

A “LEARNING REVOLUTION”? INVESTIGATING PEDAGOGIC PRACTICES AROUND INTERACTIVE WHITEBOARDS IN BRITISH PRIMARY CLASSROOMS

JULIA GILLEN^{*}, JUDITH KLEINE STAARMAN[#], KAREN LITTLETON^{*}, NEIL MERCER[#],
ALISON TWINER^{*}

^{*}The Open University, Milton Keynes, UK

[#]University of Cambridge, Cambridge, UK

Paper presented at the AERA Conference, 2006 in San Fransisco, USA.

Abstract: *Interactive whiteboards have been rapidly introduced into all primary schools under UK Government initiatives. These large, touch-sensitive screens, which control a computer connected to a digital projector, seem to be the first type of educational technology particularly suited for whole-class teaching and learning. Strong claims are made for their value by manufacturers and policy makers, but there has been little research on how, if at all, they influence established pedagogic practices, communicative processes and educational goals. This study has been designed to examine this issue, using observations in primary (elementary) school classrooms. It is funded by the UK Economic and Social Research Council and builds on the authors' previous research on ICT in educational dialogues and collaborative activities.*

1. BACKGROUND

As part of the UK Government's plans to embed ICT into the everyday life of the primary (elementary) school classroom, the Interactive Whiteboard (IWB) has been introduced in British classrooms at a rate unprecedented anywhere else in the world. Although an up to date figure concerning the number of IWBs in schools is difficult to establish with the current rates of investment, by 2004 63% of primary schools in England and Wales had at least one IWB (British Educational Communications and Technology Agency: Becta, 2005), and it seems likely that every primary schoolchild in England and Wales has some experience of them. The introduction of IWBs is expressly related by policy makers to the goal of raising attainment through improving pedagogic practice; strong claims that the use of IWBs can ‘transform’ teachers’ practice are made by both policy makers and manufacturers. The underlying assumption is that IWBs will have blanket benefits for learning, as former UK Secretary of State for Education Charles Clarke (Arnott, 2004) asserted: ‘Every school of the future will have an interactive whiteboard in every classroom, technology has already revolutionised learning’.

However, as has been the case with earlier Information and Communication Technology (ICT) initiatives, there is a danger that the introduction of this expensive, potentially valuable piece of equipment is ‘technology-led’ (i.e. it is introduced because it is available) rather than ‘education-led’ (i.e. it is introduced because it is known to meet the professional needs of teachers and the educational needs of children better than existing educational tools). Earlier research on the introduction of computers to schools has shown that a technology-led mode of introduction is very likely to create problems, especially regarding teachers’ take-up of the technology as a pedagogic tool (Dawes, 2000; Dawes & Selwyn, 1999).

There is no doubt that IWBs have some interesting affordances that could be of value for classroom teaching. For example, they allow images and texts to be selected, displayed, moved and modified in ways that conventional classroom display technology cannot. Levy (2002) identified the advantage of visual and verbal representation. Smith *et al* (2005) also reported on the IWB’s potential to foster provisionality and flexibility of teaching style and resource. The researchers suggested that it can assist teachers in addressing a range of pupil needs, and facilitate flipping back and forth through current and previous lessons’ work to reinforce concepts as and when required. They can be networked to other ICT equipment, including laptops operated by children in the class. Several practically-orientated studies of the use of IWBs have already been carried out in the UK, for example the Review Project at Hull

University (with Nesta - the National Endowment for Science, Technology and the Arts - Futurelab) and the case studies gathered by Mirandanet (Smith, 2000). Professional evaluations by practising teachers are being organised by Schoolzone, and the Department for Education and Skills (DfES) has also recently commissioned other evaluation research. Together with various other resources, such as the 'presentation technology' section of the Becta website which draws on emerging practice in schools, these studies have identified many potentially useful affordances of IWBs, as the only type of educational technology particularly suited for whole-class teaching and learning.

Our research, which draws on work on teacher-pupil communication and on the introduction and use of ICT in educational settings, stems from the conviction that there is a need for a more detached consideration and evaluation of the IWB as a pedagogic tool. By conceptualising the IWB - from a socio-cultural perspective - as a tool or *mediating artefact* (Wertsch *et al.*, 1993) in primary school classroom practices, we aim to take into account the relationship between the affordances of IWBs the pedagogical practices of teachers and the communicative repertoires of teachers and pupils.

In a recent study of whole class teaching in primary education, Burns & Myhill (2004) examined the nature of teacher-pupil interaction. In accord with earlier research (as summarised in, for example, Edwards & Westgate, 1994; Mercer, 1995), they found that teachers allowed pupils very little time to initiate responses to questions and did not elicit extended responses from pupils. Pupils generally made only brief responses and took quite a passive role in classroom interactions. 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 (Alexander, 2004; Qualifications and Curriculum Agency (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). An interesting facet of IWBs is that they are the only educational ICT tool expressly designed for whole-class interaction. So a key aim is to ascertain whether their use is associated with any changes in the dialogic patterns of whole class interaction, or whether they are simply used to sustain the *status quo* which has been so persistently documented by classroom researchers over the years.

2. AIMS AND OBJECTIVES

The current study therefore investigates how IWBs actually function as a communicative and pedagogic tool in classroom interactions, how they are used by teachers to pursue their educational goals, and how they are used to build shared frames of reference and 'common knowledge' (Edwards & Mercer, 1987) between teachers and pupils. It does so through the analysis of observed and recorded interactions in British classrooms, drawing on the considerable body of research on teacher-pupil communication in classrooms and on the introduction and use of ICT in educational settings (for example, Alexander, 2000; Burns & Myhill, 2004; Wegerif & Dawes, 2004).

More specifically, our data are used to examine:

- (a) ways that the IWB functions as a communicative and pedagogic tool in the teacher-pupil interactions of the classroom;
- (b) ways in which well-documented features of normal classroom interaction appear to be altered by the use of the IWB;
- (c) ways that the use of the IWB appear to encourage or discourage the active participation of children in the process of teaching-and-learning (or in any way to offer them new opportunities for participation);
- (d) the distinctive ways in which the IWB is used to build a shared frame of reference between teacher and children or to build common knowledge amongst members of the class;
- (e) the extent to which potentially valuable affordances of the IWB are, or are not, used by teachers to pursue their pedagogic goals.

3. METHODS

In the context of this ongoing project we have collected observation and interview data from four teachers working within urban primary schools in the South of England. These schools were selected on the basis of existing working relations with the project team, and also schools' expressed interest to be involved in the research. In justification of this sampling method our aim was not to survey classrooms to describe the normal practices with IWBs, but rather to investigate the function and value of IWBs as mediating tools in the communicative process of education. It was therefore not considered problematic if the teachers made special efforts to incorporate the IWBs into their teaching and learning practices during our visits.

We have focused on key stage two classes (children aged 7-11 years), at the upper end of primary education. Each teacher was video recorded during two sequences of two lessons, providing 16 lessons overall, with some being from Maths or Science domains. All four teachers were also interviewed to reconstruct how they account for their use of IWBs within their teaching and learning. The interview addressed their individual perceptions of the potential advantages and disadvantages of the use of the equipment, as well as any ways in which they saw its use enabling or inhibiting their effective pedagogical practice.

We also engaged in supplementary data collection, including interviewing teachers particularly interested in IWBs outside the overall design (who were self-referred, owing to interest in the project) and a small amount of additional videoing.

Data focus for this paper

For the purposes of this paper we use as case studies data drawn from two lessons in one of the schools. Extracts 1, 2 and 3 are from a year three (ages 7-8 years) English lesson focusing on written instruction. This teacher was fairly new to teaching, with just three years experience, but had had access to an IWB for most of this time. He was one of two teachers at the school in question to receive their first IWBs, which he acquired via an informal 'bidding' process within the school. The school has now supplemented these to their current levels of one in each classroom. His enthusiasm has meant that IWBs are now part and parcel of his classroom environment, with his own comments that he would certainly struggle if he had to teach without this specific technological tool. Extracts 4, 5 and 6 were taken from a year five (age 10-11 years) Science class addressing evaporation. This teacher was the IWB advisor for her Local Education Authority (LEA), and so was very familiar with the technology, but was not the regular class teacher, whereby whilst she was often based at the school she was less familiar with the pupils. Her confidence with the IWB was apparent in seamless movement through screens, and incorporation of a variety of the IWBs functionalities.

Methodology for analysis of the extracts

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, the aim was to generate descriptions of interactions between teachers and pupils which could be applied first to particular data examples and then generalised across examples. Descriptors of types of teacher-pupil interaction generated in earlier research provided an initial resource, but new descriptors were generated as necessary.

In characterising the interaction around the use of IWBs we have drawn on the work of Scott and colleagues (see for example, Scott, 1998; Mortimer & Scott, 2003) who have offered 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)

Scott and his colleagues have explained this scheme as follows:

“Interactive and non-interactive

What do we mean when we say that teaching is interactive? Put simply, we see interactive teaching as allowing for the verbal participation of teacher and pupils and non-interactive as involving only the teacher, excluding the participation of the pupils. Thus in interactive teaching the teacher might typically engage the pupils in a series of questions and answers, whilst in non-interactive teaching the teacher is presenting ideas in a ‘lecturing’ style. We see these ideas as offering one dimension for characterising science teaching; this is the interactive/non-interactive dimension.”

“Dialogic and authoritative

What then do we mean by ‘taking account of pupils’ ideas’? The idea here is that the teacher asks pupils for their points of view and explicitly takes account of them by, for example: asking for further details (‘Oh, that’s interesting, what do you mean by...’); or writing it down for further consideration (‘Let’s just put that down on the board, so that we don’t forget it...’); or asking other pupils whether they agree with it or not (‘Do you go along with what Anita has just said...?’). In a nutshell, the teacher makes room in the classroom talk for a whole range of ideas and we shall refer to this kind of talk as dialogic.

Of course, classroom talk is not always dialogic in form, there are many occasions when the teacher is not interested in exploring pupils’ ideas and taking account of them in the development of the lesson. Here the teacher is likely to focus on the science point of view and if ideas or questions, which do not contribute to the development of the school science story, are raised by pupils they are likely to be reshaped or ignored by the teacher. We shall refer to this kind of talk as being authoritative in nature. We therefore have a second dimension which we can use in thinking about teacher talk in science lessons: this is the authoritative-dialogic dimension. [...]

The two dimensions which we have identified above can be combined to generate four ways in which the teacher might communicate with pupils in the classroom. Thus any episode of classroom talk can be identified as being either interactive or non-interactive on the one hand, and dialogic or authoritative on the other, generating four classes of communicative approach.”

(Scott & Asoko, 2005, in press)

Using this frame, Scott and his colleagues make two important points:

- (a) there are different types of teacher-talk, which vary in the extent to which they position the teacher as ‘expert’ and the extent to which they offer possibilities for substantial contributions by pupils.
- (b) these different types of talk do not represent better or worse teaching strategies in any absolute sense; the quality of the teaching depends on making the right strategic choices; and the different types of talk can function in complement.

4. RESULTS

As outlined above, one common claim made by proponents of IWBs is that they enable a learning revolution. Does this mean that there is a profound change of pedagogy as a result of using the technology, or does it merely mean that some procedures or strategies within established teaching styles become easier to enact, or quicker to accomplish and/or involve difficult preparation? In other words, do we see a radical reformulation of how teaching and learning is carried out, or only a significant improvement in the technical support for conventional teaching? We have examined this by studying interactions around the IWB, situating the use of this specific mediating artefact within (established) procedures, strategies and patterns of interaction employed by the teacher.

Extract 1: Using pictures of previous lesson as resource (4:35 – 5:19)

[Times indicate the interval of the extract into the lesson, and also the duration of the extract.]

Background information: The lesson is a literacy lesson, in which the learning goal is to write a recipe. The children have made pancake batter the previous day and will be baking pancakes today (as it is Pancake Day/Shrove Tuesday). The literacy lesson is linked to this activity, as the students will learn how to write a recipe for making pancakes. The teacher has taken photographs with a digital camera from the cooking lesson the day earlier, and has put four of these photographs on the IWB. The first extract is at the beginning of the lesson (after four minutes) when the teacher asks the pupils to label the pictures, and a bit later, to put the pictures (with the correct labels) in the right order. At this stage of the lesson, the pupils are all seated in front of the whiteboard, on the carpet.

Teacher	OK, here we go. Here are some pictures of you doing it yesterday (making pancake batter) 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 whiteboard pen to pupil, who walked up to the IWB. Pupil moves pen to label in order to move it down on the IWB</i>
Teacher	Mmm, yeah: Is that right? (<i>directed 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>
		<i>Pupil gives pen back to teacher and walks back to the carpet</i>

Transcription conventions

could indicates emphasis

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

(...) indicates unintelligible

[indicates overlapping speech

(*intake of breath*) indicates contextual note

The first extract shows an imaginative use of digital photographs from the previous lesson on this topic which, by engaging the children in a fun way, cued common knowledge of past shared experience and thus provided support for the continuity of yesterday's activity to today's lesson. Linking the content of lessons can provide some coherence for pupils' experience of classroom education which, as Alexander (2000), Crook (1999) and other researchers have argued, does not naturally emerge for pupils through participation

in classroom activities. It has to be actively pursued by the teacher through appropriate teaching strategies. In addition to this, the use of the actual photographs of the pupils made the current activity (writing a recipe for making pancakes) personal and more authentic. It is hard to imagine how this could be done so well, or so relatively easily in terms of teacher effort, without this digital technology (i.e. camera + IWB).

Extract 2: Block-reveal: structure and pace (8:45 - 9:41)

Background information: 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 after the instruction 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 the second extract we see the teacher use the 'block-reveal' facility to give structure and pace to whole class discussion and review of the previous week's work on pancakes.

The IWB also is shown to be a very useful medium for presenting instructional texts in a way that allows for the order of the items to be varied, and in a way that encourages children to think about the implications for action. One of the instructions was noticed by the children to be missing: 'put oil in the pan'. However, the teacher did not take the opportunity of an IWB presentation's provisionality and mutability to revise his original formulation. This may be because at this stage in the lesson, he was very committed to the pre-designed structure of the presentation, and/or because he had expected this part to be based only on 'authoritative' discourse.

Extract 3: Provisionality: adding quantities (40:00 – 40:20)

Background information: The last extract for this teacher is from later in the lesson, after the children have been working in groups to write the content of their recipes. The teacher has put a template on the IWB which shows the heading Ingredients, a bullet list to fill in by the pupils, and some pictures of ingredients. The pupils have to fill in the same template on paper, working together in their 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, later in the lesson, the teacher does take the opportunity to use 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 link this issue to scientific understanding.

While we are not in a position to explain why the teacher took up this one opportunity and not the other, we certainly 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 (the latter using children's contributions to modify his formal presentation and hence the task-related information);
- (b) relate past shared experience and common knowledge to current tasks;
- (c) make a lively and engaging presentation;
- (d) maintain a balance between planned lesson structure and spontaneous reactions to contributions and events as they unfolded.

Extract 4: Video: engagement at lesson start (2:56 – 3:30)

Background information: The first extract for this second teacher 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 (on video)	You see I've got an ordinary frying pan here and an ordinary glass of water. I'm going to take a bit of the water, and I'm going to put it in the frying pan. Watch carefully Now you see it... (<i>pause</i>) Now you don't	<i>Holds up pan in left hand and runs right hand round it, lowers pan but keeps left hand on it Holds up glass in right hand and puts back on side Takes spoonful of water, and moves above pan Drops water into pan, which sizzles Holds up pan on its side, and no water runs out</i>
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 first extract of the second teacher shows imaginative and effective use of technology (digital camera with video + IWB) which enables the teacher to demonstrate to the children water evaporation 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. So the children saw something relevant that they would not have been able to see otherwise. Also, presenting the video file as a 'magic trick' provided the lesson with an 'anchor', which grasped the attention of the pupils and enabled the building of further understanding (Schwartz, Lin, Brophy, & Bransford, 1999). While the video effectively engaged the pupils via the presentational facility, this in itself is only a starting point for potential learning and teaching.

Extract 5: Pupil involvement: hands up and IRF sequence (Initiation-Response-Feedback) (12:00 – 12.23)

Background information: This extract is taken from later in the same Science lesson, during a task to categorise various objects as either solid, liquid or gas. Some children 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 could 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>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>Laugh 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	

In terms of dialogue, extract five illustrates that the structure and content of the dialogue was very much of traditional IRF kind, with closed questions and short responses, and in non-verbal terms relying on the usual 'hands up' competitive volunteer system. The same kind of conventional dialogue structure can be found in Extract 6.

Smith (2001) in her evaluation of IWBs within Kent Grid for Learning 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 five above. Smith also noted that in such activities where pupils are called up to interact with the board, teachers within the study 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.

Extract 6: Risk taking and error: exposure or opportunity (15:25 – 16.14)

Background information: 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 (half the picture shows a desert, and the top half is 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 looking at? <i>(to rest of class)</i> No, she [could	<i>Teacher moves finger to point repeatedly between top and 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 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 interesting use of the IWB for getting children involved in constructing the knowledge. The children 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 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 the usual risks of public exposure and ridicule for error (a cultural feature of British classrooms: cf Alexander, 2000) as in the case of the girl who put the 'desert' picture in the 'gases' box. In this respect, as with other whole class interactions, the pupils have to balance the risk of public exposure of a possible error

with the opportunity of doing an action on the IWB. 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 needs to be important for teachers. This teacher paid considerable attention to recasting the perceived error as a legitimate possibility. Errors and mistakes need to become stepping stones to understanding as opposed to potential sources of ridicule or humiliation (Alexander, 2004), with the IWB resourcing the revision and re-consideration of ideas (see Carter, 2002).

5. CONCLUSION

These first results can be examined in the light of Smith *et al*'s (2005) study of IWB use and a distinction made by them between technical interactivity and pedagogical interactivity with the IWB in the classroom. 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', as is claimed by other research (Smith, 2000), to the extent that it clearly enabled teachers to use a combination of innovative styles of presentation and the rapid succession of different kinds of multimodal information.

In terms of pedagogical interactivity the picture is more complex. Teaching from the front can mean that the teacher is better 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 the board being at the front may reinforce a traditional style of teaching, although clearly depending upon the teachers' skills children may be actively involved in the manipulation of information. The shared representation of content on the IWB potentially may be used to encourage more interactive and non-authoritative dialogue (Mortimer & Scott, 2003) when children use the representation on the IWB to challenge the teacher's (or other authority's) claims, and it seems to us that such instances in our data are noteworthy in terms of utilising the IWBs affordances to contribute to the quality of pedagogic dialogue.

Overall, an effective teacher is likely to engage in a balance of strategies at a number of levels. IWBs enable teachers to produce a very lively, varied, quite complex and interactive lesson more easily than previously possible, which is likely to have an effect on what teachers realistically *can* do in the time available. The most effective use of IWBs seems, from these early results, 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) elicitation and one word answers from pupils (Mercer, 1995). Teachers may use the IWBs technical affordances effectively yet to support an established, conventional style of teaching. This might well be an effective style: but in this sense the use of the IWB cannot be claimed to 'transform teaching' in terms of the classroom dialogue and underlying pedagogy. Owing to the possibility of the IWB to increase the pace of the lesson, for instance through the quick manipulation of images, the opportunities for extended teacher-pupil dialogue may become more limited. In summary, there certainly do exist clear opportunities for identifying ways in which the IWB may be brought into the classroom environment as a useful mediating artefact, and it is our intention to work with teachers to explore these more precisely.

6. REFERENCES

- Alexander, R. (2004). *Towards Dialogic Teaching: Rethinking Classroom Talk*. Cambridge: Dialogos.
- Alexander, R. (2000). *Culture and Pedagogy: International Comparisons in Primary Education*. Malden, MA: Blackwell Publishers.
- Arnott, S. (2004) Computers to replace blackboards. *Computing* 9th August.
<http://www.computing.co.uk/articles/print/2070841> Accessed 8th March 2006
- Becta (2005). *Becta Review 2005: Evidence on the Progress of ICT in Education*. British Educational Communications and Technology Agency.
http://www.becta.org.uk/corporate/publications/documents/Review_2005.pdf Accessed 8th March 2006

- Burns, C., & Myhill, D. (2004). Interactive or inactive? A consideration of the nature of interaction in whole class teaching. *Cambridge Journal of Education*, 34(1), 35-49.
- Carter, A. (2002). *Using Interactive Whiteboards with Deaf Children*.
http://www.bgfl.org/bgfl/custom/resources_fpf/client_fpf/teacher/ict/whiteboards/index.htm Accessed 10th January 2006
- Crook, C. (1999). Computers in the community of classrooms. In K. Littleton & P. Light (Eds.), *Learning with Computers: Analysing Productive Interaction*. London: Routledge.
- DfES (2002). *Key Stage 3 National Strategy: Training Materials for the Foundation Subjects*. London: Department for Education and Skills. http://www.standards.dfes.gov.uk/keystage3/respub/fs_trmat Accessed 8th March 2006
- Dawes, L., & Selwyn, N. (1999). Teaching with the dream machines: The representation of teachers and computers in information technology advertising. *Journal of Information Technology for Teacher Education*, 8(3), 289-304.
- Dawes, L. (2000). First connections: Teachers and the National Grid for Learning. *Computers and Education*, 33(4), 235 – 252.
- Edwards, D., & Mercer, N. (1987). *Common Knowledge: The Development of Understanding in the Classroom*. London: Methuen/Routledge.
- Edwards, A., & Westgate, D. (1994). *Investigating Classroom Talk* (2nd edn). Basingstoke: Falmer Press.
- Hall, I. & Higgins, S. (2005) Primary school students' perceptions of interactive whiteboards. *Journal of Computer Assisted Learning*, 21, 102-117.
- Levy, P. (2002). *Interactive Whiteboards in Learning and Teaching in Two Sheffield Schools: A Developmental Study*.
<http://www.shef.ac.uk/eirg/projects/wboards> Accessed 10th January 2006
- Mercer, N. (1995). *The Guided Construction of Knowledge: Talk Amongst Teachers and Learners*. Clevedon: Multilingual Matters, Ltd.
- Mortimer, E.F., & Scott, P.H. (2003). *Meaning Making in Secondary Science Classrooms*. Maidenhead: Open University Press.
- QCA (2003). *New Perspectives on Spoken English in the Classroom: Discussion Papers*. London: Qualifications and Curriculum Authority.
- Rojas-Drummond, S. & Mercer, N. (2004). Scaffolding the development of effective collaboration and learning. *International Journal of Educational Research*, 39(1-2), 99-111.
- Schwartz, D.L., Lin, X., Brophy, S., & Bransford, J.D. (1999). Toward the development of flexibly adaptive instructional designs. In C.M. Reigeluth (Ed.), *Instructional Design Theories and Models: A New Paradigm of Instructional Theory, Vol. II* (pp. 183-213). Mahwah, NJ, USA: Lawrence Erlbaum Associates, Inc., Publishers.
- Scott, P. (1998). Teacher talk and meaning making in science classrooms: a Vygotskian analysis and review. *Studies in Science Education*, 32, 45-80.
- Scott, P. & Asoko, H. (in press). *Talk in Science Classrooms*. Association for Science Education Guide to Secondary Science Education, 2005.
- Smith, A. (2000). *Interactive Whiteboard Evaluation*. <http://www.mirandanet.ac.uk/pubs/smartboard.htm> Accessed 26th October 2004
- Smith, H. (2001). *Smartboard Evaluation: Final Report*.
<http://www.kented.org.uk/ngfl/ict/IWB/whiteboards/report.html#6> Accessed 10th January 2006.
- Smith, H.J., Higgins, S., Wall, K. & Miller, J. (2005). Interactive whiteboards: boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*, 21, 91-101.
- Wegerif, R., & Dawes, L. (2004). *Thinking and Learning with ICT*. London and New York: RoutledgeFalmer.
- Wertsch, J.V., Tulviste, P., & Hagstrom, F. (1993). A sociocultural approach to agency. In E.A. Forman, N. Minick & C.A. Stone (Eds.), *Contexts for Learning: Sociocultural Dynamics in Children's Development* (pp. 336-356). New York: Oxford University Press.

Corresponding Author:
 Dr. Julia Gillen
 The Open University
 Centre for Research in Education and Educational Technology
 Walton Hall
 Milton Keynes
 MK7 6AA
 United Kingdom
 J.Gillen@open.ac.uk