Seeing the meaning. The impact of interactive whiteboards on teaching and learning

Cuthell, J. P.

MirandaNet E-mail: enquiries@mirandanet.ac.uk
Virtual Learning Boston Spa LS23 6AD UK E-mail: john.cuthell@virtuallearning.org.uk

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ABSTRACT

During the past four years Interactive Whiteboards have been installed in an increasing number of classrooms in the United Kingdom. Most teachers have embraced the technology: they see it as something that supports and extends their teaching capability (Smith, 1999; Levy, 2002). The affordances of interactive whiteboard technology, however, do more than reinforce traditional classroom praxis: they provide ways to make learning an interactive process; they create possibilities for teachers to transform their role (Glover & Miller, 2001). There is a growing body of research evidence on the impact of IWBs on pedagogy.

During the past four years the author has worked with teachers, teacher educators and curriculum designers on research projects to assess the changes that have taken place in teaching and learning (Cuthell, 2002; 2003; 2004). This paper describes action research projects based in five areas of England, from the South East to the North East. The projects assessed the effect of Promethean ACTIVboards on the ways in which students have learned, and the impact on pedagogical skills. Evidence from these studies is evaluated in the context of a yearlong UK survey of school implementation of IWB technology and teacher attitudes and other research projects. Evidence is also drawn from a range of international studies

The technology has the potential to make student learning a faster and more effective process, and to restore to teachers a sense of creative autonomy. The findings have implications for school-based in-service education, as well as for teacher educators (Cogill, 2003). Case studies are drawn from Early Years education through to post-16 students (K-12) and a range of curriculum areas. Such aspects as visualisation, the impact on disaffected students, underachieving boys and the transformation of departmental and institutional practice are also covered.

Initial Definitions

The use of computers within the school curriculum has posed a number of problems. That which I have found most critical is the way in which they are deployed within the school: This determines how computers are used to support student learning. It is easy to construct a curriculum in which the focus is learning about computers, or developing computer skills. Maddux (1991) classifies educational computer applications as being either Type I or Type II: it is as apposite today as it was more than 10 years ago. Type I applications simply reinforce existing teacher-learner paradigms, whereas Type II applications of Information and Communications Technology (ICT) transform teaching and learning. This paper is predicated on the Type II approach.

The case studies that follow are set in the context of the United Kingdom, the government of which has, since 1997, invested considerable resources in educational ICT provision. The majority of schools now have broadband online access; a National Grid for Learning (NGfL) has been established; pupil-computer ratios continue to improve; all teachers have been provided with training (known as the NOF program) to enable them to embed ICT within their teaching; and BECTa, the British Educational Communications and Technology Agency, the UK Government's lead agency for ICT in education (see www.becta.org.uk) and ICT curriculum development, has funded a range of programs and research aimed at developing and supporting teachers' ICT use.

Despite these considerable initiatives and the promotion of e-learning by the DfES (the Department for Education and Skills–the successor to the DfEE in the UK. Either acronym can appear on publications) the number of schools that have changed their praxis is small. This paper examines some successes, some issues, and some solutions in the voyage to a transformed education system. Changing the course of teachers and schools is in many ways similar to changing the course of a supertanker: It takes a long time before anything appears to happen.

The Affordances of ICT: Toward a Pedagogical Understanding

The concept of affordance was developed by Wersch (1998): The properties of a system that is perceived by the user to allow the performance of certain actions, which in turn encourage specific types of behavior. From this perspective, computers should be seen as a tool, a vehicle for combining motor skills, language, images, and symbolic manipulation through practical activities. These practical activities reflect a series of often complex thought processes. They represent a cultural tool that enables the mediation of thought. The technology enables these processes to be amplified and developed in ways that reflect the integration of technology and the enhancements that ICT, used as a tool, provides. It creates a form of scaffolding in which learners build their knowledge and develop understanding through the creation of links between new concepts and those that already exist. This creates a growing framework of linking concepts.

ICT affordances facilitate enhanced learning opportunities independent of content or preferred teaching styles. For teachers whose approach to teaching and learning is predicated on a behaviorist or an information processing approach, the support provided by ICT, in terms of feedback to the learner, error messages, prompts, templates and wizards, provides a powerful reinforcement of learning. Indeed, these affordances underpin independent learning systems and many managed or virtual learning environments. Teachers whose pedagogy is grounded in constructivism, multiple intelligence theory, or learning styles will utilize the rich learning experiences provided by diverse materials and collaborative working, where knowledge is inseparable from practice.

Three powerful elements of ICT provide drivers for e-learning. The first is the quality of ostensiveness built into the system: Young children correlate language with concepts by the act of pointing at things. This reinforces the learning. ICT systems utilize this through the use of the mouse, or, on interactive whiteboards, with the stylus or the finger. Visualization, and the ability to move backward and forward through the different stages of a process or a learning object, enables learners to recall the stages of learning. The final, powerful, reinforcement is provided by the ludic elements (those features that are seen as ‘fun’ and suggest a playful element in the system) built into systems: Through games, competitive elements, and constant feedback, learning becomes fun. With constant feedback the learner is able to to take greater responsibility for improving her or his work by refining and improving at regular intervals.

The challenge is to incorporate the affordances of ICT within a new pedagogy for e-learning. This involves new learning on the part of teachers, together with the recognition, on their part, of the dynamic nature of a new pedagogy in which a process of continual change must be accommodated. For young learners, however, the existential reality will be one of living at the cutting edge of technology, where the tools they use and the concepts they forge are an integral part of the learning process.

Teachers’ concepts of the learning process inform their pedagogical approach. The ways in which they feel they learned successfully inform the template of their own teaching. The successful implementation of e-learning into our education system will depend, to an extent, on teachers’ personal uses of ICT and e-learning, whether for access to resources, continuous professional development, or communities of practice.

ICT applications, therefore, make possible teaching styles and learning outcomes that would not be possible any other way. The urgent task for those involved in Continuous Professional Development and school improvement is to shift teachers' thinking about what ICT can do and what it is for. The Department for Education and Skills has assembled a considerable body of evidence that shows that ICT use can improve both teaching and learning. The challenge for teachers and schools is to apply this to their own situation.

The Impact of ICT on Teaching and Learning: The OFSTED Reports

Analysis of OFSTED reports by BECTa focused on the impact of ICT on pupil attainment. OFSTED is the Office for Standards in Education, the official body that inspects all nurseries, schools, colleges, teacher training providers and local education agencies in England. Reports are published for each inspection. (See: ttp://www.ofsted.gov.uk/). The reports on the schools inspected show a strong correlation between the use of ICT within a primary school and the attainment of its pupils. Schools with better ICT resources enable pupils to achieve better grades for English, mathematics and science. More than half the schools with ICT resources classified as “very good” were achieving above national standards in science; a similar picture can be observed in English and mathematics. The evidence produces a strong argument for the role of ICT in raising standards. The data were weighted to account for socio-economic factors. (BECTa, 2000)

The ImpaCT2 study, commissioned by the Department for Education and Skills to evaluate the progress of the ICT in schools program, showed that ICT is positively associated with improvement in subject-based learning. Further, ICT exerts a positive effect on learning. However, while the study indicates that the majority of pupils have a rich ICT

experience at home, many of them feel that the school ICT curriculum underestimates their capability, and that much teaching focuses on skills that they already possess.

The U.K. government has collected a large body of evidence that shows teachers and schools the most effective uses for the ICT infrastructure that it has funded. It has also commissioned studies that show the ways in which the technologies can be implemented.

A number of DfES-supported initiatives have enabled lead schools to implement technologies that have changed the ways in which teachers teach and students learn. More importantly, these changes have impacted on the ways in which the school is organized.

Interactive Whiteboards

The use of Interactive Whiteboards (IWB) has had a profound effect on schools, teachers, and learners. A considerable body of evidence from schools across the United Kingdom has shown the transformational effect of the technology on teaching and learning (Cuthell, 2002, 2003, 2004). What the boards enable teachers to do is to support the whole range of learning styles of the learners in the class. The learners themselves feel empowered: The ability to visualize and recall the lesson supports learning; the range of resources that can be embedded within the IWB lesson software, and the interactivity itself has engaged almost all of the learners and enhanced their progress.

The significant effect of the boards, however, is seen when the structure of the lessons themselves is examined. Traditional teacher discourse modes have been modified: The role of the teacher is no longer to expound and the learner to listen. The interactivity of the boards has made the role of the teacher more interactive. The learners themselves see themselves as engaged with the process of learning, rather than simply progressing through the scheme of work.

Changing teacher praxis

The DfES has used evidence of existing good practice to identify five different elements of e-learning that teachers need to understand. There is concurrent learning – learning that takes place across a number of venues, for example, home, library, school. Cinematic learning occurs when visual media influences what, where and how children learn. Collaborative learning happens in a range of contexts, but is a particular feature of online communities. Communicative learning with online support and mentoring means the availability of teachers for all students. Consensual learning places the child as a partner in the learning process (DfES,2003). Cinematic learning occurs when visual media influences what, where and how children learn. Visualization is an extremely powerful component of the learning matrix, and anything that promotes this faculty enhances the whole process. Case studies from practising teachers offer examples of ways in which we can apply the DfES elements of e-learning to different teaching and learning contexts.

What do we mean by interactive?

New Learning, e-learning

There are four key reasons why students and teachers find that learning is improved using interactive whiteboards. The more that this tool is used, and the more teachers and learners use them, the more we will identify.

Ostensiveness

The term ‘ostensiveness’ relates to the way in which young children learn through pointing at people and objects to reinforce questions or statements. Learning is reinforced through representation by imagery and perceptual organisation, so the use of the mouse and the active interface; the hand; the active desktop and web functionality within programmes are all examples of the ways in which the interactive whiteboard integrates these. The physical act of pointing and activating the screen, whether with a finger, a stylus, pen or the mouse consolidates the topic being learned. The ability to move backwards and forwards in a sequence, or laterally to another topic, provides further learner support.

Ludic elements

The element of play is an important component of learning, and the learning objects that build into the interactive whiteboard presentation combine serious intentions with fun. The ability to integrate animation, sound, video and text provides support for a range of learning styles.

Visualization

The ability for learners to visualize a process through the sequence presented on an interactive whiteboard is an extremely powerful reason for using IWBs. The use of colours, movement, the ability to move backwards and forwards between stages of a process all provide learning reinforcement for students. In a subject such as Digital Photography the use of interactive whiteboards in groups learning animation has meant that students can not only visualise the process of animation, but identify where errors may have occurred. This can then be shared by the whole group, reinforcing communally constructed learning

Bricolage

Bricolage means 'Do it Yourself' – and a bricoleur is a DIY person. Levi Strauss used the term to describe the ways in which pre-scientific thinking devised a system of meaning from the materials and ideas that were found – to hand – lying around. What IWBs offer is the ability to combine a number of what would otherwise be disparate elements – video, flash animations, text, audio files, web materials and conventional curriculum materials – to construct meaning and understanding for the learners. And the learners, too, can construct meaning for themselves and one another.

Pedagogical Architecture

Granularization of content

Granularization is a phrase one often hears in relation to e-learning materials. In simple terms it means that a topic is broken down into the smallest possible segments, each of which can be dealt with separately. Once each segment is labelled, or tagged, these granules can be assembled to produce a custom-made course for individuals or groups. What this means for interactive whiteboard users is that material can be collated in terms of levels of generality, with the detail being revealed as the learners find it necessary. Revision materials can be re-packaged from these granules to suit specific student needs. What learning objects are needed in order that a student can understand a topic? What learning objects are necessary for the student to be able to transfer and apply that knowledge to another domain? In very simple terms it means that you can organise each learning object into an appropriate folder, then combine them for whatever topic you are delivering – or whatever your students need for learning.

Modules

Modules can be created quickly and easily once banks of learning objects have been collected together. When colleagues collate their materials and distribute them through school networks and across the Internet Just In Time teaching and learning becomes possible.

Mosaics

We often think of the learning process as a mosaic: lots of tiny pieces finally come together to form a picture. Learners are often scrabbling around, with their noses so close to the grindstone, trying to shape the fragments they have so that can fit together – somewhere – that they take a long time before the picture falls into place. If it does. An IWB enables the teacher and learners to locate each fragment – the learning object – and show how it fits in the big picture.

Transforming teaching and learning

The introduction of interactive whiteboards has produced a profound shift in the ways in which the teachers think about what they do and why they do it – in other words, about the nature of what it is to be a teacher: the existential reality of teaching. This transformation in expectations, beliefs and behaviour – teacher praxis – can prove difficult to quantify. It is clearly demonstrated, however, when the teachers talk about their work.

Feedback from a mathematics teacher in an 11-18 comprehensive school provides evidence of their effects on learners (Smith, 2003). Interactive whiteboards have transformed the delivery of the curriculum in conventional whole-class settings. The use of mathematics programmes has improved the ability of many students to conceptualise mathematical processes and modelling. Student interaction with IWBs has improved learning: when interactive whiteboards are combined with all the Key Stage 3 strategy teaching aids, such as student whiteboards and oral and mental starters, student enthusiasm in participation has increased. In fact in some Year 7 lessons their eagerness to demonstrate their work and understanding to the rest of the class using the board has been quite overwhelming!

Smoother transitions of lessons is another gain for both teachers and pupils. When lessons are prepared using interactive whiteboard software they have a smooth transition between activities. This includes the use of videos in mathematics lessons. The transition between computer and video is seamless – and could not otherwise be achieved. Lesson quality is also enhanced. Staff in the school have commented on an increase in the quality of lessons when they are planned for the whiteboard. The use of presentation software has made staff think even more carefully about how key facts are explained, and to find the best way to sequence teaching. The is particularly the case with visualisation, where the use of graph plotting software enabled far faster understanding of the concepts: students had a clear visual understanding of the topic, and were able to transfer this understanding to other topics. When this is combined with activities to reinforce concepts there are clear learning gains. A Year 11 Set 4 (out of 5 groups), had been 'doing Pythagoras to death' and still struggling with the concepts. Using www.mathslessons.co.uk and 'Who wants to be a millionaire - Pythagoras edition', the students' understanding was tested in a fun and interesting way which clearly ironed out a number of false concepts. The students wanted to know **how** to work out the answer, rather than **what** the answer was.

Integrating Music technology and display technology

Tony McNally, Head of Music at Castle View School, Sunderland, here comments on the effects of ACTIVboards on teaching and learning in his department. He has used the ACTIVboard to integrate all the music technology that is used in his classroom. Pupils are able to observe notation as music plays; mixing software can be seen by all the pupils, who can suggest ways in which it could be used; pupil compositions can be seen and heard by the whole class and collaborative working extends to everyone. In addition to these conventional aspects of music technology other software is used, such as karaoke, the 'bouncing ball' to demonstrate the progression of melody and chord structure and such games as 'Mastermind' and 'Who wants to be a millionaire?', in which pupils construct quizzes on music and test their peers.

"Having the Promethean board in my room has transformed the delivery of the whole music curriculum. I am able to record individual and whole class performances and display the recording as a graphic score. I am also able to show DVDs and videos of pupil performances without having to crowd around small television screens. I can also show some of the best contemporary musicians giving workshops.

It is wonderful to create whole class compositions with the aid of the active slate and pen: it helps to encourage and engage even the most reluctant of students to provide input. You can virtually take the "black-board" to the student!

As well as being able to access students' recorded performances for appraisal, there is a wide range of CD-ROMs available that work well in the classroom when used with the board. We also view and appraise scores by the great composers.

As most of our teaching and learning materials are produced and published in-house, I can easily access activities that are in pupil booklets and directly display them for explanation and demonstration purposes. This has had a huge impact on the lessons. The bottom line is that the pupils enjoy using the interactive board every bit as much as I do !"

Students working at South Leeds Learning Centre used the Leodis site, a resource containing digital images of Leeds. These pictures provided primary sources of information for students' local history projects. The images were accessed through the interactive whiteboard, enabling students to select them, drag and drop them into a piece of work, and then edit them. The images enabled group discussions, collages to be constructed and images imported into other packages. The use of archive digital images was transformed. An additional gain was that students' sense of local history was established, and their sense of place enhanced: both factors that could inhibit acts of vandalism.

Old wine, new bottles …

Gwyneth Evans, Teaching and Learning Coordinator at Castle View School, Sunderland, uses an ACTIVBoard for teaching History. "The Promethean whiteboard has become an integral part of my teaching in the preparation, communication and assessment of lessons. It has transformed the learning environment by providing opportunities to develop pupil learning and performance. So far the whiteboard has been used for

* PowerPoint presentations delivering and transferring knowledge, key facts and details from Years 7 – 11.
* Using ACTIVstudio for competitions such as Blockbusters, saving a lot of time in preparation as the board is there instantly, Year 7 – 9 Pupils particularly enjoy it.
* Creation of materials – written, diagrams, clips from the Internet & pictures which can displayed on the board and highlighted.
* Displaying text and sources - highlighting key points especially when analysing sources for reliability.

* Displaying model answers especially for GCSE work, forming a basis for discussion from which pupils themselves can identify areas for development.
- The ACTIVslate & pen is very useful, as pupils contribute to the lesson from their desk without needing to come to the board. It is very useful when teaching, since it contributes to the flow of the lesson regardless where you are standing in the room.

I've found a number of definite advantages in using an ACTIVboard. I'm sure that, the more I use them, the more advantages I'll find. Not only do the activities heighten pupil interest, work can be clearly structured, sequenced and differentiated easily. Historical source images and information can be dynamically generated on a screen, giving a high level of interaction from the pupils interpreting sources and providing a catalyst for discussion.

It has been particularly useful when modelling activities enabling pupils to compare knowledge with others and identifying the relevance and importance of particular aspects of the information. There is enhanced enjoyment and interest in the learning task consequently pupils are motivated and remain longer on tasks. Pupils can develop and articulate their understanding and analyse information a lot more rather than just the delivery of facts. It offers opportunity for reflection easily especially when their attention is attracted.

The question that I'm often asked is 'How has the ACTICBoard transformed the delivery of History?'
- Lessons have become more varied.
- Information can be manipulated: for example, taking data or graphics and merging them with the delivery to encourage the consolidation of knowledge.
- Transferring from computer to video to the ACTIVStudio saves time, allowing smooth transitions.
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And what has the impact been on teaching and learning?
This resource can be woven into any part of the lesson – introduction, delivery, plenary and it can run alongside the pupil task. Pupils remain engaged: their attention span and concentration is greater when the active board is used. More importantly, the whole Learning Environment has developed and expanded."

Internet research days

At South Leeds Learning Centre, students use TextEase as an interface to access pages of web links, and to search, select and use data for projects. The interactive whiteboard is the medium through which the groups work. Another was of involving learners is through Interactive adventure games. The use of interactive adventure games (such as Civilizations) on an interactive whiteboard means that students can work as a team. Not only do these group activities reinforce Literacy skills, but they also develop the wider Key Skills of Problem Solving, Working with Others and Improving Own Learning and Performance. When students work through the scenarios they are engaged in modelling; the outcomes form a focus for discussion on Citizenship. If the activities are combined with a journal the students have a very powerful piece of evidence to support these cross-curricular themes.

Conclusion

The introduction of interactive whiteboards has changed the ecology of the classroom, and with it the ways in which teachers think about their role. This shift in teachers' existential reality is an important one: for the first time teachers have access to an ICT tool designed to support both teaching and learning from a whole-class perspective. The software provided with IWBs facilitates lesson planning, resource creation, assessment and the ability to annotate all of the materials to form a permanent record of the teaching and learning process. They facilitate collaborative learning amongst teachers and pupils, and collaborative work with colleagues. Teachers are provided with the scaffolding they need to support whatever learning styles and combination of multiple intelligences favoured by students at any time. The lesson materials can be distributed across a school network or intranet, so that all members of the school community can share the work.

The current paradigm for ICT use and the affordances it brings to the learning process is essentially Constructivist in its nature. Those teachers whose pedagogical style or preferences do not fit this approach tend not to use ICT as extensively, or in the same ways, as those teachers whose approach is constructivist. The net result of this can be seen in a range of analyses of effective ICT use in school (Becta, OFSTED et al), which show that, despite evidence that shows its impact on learning, not all staff use it consistently. Figures such as 35% of staff seem to recur across these studies.

In the case of interactive whiteboards, however, the teacher's beliefs about learning theory, and the ways in which these are integrated into praxis and pedagogy, can be accommodated by the boards – which then support the teacher in whatever ways they approach the classroom learning process. Feedback from teachers who have used the technology

for a year suggests that, once the initial period of familiarization is complete (about three months or so) the possibilities of the technology and the software prove increasingly effective.

When we examine interactivity we find that the initial understanding, that pupils would move to the board as part of the lesson, engage with the board and then move back to their desk – and replaced by another pupil – is not really the way that we should frame interactivity. It is, rather, something that relates to the process of learning on the part of the pupil, an interactive process that engages the learner and facilitates the cognitive development appropriate to the individual. In other words, the use of interactive whiteboards provide the teacher with a powerful tool to use that facilitates the learning of the whole class, rather than some individuals. When learners are able to see, and recall, the meaning they can incorporate it within their cognitive schemas and construct their own picture of knowledge and understanding.

REFERENCES

BECTa (2000) A preliminary report for the DfEE on the relationship between ICT and primary school standards. British Educational Communications and Technology Agency Coventry, England.
British Educational Communications and Technology Agency (2002). ImpaCT2 The impact of information and communication technologies on pupil learning and attainment. Coventry, England.
Cogill, J. (2003) Interactive whiteboards in the Primary School. An evaluation. http://www.virtuallearning.org.uk/whiteboards/IFS_Interactive_whiteboards_in_the_primary_school.pdf
Cuthell, J (2003b). Next steps for ICT teacher education: ICT for active learning. In Price, J., Willis, D., Davis, N., & Willis, J. (Eds.), Proceedings of SITE 2003 (pp. 2740-2744). Norfolk, VA: Association for the Advancement of Computing in Education
Cuthell, J. (2003) Interactive whiteboards: New tools, new pedagogies, new learning? http://www.virtuallearning.org.uk/whiteboards/index.html
Cuthell, J. P. (2002). *How do interactive whiteboards enhance learning?* Retrieved February 24, 2004, from http://www.virtuallearning.org.uk/iwb/Learning_theories.pdf
Cuthell, J. P. (2003a). *New tools, new pedagogies, new learning?* Retrieved February 24, 2004, from http://www.virtuallearning.org.uk/iwb/index.html
Cuthell, J. P. (2003c). Virtual Learning In J. Kirjonen (Ed.).Knowledge work and occupational competence, (pp.23-37) Jyvaskyla, Finland: Institute for Educational Research.
Cuthell, J. P. (2004). *Interactive whiteboards survey.* Retrieved February 24, 2004, from http://www.virtuallearning.org.uk/2003research/whiteboards_survey.doc
Department for Education and Skills (2003). Towards a unified e-learning strategy. London.
Glover, D; Miller, D.(2001) Running with Technology: the pedagogic impact of the large-scale introduction of interactive whiteboards in one secondary school. Journal of Information Technology for Teacher Education Volume 10 / No. 3 (2001) pp. 257-276
Levy, P. (2002) Interactive Whiteboards in learning and teaching in two Sheffield Schools: developmental study. Department of Information Studies, Sheffield University
Maddux, C. (1991, October). Integration versus computer labs: An either/ or proposition? Educational Technology, 31 (pp. 36-43).
Perry, S. (2000). In: Towards the classroom of the future. (p.14) London: Department for Education and Skills.
Smith, A. (1999) Interactive whiteboard evaluation. London MirandaNet
Stevens, A. (2002). In: Wireless networking in schools. (p.17) London: Department for Education and Skills.
Wertsch, J. V. (1998). Mind as action. Oxford: Oxford University Press.