

Interactive Whiteboards: does new technology transform teaching?

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1. Introduction

In this chapter we will discuss the pedagogical use of computer-based technology in schools through considering the emergent use of a new form of that technology, the Interactive Whiteboard (IWB). We examine it from a sociocultural perspective, taking Wertsch's notion (1991) of the 'heterogeneous mediational tool kit' as a frame for this study. This particular perspective emphasises the study of tools as they are used in specific sites of activities of learning and teaching, rather than just the designed properties of these tools. It captures the broad multi-functionality of a tool such as the PC or the IWB, as it can be drawn upon in the course of classroom activities. As Wertsch comments, 'only by being part of action do mediational means come into being and play their role. They have no magical power in and of themselves.' (Wertsch, 1991, p. 119). Actions take place in specific settings and circumstances, and our research has attempted to take this into account. This sociocultural perspective has led us to examine critically some ways in which technological innovations have been represented and researched, and how their use is promoted in educational settings. Our discussion is informed by our past involvement in a range of research projects on the use of computer-based technology in education, but we will here draw our illustrative examples from one recent, classroom-based study in British primary schools

We begin with a brief review of the introduction of computer technology into schools, taking the UK as an example, and set out our own critical perspective on this process. We then describe the multiple capacities of the IWB in order to show that the potential of this tool as a mediational means is not constrained in a narrow, or heavily pre-determined way. Through the analysis of observational data, we show how its affordances relate to teachers' established practices, and discuss the extent to which its introduction has been supportive, transformative or disruptive of those practices. We end with some comments about the potential educational significance of this tool and draw more general conclusions about the introduction, use and evaluation of new forms of ICT in schools.

2. Background: the introduction of IWBs in the UK

In the UK, the IWB has been commandeered to support broad claims about the value of information and communications technology (ICT) for the improvement of teaching and learning in schools. The recent widespread and rapid introduction of the IWB into British schools occurred at the direct instigation of the government. This might be characterised as the third major wave of UK government-led initiatives introducing computer-based technology into schools in the last thirty years. The first of these was around the end of the 1980s, when the first PCs were placed in schools. At that stage, the number of

machines per school was very small, perhaps no more than one or two. The second was in the late 1990s, when the number of PCs was massively increased, and a national professional development programme for teachers on the use of computers was also launched. With this third wave, government funding has provided IWBs for all schools in England and Wales. By the end of 2005, 94% of primary schools were estimated to have at least one IWB - increased from 63% in 2004 (Becta 2006a; Becta, 2005). The mean number of IWBs per primary school was reported to be five in 2005, compared to just two in the previous year (Becta 2006b).

ICT innovations in education are often surrounded by optimistic rhetoric, dating back to Papert's (1980) claims for the 'powerful machine'. The same rhetoric can be found in the discussion of the introduction of IWBs. For instance, during the time that IWBs were being introduced into English schools, Mirandanet (an association of educational researchers and developers of ICT) had on its website: 'the technology can effect a profound change in the ways in which our students learn, the ways in which we teach and, more fundamentally, the ways in which we organize the curriculum and our schools.' (Mirandanet, 2005). The Secretary of State for Education who promoted the UK whiteboards initiative, Charles Clarke, was quoted as saying 'ICT transforms education and the way that children learn.' (Public Technology, 2004), and 'I have been hugely impressed myself by the use of electronic whiteboard technology. I have seen really exhilarating lessons taking place, engaging children in an entirely different way.' (Hitachi, 2004). Evaluations of a more careful kind are well summarised by Weller (2002, p. 7): 'It is the impact upon teaching practice where educational technology seems to have been much less significant than the investment, discussion and optimism surrounding it would warrant.'

Teachers' apparent reluctance to wholeheartedly embrace technology as a transformational force is often seen by ICT advocates as simply reflecting their professional conservatism or lack of vision. As Secretary of State Clarke again said: 'The first problem is that the culture of using ICT is not deeply founded in the teaching of education - it is a long mountain we have to climb... Teachers have to be convinced to use ICT for the betterment of students' education.' (Clarke, 1999, p. 2). Many of these advocates of ICT simply trust the technology to somehow deliver in and of itself the 'transformation' and 'revolution' of educational practice. In all these initiatives, there has been little recognition of the potentially disruptive effect of introducing new technology into an established domain of work, especially given the inevitable unreliability of that technology in its early stages. Only rarely, and relatively recently, has it been suggested that computers might help teachers do the job they already do more effectively, rather than be a force for changing it. (Compare the way that computers are provided for secretaries, accountants, research scientists and graphic designers.) But of course the computers offered to schools, in the first waves of initiatives, were not expressly designed for use in the kinds of collective endeavours which take place in classrooms. In the form of 'personal computers' (PCs), they were essentially hand-me-downs from the office, well-designed only for individual activity. The tools being provided were not really fit for purpose. Moreover, educational software has often been designed without the close involvement of teachers (or even educational researchers), and so often has had

little direct relationship with the aims and constraints of the curriculum. It has therefore been difficult for teachers to properly integrate the use of ICT into their normal practice (Hennessy, 2006).

New technology is brought into schools for the use of teachers with generally well-established practices, often grounded in many years of experience, and often generating appropriate and successful educational outcomes. A technology-led mode of introduction which ignores this is very likely to create problems, especially regarding teachers' take-up of the technology as a pedagogic tool (Dawes & Selwyn, 1999; Dawes, 2000). The material situation facing teachers in the face of innovations is that the new tools, whatever they are, must be integrated into pedagogical practices of teachers (Hennessy, *op.cit.*). As the classroom researchers Burnett, Dickinson, Myers, & Merchant (2006, p. 12) explain: 'The problem with transformation is that it always seems out of reach... Whilst waiting for the bright new future, teachers have to get on with coping with the present.'

We suggest that a different perspective should be taken in introducing and evaluating new technology. The important issue is not whether or not technology transforms teaching, but how effectively it contributes to teaching and learning, in the context of normal pedagogic practice.

3. Researching the Interactive Whiteboard

The IWB, with its large, touch-sensitive display, is perhaps the only type of educational technology well-suited for whole-class interaction. Typical functionalities of IWBs include:

- Large, touch sensitive, full colour displays on which teacher and pupils can write their own text, call up images from a hard disk, Internet or intranet and run a range of software, including simulation software;
- The option to select, display, move and manipulate images (including video) and texts;
- The possibility to save and recall current and previous lesson activities, which may be revisited, reviewed and amended as and when required;
- The option of connecting the IWB to a range of other ICT equipment, including laptops operated by children in the class, digital cameras, video-players and microscopes.

By conceptualising the IWB as a tool or mediating artefact (Wertsch *et al.*, 1993), we aim to take into account the relationships between the affordances of IWBs, the pedagogical practices of teachers and the communicative repertoires of teachers and pupils within the particular context of whole-class teaching. In our recent research, we have observed sequences of lessons in the primary classrooms of teachers who have taken up the IWB with at least some measure of enthusiasm and declare themselves to be relatively keen users of this technology. Our investigation is not therefore an objective evaluation of this technological innovation *per se*. It is rather an exploration of some of the ways in which

keen, relatively competent early adopters of the new technology are making use of the IWB within their whole-class teaching. We focus upon the activities of the teacher as she or he utilises the IWB in pursuit of pedagogic goals, typically – but not always – in the context of whole class interaction. This allows us to examine not only the ways the IWB is integrated into practice, but also its ‘transformational’ potential. For example, research has shown that teachers typically use interactions with students to build a contextual foundation of ‘common knowledge’, based on past experience shared with students, to underpin classroom activity (Edwards & Mercer, 1987). Is the IWB employed for this very legitimate purpose – and does its use help the building of such a useful foundation? Research internationally has also shown that classroom dialogue normally has a regular pattern of Initiation-Response-Follow-up (IRF) (Sinclair & Coulthard, 1975) in which teacher’s talk and teacher’s questions predominate and students only make short responses (see for example Edwards & Westgate, 1994; Mercer, 1995; Burns & Myhill 2004). Although in some other countries extended contributions from pupils have been observed as more common (Alexander, 2000), this seems to typify life in most British classrooms. There have been recent attempts by both researchers and government agencies in the UK to create a more ‘dialogic’ climate in schools (Mortimer & Scott, 2003; Alexander, 2004; QCA, 2003; DfES, 2002), and our own research has shown that more active discursive involvement of pupils is associated with better learning outcomes (Rojas-Drummond & Mercer, 2004). We were therefore interested to know if the use of the IWB was associated with changes in the normative patterns of whole-class interaction, or if it was employed to sustain the discursive *status quo* which has been so persistently documented by classroom researchers. More generally, we have sought evidence of how teachers use the IWB as part of their communicative toolkit and considered which of its functionalities are actually used. Elsewhere, for example, we have examined how its multifunctionality can be applied to the teaching of primary science (Gillen, Littleton, Twiner, Kleine Staarman and Mercer, 2008).

4. Methods

Our research project focused on four teachers and four classes of children aged 7-11 years, in primary schools in the south of England. Each teacher was video-recorded during two sequences of two lessons, providing 16 lessons overall. Recordings were transcribed, with context notes added from the team’s viewing of the videos. Teachers were also interviewed to discover how they account for their use of IWBs. The interviews addressed their individual perceptions of the advantages and disadvantages of the equipment, as well as any ways in which they saw its use enabling or inhibiting their effective pedagogical practice

The analysis consisted of two main stages. The first involved a preliminary consideration of all recorded data and associated transcriptions. The second consisted of a more detailed examination of video and transcript data to create notes on topic themes, lesson content and non-verbal aspects of interpersonal interaction (including the use of technical equipment and other artefacts). Guided by the research questions, particular sequences were then selected for closer examination. The process then became one of: (a) tracing

ways in which the IWB functioned as a communicative and pedagogic tool in the teacher-pupil interactions of the classroom and (b) describing and distinguishing specific features of the interaction around the use of IWBs. This was not a coding procedure, because any emergent descriptors were not used to replace the original data. Instead, we generated descriptions of interactions between teachers and pupils in particular data examples and then attempted to generalise across examples. Descriptors of types of teacher-pupil interaction generated in earlier research provided an initial resource, but new descriptors were created as necessary.

In our analysis, we have drawn on the work of Mortimer & Scott (2003) who have devised a matrix for distinguishing different types of ‘communicative approach’ in teacher-led talk, as shown in Fig 1 below:

	<i>INTERACTIVE</i>	<i>NON-INTERACTIVE</i>
<i>DIALOGIC</i>	<i>A. Interactive / Dialogic</i>	<i>B. Non-interactive / Dialogic</i>
<i>AUTHORITATIVE</i>	<i>C. Interactive / Authoritative</i>	<i>D. Non-interactive / Authoritative</i>

Fig 1: Four classes of communicative approach (Mortimer & Scott, 2003, p. 35)

The *interactive-non-interactive* dimension represents the extent to which the students, as well as the teacher, are actively involved in the dialogue. The *dialogic-authoritative* dimension represents the relative extent to which the students’ or teachers’ ideas influence the content and direction of the classroom talk. These two dimensions allow any episode of classroom dialogue to be defined as being interactive or non-interactive on the one hand, and dialogic or authoritative on the other. Four classes of ‘communicative approach’ can thus be identified: interactive/dialogic, interactive/authoritative, non-interactive/dialogic and non-interactive/authoritative. In a dialogic/interactive episode, a teacher might ask students for their ideas on a topic. The teacher might record those ideas on the IWB for future reference, or ask other pupils whether or not they agree with what has been said. The teacher might ask students to elaborate their ideas (‘Oh, that’s interesting, what do you mean by that?’). But the teacher would not evaluate these ideas in terms of their correctness, or lead the discussion along a narrow, pre-defined track. Classroom talk becomes more ‘authoritative’ when the teacher acts more explicitly as an expert, keeps to a given agenda and directs the topic of the discussion clearly along certain routes (which may reflect the structure and content of the curriculum topic being dealt with). In a non-interactive/authoritative episode the teacher would typically be presenting ideas in a ‘lecturing’ style. These different types of talk do not represent better or worse teaching strategies in any absolute sense: the quality of teaching depends on making the right strategic choices about which to use, and the different types of talk can function in complement. But they do suggest that there is typically too little

interactive/dialogic talk in classrooms, thus limiting opportunities for students’ active involvement in the construction of knowledge.

5. Results

We will present two case studies based on data from lessons observed in the classes of two teachers in one of our project schools.

Case study one: Mr Henderson, Year 3 (ages 7-8) lesson on English (literacy).

Extracts 1, 2 and 3 are from a literacy lesson, on writing instruction texts. This teacher had just three years’ professional experience, but had had access to an IWB for most of this time.

Extract 1: Using pictures of previous lesson as resource

In a cookery lesson the previous day, the children had made pancake batter, and after this literacy lesson they went on to make pancakes (as it was Pancake Day/Shrove Tuesday). The literacy lesson is linked to this activity, as the students are learning how to structure and write a recipe for making pancakes. The teacher had taken photographs of the cooking lesson the day earlier, and put four of these photographs, showing sequential stages of making the batter, on the IWB. Also on the board as Extract 1 begins a set of labels for each of the activities shown (e.g. ‘mixing the batter’), but not yet attached to the pictures. The first extract is at the beginning of the lesson (after four minutes) when the teacher asks one of the pupils to label the pictures. The pupils are all seated on the floor in front of the IWB (a common seating arrangement in the UK). Our transcription conventions are described in a note at the end of the chapter.

Teacher	OK, here we go. Here are some pictures of you doing it yesterday (<i>making pancake batter</i>). Let's see, first of all, let's see if we can get somebody to come and label, what, some of these up correctly. Who would like to come and label the instructions to the pictures? Eh, Ruben, you come and do the first one? (And let you think) just move the, move the label onto the picture you think it goes with.	<i>Teacher gives IWB pen to pupil, who walked up to the IWB. Pupil puts pen to label in order to move it on the IWB</i>
Teacher	Mmm, yeah: Is that right? (<i>to other pupils</i>). That's, why don't you do the one, that's got you on there?	<i>Pupil moves a label to the top right picture</i>
Ruben	OK.	
Teacher	What are you doing there? Right, OK, so move that onto, right, that's it, onto that picture. Very good, right.	<i>Pupil moves label to picture of himself</i>

Extract 1 shows an imaginative use of digital photographs which, by engaging the children in an engaging way, cued common knowledge of past shared experience and thus linked yesterday’s activity to today’s lesson. This could provide some coherence for

pupils' experience of classroom education which, as Alexander (2000), Crook (1999) and other researchers have argued, may not naturally emerge for pupils through participation in classroom activities. The use of the actual photographs of the pupils also made the literacy activity (writing a recipe for pancakes) personal and more authentic. The IWB allows elements of instructional texts to be moved and ordered, and in a way that encourages children to think about the practical implications of the order. While this can of course be achieved in other ways, it is hard to imagine how this could be done so well, or so relatively easily, without this digital technology (i.e. camera + IWB). However, as a piece of classroom interaction, this extract has all the usual structural features: the teacher asks the questions, does most of the talking and follows up children's responses with an evaluative comment. In Mortimer and Scott's terms, this is interactive/authoritative discourse.

Extract 2: Block-reveal: structure and pace

This extract comes from somewhat further in the lesson, when the children are required to think about what they will have to put in the recipe text, after the instructions of making the batter.

Teacher	Right, OK. This is what we're going to be doing the next part of the recipe, so this is now the part that we haven't done yet. Can anybody think what we might be doing next? What would be the next stage in the, to make the pancake? James?	
James	Put in the pan and let it cook.	
Teacher	Putting the?	
James	Put it inside and let it cook	
Teacher	Alright, putting it in the pan and letting it cook, let's see if you're right with that one. Right, very good, yes. Heat frying pan and pour in the batter. What was the verb there? Which verb did we, what did we use there, which is the, what's the doing word in that case? (Liam)	<i>Moves block that was covering text on IWB slightly down to reveal text: "heat frying pan and pour in batter"</i>
Liam	Heat?	
Teacher	Heat, yes, and again it's coming [up at the front isn't it, it's an instruction	
Pupil	[...] instruction	<i>Some children are talking</i>
Teacher	There's two actions, two verbs in that sentence, the other one...	<i>Looks to pupils, some of whom are still talking</i>
Pupil	You also have to put oil in the pan because it's hard to get it out.	
Teacher	That's quite right, you do normally put a little bit of oil or butter, haven't put that down on there. Right.	

In Extract 2 we see the teacher using the ‘block-reveal’ facility to give structure and pace to whole-class discussion. We see the IWB being used as part of a teacher's communicative tool kit . The teacher's uses different language genres, of which one (instructional texts) is bound up with his teaching objectives. In his third turn he accepts, and slightly reformulates, a pupil's contribution towards what is the next action in the sequence of cooking a pancake. He then reformulates it more specifically into the target genre, drawing attention to its grammatical structure and giving it a label (an ‘instruction’). However, when a pupil makes a relevant suggestion, but which does not fit the more formal instructional style - ‘You have to put oil in the pan...’ - the teacher accepts this contribution but does not act on it. The exchange is interactive/dialogic with respect to the students and the teacher’s talk, but not with respect to the teacher’s actions. He chooses not to take advantage of the IWB presentation’s provisionality and mutability to revise his original formulation. The written presentation of the recipe can perhaps be considered a powerful form of 'authoritative' discourse, which cannot be easily dislodged by the oral discourse. In this way we see how the IWB is used as a tool for maintaining the discursive *status quo* of the classroom, rather than disrupting or transforming it. However, a key potentiality of the IWB is the ease of making such shifts, of drawing flexibly on the mediational tool kit in a way that Wertsch (1991) captures with the notion of *heterogeneity*, and it is to such an example we turn now.

Extract 3: Provisionality: adding quantities

The last extract for this teacher is from later in the lesson, after the children have been working in groups on their recipes. The teacher has put a template on the IWB which shows the heading ‘Ingredients’, a bullet list to be filled in by the pupils, and some pictures of various ingredients. The pupils have to fill in the same template on paper, working together in groups. The teacher walks around the classroom and talks to pupils.

Pupil	(Do you have to put like) how much to put in?	<i>Pupil walks over to teacher</i>
Teacher	Yes, (<i>directs attention to rest of the class</i>) if you can remember how much, remember it is important. Who can remember how much we used of the different ingredients? Katie?	<i>Pupils raise hands, teacher walks to IWB, where the template of the recipe is still shown</i>
Katie	Erm, one hundred grams of flour	
Teacher	Flour, yes, that was one hundred grams, good. I'll write that one here. One hundred grams, good. Can anyone remember how much milk we used?	<i>Writes ‘100g’ in the picture of the flour on the IWB</i>

In Extract 3, we see that the teacher uses the provisionality afforded by the IWB. During the group work, one of the children notices that the amounts of ingredients are not listed. The teacher acknowledges the importance of this and subsequently adds the quantities to the recipe items on the IWB, while also taking the opportunity to move into the language of weights and measures.

While we cannot explain why the teacher took up this opportunity and not the earlier one, we can say that the affordances of the IWB were used by this teacher to:

- (a) support both authoritative/interactive dialogue and non-authoritative/interactive dialogue (using children’s contributions to modify his formal presentation and hence the task-related information);
- (b) relate past shared experience and so build a contextual foundation of common knowledge for current tasks;
- (c) give children opportunities to move from everyday language into the more specialized forms of a target genre;
- (d) make a lively and engaging presentation;
- (e) maintain a balance between planned lesson structure and spontaneous reactions to contributions and events as they unfolded.

It is evident from our observations and interview data that this teacher had integrated the IWB fully into his lesson planning and teaching strategies. The technology seems to serve effectively as a tool for pursuing his normal, and legitimate, teaching goals. Its use is not in any sense disruptive of his practices. It seems to make a very useful enhancement to his teaching tool kit, but it is not in any pedagogical sense ‘transformational’.

Case study 2: Mrs Patel, Year 5 (age 9-10 years) science lesson

Extracts 4, 5 and 6 were taken from a science lesson on evaporation. This second teacher had the role of providing ICT-related support for other teachers within her education authority, and so was very familiar with the technology. She was not the regular teacher for this class, and while she was often based at this school she was not very familiar with the pupils involved. Nevertheless, her confidence with the IWB was apparent in seamless movement through screens, and incorporation of a variety of the IWB’s functionalities.

Extract 4: Video: engagement at lesson start

Extract 4 is from the start of the lesson. After overcoming a few problems in accessing the file, the teacher opens a video file of herself in her kitchen at home. The extract shows her putting water into a hot frying pan, to demonstrate how the water evaporates. This is presented in the form of a ‘magic trick’.

Teacher (on video)	Hey, this is Mrs Patel. I’m standing in my kitchen and I’m going to do a magic trick. Are you ready? <i>(pause)</i>	<i>Teacher in classroom moves to side of IWB out of the way</i>
Pupils	Yes	
Teacher (on video)	I said are you ready?	<i>Holds hand to ear in listening gesture</i>
Pupils	Yes! <i>(louder)</i>	
Teacher	You see I’ve got an ordinary frying pan	<i>Holds up pan in left hand and</i>

(on video)	<p>here</p> <p>and an ordinary glass of water.</p> <p>I'm going to take a bit of the water, and I'm going to put it in the frying pan.</p> <p>Watch carefully</p> <p>Now you see it... (<i>pause</i>)</p> <p>Now you don't</p>	<p><i>runs right hand round it, lowers pan but keeps left hand on it</i></p> <p><i>Holds up glass in right hand and puts back on side</i></p> <p><i>Takes spoonful of water, and moves above pan</i></p> <p><i>Drops water into pan, which sizzles</i></p> <p><i>Holds up pan on its side, and no water runs out</i></p>
Pupil	Whoa!	
Teacher (on video)	Tada!	<i>Looks back at camera keeps holding pan in left hand, and raises right hand to 'show off' her display</i>
Pupil	That is a magic trick!	<i>Pupils clap</i>

This extract shows the teacher making imaginative and effective use of technology (digital video camera + IWB) to demonstrate to the children how water is evaporated by heat, in a way that clearly engaged the children and avoided the need for staging an event which might create 'health and safety' problems. The children saw something relevant that they would possibly not have been able to see otherwise in a classroom. Also, by presenting the video file as a 'magic trick', the teacher provided the pupils with an 'anchor', which grasped their attention and enabled the building of further understanding (Schwartz, Lin, Brophy, & Bransford, 1999). This was a non-interactive/authoritative piece of discourse which seemed to function well in context.

Extract 5: Pupil involvement: hands up and IRF sequence (Initiation-Response-Follow-up)

This extract is taken from part way through the science lesson, during a task to categorise various objects on the IWB as solid, liquid or gas. Some class members disagree as to whether ice (the particular object they are categorising at that time) can be considered a solid or liquid. The teacher tries to draw the 'correct' answer from the pupils, to establish the difference between ice as a solid and water as a liquid.

Teacher	OK, it <u>could</u> be liquid. When is that a liquid?	
Pupils	(<i>intake of breath</i>)	<i>Raise hands energetically</i>
Teacher	When is that a liquid? (<i>pause</i>) Er, Josh.	
Josh	(<i>quietly</i>) When the temperature is very hot	<i>Lowers hand before speaking, and other students then lower their hands</i>

Teacher	When is, sorry, [when	<i>Said in a questioning tone</i>
Josh	[When the temperature is hot	
Teacher	When the temperature is hot, it's a liquid?	
Another pupil	When it melts	
Josh	<i>(laughs)</i>	<i>He laughs as if he suspects his answer isn't quite right</i>
Teacher	Does that make sense? Can somebody try to re-word that for me?	<i>Pupils begin to raise hands again (including Josh)</i>
Pupil	When it's been melted	
Teacher	When it's been melted and it's <i>(pause)</i> what?	
Pupil	Er, er water	
Teacher	Water, well done	

Extract 5 illustrates that the dialogue throughout this lesson was very much of the normal IRF kind, with closed questions from the teacher and short responses from students, and with the teacher relying on the usual 'hands up' system for selecting respondents. The same kind of conventional dialogue structure can be found in Extract 6.

Extract 6: Risk taking and error: exposure or opportunity

This extract is also from the task to categorise various objects as solid, liquid or gas. A girl has been called to the IWB, and selects a picture to categorise (the bottom half of the picture shows a desert, and the top half a blue sky). The girl (Aimee) appears confused about which category it should belong to (solid, liquid or gas), and the teacher poses questions to her and the class to work through the confusion.

		<i>Aimee comes up to the IWB. Teacher gives her the IWB pen, and she hovers the pen over a picture</i>
Teacher	What is that a picture of, Aimee?	
Aimee	A desert?	
Teacher	Yep	<i>Aimee starts to drag the picture over to the 'gases' column, but then hovers between the 'gases' and 'liquids' columns</i>
Aimee	(...)	<i>Aimee looks to teacher, but doesn't let go of the picture</i>
Teacher	You think it's a gas?	<i>Other pupils mutter</i>
Teacher	<i>(to Aimee)</i> What are we looking at? Which part of the picture are you	<i>Teacher moves finger to point repeatedly between top and</i>

	looking at? <i>(to rest of class)</i> No, she [could	<i>bottom sections of the picture</i>
Aimee	[Oh, oh	<i>Aimee starts to move picture over to 'solids' column</i>
Teacher	She could be right. She could put it there, and we'll talk about why <i>(to Aimee)</i> What part are we looking at? What do you think that picture is talking about?	<i>Aimee moves picture slowly to more central position between the three categories</i>
Aimee	I don't understand	<i>Releases the IWB pen's hold of the picture</i>
Teacher	Which material are we looking at?	<i>Teacher points between the top and bottom sections of the picture. Aimee then points to the top section.</i>
Teacher	<i>(to rest of class)</i> The sky! OK. She's looking at the sky and she wants to put it in the 'gases'. Is that correct?	<i>Teacher points from picture to the 'gases' column</i>
Pupils	[No [Yes	
Teacher	Oh, put your hands up please, hands up. Do you think she's right Allan?	<i>Pupils start to put their hands up</i>
Allan	Yes	
Teacher	Yeah. If she's looking at the sky, and she wants to put it in the 'gases' she's correct. Why?	
Allan	Because erm, well gases like, erm air, you know, and, and, erm, air's gas.	
Teacher	Good. Well done.	

In Extract 6 there is an interesting use of the IWB for actively involving children in the construction of knowledge. They are asked to come up to the IWB to put images of substances in appropriate frames (i.e. solids, liquids or gases). This activity provides the teacher with an opportunity to establish the children's level of understanding about the topic, as well as interactivity on the part of the pupils. The extract illustrates the power of the IWB to engage pupils, as from the raised hands it seems that they are very eager to be chosen to come up to the IWB for the activity. However, this affordance of the IWB also carries with it risks for pupils of public exposure and ridicule for error, as in the case of the girl who put the 'desert' picture in the 'gases' box. We would argue that since in most research the IWB is reported to be highly motivating for pupils, the issue of managing classroom behaviour when mistakes are exposed is important for teachers. We might note that this teacher paid considerable attention to recasting the perceived error as a legitimate possibility.

Smith (2001) in her evaluation of IWBs in one region of the UK emphasised the importance of pupils as well as teachers using the IWB, but also commented on the

difficulties of individual pupil use, where the one-at-a-time nature of this activity means other pupils have to sit and wait their turn (as seen in Extract 5 above). Smith also noted that in such activities where pupils are called up to interact with the board, teachers noted a loss of pace, and boredom of more able pupils. Thus the introduction and utilisation of new interaction opportunities, which pupils tend to find motivating and enjoyable when it is their turn (Smith *et al*, 2005), raises new issues for classroom management. In this lesson such potential challenges were managed through changes of pace and variation of activities.

Conclusions

As discussed earlier, one common claim made by proponents of ICT in education is that new technology is ‘transformational’. This could be taken to mean that simply using the technology will have profound effects on classroom practice, and indeed on pedagogy. The implication then is that if no transformation occurs, the technology is not being used properly. We have questioned this position and argued that a successful introduction of ICT could instead mean that some procedures or strategies within established teaching practices become easier to enact, or quicker to accomplish. In other words, we have argued that new ICT should be conceptualized as an addition to a teacher’s toolkit, rather than as a coercive means for changing educational practice. We have illustrated our argument with case studies of teachers’ use of the IWB, showing how this specific mediating artefact is used within established procedures, strategies and patterns of interaction.

We have shown that the IWB can be a very effective tool, enabling teachers to:

- Consolidate shared experience, and so enhance continuity and coherence across lessons;
- Provide a more authentic and engaging whole-class learning experience for children;
- Integrate diverse, multimodal learning resources.

In the interpretation of our findings, we draw on a distinction made by Smith *et al*. (2005) between *technical interactivity* and *pedagogical interactivity*. In terms of technical interactivity, the IWB seems to facilitate a speedy, smooth presentation compared with earlier technology (for instance when a teacher would use a video player, then write on a blackboard, then allow children to manipulate pictures on a magnetic screen and then use the video again). As a mediating artefact, it can justifiably be claimed to transform teaching to the extent that it clearly enables teachers to combine innovative styles of presentation different kinds of multimodal information.

In terms of pedagogical effects, the picture is more complex. In English schools, the IWB is always located at the front of the classroom, and so the teacher inevitably teaches from there. This can mean that the teacher is well placed to observe and respond to pupils’ comments (as Smith, 2001 suggested); but there is evidence also to support the claim by Hall & Higgins (2005) that this may reinforce a traditional style of teaching. There is the

danger of a teacher feeling tied to the structure and pace of a previously prepared IWB presentation, thus reducing the opportunity for spontaneous pupil-contributions and extended classroom dialogue. On the other hand, the shared representation of content on the IWB potentially may encourage more interactive/dialogic interaction, in Mortimer & Scott's (*op.cit.*) terms, if children use the representation on the IWB to challenge the teacher's (or other authority's) claims (as we saw in Extract 2). This illustrates the potential of IWBs for contributing to changes in the quality of pedagogic dialogue.

Overall, we have observed that IWBs enable teachers to produce lively, engaging, well-structured and interactive lessons quite easily, which is likely to have an effect on what teachers realistically *can* do in the time available. The most effective use of IWBs seems likely to involve striking a balance between providing a clear structure for a well resourced lesson, and retaining the capacity for more spontaneous or provisional adaptation of the lesson as it proceeds. Otherwise there remains a danger of over-reliance on the conventional IRF structure for dialogue, with its associated closed questioning, 'cued elicitations' (Mercer, 1995) and one word answers from pupils. Teachers may use the whiteboard's technical affordances effectively, yet maintain their established, conventional style of teaching. In this sense the use of this new technology cannot be claimed to 'transform teaching', in which interactive/authoritative talk prevails. Indeed, since it is possible to use the IWB to increase the pace of the lesson, for instance through the quick manipulation of images, opportunities for extended teacher-pupil dialogue may even become more limited.

In summary, we have observed Interactive Whiteboards being used effectively by teachers in English primary schools to facilitate what they want to do: but we have not seen this technology cause a radical reformulation of how teaching and learning is carried out. Our research therefore reinforces our belief that expectations of ICT in education as a 'transformational' force are often misconceived, and probably counter-productive to the effective use of the technology in schools. If new technology was reconceptualized as a potential means for helping teachers do their job more effectively, rather than as a means for making them change their established practices, it would almost certainly receive a warmer welcome from the professional workforce. It would probably also be more likely then to contribute to better learning outcomes for students. It may well be that some established pedagogic practices need to be criticised, re-evaluated and changed: indeed, there is much evidence that this is the case. But this cannot be achieved simply by introducing new technology. To paraphrase Wertsch's (1991) comments, as quoted at the beginning of this article: the tools of educational technology have no magical power in themselves: only by being embedded in the practices of teachers and learners do their mediational means come into play. It is only when this is properly appreciated that we will be able to make best use of governmental boldness in technological investment, welcome as that may be. In future research on technological innovation in education, we suggest that there is a need to reassess the appropriateness of the 'transformational' image of ICT in education; plan and assess the use of computer technology from an educational, rather than a technological, perspective; and develop a more sophisticated conceptual model of how ICT can facilitate teaching and learning in the classroom

Note: Transcription conventions

could indicates emphasis

(making) indicates partly unintelligible speech, with most likely speech noted

(...) indicates unintelligible speech

[indicates overlapping speech

(*intake of breath*) indicates contextual note

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