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**Reflections on the interactive whiteboard phenomenon:
a synthesis of research from the UK**

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Abstract

It is unusual to focus educational research on a particular piece of equipment, but the interactive whiteboard (IWB) seems to have a pedagogical and cultural status which makes it different from other new pieces of ICT equipment. In particular, it has been enthusiastically adopted by nearly all the teachers who have one installed in their classrooms, and is sought after by most of the teachers who do not currently have access to one. A group of researchers has formed within BERA New Technologies SIG, covering several projects in the UK which have been funded to investigate, directly or indirectly, the impact of the IWB on teaching and learning.

On behalf of the BERA group, this paper reviews recent research concerning the use of IWBs and:

- analyses the nature of the medium
- characterises the associated pedagogies
- synthesises some roles for the IWB
- discusses what we have found concerning the potential of the technology for supporting 'engaging pedagogies';

It also considers the effects of national policy contexts on our work in the UK, raises issues for other countries and helps to generate questions concerning what we do not yet know.

Introduction

It has long been recognised that the study of pedagogy and didactics is crucial to understanding the potential role of ICT in teaching and learning and the ways in which new technologies are appropriated by teachers. For many years, however, research exploring the use of ICT by students in learning across the curriculum has found only limited adoption of new technology for purposes other than learning about computers. The massive influx of interactive whiteboards (IWBs) in the UK has transformed this situation and led to a corresponding explosion of interest in research into the effect of IWBs in classrooms on the part of both policymakers and

researchers, with policymakers interested in measuring the expected gains in attainment and researchers more interested in describing and explaining how IWBs are used to aid learning. Current or recent research projects funded by the UK governments, either directly through the DfEE or indirectly through Research Councils number at least seven, and there are others funded by large charitable organisations or local government authorities. An informal group of teams involved in these funded research projects meet and communicate regularly to discuss issues emerging and plan collaborative work. This paper is produced on with the assistance of this Interactive Whiteboard Pedagogy Research Group.

What IWBs are and what teachers do with them

IWB technology comprises a computer linked to a data projector and a touch-sensitive board which both shows the image projected from the computer and allows input from a stylus placed on or near the board. Software provided with the board 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, and others which have not previously been possible on a large, vertical display, 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 et al., 2005)

As a consequence, they have the potential to enhance demonstration and modelling; to improve the quality of interactions and teacher assessment through the promotion of effective questioning; to redress the balance of making resources and planning for teaching; to increase the pace and depth of learning (Becta, 2004)

These general types of effect are achieved by teachers using the board effectively to:

- provide an initial structure for their teaching
- save time scribing
- provide a large display that children could see and read easily
- demonstrate skills for children
- attract and retain children's attention
- provide images or text that children could not easily have had access to in other ways
- engage in quizzes or tests within the whole-class environment
- increase class participation by children writing their solutions on the board.
- save work so that the teacher and class could access their joint contributions at a later stage
- provide a tool for children to create their own multimedia screens for class presentations
- enable collaborative work

- provide images that could later be adjusted by children to display their own work
- foster independent thinking skills in children and improve their cognitive skills.

(Cogill, 2004)

An illustrated collection of ideas can be found at <http://ferl.becta.org.uk/display.cfm?resID=8224>

The rate at which these still quite expensive items have permeated UK schools sector is phenomenal. There are estimated to be an average of 6 IWBs in primary schools and 16 in secondary schools (BESA, 2006). Indeed, many primary schools have equipped every classroom.

What we know from published reviews of research in the UK

Much of the currently published literature is concerned with the process of adoption of IWBs in schools (e.g. Glover & Miller, 2002) and their integration into pedagogical practice (e.g. Levy, 2002; Coghill, 2004). It is clear that, initially at least, the arrival of an IWB does not generally stimulate or require any fundamental change from the dominant pedagogical paradigm which has been established as government policy in England, at least, since the late 1990s. In the National Strategies, teachers are encouraged to base their lessons on “direct teaching and questioning of the whole class...” (DfEE 1999: 1.11) which is “oral, interactive and lively” (DfEE 2001:1.26). The Strategies recommend predominantly whole class mode of organisation with relatively brief periods of individual or collaborative work which are subsequently reviewed in a reflective plenary session.

Indeed, it is reasonable to conjecture that it is precisely because the IWB is so suited to supporting whole-class teaching that it has been adopted so rapidly in comparison with more personal technologies which integrate less readily into traditional teaching methods. This may lead to the technology merely being used to reinforce current teaching approaches (Hall & Higgins, 2005), rather than supporting a transforming pedagogy. Certainly, there is now a considerable body of in which teachers are found to attest to the benefits of IWBs. Smith et al (2005) identify a number of themes concerning effects on teaching and learning, including:

- flexibility and versatility
- efficiency
- supporting planning and the development of resources
- interactivity and participation in lessons.
- motivation and affect
- multimedia and multi-sensory presentation.

However, some negative factors emerged, including lack of adequate training and support, and practical difficulties with equipment and its use in settings not designed for the purpose.

Miller et al (2005) highlight a number of more specific features in the course of reviewing a further range of relevant literature. Teachers find them quite easy to use; whilst they take longer to prepare material, there is a greater reward in terms of student interest and material can easily be adapted and re-used; visual and kinaesthetic learning styles are supported; retention/recall and sequential explanations are aided;

improved planning, presentation, and revisiting; better motivation and attention on the part of students, particularly slower learners; interactivity is supported through questioning, software features and multimedia.

Since these reviews, some more rigorous and analytical research has been reported. Higgins et al (2005) carried out quantitative investigations into classroom activity and the resulting attainment in IWB and non-IWB classrooms. They found no major changes in pedagogy; indeed:

- IWB classrooms demonstrated more whole class teaching and less groupwork;
- whilst there were more open questions and answers/evaluation, there was less uptake of responses;
- a faster 'pace';
- a boost to attainment in maths, science but not English in first year, but not in the second year of IWB use.

Qualitative work analysing systematic observations in classrooms has highlighted the mediating/orchestrating role of the teacher with IWB software (Armstrong et al, Kennewell et al 2004); Interactivity has been characterised on two independent dimensions: technical and pedagogical (Smith et al, 2005). Teachers (and pupils) may use the IWB features to carry out sequences of interaction with the board, with the class merely looking on; on the other hand, the teaching may involve sustained interaction between teacher and pupils or within group of pupils with the IWB taking a passive display role. The combination of the two dimensions involves a process of development from the early stages of use which replicates traditional classroom resources to a state in which the IWB is a tool for teachers to think with rather than about and to use effectively as an extension of themselves. (Beauchamp, 2004; Miller et al., 2005; Haldane, 2005). Indeed, many teachers would feel bereft if they were to be deprived of the IWB (Henessey et al in press). Teachers feel pressure to use the IWB productively immediately, and need more time to play with the technology (Cogill, 2004)

Pupil perspectives have also been explored; children value the use of the IWB for whole-class games; exploring the Internet together; its visual, aural and tactile properties; and multimedia presentations. They also identify some problems, including technical glitches, difficulty seeing the board in some classroom conditions, lack of teacher and pupil skills; inadequate opportunities for students to use independently and insufficient equity when they do use it (Hall & Higgins 2005). They understand its potential, and have feelings about performance and involvement. It appears that changes in role of teachers and students in the classroom facilitated by new tools are not fully appreciated or exploited.

What we are finding from more recent work

Comparison of ICT's adoption across different national systems reveals the importance of policy contexts. The IWB phenomenon in the UK seems closely associated with the National Strategies' promotion of particular pedagogies and the political rhetoric of 'raising standards'. Much of the finance for IWB initiatives in England has originated in the 'Standards Fund', including some of the projects represented in the Interactive Whiteboard Pedagogy Research Group. It is inevitable that the government bodies funding such research will seek evidence of improvements

in teaching and learning. Other projects have been funded by the UK Research Councils and charitable trusts, with a wide range of success criteria for their research. The various research teams have recently collaborated in producing papers for a publication devoted entirely to the issue of IWBs. These papers have particularly focussed on analysing the IWB as a mediating tool in the classroom and on characterising the pedagogies associated with its use.

The nature of the IWB as a mediating tool in the classroom

They are a number of classroom actions which are particularly supported by the features of IWBs in primary and secondary schools. The features exploited by teachers include those that are intrinsic to ICT and those that are constructed by resource designers, teachers and students (Kennewell & Beauchamp, in press).

The resources, or 'texts', brought into - or created within - the classroom are framed by the government policy rhetoric of multimodality, pace and interactivity. They define the version of knowledge and student identity to be promulgated. IWB resources are seen as multimodal texts, and the features of IWB as affordances and constraints for the design of these. Teachers can use them for replicatory functions (for example, putting a worksheet on the screen) and novel functions (eg drag and drop matching tasks) (Jewitt et al., in press).

IWBs are used to encourage student participation, but often only in relatively superficial ways: for example by asking students in turn to manipulate items on the board. Encouraging students to actively participate by using 'drag and drop' on the board in front of the class requires careful management if students are not to feel unduly exposed to critical comment by their peers (Gillen et al, in press). When managed effectively, however, this engages the whole class in a form of vicarious participation. 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. These objects support the setting of challenges, building representations, evaluation of ideas, speculation, appropriation of student ideas into descriptions of formal knowledge, and student independence (Hennessy et al.).

Early years teaching enjoys a policy context different from that of the National Strategies, particularly in Wales which is piloting a Foundation Phase (ages 3-8 years). In this policy, *play* is central as a pedagogical approach, but there are difficulties in implementing it effectively with IWBs which tended to be used for large display purposes (Morgan, in press).

Characterising the associated pedagogies

Multimodality, efficiency/pace and interactivity are features derived from government policy rhetoric which consequently become normative conventions. In practice, teachers believe multimodality to help less able students develop mental representations of difficult concepts. They implement the notion of pace through preloading materials, rapid movement between screens/programs, and revisiting material for review. There is a distinction between technical, physical and conceptual

interactivity and a trade-off between pace and interactivity. It is often the case that deeper thinking is carried out away from the board (Jewitt et al., in press)

Tanner & Jones (in press) have carried out an analysis of interactivity and teacher questioning, producing continuum of interactivity from the level of *lecture* (no interactivity) through to *collective reflection* with a deep level of thinking and a much more equal status assigned to teacher and students in dialogue in the same way as in Alexander's (2004) *dialogic teaching*. Gillen et al. (in press), take this idea further in their use of Mortimer & Scott's (2003) framework for analysis of pedagogic practice. This model distinguishes an *interactive/non-interactive* dimension (concerning the extent to which students contribute to the talk) from a *dialogic/authoritative* dimension (concerning the extent to which the teacher controls the presentation and production of knowledge). Based on an investigation in English primary schools, 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 based on prepared or purchased resources.

There is thus a potential fit between the higher levels of pedagogical interactivity and the features of IWBs, but this requires an understanding by teachers and by students of the pedagogical intention of IWB resource designers. If much control is delegated to students in the use of resources in the absence of this understanding, there is potential for subversion rather than appropriation of learning objectives (Tanner & Jones, in press). This problem is amplified in early years settings, where IWBs are used for group work more than in other classrooms. Resources for supporting effective collaboration in the absence of an adult (rather than turn-taking) were either not found by teachers, not used or not effective without more opportunity for children to play and develop ICT skills.

For more experienced and expert teachers working with children in secondary schools, Hennessy et al. (in press) find that interactivity and participation in relation to IWBs enables articulation of student knowledge and feedback from teacher/peers. The IWB assists in providing classroom conditions favourable to guided participation in mentally challenging activity. In this context, teachers collect, adapt and use resources from multiple sources and add material of their own. Much material is constructed in the classroom with students, resulting in shared ownership.

Indeed, the role of teacher is central in orchestrating the affordances and constraints of the classroom's features to optimise potential for learning (see Kennewell et al 2004). As well as the functions of the IWB, these features include student knowledge/skills. The property of provisionality and the teacher's encouragement of errors and 'undo', the multiple representations, the interactivity/feedback help to support the process of scaffolding. IWBs also support teacher collaboration in the production of materials, but there are important differences in actions and features exploited between curriculum subjects (Kennewell & Beauchamp, in press).

In terms of Kozma's idea of the stability of a medium, i.e. the ease with which ideas can be interacted with and revisited in order to develop mental representations, ICT is potentially highly stable (like books, as opposed to TV or oral dialogue) and IWBs are particularly supportive of interaction with ideas through highlighting, annotation and

amendment. Furthermore, they support primary teachers in weaving threads of linked interactions through a lesson related to specific ideas they want learners to understand and remember (Haldane, in press).

Clearly, as with any other classroom resource, what the teacher does with an IWB is much more important than the nature of the resource itself. The approach to professional development concerning the provision of IWBs is therefore important in ensuring that the most benefit is gained from an expensive investment. Factors found to be important in the success of professional development include the roles which different teachers take, the nature of collaboration, and the use of internal mentors for pedagogical development and external expert support for more technical aspects.

Synthesis: roles for the IWB

To date, the top-down policy driven approach to pedagogical change, represented by the National Strategies in England, seems to have stalled at the stage of surface interactivity which is reflected in replicatory use of IWBs. Many of the activities described in research reports merely use the features characteristic of a large, bright display which is visible to anyone in the classroom. Yet there is a level of enthusiasm at the practitioner level driving the adoption of IWBs which seems to have a momentum beyond that generated by policy. This seems to be based on the emergence of a role for the IWB's engaging role, supplementing the teacher as a focus of communal attention, interaction and cognition and in storing/organising material to stimulate and support this. Can this enthusiasm be channelled into developing the dialogic teaching approaches which are supported by the IWB?

It does seem that IWB technology can be more than just a tool to support outmoded pedagogies of direct instruction to large groups of students. It can be a tool to support communal learning in a way which complements other technologies which are better suited to individual and small group collaborative learning – wireless laptops, handhelds, VLEs, etc. But this pedagogical transformation does not happen automatically when an IWB is installed in a classroom. Only a few teachers are at the top of the scale on either IWB expertise or dialogic/interactive teaching and the potential of IWBs for engaging pedagogies is not being fully realised. Indeed, perhaps technical engagement with the IWB is becoming a substitute for pedagogical engagement between teacher and pupils.

It is important, then, to develop a perception of the IWB as a tool for implementing engaging pedagogies. The recent research suggests that the IWB serves very effectively as a focus for communal attention, action and cognition. Further analysis of the classroom settings described in the recent research suggests that the IWB takes a variety of roles in the full interactive/dialogic teaching approach:

- **Consultant** – providing information, such as prepared 'answers' for discussion; planned or ad hoc Internet searching; exploring simulations.
- **Organiser** – providing tight structure but unpredictable results for activities, such as games, so that the teacher is free to discuss strategies with the students as equal participants.
- **Facilitator** – providing looser structure for focusing or construction activities involving choice, such as annotating or matching tasks, where teacher/students can discuss options and guide the less knowledgeable.

- **Repository** – enabling student ideas to be recorded for later revisiting, reflection and revision.

It is in the way that these roles are enacted that the difference made by the IWB compared with traditional media and the basic projected computer display can be seen.

Issues to be addressed in future work

The study of pedagogy involves many complex, inter-related factors. Most studies of IWBs to date have focused on whole-class teaching and thus have reduced the parameters of ICT pedagogy research. This has perhaps made it easier for us to see certain events and relationships in the classroom; certainly the IWB makes key features of classroom setting literally more visible. But future IWB research will need to deal with a wider range of issues, particularly the role of this sort of technology in supporting group and individual work. What is the value of using handheld devices – either one per student or one which can be passed round the class – to interact with the display, rather than coming up to the board? This creates a quite different classroom dynamic. Physical touching of the board is different from working at a distance with a different image; standing at the front of the class is different from sitting in normal seat; the number of devices is different: the IWB is an extra machine to go wrong, but the tablet PC can more easily be stolen!

The consistent findings concerning the limited nature of pedagogical change resulting from the introduction of IWBs suggests that a future focus on professional development would be valuable. Concern over the lack of development in pedagogy is reinforced by the lack of sustained improvement in attainment when IWBs are used. How can the majority of teachers develop the expertise demonstrated by the best? Is it enough to provide technical training, or must IWB professional development address fundamental pedagogical approaches, with trainers/mentors being sensitive to teachers' existing styles and beliefs and focusing on developing an interactive/dialogic approach? Does there need to be a 'critical mass' of fixed IWBs in a school before its use becomes the norm?

The identification of the classroom roles of consultant, organiser facilitator and repository, for which the IWB seems to make an important difference in the classroom, will help structure our response to such questions. Underlying these questions, however, there are some deeper issues. The adoption of the IWB has been predominantly in English-speaking educational cultures; is this caused purely by economic factors, or is there something culturally specific about 'interactivity' as a pedagogic ideal? Are the roles identified for the IWB appropriate in all classroom settings?

And in any case, how long will it be before IWBs go back in the cupboard when the next generation of technologies emerge?

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