providing to stimulate cross-site discussion, reflection and interaction efficiently meeting the stimulation described by Laurillard (1995) for deeper learning.

At these higher levels of pedagogic practice, teaching is responsive and reconceptualised. ICT is being used to its full potential in order to transform the paradigm itself, in other words 'to challenge and transform our understanding of what teaching and learning is all about' (burden 2002 pp) Examples of this in practice are given by subjects who, from the privilege of the missionary position, have had the opportunity to develop pedagogic practice which maximises the benefits of the IWB.

Non Pedagogic Benefits

Glover et al (2005) dedicate one third of their literature review to the non-pedagogic benefits of the board on teacher effectiveness and they arose in this research. The respondents listed several examples of effective

working facilitated by the board. These include time, energy and cost efficiency and are clear benefits which will promote and endear its use to both teaching staff and management.

Summary And Recommendations

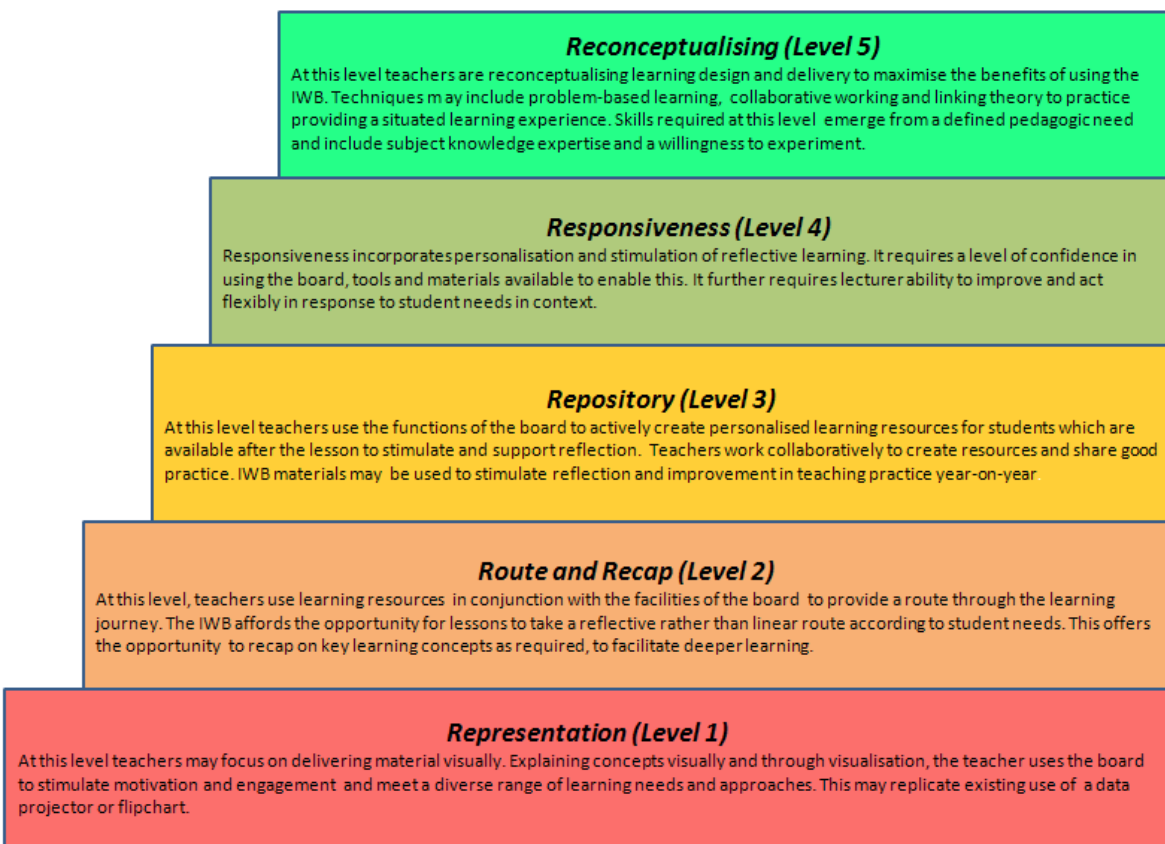
This paper does not seek to report generalisable findings since all teaching contexts are different. However it is hoped that by painting a picture of pockets of exemplary practice in using the IWB from across the University I might identify benefits and practices which are transferable to other contexts and beneficial examples in training. The new typology below (see figure 2) describes the recategorisation of Haldane and Somekh's (2005) typology according to my findings and may be used usefully to stimulate discussion in training scenarios.

Mann C. (2009) Typology of interactive whiteboard pedagogies in Higher Education

As Wagner (1993) suggests, as our areas of ignorance are filled, further blind spots emerge. There are many

areas still to be explored in relation to pedagogies of interactive whiteboard use which would be of benefit to higher education research. These include the student voice on the benefits of visual learning and the potential of the IWB to facilitate deep over surface learning.

It is hoped that by considering the Haldane and Somekh (2005) typology of use and examples



from Glover et al or whoever (2005) against the practice observed and discussed in this research, I have been able to usefully categorise practice and the potential pedagogic benefits of using the IWB.

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