

# **Embedding ICT In The Literacy And Numeracy Strategies**

Final Report

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## Contents

Contents .....	2
Executive Summary .....	3
Introduction .....	9
Section 1: Analysis of the attainment data .....	10
Section 2: Classroom Observations .....	16
Section 3: Interviews with Teachers.....	33
Section 4: Teachers' Reported Use of the Interactive Whiteboard.....	45
Section 5: Pupil interviews .....	49
Section 6: Surveying the Literature on Interactive Whiteboards.....	55
Section 7: Discussion and conclusions .....	67
References .....	70

## **Executive Summary**

### ***Background***

The purpose of this document is to present the findings from the evaluation of the 'Embedding ICT in the Literacy and Numeracy Strategies' pilot project. In this project interactive whiteboards (IWBs) were installed in Year 5 and Year 6 classes in 12-15 schools in each of six Local Education Authorities (LEAs): Cumbria, Bracknell Forest, Lewisham, Oxfordshire, Redcar and Cleveland, and Wakefield. In each of these LEAs a local co-ordinator was appointed as an IWB Consultant to manage the project locally and to provide training and support to the teachers involved. The pilot project ran from Autumn 2002 to Summer 2004.

The evaluation, undertaken by a team based in the Centre for Learning and Teaching in the School of Education Communication and Language Sciences at Newcastle University investigated aspects of classroom interaction through a series of structured observations, the views of teachers and pupils through interviews, teachers' weekly records of IWB use and the impact on pupils' attainment through their performance in national Key Stage 2 tests. In addition a literature review was undertaken to support both the pilot project and the evaluation.

### ***Summary of Findings***

#### **Overall summary**

The introduction of the technology, training in its use and the support of the IWB consultants were all rated highly. There can be no doubt that the introduction of IWBs had a real impact on the primary classrooms where they were introduced. The response of the teachers and pupils involved in the project has been overwhelmingly positive. Both were convinced that these changes were improving the teaching and learning in lessons where they were used. The observations confirm that there were significant differences in patterns of classroom interaction, both as the teachers learned to use the technology and a year later as IWBs became more embedded in literacy and mathematics lessons. The indications from these observations also suggested that the changes in questioning by the teachers and the responses from their pupils were consistent with the kinds of interaction associated with effective teaching. Analysis of national test data at first suggested that the impact of the introduction of IWBs was associated with improvements in children's learning. However these gains were not found in the second year, suggesting that the early improvement was due to the initial intervention or that sustained improvement is harder to achieve, especially in high performing schools.

#### **Analysis of the attainment data**

Compared with other schools nationally the pupils in the IWB pilot schools performed better on national tests in mathematics and science in 2003. However, though statistically significant, the extent of the difference is small.

No difference was found in performance on national tests for the pilot project schools in 2004.

A more detailed analysis using a comparison group of schools from each of the LEAs shows a similar picture with small improvements in 2003 and no difference in 2004.

There is some evidence that the use of IWBs improves the performance of low-achieving pupils in English and that the overall impact is greatest on writing.

The impact of the use of IWBs is broadly similar for both boys and girls.

### **Classroom observations**

Structured observations of classroom interaction were undertaken in early 2003 and again a year later in early 2004. A total of 184 lessons were observed; the research focused on differences between lessons where teachers did and did not use IWBs for literacy and mathematics and on any changes in patterns of interaction a year later.

Overall IWBs do seem to make a difference to aspects of classroom interaction. Some of these are relatively short-lived; others appear over time as the use of the technology becomes embedded.

From both the 2003 and 2004 observations, there were fewer pauses and uptake questions in IWB lessons (these are questions which build on a pupil's answer); but an embedding effect was observed in 2004 whereby there were also more open questions, repeat questions, probes (where a teacher asks for further information or an explanation of the answer from a pupil), longer answers from pupils, and general talk in these lessons. There was almost twice the amount of evaluative responses from teachers in whiteboard lessons.

There was a faster pace in the whiteboard lessons in 2004 compared with the non-whiteboard lessons in 2003. This measure of pace is based on an increase in the total number of interactions between the teacher and pupils in these classes.

The initial increase in the number of answers from pupils observed in 2003 was not observed a year later. However, answers from pupils were longer in whiteboard lessons compared to non-whiteboard lessons. Also, the initial decrease in the amount of explanation was short-lived (it increased again in 2004).

Teachers using IWBs after a year of use tended to focus their uptake or follow-up questions on the whole class rather than an individual pupil. This suggests that pupils' responses were being used to involve other pupils in these lessons.

In the observations in 2003, IWB lessons contained about five minutes more whole class teaching and five minutes less group work than lessons without an IWB. This difference was found in both literacy and mathematics. After a

year, the amount of whole class teaching in IWB lessons was not significantly different to non-IWB lessons, but the amount of group work had decreased further (this time a difference of nearly seven and a half minutes). This difference was found in both Year 5 and Year 6 classes.

The patterns of interaction in lessons by boys and girls remained consistent across both IWB lessons and lessons where such technology was not used. There was no difference in who initiated or received questions and answers between IWB and non-IWB lessons in terms of gender.

### **Interviews with teachers**

There were 68 teachers from pilot project schools interviewed between December 2003 and March 2004.

Overall, the teachers interviewed were extremely positive about the impact of IWBs on their teaching. They were also very positive about the training and support that they had received as part of the pilot project and believe that using the IWB has improved their confidence in using ICT more generally.

All the teachers (100%) felt that the IWB helped them to achieve their teaching aims and cited a number of factors such as the wealth of resources available, the stimulating nature of the presentation and the flexibility that the technology offers.

Almost 99% percent of teachers surveyed believe that using the IWB in lessons improves pupils' motivation to learn.

Of the respondents 85% believed that IWBs will lead to improvements in pupil attainment. Some feel this will be dependent on how IWB is used and may not be evident immediately.

The IWB consultant was identified as the most useful source of training by 40% of the teachers followed by IWB training sessions (32%) and other teachers (28%).

About 81% percent of teachers said they had received some informal training, which tended to come from colleagues and their ICT co-ordinator.

87% of teachers said that using the IWB had affected their confidence in using ICT and of these 98% said they were more confident after using IWB.

86% of respondents who had received IWB training rated it as useful.

Training sessions were the most popular source of further information about the IWB identified by 72% of those interviewed followed by other teachers (65%) and then their IWB consultant (62%). The IWB website was also popular with 53% respondents identifying that as a useful source of information.

Respondents were asked whether they were spending less/same/more time teaching at the whole class level. Of these, 71% of teachers said they were doing more whole class teaching.

81% of respondents said their workload had increased since the introduction of IWB but 35% of these believe the increase to be only temporary in nature as they develop and store their IWB resources.

56% percent of respondents said they had not noticed any differences between boys and girls in relation to IWB use while 44% said they had noticed differences, usually commenting on a positive impact on boys such as that they were more motivated and interested or more focused and involved.

50% of teachers said they had had no problems with installation of the IWB. However, 21% said they had issues with the actual positioning of the IWB in the classroom.

### **Teachers reported use of the interactive whiteboard**

Online logs detailing how the IWBs were being used each week were recorded by teachers in the pilot for two periods of approximately six weeks during Spring 2003 and again in 2004; 655 weeks of forms were completed for 2003 and 817 weeks of forms for 2004.

Overall patterns of use were fairly consistent across the pilot project schools. The teachers involved were using IWBs in the majority of their literacy and mathematics lessons. Their use of the IWB has increased during the project. Teachers also appear to be more confident after a year or so of experience to create or develop their own materials.

Teachers reported using the IWB in about two thirds of literacy and mathematics lessons in 2003 and nearly three-quarters of these lessons in 2004.

Reported use was significantly greater in the second year of the pilot project (2004) in both mathematics (6.3% increase) and literacy (9.7% increase).

Use of the IWB in 2003 was relatively consistent throughout the school week. In 2004 use during the week was again relatively consistent but there was a significant increase on Mondays for both mathematics (4.2% increase) and literacy (5.3% increase) compared to the next most popular day. For both 2003 and 2004 Friday was the least popular day for using an IWB (ranging from 56% to 68% of lessons).

In 2003, teachers adapted or created resources for use in 50% of mathematics lessons and 63% of literacy lessons. This significantly increased in 2004 with teachers reporting making or adapting resources in 58% of mathematics lessons and 67% of literacy lessons.

Between 2003 to 2004 there was a reduction in the use of Interactive Teaching Programs (ITP) software compared with other kinds of software in mathematics lessons (9.5% decrease from about 41% of lessons to 31.5% of lessons).

Use of the whiteboard manufacturer's software to manage and display resources increased from 2003 to 2004 for both literacy and mathematics lessons (from about 40% of lessons to 46% of lessons).

### **Pupils' views**

12 group interviews were conducted with pupils between March and April 2004 with groups of pupils who had been in classes where an IWB had been used for two years. Pupils were drawn from each of the six pilot areas. In total, 72 pupils were involved in the group interviews.

Pupils are very positive about the use of IWBs, they particularly like the multimedia potential of the technology and believe that they learn better when an IWB is used in the classroom.

Most of the pupil groups interviewed believe that the IWB helps them to pay better attention during lessons. Reasons for this appear to revolve around the opportunities for a wider range of resources and multi-media features being used.

Most pupils seem to like having their work shown on the IWB. It is seen as an opportunity to learn and to improve their work.

The consensus seems to be that mathematics is the most popular lesson among those pupils interviewed although pupils also readily identified other lessons where they enjoyed their teachers using an IWB.

Pupils identified a number of common problems which were encountered by their teachers. Apart from the IWB breaking down entirely or having to be recalibrated (which they universally found frustrating), pupils mentioned difficulties seeing the IWB when sunlight shone through the windows. They also noted that sometimes moving objects on the board can be difficult for their teacher to manipulate or for them to see clearly.

Pupils also said that they would like to use the IWB themselves more than they currently have opportunities to and that they would like it if their teachers used the IWB more in lessons.

### **Surveying the literature**

A wide range of literature was reviewed to support the evaluation. This was mainly drawn from sources on the internet as there is relatively little available in published journals and books. Two main categories emerged from the literature review: considering the IWB as a tool firstly to enhance teaching,

and secondly, as a tool to support learning. Within the first category, issues which are discussed and illustrated about the advantages and disadvantages of such technology are:

- flexibility and versatility;
- saving and printing work;
- multimedia or multimodal presentation;
- efficiency;
- planning and saving Lessons;
- teaching ICT;
- interactivity and participation in lessons.

The second category into which the IWB literature falls concerns the unique features of IWBs which are argued to promote pupils' learning, and issues referred to include:

- motivation and affect;
- multimedia and multi-sensory presentation.

A further area emerged regarding the concerns expressed by both teachers and pupils in terms of the problems and issues encountered when using IWBs in real-life educational settings, and focus on:

- training and support;
- logistics.

The literature review has revealed a clear preference for IWB use by both teachers and pupils. It remains unclear, however, as to whether such enthusiasm is being translated into effective and purposeful practice. For the use of such technology to be justified it must be used in ways which promote more effective learning above and beyond that which is possible when teaching with other kinds of projection technology or with ordinary whiteboards.



## Introduction

The purpose of this document is to present the findings from the evaluation of the 'Embedding ICT in the Literacy and Numeracy Strategies' pilot project. In this project interactive whiteboards (IWBs) were installed in Year 5 and Year 6 classes in 12-15 schools in each of six Local Education Authorities (LEAs): Cumbria, Bracknell Forest, Lewisham, Oxfordshire, Redcar and Cleveland, and Wakefield. In each of these LEAs a local co-ordinator was appointed as an IWB Consultant to manage the project locally and to provide training and support to the teachers involved. The pilot project ran from Autumn 2002 to Summer 2004.

The evaluation, undertaken by a team based in the Centre for Learning and Teaching in the School of Education Communication and Language Sciences at Newcastle University, investigated the impact of the pilot on the teaching and learning of literacy and mathematics. The research was conducted between January 2003 to November 2004 across the pilot schools. Wherever possible data was collected and exchanged electronically to keep the burden of paperwork on schools to a minimum.

The research project aimed to evaluate a number of areas:

1. Impact on pupil attainment

Pupil attainment data from Y6 national tests in 2003 and 2004 was analysed to examine to what extent IWB project classes perform compared with a sample of similar schools.

2. Changes in classroom interaction

A sample of teachers in each LEA was observed using a structured coding schedule on a palmtop computer. Teachers were observed for four lessons in 2003 (literacy and mathematics with and without the use of a whiteboard) then again for two lessons in 2004 (literacy and mathematics with an IWB).

3. The use of interactive whiteboards for literacy and mathematics

Descriptive data about the day-to-day use of the whiteboards was collected over two half terms (Feb/March 2003 and the same period in 2004). The records contain data about the teachers' daily use of IWBs (which parts of the lessons and what software).

4. Teachers' perceptions

Teacher interviews were undertaken with a sample of 68 teachers to determine their perceptions of the impact of IWBs on their teaching and their views of the training and support they had received as part of the pilot.

5. Pupils' views

Small groups of pupils were interviewed about their views of literacy and mathematics teaching and learning and the use of IWBs.

A literature review was also undertaken to support the pilot project formatively and the approach to the evaluation.

## Section 1: Analysis of the attainment data

### *School level comparisons 2002-2004*

In 2002 the national averages for the percentage of pupils reaching Level 4 or above were 75% for English, 73% for Maths and 86% for Science. The mean scores for the six LEAs in the pilot project coincide with these national figures. However, the IWB schools themselves formed a relatively high-achieving group, scoring approximately five points above the national average.

To compare the mean progress of IWB and non-IWB schools, the 2002 scores for all schools in the six LEAs were used to predict scores for 2003 and 2004. Standardised residuals for the two groups of schools (measuring how far each school's results differs from the prediction) were then compared by t-test.

The aggregated results show that overall in 2003 the IWB pilot project schools made slightly more progress than the non-IWB schools, with a rather small effect size (Cohen, 1988) of 0.09<sup>1</sup>. However, when the 2004 results are compared with the 2002 baseline, the IWB aggregate results reveal marginally less progress than in the non-IWB schools (effect size -0.10).

The 2002-2004 progress of the two groups is shown in Table 1 below, where it can be seen that overall, the non-IWB schools made marginally more progress in English, Maths and Science (shown by the small negative effect size). The gains made by the IWB schools between 2002 and 2003 were therefore not sustained in the following full year of IWB use.

**Table 1.** Overall comparison 2002 -2004

Subject	Group	n schools	% >L4 2002	% >L4 2003	% >L4 2004	Effect size for 2-year progress
ENGLISH	IWB pilot	67	79.9	80.0	81.7	-0.03
	Non-IWB	55	80.5	80.4	82.3	
MATHS	IWB pilot	67	78.0	79.1	78.1	-0.12
	Non-IWB	55	77.3	76.7	79.0	
SCIENCE	IWB pilot	67	90.6	91.4	89.4	-0.17
	Non-IWB	55	91.1	91.1	90.9	

(Mean scores by subject and group over two years, with effect sizes for relative progress)

<sup>1</sup> An effect size of 0.2 would move a class ranked 50<sup>th</sup> in a league table of 100 schools up about eight places, and effect size of 0.1 up about 4 places.

## Pupil level analysis

Data at pupil level from the Year 6 national tests were provided by the Department for Education and Skills (DfES) for 2003 and for 2004. Data were provided for both the project schools and a further control group of schools in the same LEAs as a comparison. These data were then analysed to identify any impact of the use of IWBs in the project schools in English, Mathematics and Science and to see if there was any difference in impact according to gender or for high or low attaining pupils.

The group of the pilot project schools and matched control group consists of 67 of the schools in the six LEAs who participated in the project, while the control group consists of 55 schools from the same LEAs. As the use of interactive whiteboards started in most schools early in 2003, the schools were matched on the basis of their 2002 national test performance, using both mean points score and mean percentage of pupils achieving Level 4 and above. As the IWB schools had test scores about five points above the national average, it was not possible to constitute a control group of the same size as the IWB group, or to include all project schools in the experimental group. Schools were included only if test data was available for all three years from 2002-2004. The matching was carried out so as to ensure similar proportions of schools in each of eight percentile bands and where there were more potential control group schools than required in a band, the selection was carried out using random numbers. A summary of the main results of the matching procedure is presented in Table 2 below.

**Table 2.** Baseline comparison in 2002

Subject	Group	n schools	Mean % >level 3	SD <sup>2</sup>	t	p <sup>3</sup>	Effect size
ENGLISH	Whiteboard	67	79.88	10.34	0.29	n.s. <sup>4</sup>	-0.05
	Controls	55	80.47	12.47			
MATHS	Whiteboard	67	78.00	12.57	0.31	n.s.	0.06
	Controls	55	77.25	14.10			
SCIENCE	Whiteboard	67	90.57	9.51	0.30	n.s.	-0.05
	Controls	55	91.09	9.64			
Points score	Whiteboard	67	28.03	1.53	0.12	n.s.	-0.02
	Controls	55	28.06	1.46			

(KS2 test scores: IWB and controls- school level)

Checks were made that the two groups were well matched on the following additional criteria: mean number of pupils on roll in 2002, mean proportion of statemented and non-statemented pupils with SEN, authorised and non-authorised absence in 2002 and national test performance in 2001. In all

<sup>2</sup> Standard deviation

<sup>3</sup> Significance level

<sup>4</sup> not significant

cases the two groups were seen to be equivalent, with no differences approaching statistical significance.

The 2003 Year 6 national tests were taken in May, after approximately five months of use of IWBs in the project schools. This is a relatively short time for any effect to become apparent, but as shown in Table 3, the mean raw test scores in the IWB schools are slightly higher than in the control schools, with statistically significant margins for Maths and Science. However, the effect sizes are in all cases very small.

**Table 3.** Comparison of 2003 pupil attainment data

Subject	Group	n pupils	Mean test score	s.d.	t	p	Effect size
ENGLISH	IWB	2879	58.69	16.39	1.28	n.s.	0.04
	Controls	2085	58.09	16.32			
MATHS	IWB	2892	63.93	21.00	3.62	<0.001	0.10
	Controls	2094	61.75	21.06			
SCIENCE	IWB	2921	59.42	11.94	3.79	<0.001	0.11
	Controls	2108	58.10	12.30			

(Raw KS2 test scores: IWB and controls - pupil level)

A year later, in 2004, raw test scores were again made available by the DfES and the overall comparison of IWB and control samples is presented in Table 4. Here it can be seen that there are no significant differences between the two groups and the effect sizes are negligible. The small benefit for the IWB schools seen in Maths and Science test results in 2003 has not been sustained. Analysis of teacher assessments in 2004 yield a very similar set of results, with non-significant between-group differences and very small effect sizes of 0.06 for English, 0.04 for Maths and 0.01 for Science.

When the 2004 Reading and Writing test components for English are compared separately, the effect sizes for between-group differences are -0.01 for Reading and 0.05 for Writing.

**Table 4.** Comparison of 2004 pupil attainment data

Subject	Group	n pupils	Mean test score	s.d.	t	p	Effect size
ENGLISH	IWB	2763	55.36	15.08	0.63	n.s.	0.02
	Controls	1965	55.08	14.89			
MATHS	IWB	2824	66.53	21.41	0.09	n.s.	0.00
	Controls	1980	66.47	21.20			
SCIENCE	IWB	2850	57.29	12.45	1.16	n.s.	-0.03
	Controls	1944	57.71	11.99			

(Raw KS2 test scores: IWB and controls - pupil level)

Although some of the initial differences were statistically significant the extent of the difference (the “effect size”) was small. The early improvement seen after the first few months may have been a ‘halo’ or novelty effect of some kind. It did not lead to further improvement in the following year, which might have been expected on the hypotheses that pupils are taught more actively and therefore more effectively, in IWB classes. The initial small improvement in Mathematics and Science did not seem to provide a platform for continued improvement for pupils the following year. It therefore appears that, after two years, the impact of the use of IWBs is not identifiable in the levels of attainment of pupils, at least as measured in national tests.

### **Are there any gender differences in the impact of IWBs?**

For both years (2003 and 2004), while significant gender effects were found for English, Mathematics and Science, no group-by-gender interactions approached statistical significance<sup>5</sup>. This means that overall the use of IWBs appears to have a broadly similar impact on both boys and girls.

### **Changes in the proportions of low and high-achieving groups 2003-2004**

The sample sizes for these comparisons varies between 1937 and 2910. A test of the significance of difference in proportions was applied to compare the 2003 proportion with the 2004 proportion in each case and to test the hypotheses that (a) a full year of IWB usage will decrease the proportions of low attaining pupils in the IWB group in all subjects and (b) increase the proportion of high-attaining pupils in the IWB group in all subjects.

The results for lower-achieving pupils (see Table 5) show that there was a significant decrease in the proportion achieving Level 4 or below in English in the IWB group, but not in the control group. However, the overall decrease is 16% for the IWB pupils, compared to an 11% decrease in the control group, a relatively small difference. This suggests that IWB use benefits lower attaining pupils in English.

There is no evidence of significant changes in Mathematics, but in Science the proportion of lower-achieving pupils *increased* significantly in the IWB group. The increase is 24% for the IWB pupils, compared with a two percent increase for the controls. This indicates that the lower attaining pupils in the embedding ICT pilot classes did less well in Science than those in the comparison classes, though it should be noted that Science was not a focus for development in the project.

When the decrease in the proportion of low-achievement in English in the IWB group is analysed by gender, similar decreases are found for both boys (15%) and girls (18%). When the increase in low achievement in Science in the IWB

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<sup>5</sup> This question was addressed by carrying out multivariate analyses of variance using the general linear model procedure provided in SPSS.

group is analysed by gender, it appears to be rather less for boys (20%) than for girls (30%).

**Table 5.** Percentages of pupils achieving below Level 4 by group and by year

Subject	Group	% < level 4 2003	% < level 4 2004	Sig. of diff.
ENGLISH	IWB	16.45	13.83	<0.01
	Controls	16.10	14.40	n.s.
MATHS	IWB	17.81	18.69	n.s.
	Controls	20.65	18.85	n.s.
SCIENCE	IWB	6.43	8.00	<0.05
	Controls	7.55	7.73	n.s.

As shown in Table 6, the results for higher-achieving pupils show no significant changes in English for either group between 2003 and 2004. However, in Maths and in Science there are substantial increases, in the control group only, in the proportions of pupils achieving Level 5. In percentage terms these increases are 16% for Maths and 17% for Science. When the Maths increase is analysed by gender, it is found to be rather greater for boys (19%) than for girls (11%). This is also true of the Science increase, which is 21% for boys and 11% for girls. These effects may have been due to the focus of the pilot project on literacy and mathematics so the impact on science may have been as a result of less emphasis in this area of the curriculum.

**Table 6.** Percentages of pupils achieving above Level 4 by group and by year

Subject	Group	% > level 4 2003	% > level 4 2004	Sig. of diff.
ENGLISH	IWB	33.71	31.79	n.s.
	Controls	31.67	30.82	n.s.
MATHS	IWB	35.00	35.84	n.s.
	Controls	30.54	35.34	<0.01
SCIENCE	IWB	49.42	48.03	n.s.
	Controls	43.02	50.23	<0.001

The following conclusions can be drawn from the analysis above:

- IWB use may help reduce the proportion of low-achieving pupils in English;
- IWB use provides no particular advantage in mathematics for either low-achieving or high-achieving pupils;
- IWB use for literacy and mathematics does not produce benefits for pupils in science.

## Summary

Compared with other schools nationally the pupils in the IWB pilot schools performed better on national tests in mathematics and science in 2003. However, though statistically significant, the extent of the difference is small.

No difference was found in performance on national tests for the pilot project schools in 2004.

A more detailed analysis using a comparison group of schools from each of the LEAs shows a similar picture with small improvements in 2003 and no difference in 2004.

There is some evidence that the use of IWBs improves the performance of low-achieving pupils in English and that the overall impact is greatest on writing.

The impact of the use of IWBs is broadly similar for both boys and girls.

## Section 2: Classroom Observations

### ***Observation Approach, Sample Design and Characteristics***

Structured observations of classroom interaction were undertaken in early 2003 and again a year later in early 2004. A total of 184 lessons were observed; the research focused on differences between lessons where teachers taught literacy and mathematics with and without an IWB and on any changes in patterns of interaction a year later.

In early 2003, 114 Year 5 lessons were observed. The sample consisted of 30 teachers: 18 female and 12 male teachers. Most teachers were observed four times: once using a whiteboard to teach mathematics, once without; and once using a whiteboard to teach literacy, once without. This enabled us to investigate potential differences in classroom interaction between those teachers using whiteboards and those not. Our sample size was also large enough to compare literacy and numeracy lessons and to examine any interaction effect between lessons with and without and IWB ('medium used') and subject area.

**Table 7:** Number of lessons observed by year, medium and subject area

Year of observation	School year	Medium used	Numeracy	Literacy	Total
2003	Year 5	With whiteboard	30	30	60
		Without whiteboard	27	27	54
		Sub-total:	57	57	114
2004	Year 5	With whiteboard	15	15	30
	Year 6	Without whiteboard	20	20	40
	Sub-total:	35	35	70	
				Total:	184

In 2004, we observed a further 70 lessons (see above); giving a total sample size over 2003 and 2004 of 184 lessons - very large in the field of observational research. All of these 70 lessons used whiteboards. 15 of the 30 teachers were observed again (literacy and numeracy): still teaching Year 5 pupils, but obviously with a different class. This allowed the teachers a further year to become familiar with the new whiteboards, and enabled us to see if an extra year with a whiteboard changed classroom interaction in any way. Therefore, the same 15 teachers were observed teaching literacy and numeracy in three different situations:

- 28 non- whiteboard lessons in 2003 (baseline)<sup>6</sup>;
- 30 whiteboard lessons in 2003;
- 30 whiteboard lessons in 2004.

<sup>6</sup> (Note this sample size was not 30 because one teacher was unavailable in 2003)



The classes we observed in Year 5 in 2003 moved into Year 6 in 2004. We observed a sample of these Y6 classes with their new teachers (20 teachers in total: 14 female, six male). Again, we watched these teachers twice across literacy and numeracy (40 lessons in total). With these data we were able to compare Y5 and Y6 teaching to see if there were any pedagogical differences between the age groups when using a whiteboard. For this comparison, we compared the 40 Y6 lessons with the 30 Y5 lessons observed in 2004.

Just before each observation took place, the researchers recorded some contextual data about the class: class size, number of boys and girls, number of SEN pupils. The average class size was 27.5; the boy/girl split in each class was roughly half and half; and the average percentage of pupils with special needs (SEN) in the class was 13.6%. On average each lesson lasted 59 minutes. Most lessons (180) were observed in the morning (most schools teach the literacy hour and mathematics lessons before midday).

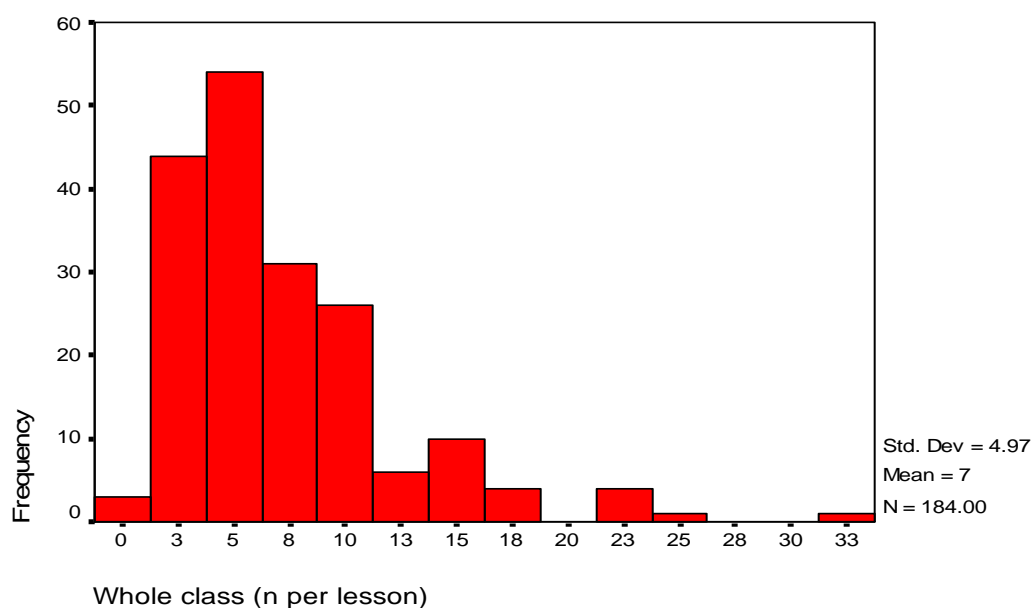
The coding scheme for classroom interaction used builds upon the work of Sinclair and Coulthard (1992), Good and Brophy (1991) and Galton and Williamson (1992). The Classroom Interaction System (CIS) uses 'The Observer' software (Noldus Information Technology, 1995) to log the number of different types of discourse (Hardman, Smith and Wall, 2001). This is done using a handheld device about the size of a calculator. This computerised system enables observation of lessons in real-time and is quicker than traditional recording methods because the data is instantly stored, and therefore available for immediate analysis. The computerised system logs (for each teaching exchange): the 'actor' (usually the teacher), the discourse move and who the 'receiver' was (usually a pupil).

The scheme primarily focuses on the three-part, Initiate-Respond-Feedback (IRF) structure and gathers data on teachers' questions, whether questions were answered (and by whom), and the types of evaluative response given by the to pupils' answers. It also records pupil initiations in the form of questions and statements. Within each IRF discourse move a range of modifiers are available to record further details. For example, the system records whether teacher questions are 'open' (defined in terms of the teacher's probable reaction to the pupils' answer: only if the teacher is calling for more than one answer to the question would it be judged as open) or 'closed' (calling for a single response or offering facts). Responses are coded according to whether a boy or girl answered or whether there was a class reply. Teacher feedback to a pupil's answer is coded according to whether the response was praised, criticised or corrected, or accepted. The system also records teacher explanations, directions and refocusing of the class. In order to see whether teachers are using a range of discourse styles as suggested in the research literature, the system also captures a range of alternative strategies, for example, probing (to check what pupils mean, or to get them to extend a response) or uptake questions (where the teacher incorporates a pupil's answer into a subsequent question).

## Frequency of the lesson parts

Before focusing upon the discourse moves and patterns of interaction which occur during the whole class sections of a lesson, it is important to gain an overview of the general format or structure used by the teacher within each lesson or to consider to what extent teachers move between whole class teaching, group work and individual work.

The average number of whole class lesson sections or parts within a lesson was seven, but Figure 1 shows a positive skew indicating that the majority of teachers kept to under seven whole class sections. A minority of teachers moved frequently from whole class teaching to individual or group work lessons – as indicated by the tail in the histogram.



**Figure 1:** Number of whole class sections per lesson

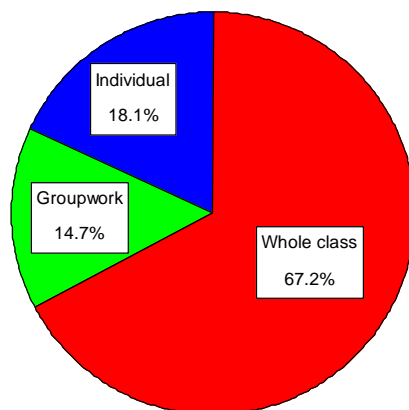
When comparing lessons where an interactive whiteboard was used with lessons where it was not (which was investigated using the large sample of 60 whiteboard lessons and 54 non-whiteboard lessons), no significant differences were found in these patterns of whole class, group and individual work. No difference was found in the frequency of any of these sections between subject areas (for example, group work was no more frequent in mathematics lessons compared with literacy lessons).

However, when the teachers were observed again in 2004 using whiteboards there was a marked increase in alternating between whole class work and individual work, while group work stayed the same<sup>7</sup>.

## Duration of the lesson parts

Just over two thirds of most lessons consisted of whole class work. Pupils spent on average 15% of a lesson on group work and 18% on individual work.

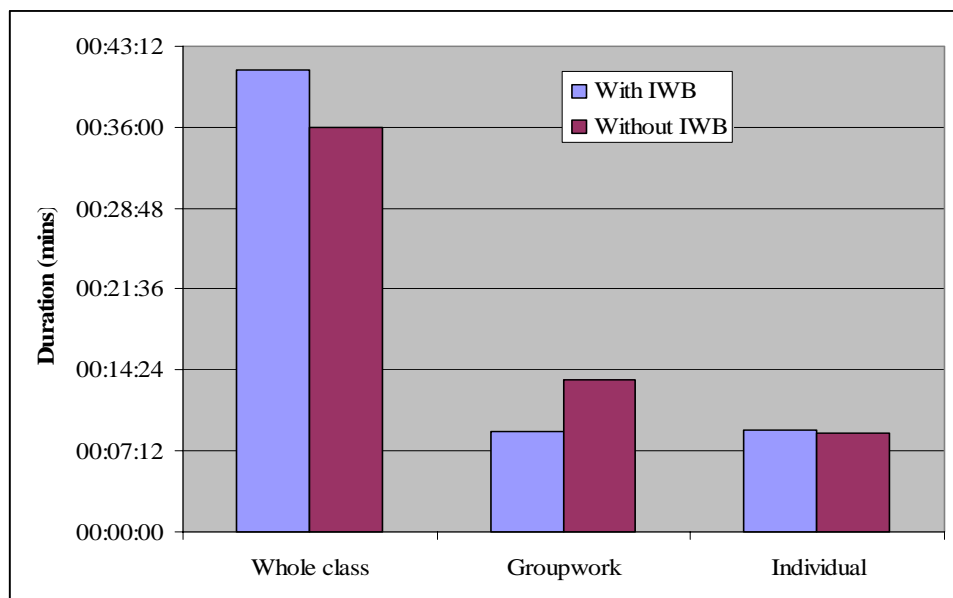
<sup>7</sup> A one-way ANOVA, followed by a post-hoc Bonferroni test, found this to be significant ( $p < 0.01$ ).



**Figure 2: Contribution of each section to the lesson (by percentage)**

Whole class work was observed in all 184 lessons, but 42% of the lessons contained no group work, and 26% did not consist of any individual work. Only two teachers maintained whole class work for the entire lesson (no group work and no individual work).

In 2003 we found that IWB lessons contained significantly more whole class work<sup>8</sup> and significantly less group work<sup>9</sup>. IWB lessons contained about five minutes more whole class teaching and five minutes less group work. 69.5% of whiteboard lessons were spent as a whole class, compared to 62% of non-whiteboard lessons. Similarly, 22.8% of non-whiteboard lessons were spent in group work compared to 15.2% in whiteboard lessons.



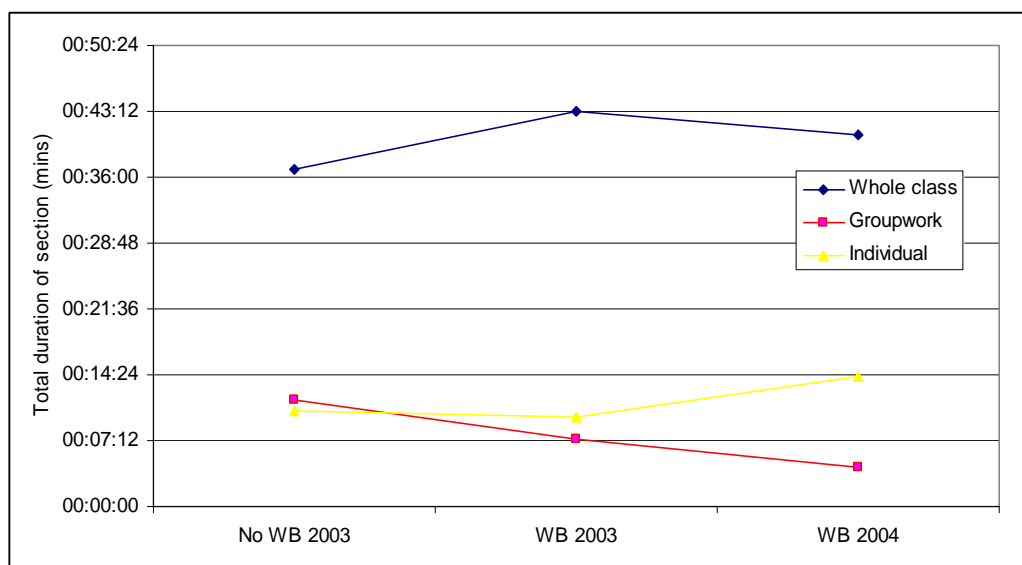
**Figure 3: Average duration of each section of the lesson (minutes)**

<sup>8</sup>  $t=3.24, p<0.01$

<sup>9</sup>  $t=-2.11, p<0.05$

No differences were found for the durations of lesson parts between literacy and mathematics.

There was more whole class teaching with an IWB in 2003 when compared to those lessons not using a whiteboard, but this difference was not significant a year later in 2004<sup>10</sup> The fact that there was less group work in the whiteboard lessons in 2003 than the non-whiteboard lessons became more pronounced in 2004<sup>11</sup>. The total drop in the amount of time spent on group work from 2003 (non-whiteboard lessons) to 2004 (whiteboard lessons) was 07:24 mins.



**Figure 4:** Average duration of each section of the lesson (minutes)

No difference was found in the percentage contribution of any of these sections between Y5 and Y6 teachers.

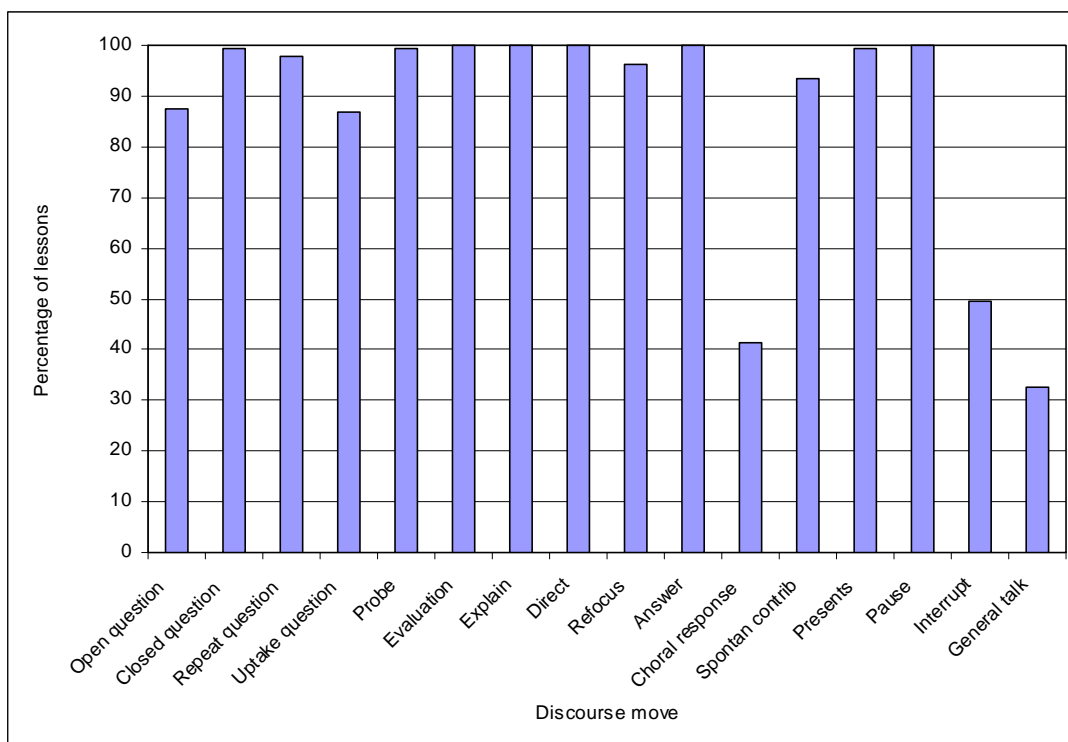
### ***Analysis of Whole Class Interaction***

#### **Summary of the whole sample (2003 and 2004 data)**

The figure and table below show the number of lessons in which we observed certain types of discourse moves (out of 184 lessons). This graph shows, for example, that all of the teachers used an evaluation move at one point during their lesson. Open questions were observed in 88% of the lessons. It is interesting to note that uptake questions were asked in 87% of the lessons. Interruptions occurred in half of the lessons and general talk occurred in 33% of the lessons. This last figure is the only sizeable increase from those found in the previous year: otherwise the figures are very similar.

<sup>10</sup> One-way ANOVA, then Bonferroni.

<sup>11</sup> p<0.05



**Figure 5:** Number of lessons in which certain types of discourse were observed

**Table 8:** Number of lessons in which certain types of discourses were observed:

Discourse move	Count	Percentage
Open question	161	87.5
Closed question	183	99.5
Repeat question	180	97.8
Uptake question	160	87.0
Probe	183	99.5
Evaluation	184	100.0
Explain	184	100.0
Direct	184	100.0
Refocus	177	96.2
Answer	184	100.0
Choral response	76	41.3
Spontaneous contribution	172	93.5
Presents	183	99.5
Pause	184	100.0
Interrupt	91	49.5
General talk	60	32.6

The table above and graph below show the rate (number per hour) for each discourse move (all 184 lessons). In terms of purely teacher-initiated moves, the most frequent included explaining (135 per hr), closed questions (62 per hr), evaluation (62 per hr), and direction (51 per hr).

Throughout the observations our focus was upon the teacher: but we also analyzed responses and initiations from pupils during the whole class sections of the lessons. When pupils spoke, the most dominant discourse was to answer a question (127 per hour).

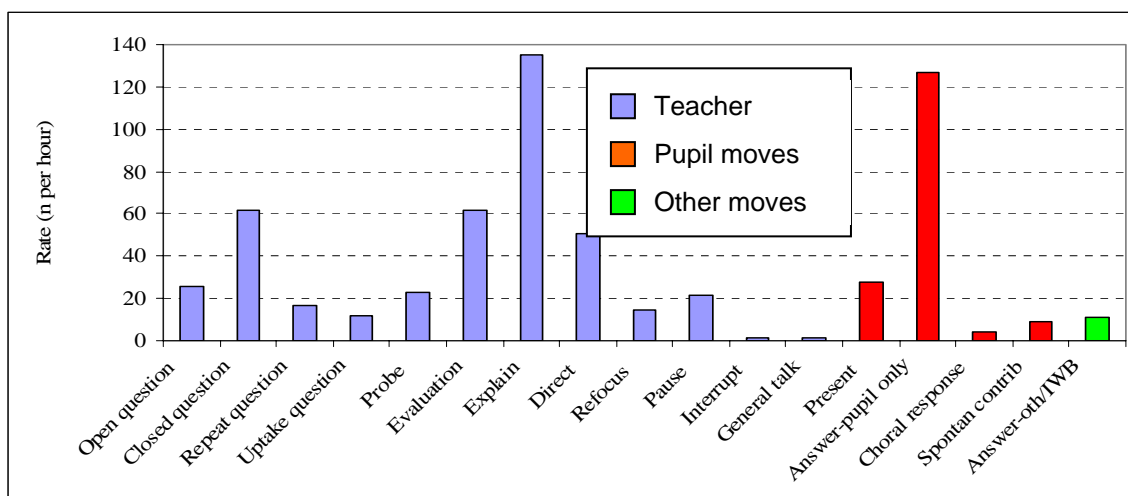


Figure 6: Rate of discourse moves (n per hour)

### Focus on the evaluation objectives

The figure below presents further detail from the data to see if there are differences between those lessons which used whiteboards and those which did not.

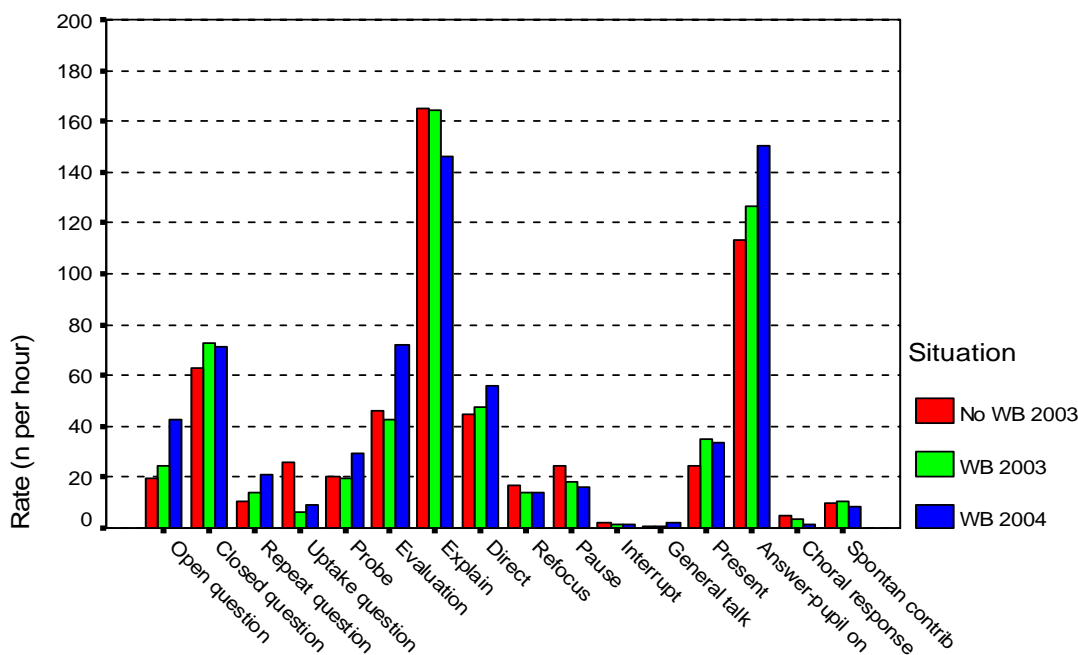


Figure 7: Rate of discourse moves by medium used and year of observation

Eight discourse moves were significantly different between the two types of

lessons<sup>12</sup>. In those lessons which used a whiteboard there were significantly more open questions, repeat questions, probes, evaluation, answers from pupils, and general talk. Most of these differences were only observed after the whiteboards had been in use for a year: an embedding effect. Fewer pauses and uptake questions were observed in the lessons which used whiteboards.

Significantly more closed questions and fewer open questions were asked in mathematics lessons<sup>13</sup>. This concurs with our findings in a previous ESRC study where we found that closed questions were more common in numeracy than in literacy lessons (Smith *et al.*, 2004). A multivariate ANOVA was performed with medium used and subject area as the independent variables to see if there were any interaction effects – there were none. This indicates that the impact of the IWB was consistent across both literacy and mathematics lessons.

Some differences were found between Y5 and Y6 classes (Figure 10). In the Y6 classes there were more uptake questions, more pauses and more choral responses; there were also fewer explanations and fewer answers from the pupils. This finding needs to be taken into account along with the duration data, since it takes no account of how long a particular discourse move may last, for example Y6 pupils may have given fewer answers in terms of rate, but their answers may have been longer.

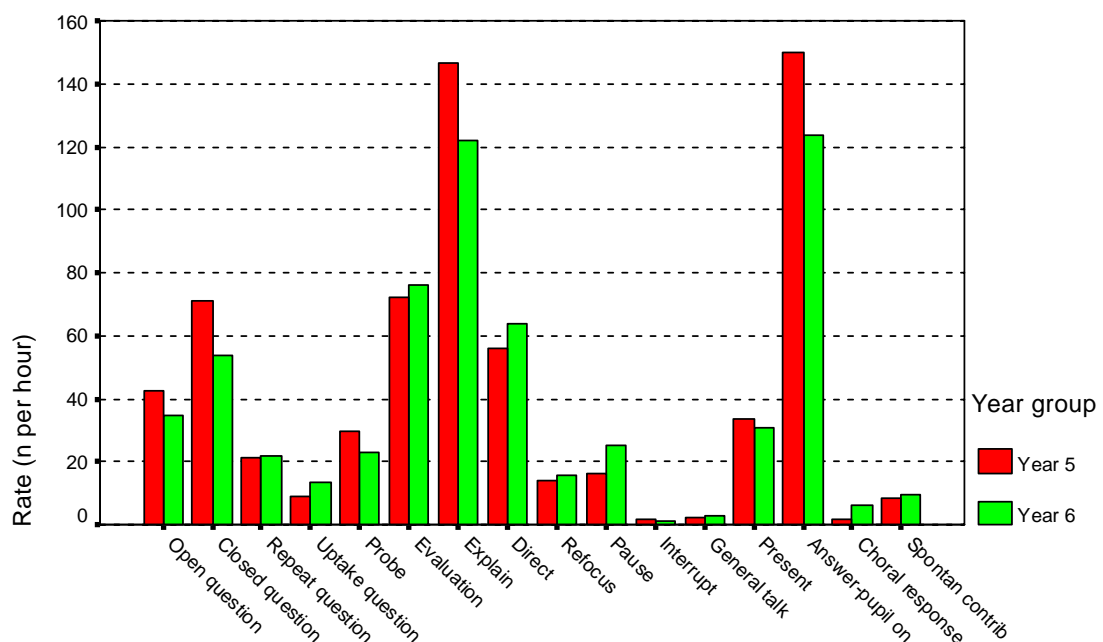


Figure 8: Rate of discourse moves by year group

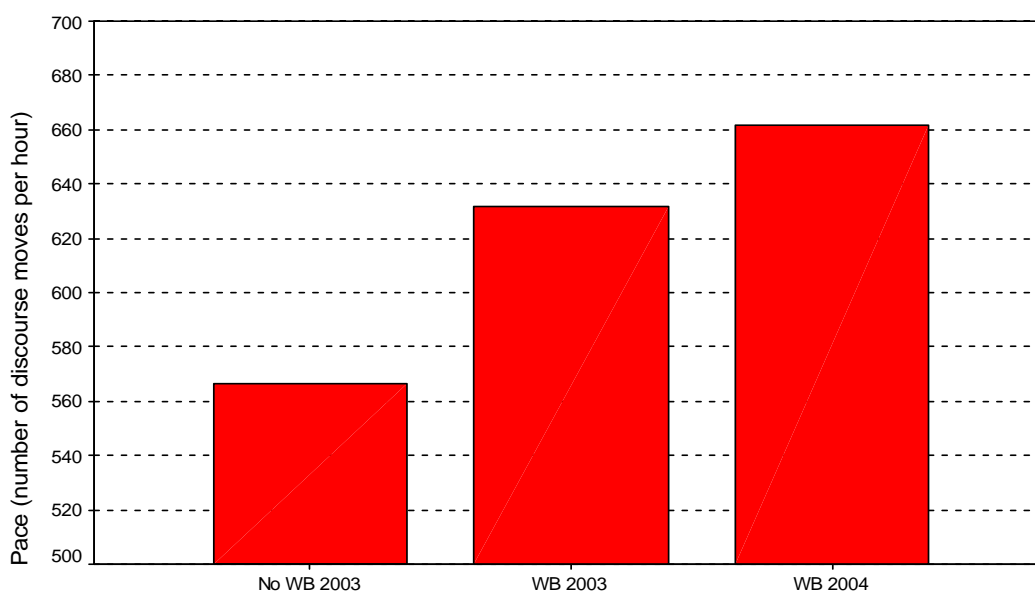
<sup>12</sup> A one-way ANOVA followed by a Bonferroni test.

<sup>13</sup>  $t=9.43, p<0.001$ ;  $t=-4.99, p<0.001$ , respectively.

## Pace

As a rough indicator of pace in the classroom, all of the discourse moves initiated by both teacher and pupil (with the exception of pause and interrupt) were summed. This sum total was then divided by the duration of the whole class section of the lesson to obtain a rate per hour.

Further inspection of the rate of discourse moves (Figure 8 above) seems to reveal a quicker pace in the whiteboard lessons in 2003 compared to the non-whiteboard lessons, and then again in 2004. Figure 9 shows this as pace. Although the difference was not significant<sup>14</sup> for IWB lessons and non-whiteboard lessons in the first year (2003), a difference was found in the second year<sup>15</sup> indicating a faster pace of IWB lessons after one year of experience. Whiteboard lessons consisted of, on average, 96 more discourse moves per hour (a 17% increase in pace).



**Figure 9:** Pace by medium used and year of observation

Numeracy lessons were faster paced than literacy lessons<sup>16</sup>. Also, Year 5 lessons were faster paced than Year 6 lessons<sup>17</sup>.

## Duration of the Discourse Moves

Rather than looking at rate per hour (which takes no account of the length of a discourse move) it is also possible to report the *mean duration* for each discourse move (average length in seconds) and the *percentage duration* for

<sup>14</sup> independent t-test

<sup>15</sup> A one-way ANOVA, then Bonferroni, found faster pace in the whiteboard lessons in 2004 compared with the non-whiteboard lessons in 2003 ( $F=6.83$ ,  $0 < 0.01$ ).

<sup>16</sup> 16% difference;  $t=3.45$ ,  $p < 0.001$

<sup>17</sup> 10% difference;  $t=2.06$ ,  $p < 0.05$



each discourse move (each discourse move's total contribution to the entire whole class section, so if explaining took up five minutes of a 20 minute whole class section the percentage duration would be 25%).

In many ways, percentage duration (the time each discourse move actually contributed to a lesson), is a 'richer' gauge of classroom interaction than simple duration as measured in seconds. For example, take two different lessons: in both lessons, answers lasted on average three seconds; but we may also know from the frequency data that the rate of answers was very different between the two lessons (100 answers per hour compared to 140 answers per hour). Percentage duration uses both of these figures to reveal the relative contribution of a discourse move compared to other moves.

### Summary of whole sample (2003 and 2004 data)

Mean durations and percentage durations for each discourse move are shown in the table below (for all 184 lessons).

**Table 9:** Mean duration and percentage duration for discourse moves

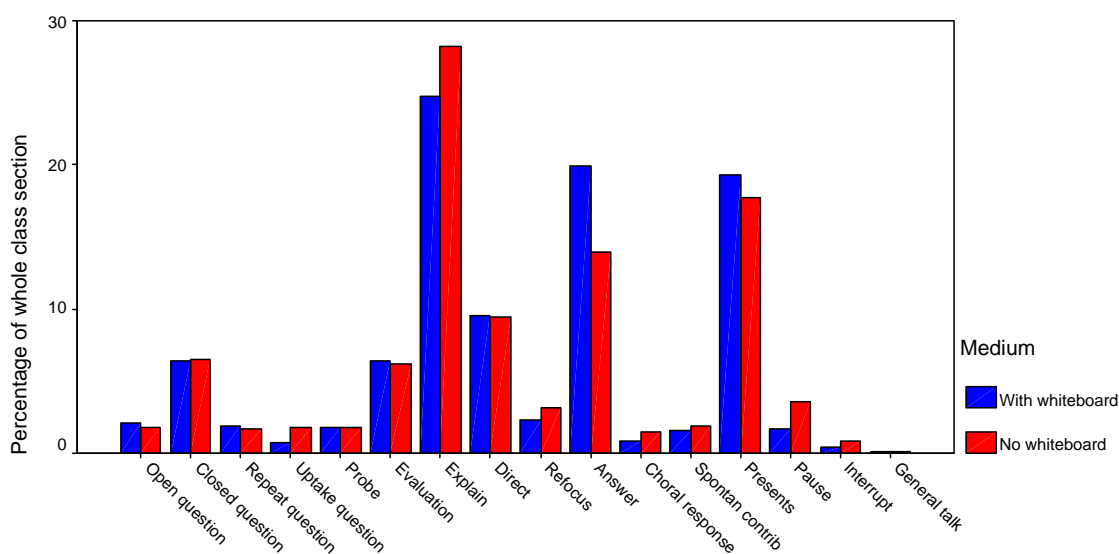
Discourse move	Mean duration (secs)	Percentage duration
Open question	4.1	2.3
Closed question	3.5	5.8
Repeat question	4.4	2.0
Uptake question	3.3	1.2
Probe	2.7	1.7
Evaluation	4.7	7.5
Explain	12.2	27.8
Direct	8.1	9.4
Refocus	6.0	2.4
Pause	5.0	3.0
Interrupt	12.0	0.5
General talk	6.2	0.2
Presents	9.9	16.9
Answer	4.4	16.5
Choral response	10.1	1.0
Spontaneous contribution	7.0	1.6
Total:		100%

Again, this table concurs well with our previous research (Hardman et al. 2001; Smith et al. 2004) which found that explaining, directing, presenting, choral response and interruptions all had the longest mean durations (that is, *when* they occurred, they lasted longer than other discourse moves). For example, it was found earlier that the most frequent discourse moves included explaining (135 per hr), closed questions (62 per hr), evaluation (62 per hr), and direction (51 per hr). We can now expand upon this data and note that a typical explanation would last for 12 seconds; closed questions may have been frequent, but they were brief (3.5 secs). A typical pupil answer lasted for 4.4 seconds.

In the table above, the second column of data shows that the total contribution of each discourse move adds up to 100% (representing the entire whole class section of the lesson). Here we can see that explaining (which was both frequent and long) took up 28% of the whole class section. 17% of the whole class section consisted of presenting, and another 17% of individual pupil answers.

**Focus on the evaluation objectives**

The figure and table below show any differences between those lessons which used whiteboards and those which did not.



**Figure 10:** Contribution of each discourse move to the whole class section – medium comparison

Answers took up more time (in terms of percentage of the whole class section) in whiteboard lessons compared to non-whiteboard lessons (20% as opposed to 14%<sup>18</sup>), and pauses were briefer in whiteboard lessons<sup>19</sup>. Uptake questions and explaining took up more time in non-whiteboard lessons<sup>20</sup>.

After a year of use, the data revealed a different pattern of classroom interaction. The initial increase in the amount of answers from pupils we observed in 2003 settled back down: so that there was no significant<sup>21</sup> difference between whiteboard and non-whiteboard lessons. Similarly, the initial decrease in the amount of pauses and the amount of teacher explanation was short-lived (both increased again in 2004). Only three discourse moves were found to be different in whiteboard lessons: there was almost twice the amount of evaluation in whiteboard lessons<sup>22</sup>; uptake

<sup>18</sup> p<0.001

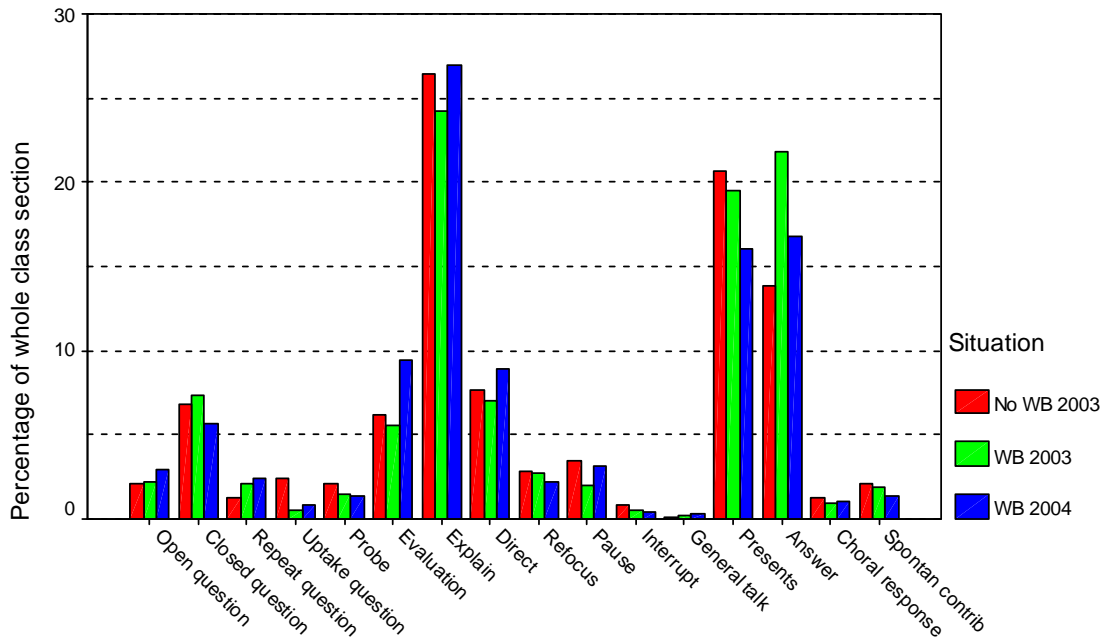
<sup>19</sup> p<0.001

<sup>20</sup> p<0.01 and p<0.05, respectively

<sup>21</sup> Again, a one-way ANOVA and Bonferroni were used to investigate this.

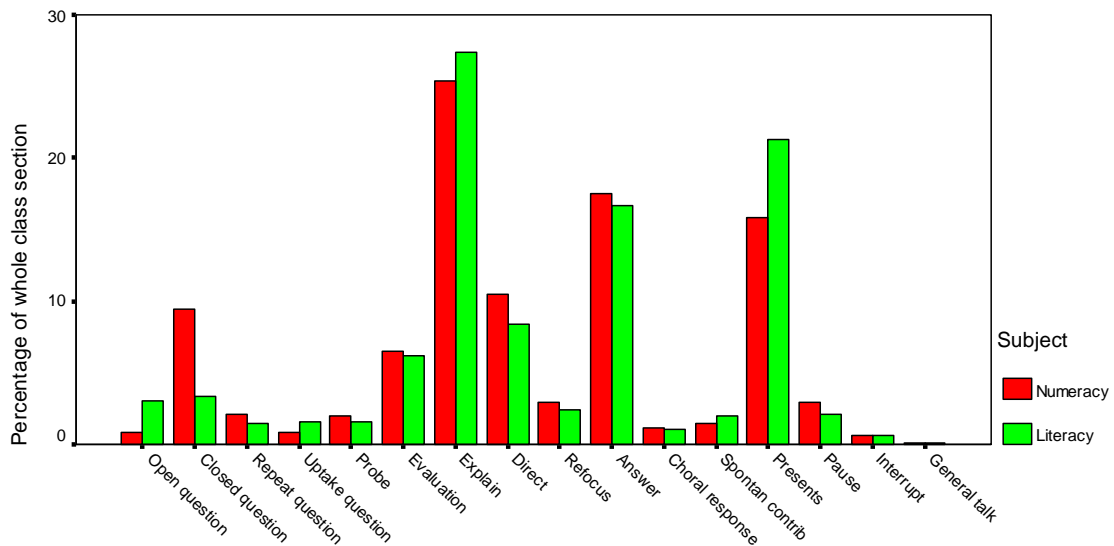
<sup>22</sup> p<0.001

questions and presentations from pupils were both lower in IWB lessons in terms of whole class percentage<sup>23</sup>.



**Figure 11:** Percentage contribution to whole class sections – by year of observation and medium used

The figure below shows the differences in percentage contribution across the subject areas.



**Figure 12:** Contribution of each discourse move to the whole class section – subject comparison

<sup>23</sup> p<0.001 and p<0.05 respectively

Closed questions contributed to 9.5% of a numeracy lesson but only 3.4% of a literacy lesson<sup>24</sup>. Open questions contributed to 3.1% of a literacy lesson but only 0.9% of a numeracy lesson<sup>25</sup>. Presenting from pupils<sup>26</sup> and uptake questions<sup>27</sup> both had larger percentage contributions in literacy lessons; teacher direction had a larger percentage contribution in numeracy lessons<sup>28</sup>.

Only one difference was found between Y5 and Y6 classes: more explanation in Y6 classes (33% of whole class time) compared to Y5 classes (27%)<sup>29</sup>.

### ***Further Analysis of the Discourse Moves (modifier data)***

In addition to basic information such as frequency and duration of each discourse move, we also gathered further data about certain discourse moves. For example, if the teacher asked an open question, we recorded the who was asked (e.g. the whole class, a male pupil, or a female pupil). This is known as 'modifier' information. We only collected modifier data for some of the discourse moves. We did this for two reasons: first, the more complex we make the coding system, the more we affect the reliability of the system; and second, some discourse moves are not 'directed' at anyone or an appropriate modifier is not obvious (e.g. when pupils make a choral response).

For the receiver and initiator modifiers therefore, we recorded who the discourse move was directed to or who the discourse move originated from (e.g. the whole class, a boy, a girl, the whiteboard, another person such as a classroom assistant, or the teacher). Where a spontaneous contribution was made, we recorded the initiator, but we also recorded the type of contribution: whether it was simply procedural or curricular in nature. Where the teacher made an evaluation, we recorded the receiver, and also how this evaluation was given – whether it was praise, criticism, or a simple acceptance.

### **Summary of whole sample (2003 and 2004 data)**

The table and figure below show a breakdown for each discourse move in terms of:

- who the discourse move was directed to (top nine moves in the table); and
- who initiated a discourse move (bottom three moves).

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<sup>24</sup>  $p < 0.001$

<sup>25</sup>  $p < 0.001$

<sup>26</sup>  $p < 0.001$

<sup>27</sup>  $p < 0.05$

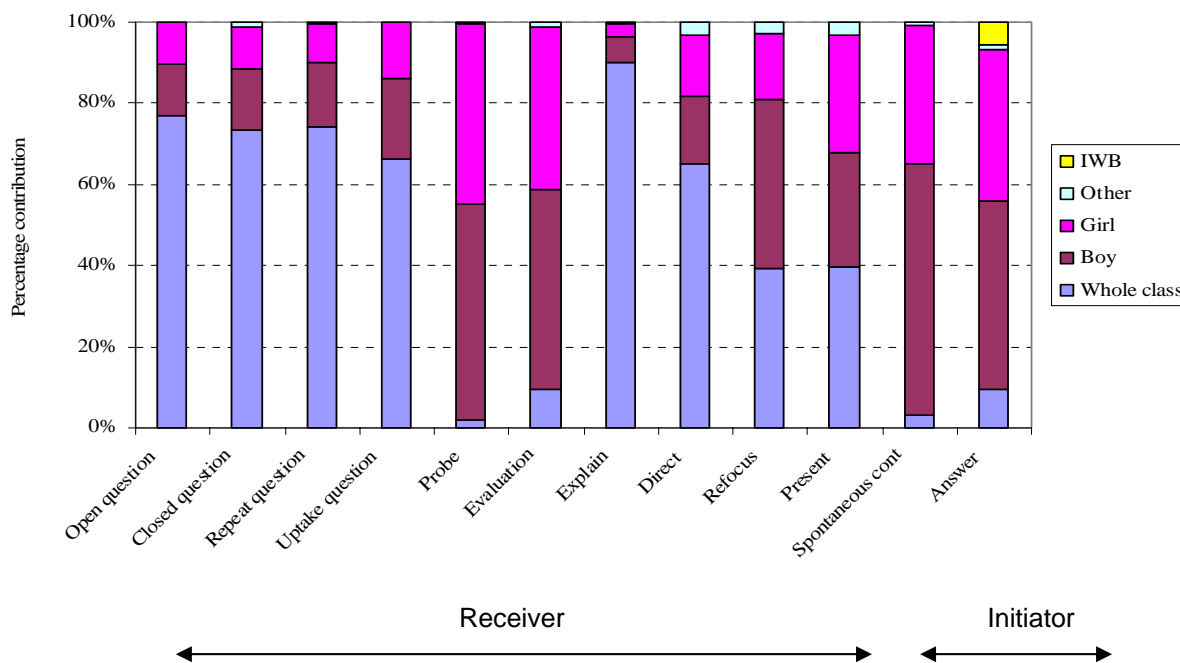
<sup>28</sup>  $p < 0.05$

<sup>29</sup>  $t = -3.14, p < 0.01$

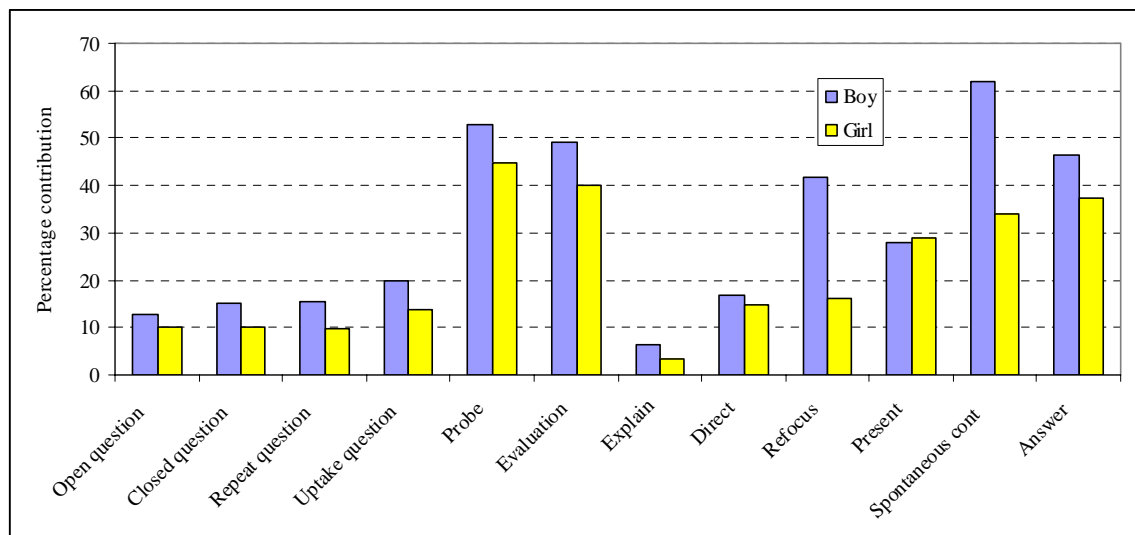
**Table 10:** Receivers and initiators of discourse moves

	Whole class	Boy	Girl	Other	Whiteboard	Total
Open question	76.9	12.8	10.1	0.1		100%
Closed question	73.5	15.0	10.2	1.3		100%
Repeat question	74.4	15.5	9.8	0.3		100%
Uptake question	66.3	19.8	13.9			100%
Probe	2.1	53.0	44.6	0.3		100%
Evaluation	9.5	49.2	40.2	1.1		100%
Explain	90.0	6.2	3.4	0.3		100%
Direct	65.0	16.8	14.9	3.3		100%
Refocus	39.5	41.6	16.1	2.8		100%
Present	39.8	28.0	28.9	3.3		100%
Spontan. Contr.	3.1	62.0	34.0	0.9		100%
Answer	9.7	46.3	37.2	1.0	5.7	100%

The majority of questions were directed at the whole class (ranging from 66% for uptake questions, 77% for open questions) where the teacher focused on an individual. All of the discourse moves were directed at boys more than girls. The largest disparity appears to be the amount of refocusing directed at boys (42%) compared to girls (16%), and the number of spontaneous contributions initiated by boys (62%) compared to girls (34%). Boys were also answering more in the classroom and being evaluated more. The whiteboard was used to explicitly answer questions occasionally (5.7% of the time).



**Figure 13:** Receivers and initiators of discourse moves



**Figure 14:** Receivers and initiators of discourse moves (gender comparison)

Significantly more closed questions were asked of boys than girls<sup>30</sup>. This makes sense taken with the earlier finding that boys answer more in the classroom.

So it seems that the boys in our sample received more feedback *per se* than the girls. However the table below reveals that praise, criticism and acceptance were given in equal measures irrespective of gender.

**Table 11:** Type of evaluation given by gender

Evaluation type	Boys	Girls	Whole sample
Praise	48.6	49.6	51.4
Accept	40.4	39.6	38.6
Criticise	11.0	10.7	10.1
Total	100.0	100.0	100.0

Looking at the type of evaluation given (to the whole class, boys and girls), praise was given 51% of the time, acceptance 39%, and criticism 10% of the time.

The three most significant results<sup>31</sup> concern refocusing, spontaneous contributions and explaining. Refocuses were aimed at the whole class 40% of the times, 16% of refocuses were given to girls, the majority of refocuses (42%) were aimed at boys.

<sup>30</sup> A related t-test was performed (on the raw frequencies, not the percentage values):  $t=2.26$ ,  $p<0.05$ .

<sup>31</sup> All at  $p<0.001$ .

Most spontaneous contributions (62%) came from boys, compared to 34% from girls<sup>32</sup>. Table 12 shows that boys were more likely than girls to offer a curricular spontaneous contribution.

**Table 12:** Type of spontaneous contribution given by gender

Contribution type	Boys	Girls	Whole sample
Procedural	9.7	14.2	10.9
Curricular	90.3	85.8	89.1
Total	100.0	100.0	100.0

The most common type of spontaneous contribution given (whether from the whole class, boys or girls) was a curricular one (89% of the time).

Finally, teachers were significantly more likely to explain something directly (or individually) to a boy than a girl<sup>33</sup>.

### Focus on the evaluation objectives

Tests were carried out to see if there were any differences between interactive whiteboard lessons and non-whiteboard lessons for the modifier data. None were found. For example, boys were no more likely than girls to answer in IWB lessons, or vice versa; the type of evaluation given by a teacher did not vary according to the type of lesson; the type of spontaneous contribution given by a pupil did not vary by type of lesson; direction and refocusing were not more common in whiteboard lessons. Although there are different patterns of interaction for boys and girls these differences were consistent across IWB and non-IWB lessons.

Similarly, no differences were found between subject areas for the modifier data. Again patterns of interaction were consistent in literacy and mathematics lessons in terms of IWB use.

A repeated measures ANOVA was used to see whether another year with a whiteboard made a difference. Earlier it was found that uptake questions were less likely in whiteboard lessons: the ANOVA reveals that the teachers using whiteboards after a year of use tended to focus their uptake questions on the whole class rather than an individual pupil<sup>34</sup>.

No significant differences were found between year group and the modifier data.

### Summary

Structured observations of classroom interaction were undertaken in early 2003 and again a year later in early 2004. A total of 184 lessons were observed; the research focused on differences between lessons where teachers did and did not use IWBs for literacy and mathematics and on any changes in patterns of interaction a year later.

<sup>32</sup>  $t=4.43, p<0.001$

<sup>33</sup>  $t=4.30, p<0.001$

<sup>34</sup>  $F=7.45, p<0.001$

Overall IWBs do seem to make a difference to aspects of classroom interaction. Some of these are relatively short-lived; others appear over time as the use of the technology becomes embedded.

From both the 2003 and 2004 observations, there were fewer pauses and uptake questions in IWB lessons; but an embedding effect was observed in 2004 whereby there were also more open questions, repeat questions, probes, longer answers from pupils, and general talk in these lessons. There was almost twice the amount of evaluative responses from teachers in whiteboard lessons.

There was a faster pace in the IWB lessons in 2004 compared with the non-whiteboard lessons in 2003.

The initial increase in the number of answers from pupils observed in 2003 was not observed a year later. However, answers from pupils were longer in whiteboard lessons compared to non-whiteboard lessons. Also, the initial decrease in the amount of explanation was short-lived (it increased again in 2004).

Teachers using IWBs after a year of use tended to focus their uptake or follow-up questions on the whole class rather than an individual pupil.

In the observations in 2003, IWB lessons contained about five minutes more whole class teaching and 5 minutes less group work than lessons without an IWB. This difference was found in both literacy and mathematics. After a year, the amount of whole class teaching in IWB lessons was not significantly different to non-IWB lessons, but the amount of group work had decreased further (this time a difference of nearly seven and a half minutes). This difference was found in both Year 5 and Year 6 classes.

The patterns of interaction in lessons by boys and girls remained consistent across both IWB lessons and lessons where such technology was not used. There was no difference in who initiated or received questions and answers between IWB and non-IWB lessons.





## **Section 3: Interviews with Teachers**

### ***Introduction***

A telephone interview survey was undertaken between December and March 2004 with teachers regarding their perceptions and attitudes to Interactive Whiteboard technology. The survey indicates that the teachers overwhelmingly found that the technology increases their opportunities for flexibility in lessons and for motivating pupils. They also identified some areas of concern, specifically, equipment reliability and technical support. This section will focus on teachers' perceptions of IWBs and specifically their ICT experience, training and technical support.

### ***Data Collection***

Telephone interviewing using a standardised interview schedule was considered to be the most appropriate method in this particular case for two main reasons. Firstly, the sample was widely dispersed in six areas of England, three LEAs in the north and three in the south making the choice of face-to-face interviewing less feasible. Secondly, it was felt that shorter interviews with key questions could be completed much more quickly over the telephone. Given that teachers' time is at a premium it was felt that interviews of around 20 minutes might be considered more acceptable by teachers than a face-to-face interview of longer duration. The length of most of the interviews was around 20 minutes initially but tended to get shorter as the interviewers got used to administering them.

Pilot telephone interviews were conducted with volunteers in some of the project schools in December 2003. Further refinements were made to the interview schedule and the first contacts with schools were planned for January.

A literature review highlighted a number of issues raised by teachers in regard to using ICT in the classroom. Some of these issues were incorporated into the interview schedule. The interview schedule was composed of mainly closed questions but included a few requiring a more open-ended response.

### ***Sampling***

Lists of project teachers' names were collected from the IWB Consultants in each of the six project areas providing a list of 257 Year 5 and Year 6 teachers with two years experience with Interactive Whiteboards. A pseudo-random sample of 160 teachers was drawn from the list, two teachers from each school in the pilot, one to act as the first choice for interview and the other to act as the second choice if the first was unavailable. Seventy-five percent of the final sample was composed of those teachers selected as the first choice.

With a target of 80 teachers in mind, sixty-eight interviews were completed between December 2003 and the end of March 2004 giving a response rate of 85 percent.

The sample was composed of 68 primary school teachers drawn from the population of Y6 and Y5 teachers in the 80 IWB project schools. This constitutes 26% of the population of 257 project teachers who have been using IWB since the start of the evaluation, which began in 2003, and so have gained, in most cases, two years experience of using the technology specifically in literacy and numeracy lessons.

**Table 13:** Distribution of teachers interviewed by LEA

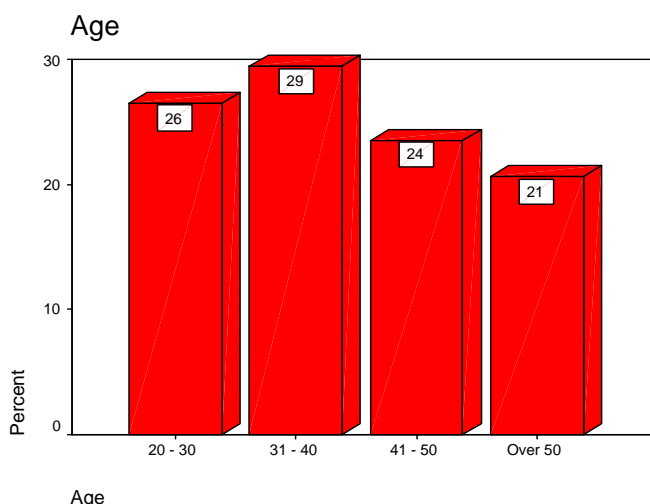
LEA	Number	Percent
Bracknell Forest	14	20.6
Cumbria	11	16.2
Lewisham	8	11.8
Oxfordshire	13	19.1
Redcar & Cleveland	12	17.6
Wakefield	10	14.7
Totals	68	100

The final sample was composed of 55 female and 13 male teachers. Over half the sample had been teachers for over 10 years. A quarter had been teachers for between six and ten years and the remaining quarter had been in teaching from between zero and five years.

51% percent of the sample worked with Y5 pupils and 37% worked with year six pupils. 12% worked with both Y5 and year six pupils thus providing them with an overview of Y5 and Y6 teaching with the IWB.

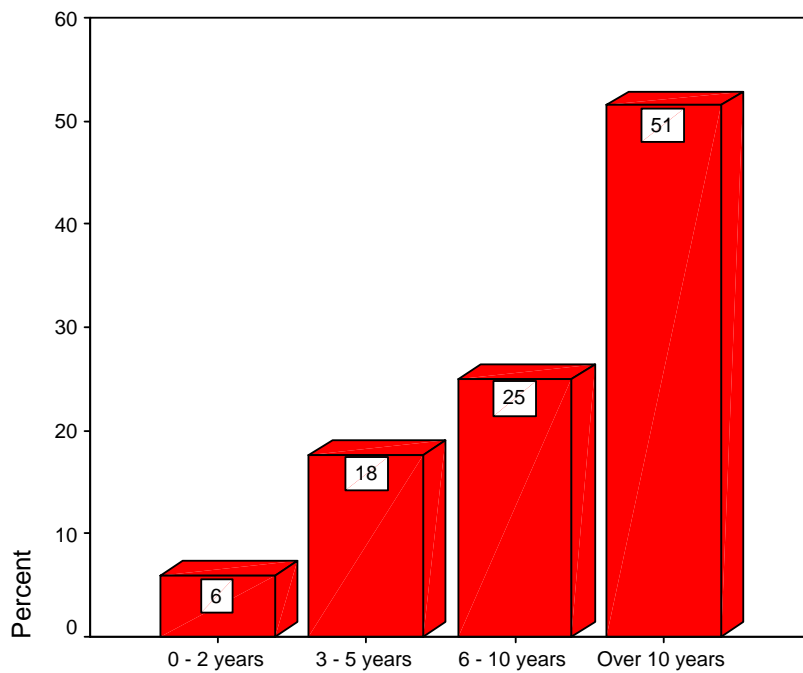
**Demographic Data**

Questions 1-5 were concerned with demographic characteristics of the sample including aspects such as age, gender, number of years as a teacher, year group taught and main roles in school.



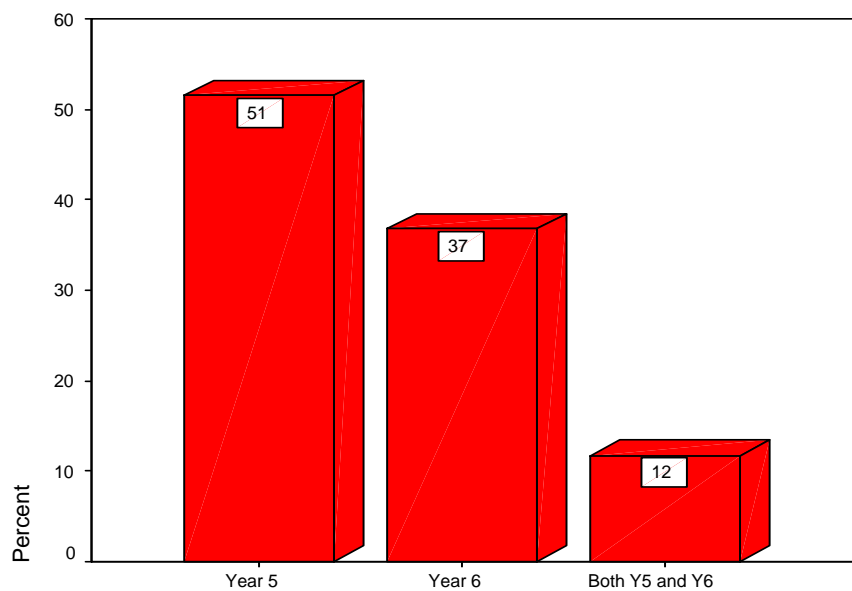
**Figure 15:** Ages of teachers interviewed

85% (55) of the sample was female and 19 % (13) was male. The majority of the sample has over ten years teaching experience



**Figure 16:** Number of years as a teacher (n=68)

51% percent of the sample worked with Y5 pupils and 37% worked with Y6 pupils. Twelve percent worked with both Y5 and Y6 pupils.



**Figure 17:** Year group taught (n=68)

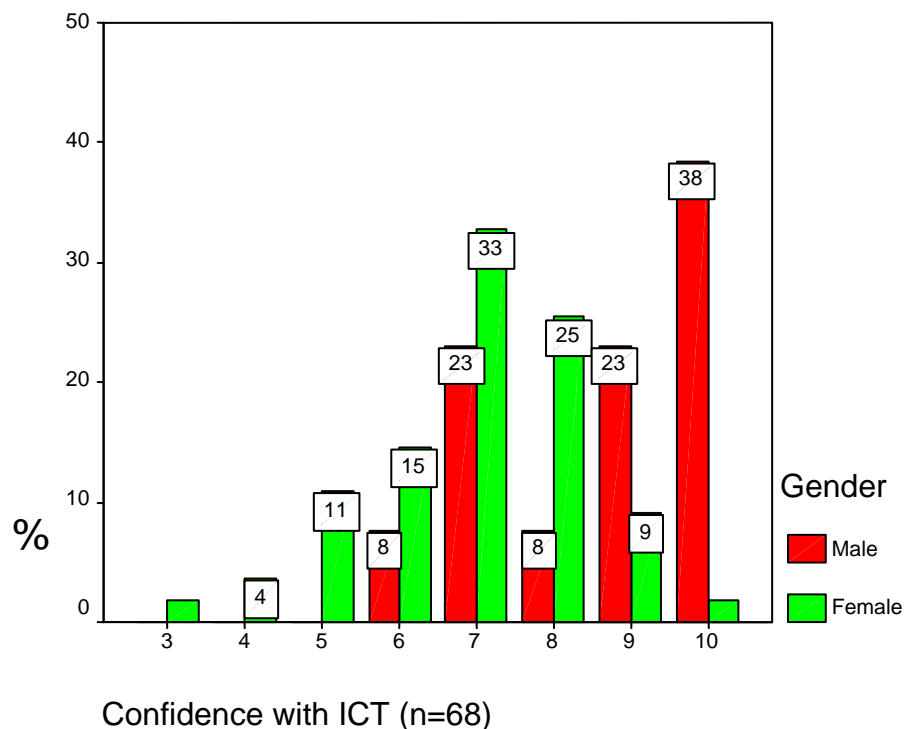
Teachers' had multiple roles including classroom teacher and various co-ordinator roles e.g. KS2, History, Geography.

### ICT Experience

Q. 6: 85% of the respondents said they had no formal ICT qualifications. Eight respondents mentioned secondary school level and college qualifications such as GCSEs and A levels.

Q. 7 – 8 were about NOF training. The majority of respondents had received NOF training (87%) while 13% said they had not. 25 of the respondents were able to identify their NOF Trainers. The remaining 75% said they could not remember. Of the 59 respondents who said they had received NOF training, forty-six percent said they had found the training useful, or very useful. Nineteen percent rated it as average and 36% (collapsing not at all useful and not useful together) said they found the training not useful or not at all useful.

Q. 9. Respondents were asked to rate their confidence with using ICT. The average rating was 7.26. Males rated their confidence more highly than females.



**Figure 18:** Confidence with ICT by gender

Q.10 Respondents were asked whether using an Interactive Whiteboard had affected their confidence levels. 59 respondents said that using IWB had affected their confidence and of these 58 said they were more confident. 87%

Q. 11: Respondents were asked to provide an estimate of the training they had received in days and half days. Practically all respondents had received some IWB training (one failed to provide data). The number of days training received ranged from one day to ten days. The average number of days training received was 4.3 days.

Q. 12: Respondents were asked to identify the person who delivered the IWB training. The majority (97%) identified the IWB Consultant as the person who delivered the training.

Q.13: Those respondents who had received IWB training were asked how useful they had found the training. Eighty-six percent of the respondents (collapsing the useful and very useful categories together) said they had found the training useful and six percent (collapsing the not at all useful and the not useful categories together) said that it had not been useful.

Q.14: Of the 67 respondents who had received IWB training, 84% said the training had been suitable for their particular needs.

Q.15: Those respondents who had received training were asked if there was any other training they felt they needed. Respondents provided a variety of responses to this question. Responses were categorised as follows:

**Table 14:** Is there any other training you feel you need?

Further training required?	Count	Percentage of responses
No further training required	16	24
General comments	16	24
Practice with IWB	14	21
Training in new developments	13	20
Training on specific software	7	10
Total	66	100%

Q.16: *Have you had any informal support?* 81 percent of respondents said they had received informal support. Three identified their school ICT Co-ordinator as providing informal support while four identified other colleagues.

### **Subject Related Questions**

Q. 17: *What other equipment did you regularly use prior to the installation of IWB?* The normal whiteboard and OHP were the most frequently used pieces of equipment prior to the installation of the IWB.

Q.18: *In what subject areas are you using IWB?* Most respondents listed most subject areas while others simply said 'all curriculum areas'.

Q.19: *Where do you get your information about IWB from?* The most frequently identified sources of information about IWB include the website, training sessions, the IWB Consultant and other teachers.

**Table 15:** Sources of information

Dichotomy label	Count (n=68)	% Responses	% Cases
Training sessions	49	21.2	72.1
Other teachers	44	19.0	64.7
Whiteboard Consultant	42	18.2	61.8
IWB website	36	15.6	52.9
Other	33	14.3	48.5
CD	19	8.2	27.9
School intranet	8	3.5	11.8
Totals	231	100.0	339.7

0 missing cases; 68 valid cases

*Q.20: Which of these sources of information have you found most useful?* Respondents identified the IWB Consultant (40.3%), training sessions (35.8%), other teachers (29.9%) and the IWB website (13.4%) as the most useful sources of information.

**Table 16:** Most useful sources of information

Dichotomy label	Count (n=67)	% Responses	% Cases
Whiteboard Consultant	27	25.2	40.3
Training sessions	24	22.4	35.8
Other teachers	22	20.6	32.8
Other	20	18.7	29.9
IWB website	9	8.4	13.4
CD	4	3.7	6.0
School intranet	1	0.9	1.5
Totals	107	100.0	159.7

1 missing case; 67 valid cases

## ***Impact on Teaching***

*Q. 21 Do you think IWB has affected the structure of your literacy and numeracy lessons?* 69% believed that using the IWB had affected the structure of their literacy and numeracy sessions; 28% did not.

A breakdown of the comments made by the 47 respondents, who said yes, the structure of their lessons had changed, can be found in the table below:

**Table 17:** Has IWB affected the structure of your lessons?

Comments	Count	Percentage of responses
General comments	14	30
More whole class teaching	13	28
No comment	9	19
Increased pace of lesson	7	15
More interaction	4	9
Total	47	100%

Typical comments from the teachers included:

“Lessons are better since using IWB.”  
 “Can target things more.”  
 “More whole class teaching (significantly more in numeracy, less group work.)”  
 “Quicker pace. Has affected how much goes into each lesson. Less running around.”  
 “Impacted on the pace of the lesson – get through more.”  
 “Children are more focused, more on task. Can interact with teacher more.”  
 “More interactive structure – not so rigid – more flexibility.”

Q.22: Do you find that you spend less/same/more time teaching at the whole class level with IWB? 71% of those who responded to this question said they were doing more whole class teaching (based on 65 responses).

### **Impact on Pupils**

Q. 25: Do you find that using IWB in literacy and numeracy increases pupils’ motivation to learn? 99% of respondents felt that the IWB increases pupil motivation.

Q. 26: Have you noticed any differences between girls and boys in relation to IWB use? 56% of respondents felt that there were no differences between boys and girls in relation to IWB use. 40% felt there were differences and provided comments.

Out of the 30 respondents who answered yes to this question, 80% mentioned differences they had noticed in boys. 13% made specific reference to differences in girls and the remaining seven percent made reference to both boys and girls. Comments about the boys used words like, more motivated (2), interested (4), focused (3), involved (2), confident (2), hands on (2) and participate more (2).

**Table 18:** Differences between boys and girls?

<b>Comments</b>	<b>Count</b>	<b>Percentage of responses</b>
About boys	24	80
About girls	4	13
About both	2	7
Total	30	100%

Sample comments about boys include:

“Boys thoroughly enjoy visual aspect. More boys have improved with their writing.”  
 “Boys focus more.”  
 “Boys participate more.”  
 “Boys are far more interested than they were before.”  
 “Boys are more switched on.”

Sample comments about girls:

“Particularly helped girls’ spatial awareness. Numeracy: Girls tend to need to see something happening.”  
 “Girls are more confident.”  
 “Least confident - girls are better mathematically.”

*“Girls tend to want to use it for drawing and artwork other than that equal.”*

Comments about both:

*“Boys are more willing to interact. Less able girls more willing to now.”*

*“Boys more likely to interact with IWB in literacy. Girls in maths with IWB.”*

Q.27: Do you believe that the use of IWB will lead to improvements in pupil attainment? The majority of teachers (85%) believed at the time of the survey that IWB will lead to improvements in pupil attainment. Ten respondents qualified their statements with comments which suggest a little more uncertainty about improvements in attainment. Some sample comments are listed below:

*“I feel this need a longer time of use in schools to answer this question.”*

*“No, not on its own.”*

*“It's a useful resource not a magic wand - it won't replace good teaching.”*

### **Impact on Teachers' Workload**

Q. 28: What affect has using IWB had on your workload? 81% of respondents said that their workload had increased. 12% said their workload had actually decreased while the remaining 7% said it had not changed. 19 of those respondents who said yes, their workload had increased provided qualifying comments which in the main indicate that the increase in workload is or may be temporary in nature. 16 out of the 20 comments related to initial increase in workload and then a decrease. Comments include:

*“Initially increased.”*

*“Long term will be different.”*

*“Decreased in second year.”*

*“Increased at start decreased later.”*

Q. 29: If your workload has increased where do you think the increase lies? Those respondents who said their workload had increased, highlighted gathering and adapting resources.

**Table 19:** Impact on workload

Dichotomy label	Count (n=53)	% Responses	% Cases
Gathering Resources	33	27.3	62.3
Adapting Resources	32	26.4	60.4
Other	22	18.2	41.5
Lesson Planning	21	17.4	39.6
Setting up IWB	13	10.7	24.5
Totals	121	100	228.3

15 missing cases; 53 valid cases

22 respondents mentioned other factors that had added to their workload. These can be broken down to resource related factors (16/22) such as making, preparing, finding IWB resources and technology/technical related issues (6/22) such as gaining an increasing familiarity in using the IWB. Comments included:

*“Production of Notebook files”.*

*“Lesson planning”.*



*“Setting up the IWB, preparation”.*

*“Transferring things you had before to the PC. Less work in future”.*

*“Creating slides.”*

*“Time consuming to prepare interactive lessons.”*

*“Always have to have a backup plan in case IWB failed.”*

*“Initially getting used to it: not an issue anymore.”*

*“Having more time on computer find my way around it.”*

## **Technical Issues**

Q. 30: Do you have access to IWB technical support? 90% of the respondents said they had access to IWB support. Seven percent said they did not have access to technical support and three percent were not sure. Checking through responses it is clear that some respondents said they did not have access to technical support and then went on to give details of technical support they had accessed! This required some recoding of responses.

Q. 31: How do you normally access IWB support? 55 of the 61 respondents provided valid answers to this question. Most said they access it by telephone. 15 respondents said they used e-mail while a further 17 mentioned other ways of accessing technical support.

**Table 20:** Other technical support

<b>Means of access</b>	<b>Count</b>	<b>Percentage</b>
Technician	9	53
School ICT Co-ordinator	3	18
LEA	2	12
IWB manufacturers	1	6
Teachers	1	6
Head Teacher	1	6
Total	17	100

Q. 32: *Have you used technical support?* 81% said they had used technical support compared with 19% who said they had not.

Q. 33: Was the support prompt? 34 (n=49) 69%) said it had been prompt.

Q. 34: Can you think of any other IWB support systems you would find useful? Comments from respondents indicate concerns with rapid access to technical support. The breakdown of comments is presented in the table below (n=66).

**Table 21:** Other support systems

<b>Comments</b>	<b>Count</b>	<b>Percentage</b>
Technical support	31	47
None	19	29
Resource related	7	11
Don't know	3	4.5
Training related	3	4.5
Teacher support groups	3	4.5
Total	66	100

Comments included:

*“Somebody instantly on hand but realistically there is no funding for this”.*

*“Some sort of trouble-shooting guide; List of checks. A check list”.*

*“Need more varied software - would be good to have someone to contact with software information.”*

*“A resource making consultant to support staff who struggle to make resources.”*

*“Demonstrations when new stuff comes out.”*

*“Teachers coming together - discussion groups.”*

*“Talk to other schools and ICT Co-ordinators.”*

Q. 35: Have there been any issues with installation and placement of the IWB? 51% of respondents said they had had no installation related problems. Others pointed out a number of deficiencies relating to the installation of the IWB. Comments have been broken down into broad categories in the table below. Nearly half said there had been no installation problems. Positioning of the IWB was the biggest installation issue.

**Table 22:** Installation issues

<b>IWB installation issues</b>	<b>Count</b>	<b>Percentage</b>
No problems	33	50.0
Positioning of IWB	14	21.2
General installation problems	6	9.0
Projector problems	5	7.5
Wiring/cables/sockets	5	7.5
Problems seeing the board	3	4.5
Total	66	100

Comments included:

*“The position of the IWB; Light shining onto the IWB was a concern”.*

*“IWB was placed at wrong end of the classroom. No negotiation.”*

*“Problems with installation. It had to be reinstalled.”*

*“Had to have the projector raised (gymnastics in the same room).”*

*“Yes. False ceilings for projectors. All sorted now.”*

*“Some of the leads are too prominent (health and safety).”*

*“Cable missing - no audio connection - nearly a year before sorted.”*

### **Teachers’ Views about IWB**

Q. 36: Does the IWB help you to achieve your teaching aims? All respondents felt that using the IWB helped them to achieve their teaching aims.

Q. 37: Do you think all teachers should have an IWB? 97% of teachers felt that all teachers should have an IWB and provided a range of reasons.

*Q. 38: Do you feel having IWBs in your classroom helps to promote your school?* The majority of teachers (91%) believe that having IWBs helps to promote their school.

*Q. 39: Does IWB give you greater choice in planning your lessons?* Practically all respondents (99%) believed that the IWB gave them greater choice in planning lessons. Once again, respondents provided multiple responses.

*Q.40: Do you think IWBs are good value for money?* 87% indicated that they thought IWBs were good value for money, though they found the question difficult to answer.

*Q.41: Are there alternatives to IWB you feel may offer better value for money?* Respondents could not identify any alternatives to IWB that offered better value for money. It is probably the case that this question was targeted at the wrong audience. Headteachers or those with budget responsibility may have been more able to make suggestions.

## **Summary**

68 teachers from pilot project schools were interviewed between December 2003 and March 2004.

Overall, the teachers interviewed were extremely positive about the impact of IWBs on their teaching. They were also positive about the training and support that they had received as part of the pilot project.

All the teachers (100%) felt that the IWB helped them to achieve their teaching aims and cited a number of factors such as the wealth of resources available, the stimulating nature of the presentation and the flexibility that the technology offers.

99% of teachers surveyed believe that using the IWB in lessons improves pupils' motivation to learn.

85% of respondents believe that IWB will lead to improvements in pupil attainment. Some feel this will be dependent on how IWB is used and may not be evident immediately.

The IWB Consultant was identified as the most useful source of training by 40% of the teachers followed by IWB training sessions (32%) and other teachers (28%).

81% of teachers said they had received some informal training, which tended to come from colleagues and their school ICT co-ordinator.

87% of teachers said that using the IWB had affected their confidence and of these 98% said they were more confident after using IWB.

86% of respondents who had received IWB training rated it as useful compared with six percent who rated it as not useful.

Training sessions were the most popular source of IWB information identified by 72% of those interviewed followed by other teachers (65%) and then their IWB consultant (62%). The IWB website was also popular with 53% respondents identifying that as a useful source of information.

Respondents were asked whether they were spending less/same/more time teaching at the whole class level. 71% percent of (46 out of 65) respondents said they were doing more whole class teaching.

81% of respondents said their workload had increased since the introduction of IWB and 35% of these believe the increase to be only temporary in nature as they develop and store their IWB resources.

66% of respondents said they had not noticed any differences between boys and girls in relation to IWB use while 44% said they had noticed differences, usually commenting on a positive impact on boys such as that they were more motivated and interested or more focused and involved.

50% percent of respondents said they had no problems with installation of the IWB. However, 21% said they had encountered problems with the actual positioning of the IWB.

## Section 4: Teachers' Reported Use of the Interactive Whiteboard

### Teacher Logs

In 2003 teachers completed 655 web-based log forms recording their use of the Interactive Whiteboard (IWB). In 2004 a second (partially-inclusive) set of teachers completed 817 further forms. The logs from the teachers participating came from each of the six LEAs (Bracknell Forest 13%, Cumbria 15%, Lewisham, 12%, Oxfordshire 19%, Redcar and Cleveland 26%, Wakefield, 16%).

### How many lessons used the IWB?

#### All mathematics & Literacy Lessons

	Numeracy 2003		Literacy 2003		Numeracy 2004		Literacy 2004	
	Total	% of sample	Total	% of sample	Total	% of sample	Total	% of sample
Used IWB	2219	68%	2096	64%	3026	74%	3009	74%
Did not use IWB	1056	32%	1179	36%	1059	26%	1076	26%

Sample size\*: 3275 days (from 655 forms.) Sample size\*: 4085 days (from 817 forms.)

\* Sample = all valid lesson records submitted.

There was generally a significant increase in the overall reported use of the IWB in between 2003-2004 (6.32% more in mathematics, and 9.66% more in literacy). In 2003 the IWB was used slightly more often during mathematics lessons compared to literacy in 2003 (3.76% more<sup>35</sup>), but this difference between subjects was not significant in 2004.

### Was the IWB used in a particular part of a lesson?

#### All mathematics & literacy Lessons

	Numeracy 2003		Literacy 2003		Numeracy 2004		Literacy 2004	
	Total	% of sample	Total	% of sample	Total	% of sample	Total	% of sample
Introduction	1689	52%	1764	54%	2325	57%	2400	59%
Main	1845	56%	1629	50%	2621	64%	2447	60%
Plenary	1329	41%	1076	33%	1959	48%	1661	41%

Sample size\*: 3275 days (from 655 forms.) Sample size\*: 4085 days (from 817 forms.)

\* Sample = all valid lesson records submitted.

In 2003 the IWB was used most often in the main part of the lesson for mathematics (with 56% of the teachers reporting use in this part of the lesson in 2003) and the introductory part of the lesson for literacy (54% of the teachers in 2003.) But in 2004 usage of the IWB for all parts of the lesson increased (between five percent and ten percent), especially for literacy in the main part of the lesson

<sup>35</sup> p<0.002

(ten percent increase in 2004) which became part of the lesson where the IWB was most frequently used.

### What day of the week was the IWB used?

All mathematics & literacy Lessons

	Numeracy 2003		Literacy 2003		Numeracy 2004		Literacy 2004	
	Total	% of sample	Total	% of sample	Total	% of sample	Total	% of sample
Monday	451	69%	414	63%	651	80%	653	80%
Tuesday	479	73%	457	70%	614	75%	610	75%
Wednesday	454	69%	436	67%	617	76%	602	74%
Thursday	437	67%	424	65%	606	74%	591	72%
Friday	398	61%	365	56%	538	66%	553	68%
Sample size*: 655 weeks.					Sample size*: 817 weeks.			

\* Sample = all valid weekly forms submitted.

Use of the IWB in both 2003 and 2004 was relatively consistent throughout the five-day week with slightly greater usage reported early in the week declining as the week progresses. For both 2003 and 2004 Friday was the least popular day for using an IWB (ranging from 56% to 68% of usage).

### Of the lessons that used the IWB, did teachers adapt any resources themselves?

All Numeracy & Literacy Lessons

Adapted resources for:	Numeracy 2003		Literacy 2003		Numeracy 2004		Literacy 2004	
	Total	% of sample	Total	% of sample	Total	% of sample	Total	% of sample
Any part of the lesson	1123	50.61%	1314	62.69%	1755	58.00%	2029	67.43%
Introduction	691	31.14%	998	47.61%	982	32.45%	1470	48.85%
Main	779	35.11%	924	44.08%	1367	45.18%	1478	49.12%
Plenary	555	25.01%	525	25.05%	929	30.70%	918	30.51%
Sample sizes*	2219		2096		3026		3009	

\* Numeracy sample = Only the numeracy lessons that used an IWB. Literacy sample = Only the literacy lessons that used an IWB.

In 2003, teachers adapted or created resources for use in 50% of mathematics lessons and 63% of literacy lessons. This significantly increased in 2004 (7.39% increase in mathematics,  $p < 0.000001$ , and 4.74% increase in literacy,  $p < 0.0006$ ) with adapted resources accounting for 58% of mathematics lessons and 67% of literacy lessons.

For both 2003 and 2004 the teachers reported that they created or adapted resources least for the plenary part of the lesson (ranging from 25% to 31% of usage).

### Use of Interactive Teaching Programs (ITPs)

Interactive teaching Programs (ITPs) were widely used in mathematics lessons. Overall the most popular ITP software used was 'Fractions' which was used during nearly 8% of all IWB numeracy lessons in 2003 and 5% of IWB numeracy lessons in 2004. Other frequently used software titles over the two years were those with generic use across a number of different mathematical topics such as 'Number Grid' and 'Number Line'. From 2003 to 2004 there was a small but significant decrease<sup>36</sup> in the use of ITP software in lessons, reflecting a general increase in the use of resources that teachers prepared or adapted themselves.

### **Use of other resources**

Software designed for use of IWBs was also very widely used. This was mainly the proprietary software produced by the whiteboard manufacturers ('SMART' (Notebook/ Board - SMART)', 'Easiteach' (Maths/ literacy)- Research Machines™ and 'ACTIVstudio' (Primary) are (Smart™, and Promethean™ respectively). These are designed to support presentation of information from the boards (as opposed to control from a computer) and were widely reported and increased between 2003-4. Three of the most popular uses in mathematics lessons (for both 2003 and 2004) were displaying Unit Plan Resources, scanned material and national test papers. The most popular use in literacy lessons (for both 2003 and 2004) was displaying scanned material (16% of lessons in 2003 and 18% in 2004).

### **Summary**

Online logs<sup>37</sup> detailing how the IWBs were being used each week were recorded by teachers in the pilot for two periods of approximately 6 weeks during Spring 2003 and again in 2004; 655 weeks of forms were completed for 2003 and 817 weeks of forms for 2004.

Overall patterns of use were fairly consistent across the pilot project schools. The teachers involved were using IWBs in the majority of their literacy and mathematics lessons. Their use of the IWB has increased during the project. Teachers also appear to be more confident after a year or so of use to create or develop their own materials.

Teachers reported using the IWB in at least 60% of literacy and mathematics lessons in 2003 and 70% of these lessons in 2004.

Reported use was significantly greater in the second year of the pilot project (2004) in both mathematics (6.3% increase) and literacy (9.7% increase).

Use of the IWB in 2003 was relatively consistent throughout the five-day week. In 2004 use throughout the five-day week was again relatively consistent but there was a significant increase on Mondays for both mathematics (4.2% increase) and literacy (5.3% increase) compared to the next most popular day. For both 2003 and 2004, Friday was the least popular day for using an IWB (ranging from 56% to 68% of lessons.)

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<sup>36</sup> 9.50% decrease,  $p < 0.000001$

<sup>37</sup> Paper versions were available in case of technical problems.

In 2003, teachers adapted or created resources for use in 50% of mathematics lessons and 63% of literacy lessons. This significantly increased in 2004 with teachers reporting making or adapting resources in 58% of mathematics lessons and 67% of Literacy lessons.

Between 2003 to 2004 there was a reduction in the use of Interactive Teaching Programs (ITP) software compared with other kinds of software in mathematics lessons (9.5% decrease from about 41% of lessons to 31.5% of lessons).

Use of the whiteboard manufacturer's software to manage and display resources increased from 2003 to 2004 for both literacy and mathematics lessons.



## Section 5: Pupil interviews

12 sets of interviews were conducted between March and April 2004 with groups of around six pupils who had been in classes where an IWB had been in use for both years of the pilot. Interviews were held in each of the six pilot areas: Bracknell Forest, Cumbria, Lewisham, Oxfordshire, Redcar and Cleveland, and Wakefield. In total 72 pupils were involved in these group interviews. Group interviews are thought to be less threatening for pupils and tend to produce a greater range of comments. The interviews were taped and transcribed, then analysed for the responses to each of the questions as well as any themes which emerged.

### What do the pupils like?

A number of common themes emerge across the schools in relation to what pupils like when an IWB is used in the room. In the first place, what seems to come out of the pupil interviews in relation to this question is the visual aspect of the IWB and how this seems to help children understand the subject matter. A word frequently used by pupils to describe what they like best about IWB is 'easier'. In this context it seems to refer to actually 'seeing' what the teacher is doing and combining what is seen with the teacher's explanation. The impression is, however, that 'seeing' first aids understanding.

*"Because they can just see the whiteboard and if they can't hear then they can just see it."*

*"Say if the teachers wanted to show something, they can show it easier on the whiteboard."*

Pupils believe that IWB contributes to lessons in terms of making them more enjoyable:

*"Its got quite good things that make it fun as well as teaching and learning. It makes maths fun, we play maths games."*

Pupils clearly view the IWB as more versatile than the normal whiteboard in that it can access and utilise more resources, such as the Internet, games, SATs papers, and examples of work done by other pupils.

*"It's like better than the normal whiteboard because on that whiteboard all you can do is write and draw like boring pictures but on that one you can do loads of different kinds of stuff and you can play games on it."*

Multi-media elements appear to play a part in engaging pupils and holding their attention. Pupils reported that they enjoyed sounds, the visual aspects and touching the IWB. Although some claimed that they would like to use and touch the IWB more:

*"I like it because it helps to get you more involved with the thing you are doing."*

*"You can watch a clip because you actually pay more attention watching something than just listening."*

### What don't you like?

The main issues that emerge in relation to this question are teacher skills and technical problems with the IWB. Looking across the schools, pupils in five out of the 12 mentioned technical issues and teachers skills as problematic. The impression received from pupils is of frustration, disruption and delay due to difficulty in controlling the board, the IWB breaking down or having to be reoriented. The pupils also identified an issue about new teachers and supply teachers' skills with the IWB:

*"It can get a bit annoying when she can't remember how to work it."*

*"Because sometimes it's a bit dodgy. It doesn't work sometimes and she has to calibrate it."*

*"It's mostly good but when you scan things it can go a bit jerky."*

### **What would you change?**

A common theme that emerges from the pupil interviews in relation to this question is technical issues. Pupils are apparently irritated when the IWB fails (four groups of pupils specifically mentioned that they found having to re-orientate the board was irritating):

*"You shouldn't have to orientate it all the time."*

*"That gets on your nerves. That's the only thing that lets the whiteboard down, isn't it (to other children). I can't think of anything else."*

Not being able to see what is on the IWB is another issue. This might be due to the fact that the IWB display is not bright enough or when light shines in through the windows onto the screen. Pupils seem to feel that they are not being allowed to use the board as much as they would like.

### **Do IWBs help your learning?**

Overall, pupils across the schools believe that they learn better when an IWB is used in the classroom (eight out of the 12 pupil groups said this). However, they are not able to explain precisely why they think it helps them to learn. When pressed on this point, they simply employ a cause and effect logic that, for example, playing a maths or literacy related game must inevitably improve their learning. While pupil comments about numeracy are more detailed (probably related to the availability of a variety of software) than those made about literacy, there appear to be no real differences highlighted in pupil comments other than those that are subject related, such as sentence structure and stories in literacy and various mathematical operations in numeracy. The following issues relate to both mathematics and literacy lessons.

Touching the board and getting instant feedback, such as when the right answer is shown and pupils can instantly know whether they are right or wrong. If the answer is revealed with an accompanying positive sound it seems to enhance the experience:

*"There's this program, it's called Easiteach Maths. It's got functions and things. You do your numbers, say times it by 5 and it just brings up the answer right away."*

*"Yesterday we were doing fractions to see which was bigger and you, like, split it into different bits and you click it and see which is bigger."*

There is clearly an element of fun and excitement compared to other learning. There is a sense that a maths problem presented on the normal whiteboard is somehow less engaging than if it were presented on an IWB.

*"It's fun, but it teaches you in like a fun way so its not like... say you had to times or something its not just like  $4 \times 7 =$  or that. .But it makes into like a fun way."*

*"So its more easy and like with interactive whiteboard if you are doing boring sums on the board like  $5 \times 80$  then its just like boring, but if you use the time machine then it makes it more interesting and if its more fun then you will concentrate better."*

The multi-media features of IWBs are appreciated by pupils. Many pupils talk about 'seeing' and 'understanding' better when something is simultaneously presented in a visual fashion and then accompanied by an explanation from the teacher. Pupils make comparisons between traditional ways of learning such as from books, and learning from an IWB as in this example:

*"It helps you learn better because sometimes, in books, it is just all words and words but you get pictures and things, you can actually see what is happening."*

There is a sense of greater clarity and less clutter, when the IWB is used in lessons when compared with books which seem to contain more words, which are difficult to grapple with when compared with a picture or image.

*"There's this program on it and it helps you to learn fractions and you can see it and actually come up and do fractions yourself."*

*"There are all kinds of programs that make it clearer to understand and things."*

However, it is clear that while most pupils believe that these particular features can enhance the learning experience, one pupil felt that that they can be overdone and may actually detract from the learning experience:

*"For some reason I think it's, I prefer it normal. I don't know why. I just 'cos well I find it a bit too complicated for literacy... because there's loads of different things like the flip chart and the spot light and like you have to turn onto a different page and all that stuff, which I find quite annoying sometimes 'cos I forget quite, I'm not very good at remembering stuff."*

The capacity to save work and return to it later is also valued by pupils:

*"Well, we are writing stories and if you do it on Notebook you can save it on Notebook and you can bring it up again the next day if you want to do your story and it reminds you of things when you were doing your story. It's made me improve a lot on my stories."*

A final issue that emerges from this particular question for both literacy and mathematics relates to what appears to be 'lesson readiness'. The IWB allows greater immediacy in lessons since the lesson materials can be stored on a hard drive and can be displayed instantly on the IWB Screen. This means that the lesson starts more or less straightaway without any time being used up on the practical issue of preparing something on the normal whiteboard such as a story or something for the pupils to copy down.

*"Also it means that the teacher doesn't have to spend a long time writing things up on the board."*

*"If you are doing sums or something like that instead of (Teacher) writing while we are all waiting, he can do it all during break time, like typing up a story, he can save it to disk and when he plugs the laptop in it all comes on automatically. It's easier than faffing on really".*

### **Do IWBs help you pay attention?**

Most of the pupil groups believe that the IWB helps them to pay better attention during lessons. Reasons for this appear to revolve around the multi-media aspects of the IWB. The normal whiteboard is viewed as plain and uninteresting by comparison with the IWB as the following comments highlight:

*“Everybody likes the [Interactive] Whiteboard because it is colourful and gets your attention. When you look at that one (plain whiteboard) it is dull, but on there it is colourful and gets your attention.”*

However, while most pupils believe it helps them to pay attention, three felt that it could be distracting too.

*“Sometimes when (teacher) is typing or something, we are all looking at that instead of doing us work”.*

### **Have you had any of your own work shown on the IWB?**

Across the schools there is a mixed pattern of responses to this question. Most pupils seem to like having their work shown on the IWB. One or two are very enthusiastic about it. For some it is an embarrassing and nerve wracking experience. However, for most it is seen as an opportunity to learn, to improve their work. A selection of comments is presented below.

*Well, it's kind of quite good like, well its good for checking it so that you can um see how its wrong. But then if its yours you don't really want everyone to see it.”*

*“I usually like my work going up 'cos I can kind of like, (teacher) checks it for me, so then I can change it or she checks it so I can get better marks and stuff. Also I like kind of showing off a bit.”*

*“Sometimes it's a bit embarrassing if you don't think it's very good.”*

### **What is your favourite IWB lesson and why?**

Pupils make most references to maths and very few to literacy (unless prompted). Reasons for this seem to be related to a greater choice of software but also what can be done with the IWB. There is a sense of greater pupil involvement in lessons where there is the opportunity for more activities with the IWB as the following comments suggest:

*“Maths because its got the most things on about maths. Because the whiteboard helps us, its juts really good.”*

*“It's got loads of protractors and rulers. It's got the most interactive stuff, which you can drag up and stuff.”*

Some pupils believe that the IWB is not necessarily suitable for all lessons.

*“It depends what kind of lesson it is”. If it is Art and DT it doesn't really help you much. It works with maths, literacy, science, geography, history. We used it in DT just to get an overall feel for bridges and things like that”.*

### **Have you noticed any differences between girls and boys in relation to IWB use?**

Asking pupils whether there are any differences between boys and girls in connection with IWB use sparks off a certain rivalry between them, which makes it difficult to tease out whether there are any real differences. Pupils seem to fall into four distinct themes: specific pupils are chosen more than other pupils to answer

questions; boys use the IWB more than girls; girls use the IWB more than boys; everyone gets an equal chance to use the IWB. The comments below highlight some of these views:

*"It is always (boy's name). He's got his hand up before they even start asking the questions".*

*"The boys have got their hands up for ages then the girls just put their hands up and he lets them answer."*

*"Girls always get to use it."*

*"Boys actually answer more questions because there are more boys not because they are smarter."*

### **Have you noticed any problems with the IWBs?**

A common theme across all of the schools is in relation to problems seeing what is on the board and touching the board. Problems can be categorised as directly related to faults or failings in the technology itself or to something external impacting on the technology. The former include, for example, the board breaking down completely and constantly having to reorientate the board. The latter include sunlight shining on the board preventing pupils from seeing it properly. Moving objects on the board appears to be problematic with some pupils reporting that objects won't always go where they want them to go.

*"Sometimes we can't see it because the light from the window shines on it. Sometimes you have to turn the lights off because it is too bright."*

*"It's hard to write on it because when you are writing, your hand goes on it, and you are not allowed to put your hand on it because it puts stuff where your hand has been."*

*"Sometimes it breaks down. It goes completely blank."*

*"Sometimes if you touch it (the IWB Screen) it goes all over the place."*

### **What advantages does an IWB have over a normal whiteboard or blackboard?**

Pupils are clearly aware of the advantages that an IWB has over a normal whiteboard as the following comments highlight. A common theme among pupils is that the IWB is 'interesting' while the normal whiteboard is 'boring'. There is also a sense that much more can be done with an IWB than with a normal whiteboard. Practically all the pupils highlighted the way that the IWB saves time especially for the teacher since its multiple page capability makes it unnecessary for the teacher to constantly rub out work so that more can be put up. It is simply a matter of opening a fresh page and then flipping between different pages as and when necessary.

*"You can get stuff off the Internet onto it". With that (plain whiteboard) you can only write on it".*

*"(Teacher) can save her work and print it off for us".*

*"It's faster.(referring to the lesson)"*

*"There's more programs on the interactive whiteboard and it's easier to learn."*

*"Everything is accurate, like the shapes and everything. Before you had to get a ruler and draw it and you can't get it exactly accurate."*

### **Do you like lessons with IWB better than lessons without IWB?**

There seems little doubt that pupils prefer lessons with the IWB rather than without. Pupils apparently find lessons more exciting, interesting and fun when the IWB is used. One pupil suggested, however, that this would depend on the lesson it was going to be used in.

*"It depends what kind of lesson it is". If it is Art and DT it doesn't really help you much. It works with maths, literacy, science, geography, history".*

Overall, the pupils identified all of the features which the teachers' valued, together with their perspective on the disadvantages and difficulties of using the boards. They are all clearly in favour of the use of IWBs and can readily talk about the way that they think they help the teacher to support their learning as well as their enjoyment of the benefits of the technology.

### **Summary**

12 pupil interviews were conducted between March and April 2004 with groups of pupils who had been in classes where an IWB had been used for two years. Pupils were drawn from each of the six pilot areas. In total 72 pupils were involved in the group interviews.

Overall pupils are very positive about the use of IWBs, they particularly like the multimedia potential of the technology and believe that they learn better when an IWB is used in the classroom.

Most of the pupil groups interviewed believes that the IWB helps them to pay better attention during lessons. Reasons for this appear to revolve around the opportunities for a wider range of resources and multi-media being used.

Most pupils seem to like having their work shown on the IWB. It is seen as an opportunity to learn and to improve their work.

The consensus seems to be that mathematics is the most popular lesson among those pupils interviewed although pupils also readily identified other lessons that they enjoyed where an IWB was used.

Pupils identified a number of common problems which were encountered by their teachers. Apart from the IWB breaking down entirely or having to be recalibrated (which they universally found frustrating), pupils mentioned difficulties seeing the IWB when sunlight shone through the windows. They also noted that sometimes moving objects on the board can be difficult to manipulate or see clearly.

Pupils also said that they would like to use the IWB themselves more than they currently have opportunities to and that they would like it if their teachers used the IWB more in lessons.

## Section 6: Surveying the Literature on Interactive Whiteboards

### ***Introduction***

This section aims to review the literature currently available on the introduction of Interactive Whiteboards (IWB) as a pedagogical tool in educational contexts. IWBs or electronic whiteboards as they are sometimes known as are large, touch-sensitive boards which are connected to a computer and a digital projector which projects images from the computer screen onto the board. IWBs are a relatively new technology to education having been originally developed to satisfy needs identified in office settings (Greiffenhagen, 2002). Consequently the available literature in refereed academic journals is limited. There are, however, a number of reports and summaries of small-scale research projects undertaken by individual teachers, schools and higher education institutes through, for example, Best Practice Research Scholarships. There are also descriptions of good practice and teaching experience published in teacher-oriented journals and newspapers and magazines. Some of these accounts or reports are also available on Local Education Authority or other websites (such as National Grid for Learning) websites. There are also reports of several small scale research projects undertaken by teachers and schools across Canada and the USA directly funded by SMART technology grants, most of which appear as Smarter Kids research papers. This review draws upon all of these sources. It is worth sounding a note of caution regarding the methods used in collecting data for many of the research projects cited in this survey. Evidence is often taken from surveys and questionnaires relating to teachers' and pupils' perceptions of IWB use. Some caution may therefore be necessary in interpreting the impact of IWB use on, for example, pupils' attainment. BECTA (2003) have produced a valuable research summary of issues related to the use of IWBs which is available on their website ([www.becta.org.uk](http://www.becta.org.uk)). Further references about the use of IWBs in education can also be found from the links from our project website (<http://edu.ncl.ac.uk/iwp>).

Having collated the IWB literature it was found that two broad categories emerged: the IWB as a tool to enhance teaching and as a tool to support learning. This article will focus primarily on these two categories, but will also consider the problems and issues which have been recorded as arising from using IWBs as a tool for teaching and learning.

### ***The IWB as a Tool to Enhance Teaching***

#### **Flexibility and versatility**

Teachers report finding IWBs a flexible and versatile teaching tool for different age groups and for pupils with Special Educational Needs (e.g. Austin, 2003, Jamerson, 2002). Studies suggest effective use across the age range from nursery (Lee & Boyle, 2003; Wood, 2002) through to higher education (Damcott, *et al.*, 2000; Ekhaml, 2002; Malavet, 1998) and even long distance teaching (Abrams & Haefner, 1998; Bell, 2002). Smith (2001) reports on the particular benefits of using

a graphics package to support younger pupils' handwriting skills. Pupils found gross movements on the IWB helped their handwriting on paper. Similarly, younger pupils in Goodison's study (2002c) report a preference for using the IWB as opposed to a computer because they found the keyboard and mouse difficult to manoeuvre.

Teachers have also reported that IWBs enable the catering of a range of needs within a lesson. An observation conducted by Miller and Glover (2002) as part of their research in five primary schools in one Local Education Authority in the UK revealed one teacher's ability to adapt her teaching of a 'Big Book' story to meet varying pupils' needs. The facility to flip back and forth between pages on an IWB screen is also reported as useful in flexibly and spontaneously supporting a range of needs within a class (Latham, 2002; Levy, 2002; Walker, 2002b).

### **Saving and printing work**

'Reinforcement on the fly' is also possible because teachers are able to save and print work recorded during an IWB lesson: as Boyle (2002) puts it, IWBs are able to record "every move you make and every breath you take". This facility for dynamic 'recordability' (Canturbury Christ Church University College, 2003) is being used by teachers to capture information on the screen for immediate printing or as evidence of pupils' work.

Teachers are also printing work directly from the screen to act as worksheets. A study by Salintiri *et al.* (2002) into special needs pupils in one mainstream school in Canada found that printing out examples from the IWB for the students to work on as a task, reduced pupils' anxieties in incorrectly transferring information from the board to their own paper, thereby improving their success at the task. Claims have also been made that the facility of IWBs to save and print reduces the need for note-taking (Becta, 2003). This, in turn, would allow the students time to process information in more depth (Eivers, 2000). The study by Glover and Miller (2001: 262), however, showed that teachers were a little wary of printing off from the screen because of printing costs and, as one teacher wisely commented, it may mean falling "into the trap of using too many worksheets by another name".

### **Multimedia/multimodal presentation**

The range of materials available to use on an IWB and the facility to in some way manipulate such materials is reported by educators as a major benefit of their use. Levy's (2002) in-depth interviews with teachers in two secondary schools in one LEA in the UK revealed that they found it easier to draw on a greater number and wider variety of information and learning than possible without an IWB. As one teacher commented, "Now you can colour the lesson with sound, video and images depending on the topic". In fact the multimedia/multimodal facility of IWBs is being used in specific ways in several different subject areas across the age range. Morrison (accessed 2003), a secondary school history teacher, describes making full use of a range of resources including the internet to bring his history lessons to life. Similarly, Johnson (2002) recommends the use of programs such as Textease 2000, and software such as Secrets to generate multimedia literacy lessons, so that words, phrases and images can be freely dragged and re-positioned and video and sounds can be attached to texts.



An interesting study into the use of a traditional whiteboard in secondary school maths lessons, led Greiffenhagen (2000a) to the conclusion that the teacher often pointed to the board in reference to an object/image on the board, and that such objects were most often the primary focus of the maths lesson. He classified the act of pointing and the teacher talk which accompanies this act a transient resource, whereas the object/image itself, which remains on the board, is a permanent resource. Greiffenhagen (2000a) suggested that maths lessons incorporating an IWB would be enhanced as, although the transient resources would disappear, and may in fact not have been attended to by the pupil, the fact that the permanent resources can be highlighted or annotated in some way relating to the teacher's and pupils' talk (the transient resource), may mean that pupils thinking and understanding over the course of the lesson is supported. Discussing the ways IWBs were used by trainee maths teachers, Edwards, Hartnell and Martin (2002) found that real-time movement such as rotation alongside visual cues such as highlighting greatly facilitated the teaching of fractions, measurement of angles and a variety of transformations such as translation and tessellation.

Carson (2003), a primary school teacher, reported using interactive games such as number wheel spinning to teach maths on an IWB. He suggested that this facilitated the sort of whole class discussion and debate which led to the sharing of ideas and theories. Both the primary and secondary teachers seemed to value the ability to play such maths games as a whole class, rather than pupils each working at individual computers. The trainee secondary teachers identified by Edwards *et al.* (2002: 31) found whole class game playing on an IWB allowed them to monitor pupils' progress and "to identify weaknesses or misconceptions very early in the activity so that these can be rectified". The ease with which switching between pages and modes of presentation is possible with an IWB, supports this task.

The literature also reveals that Modern Foreign Language (MFL) teachers are also making use of the range of materials available on an IWB. Thomas (2003) reports on the use of CD-ROMs, website pages, Word documents and PowerPoint slides in conjunction with the facility to highlight, annotate, drag, drop and conceal linguistic units. The facility to mix visual and aural information is argued to facilitate the process of MFL learning, as learners can make connections between what they see and what they hear.

### **Efficiency**

Of course, one could argue that multimedia resources and the facility to highlight, for example, are pedagogic tools available without the need for expensive IWB equipment. Teachers argue, however, that IWBs facilitate a more efficient presentation and more professional delivery of those resources (Boyle, 2002; Thomas, 2002). For example, the Head of Faculty of English, interviewed as part of Glover and Miller's (2001: 264) research study in one secondary school in UK, reported "instant access to material from a variety of sources and the possibility of using pre-prepared lessons that move without apparent effort from the visual to the verbal and back again". The North Islington Mathematics project also found a seamless flow from one teaching point to the next in maths lessons with an IWB (Latham, 2002).

Many teachers also report that IWBs quicken the pace of lessons. Several have noted that there is less time spent on “a preoccupation with management of resources” (Latham, 2002: 7), such as the real time throwing of dice in maths lessons (versus the tapping of the board for a virtual throw (Ball, 2003)); the turning of pages to locate a map in geography lessons (versus maps downloaded from the internet or saved files (Walker, 2003a)); or the need to keep referring to one’s teaching notes (the IWB can act as a prompt (Walker, 2002b)). Others have noted how there is less time spent on writing or drawing as these are already available from the IWB ‘library’ of pre-prepared materials (Levy, 2002). Wiggins and Ruthman (2002) found that IWBs increased the pace of music lessons at Oakland University in USA, because the board acted as a focal point, thereby reducing the time spent by teachers waiting for students’ attention.

### **Planning and saving lessons**

Although it can take time to prepare lessons with an IWB and to become technically literate in using IWBs (Ball, 2003; Glover & Miller, 2001; Greenwell, 2002; Levy, 2002), teachers report that planning time is eventually reduced given the facility to save, share and re-use lesson materials (e.g. Lee & Boyle, 2003). For example, one of the teachers interviewed by Levy (2002: 14) believed that the extra time spent in preparing lessons would be “an investment”. Indeed the secondary school teachers interviewed by Glover and Miller (2001: 263) saw the ability to save materials on an IWB as “a means of teaching development based on reflections not just from lesson to lesson but also year to year”.

The literature also reveals that some secondary schools are sharing resources prepared on and for IWB lessons across the school via the school network or intranet (Boyle, 2002; Levy, 2002). A Headteacher in Miller and Glover’s research (2002) pointed out that this could save money in the long term as resources could be used more efficiently. Morrison (accessed 2003) reports on an innovative way of sharing IWB history resources with secondary age pupils. He sends the files used on the IWB together with a few extra web links to each student after a lesson via the school intranet: a process especially useful for absentees. The students then email essays and homework to the teacher, thus enabling him to incorporate their work into his next lesson.

### **Teaching ICT**

One area of the curriculum which teachers report as easier to demonstrate and explicate with an IWB is ICT. Rapid improvements in pupils’ ICT skills seem to relate to the fact that teachers are using IWBs to teach across the whole curriculum. Hence pupils are immersed in a world of computer skills, able to “observe the manipulation of the operating system, the main applications and the network structure on a routine basis, so that when they come to use computers in class ... they are fully aware of what needs to be done” (Goodison, 2002c: 288). Pupils’ comments in Goodison’s (2002c) study seem to support this contention. One primary school in Australia report that they no longer explicitly teach ICT skills as pupils gain enough experience watching the IWB in use and using it themselves (Lee and Boyle, 2003). Interestingly, the National Association for the Advancement of Computers in Education (NAACE) advises that the British ‘Literacy Hour’ is not the forum for teaching ICT skills, which, if new, should be taught at another time so as not to negatively impact with pupils’ literacy learning (NAACE, 2001).

Improvements in ICT learning are also said to relate to the size and clarity of images on an IWB. Pupils are able to view every move a teacher makes in demonstrating a particular program (Bell, 2002, Levy, 2002) and this is argued as easier to interpret than the movement of a mouse pointer across a screen (Christchurch Canterbury, 2003; Smith, 2001; Tameside, accessed June 2003). The ability for all pupils in a class to see the screen at the same time is certainly more advantageous than all children crowding around an individual monitor (Buckinghamshire ICT, accessed June 2003; Gage, 2002). As Levy (2002: 7) writes, "it eliminates disruption associated with movement around the classroom, improves visibility for the students, and reduces time spent in repeating explanations to individuals or writing out procedural instructions on a traditional board."

In this sense, using an IWB to teach ICT frees the teacher from the constraints of sitting next to the computer in order to control a program, as with traditional projection methods. In fact the facility to face the class whilst teaching is reported as a major advantage of teaching all subjects with an IWB (Becta, 2000; Bell, 2001; Christchurch Canterbury, 2003; Drage, 2002; Smith, 2001; Wood, 2002;). As Wood (2002: 3) comments, working at a computer to the side of a board means that a teacher is physically detached from the visual presentation, and may even be "more in tune with their laptop than with the children". Hence, facing the class allows the teacher to spend more time focusing on the pupils (Ball, 2003; Smith, 2001). Physical proximity to the board is reported as being particularly advantageous for teaching deaf pupils, who would no longer have to glance away from the visual image on the board to the teacher's signing as both images would be within their line of vision (Carter, 2002). Teaching from the front of the class with the aid of a board is such a familiar medium to most teachers and indeed pupils that it is said to encourage even the most technophobic teachers to engage with IWB technology and integrate ICT into their lessons (Becta, 2003; Christchurch Canterbury, 2003; TechLearn, accessed February 2004).

### **Interactivity and participation**

One of the main claims made in relation to IWBs as a pedagogic tool is that they promote an 'interactive' class. Becta (2003: 3) state that students are motivated in lessons incorporating an IWB because of "the high level of interaction – students enjoy interacting physically with the board, manipulating text and images". They also say that IWBs present "more opportunities for interaction and discussion". This exemplifies the ambiguity which exists in the literature surrounding the meaning of the term interactive. Some of the literature focuses on the technical interactivity of the boards, i.e. the facility for teachers and pupils to interact physically with the technical interface: an act not necessarily requiring verbal interaction. It is quite possible, for example, for the teacher to present or demonstrate something on the board, such as ICT skills, with verbal communication afforded scant consideration. As one practitioner noted, however, teachers "should try and remember how tedious it is to sit through yet another presentation at a conference ... the thrill of PowerPoint transitions and such like soon wears off." (Virtual Learning(b), accessed June 2003). In other words, if IWBs are argued to promote interactivity, teachers must also consider the active participation of their students.

Some of the literature does, in fact, associate interactivity with the notion of pupil participation. For example, Austin (2003) reports one teacher's use of a number program where the pupils themselves come up to the board and, using the pen, count forwards or backwards on a number line. However, despite reports that pupils' "eagerness to come up and write on the board has been quite overwhelming" (Virtual Learning(a), accessed June 2003), evidence from research suggests that not all teachers are involving pupils to this extent (Bell, 2001; Levy, 2002). In fact some would claim that pupils' active involvement with the board during whole-class teaching reduces the pace of the lesson and causes boredom for the 'more able' pupils (Smith, 2001). Another word of caution is offered by Thomas (2003) who notes that teenagers may not be as keen to leave their seats as younger pupils. Smith, (2001) also reports that some pupils find the boards difficult to manipulate without making 'spurious marks'.

The issue of the quality and depth of classroom interaction is also considered. To begin with, it is argued that the scale of the boards enable the visual information to be more easily shared, thereby "drawing the class together" (Levy, 2002: 11). As one pupil in Levy's study (2002: 11) put it, "I like the whiteboards because they are big and everyone can join in what's going on." Given such a sense of whole class cohesiveness, pupils are encouraged to take a greater role in classroom interactions, as evinced by one of the teachers interviewed by Levy (2002: 9) who explained that, "students ask questions like, 'what if we do this sir?' And we can do it on the whiteboard. All the sources of information are there, we can tap into anything". One of the most powerful activities utilising such class cohesiveness is a "whole-class modelling exercise" (Walker, 2002a: 1) based on one pupil's piece of work. This, argues Greiffenhagen (2002), widens the perception of audience for pupils' writing to more than just the teacher, who is usually the only person to read and evaluate pupils' work. Providing the pupils agree to share their work as a public document, this could provide the basis for class discussion and peer feedback. The empowerment of pupils to ask as well as answer questions during IWB teaching, thereby reversing the prototypical teacher-pupil I-R-E exchange, is also reported by primary school teachers (Cogill, accessed September 2003) and secondary science school teachers (Blane, 2003). One of the teachers interviewed by Cogill (accessed September 2003: 3) noted, "sometimes I might not have the answer but another child might. So it does change questions and answers ... there's more interaction, there's more involvement from everyone in their learning".

However one of the teachers interviewed by Goodison (2002b: 224) noted, "with use of the internet for example, the teacher cannot predict what the outcomes may be and must be flexible enough for the learning to take a new direction". The pupils interviewed by Goodison (2002c) were aware of and approve of the teacher's change in role from the 'fount of all knowledge' to facilitator when using an IWB. They were also aware of the social dimension of learning with IWBs in that pupils could share knowledge publicly and learn by making mistakes together. Teachers in Glover and Miller's study (2001) found that students relished making power point presentations, and that boys, in particular, were keen to impress their peers. Pupils in Levy's study (2002) reported that sharing their work with others in the class helped them to articulate their ideas and give explanations. They also enjoyed the opportunity to see and discuss other pupils' work. Birch (accessed June 2003),

Glover and Miller (2001) and Walker (2003a) all report that pupils are very good at listening to each other, and are supportive and encouraging when a class member is at the board. It is possible that pupils' anxieties in making mistakes in public are reduced given the impermanent and unfixed nature of work 'in-progress' on an IWB, as argued by Carter (2002) in her study of IWB use with deaf pupils.

In this social constructivist model of classroom interaction the teacher is viewed as mediator between the computer and software, and the pupils' learning experience (Virtual Learning (d), accessed June 2003; Wiggins & Ruthman, 2002). This has several implications, including the positioning of the teacher within a classroom. For example, Cogill (accessed September 2003) reports on one lesson in which the teacher stood to the side of the class whilst the pupils used the Maths 2000 website to 'run' their own learning. Bell (2002: 3) describes a scenario in which the teacher is stationed at the computer, "with students at the board and in the class offering suggestions and physically contributing ideas and actions". The inclusion of interactive A6-sized 'tablets' into a primary school has enabled one teacher "to be with the children rather than standing at the front doing the chalk-and-talk thing" (Walker, 2002a: 2). Greiffenhagen (2002) reports on one school in Duisberg, Germany, which created a 'computer-integrated classroom' by installing an IWB which worked in connection with several electronic tablets used by both teachers and pupils. These new electronic devices used in combination with IWBs largely remove the necessity for prototypical 'front of classroom' lesson delivery commonly associated with recitation script questioning: and interesting point when considering that front-of-class teaching is argued as a major benefit of IWBs (Becta, 2003).

Interestingly, not all of the teachers interviewed by Levy (2002) agreed that IWBs encouraged whole-class interactive activity. Some suggested that because IWBs presented the introductory part of lessons so efficiently, more time was freed up for 'interactive activity-based learning'. Where IWBs have been installed at the right height for pupils in nursery schools, teachers have noted greater collaboration and sharing of the task than typical of work at a computer in that pupils "are sharing the task and discussing what they see on the screen, what happens next, what they have to do and often relating this back to their own life/experiences" (Wood, 2002: 5). Interestingly, however, Smith (2001) suggests that fixing an IWB to a wall militates against collaboration, as only one pupil at a time can be stationed at the board whilst the rest must sit remaining out of the way of the projector.

The use of an IWB to encourage an interactive environment wherein pupils actively participate in the social (re)construction of knowledge and understanding is argued as the use of technology to transform educational practices (Burden, 2002). It is also argued as relatively rare (Burden, 2002; Glover & Miller, 2001). Levy's classroom observations suggest that even though some teachers felt that IWBs promoted teacher-pupil interaction, the most interaction between teachers and pupils and between pupils, occurred after whole-class teaching when pupils were working on individual tasks. In fact, the argument that IWBs are a profitable teaching tool because it is possible to teach from the front of the class, may, in fact, hinder the use of IWBs as transformative devices.

## ***The IWB as a Tool to Support Learning***

The second category into which the IWB literature falls concerns the unique features of IWBs which are argued to promote pupils' learning.

### **Motivation and affect**

The most widely claimed advantage of IWBs is that they motivate pupils because learning is more enjoyable and interesting, resulting in improved attention and behaviour (see, for example, Beeland, 2002). For example, pupils interviewed by Levy (2002) reported that their lessons were quicker and more fun and exciting. The reasoning underneath such observations revolves around IWBs' capacity for quality presentation (Becta, 2003) incorporating large visual images (Smith, accessed November 2002) with a more modern/cool feel which satisfy the expectations of pupils already immersed in a world of media images (Beeland, 2002; Glover & Miller, 2001). Birch (accessed June 2003) reports anecdotal evidence that this particularly motivates boys to become more involved in literacy lessons. Teachers too seem excited by the boards and this influences pupils' perceptions of the overall environment, creating an 'excited classroom' (Cogill, accessed September 2003). Teachers in Levy's study (2002) felt that pupils wanted to stay on top of the lesson, full of anticipation and interest for what would appear next on the board. Similarly, teachers in Miller & Glover's study (2002) felt that pupils' zest for learning was enhanced given the element of surprise that IWBs and accompanying software can bring to lessons. Others suggest that programs used on IWBs which have a reward screen appearing whenever pupils reach a 'correct' answer (Richardson, 2002), or sound clips to correct or signify repeated errors (Miller & Glover, 2002) are so much fun that pupils' anxieties and fear of failure are reduced, thereby motivating wider participation. Interestingly, teachers in the North Islington Mathematics project reported that because care was taken in presenting maths information on the IWBs, pupils felt their maths development must likewise be important and valuable, and were motivated to take as much care in their own work (Latham, 2002). Of course the opportunity to come up to the front of a class and use the board, or present and discuss one's own work, or become involved with, for example, an ACTIVote slate, is also likely to improve attention and engagement in the learning process (Becta, 2003; Bell, 2001; Burden, 2002; Miller & Glover, 2002). This is why Kennewell (2001) argues that pupils must be allowed to use IWBs themselves. There are some concerns, however, that the 'novelty value' of IWBs may wear off as pupils become accustomed to their features (Becta, 2003; Levy, 2002; Miller & Glover, 2002).

Much of the evidence for these observations is anecdotal; however, a study by Weimer (2001) carried out in one rural middle school in USA, used a Likert scale to measure student attitudes and motivations towards a class project. The study compared one class whose teacher and pupils used an IWB with a control class who did not have access to this resource. The results showed a tendency (strong in some of the test items) towards improved motivation for those in the class using an IWB.

### **Multimedia and multisensory presentation**

Another feature of IWBs which is claimed to promote learning is their multimedia and multisensory capacity. The presentation of large visual images is claimed to

enhance pupils' memory: "when I talk to the children about what helps them remember, they say they can still see the images in their mind, even after we have finished a lesson" (Burden, 2002: 17). Similarly, physical science students with non-science majors reported that the IWB had helped them remember more of their lecture (Damcott et al, 2000). MFL learners too are reported as finding that the multi-sensory experience offered by IWBs helps make language more memorable (Thomas, 2003).

Moreover, the facility of IWBs to present information in sharp colours, and to annotate, conceal, manipulate, move and zoom in on or focus on images, including text, is also said to enhance the learning process (Bell, 2002; Damcott *et al.*, 2000; Levy, 2002; Thomas, 2003). For example, real-time movement and the addition of colour to visual images on an IWB screen is argued to facilitate an understanding of fractions and percentages in relation to coloured squares in a shape, the measurement of angles, and the transformation of shapes (Edwards *et al.*, 2002). Furthermore, when pupils are allowed to directly interact with the board themselves, the sensitivity of the boards is claimed to reinforce the learning experience (Clemens *et al.*, 2001).

The fact that IWBs have the capacity to present a wide variety of multimedia resources so efficiently is also argued to help pupils as not only is there is more information available and present on the board at one time, there is also a wider variety of information so that ideas and concepts become more 'tangible' and pupils find the concepts easier to 'grasp' (Levy, 2002). It is also argued that IWBs accommodate a range of learning styles, as teachers are able to call on a whichever type of resource is suitable for particular pupils' needs (Bell, 2002; Billard, 2002; Glover & Miller, 2001). This capacity however, raises another important question: when does lots of information become too much information? This was highlighted in comments recorded by Levy (2002: 14) when pupils expressed concerns such as "it can be confusing", and "it is complicated to take in". Seufert (2003: 228) presents recent research which suggests that the effective use of multiple representations in the construction of coherent knowledge often depends on students' prior knowledge of lesson material. Students with less experience of subject material tend to focus in on only one representation, "often the more familiar or concrete one".

### **Problems and Issues**

This final section reviews the concerns expressed by both teachers and pupils in terms of the problems and issues encountered when using IWBs in real-life educational settings.

#### **Training and support**

One of the most frequently cited issues raised by both teachers and pupils is the need for adequate training in order to use IWBs to their full potential. Teachers' inexperience in setting up equipment and in manipulating features on the board, leading to lesson disruption, was a concern for both teachers and pupils interviewed in Levy's study (2002). Interviews in Glover and Miller's study (2001: 261) found that initial training by companies and suppliers with their "slick presentation and high-quality prepared materials" were successful in 'firing' teachers with initial enthusiasm (Glover & Miller, 2001: 261). The long-term value

of such training, however, remains more questionable, because as one teacher interviewed by Walker (2003b: 2) put it, “if you don’t catch them at the start, provide support and show them how to use learning material, their enthusiasm quickly wanes.” Some researchers have highlighted that even when if a teacher aims to use IWBs as a transformative pedagogic tool (Burden, 2002), lack of practical and methodological training can impede and frustrate such aims (Greiffenhagen, 2000(b); Malavet, 1998).

In terms of how such training should be delivered, Levy (2002) discovered that those teachers who were already confident ICT users tended to become enthusiastic ‘early adopters’, able to experiment and develop their own IWB use following initial training. Those teachers with less confidence and experienced in ICT, however, were less able to adopt a ‘self-training’ approach, preferring instead more sustained and individually tailored guidance of a ‘human-to-human’ nature based on a ‘need-to-know’ basis (Granger *et al.*, 2002), or as part of more structured on-going support. This has been achieved in some schools by a system of buddy coaching, where more experienced users work alongside novice users (Glover & Miller, 2001).

Teachers also need support when technical difficulties arise immediately prior to and during lessons. There may be networking problems with slow log-on facility, or a slow or non-existent response from electronic pens, unresponsive or awkward to move images, and a lack of signal between individual slates and the board. (Levy, 2002). In such instances, rapid ‘troubleshooting’ support is a priority.

### **Logistics**

Other commonly cited difficulties relate to the logistics of placing IWB equipment in classrooms. It is reported that pupils find it difficult, and sometimes impossible, to see the screen on an IWB when sunlight is shining directly on it (Tameside, accessed June 2003). This has implications for the positioning of a board within a classroom and suggests the need for effective blinds (another expense) (Levy, 2002). Visual problems are compounded by the use of inappropriate colours and fonts and the presence of dust on the screen (Levy, 2002). Due to the projection beam, teachers report that they must stand to the side of the board or a shadow is cast over the screen (Bell, 2001; Walker, 2003b), a difficulty also experienced by pupils (Smith, 2001). Also in terms of accessibility, concern is often expressed regarding the health and safety implications of the multitude of wires required for IWBs; equipment originally designed for boardrooms (Bell, 2001; Smith, 2001; Tameside, accessed June 2003).

Schools must also consider the height at which an IWB is placed on a wall. This is essential if it is to be permanently fixed and if pupils are to have ready access and (Tameside, accessed June 2003). If the board is placed too low on the wall the screen may not be seen by pupils at the back of the class and some functions such as the keyboard may be difficult to operate (Canterbury, 2003). If the board is placed too high, however, even teachers may have difficulty reaching the entire board (Tameside, accessed June 2003). The size of the screen, which seems to depend on the manufacturers, is another visibility factor to consider (Damcott, 2000; Smith, 2001). Many teachers also report difficulties in movement of the board or projector, especially when the board is not permanently fixed, as this



causes the calibration to be disturbed and necessitates re-alignment: a major inconvenience if it happens every time a pupil tries to use the board (Bell, 2001; Smith, 2001; Tameside, accessed June 2003).

The advantages of portable IWBs relate to security issues and accessibility at a reduced cost. This is not much comfort, however, to teachers who have to climb three flights of stairs with large and heavy pieces of equipment (Bell, 2001) and then take time to set up the system (Damcott *et al.*, 2000). In contrast, some schools have opted to place IWBs in ICT suites so that all teachers have regular but restricted access. Results have shown, however, that teachers' development with IWBs depends on easy and frequent access (i.e., in their own classrooms) (Levy, 2002). Levy (2002) found that there was little incentive for secondary school teachers to take time planning a lesson incorporating the board, if they were faced with repeating the same lesson without a board. Moreover, she found that teachers preferred to remain in their regular classroom rather than disrupt the class and move to another room, even if timetabled for IWB access (Levy, 2002). Other research revealed that those teachers with IWBs in their classrooms made more positive comments regarding their use than those without immediate IWB access (Glover and Miller, 2001). Indeed it has been argued that use of IWBs as a 'transformative' device is only possible when they become part of the regular fabric of classroom life (Greiffenhagen, 2000(b)).

## **Conclusion**

This literature review has revealed a clear preference for IWB use by both teachers and pupils. The government too, is keen to promote IWB technology. It remains unclear, however, as to whether such enthusiasm is being translated into effective and purposeful practice. IWBs are very expensive, and as John (2002) points out, the technology is not standing still. Consequently, such technology must be used in unique and creative ways above and beyond that which is possible when teaching with normal whiteboards or other projection methods. As one commentator noted, "in the hands of a teacher who is interested in developing the independent, creative, thinking skills of their students, (the IWB) will be used to further these purposes. ... It's not what you use it's how you use it" (Virtual Learning (b) 2003: 1). In order for us to understand the best way for practitioners to use IWB technology in the future as transformational devices, research is needed in order to collect empirical evidence so that the processes of teaching and learning with this new technology are more fully understood and more coherently conceptualised.

## **Summary**

This section provided a review of the literature currently available on the introduction of interactive whiteboards (IWB) as a pedagogical tool in educational contexts. This serves to place the current research and evaluation of the 'Embedding ICT in the Literacy and Numeracy Strategies Pilot Project' in a broader context.

Two main categories emerged from the review, the IWB as a tool to enhance teaching, and secondly, as a tool to support learning. Within the first category, issues which are discussed and illustrated referring to the literature include:

- Flexibility and versatility;
- Saving and printing work;
- Multimedia/multimodal presentation;
- Efficiency;
- Planning and saving lessons;
- Teaching ICT;
- Interactivity and participation.

The second category into which the IWB literature falls concerns the unique features of IWBs which are argued to promote pupils' learning, and issues referred to include:

- Motivation and Affect;
- Multimedia and Multi-sensory Presentation

The final part of the review summarises the concerns expressed by both teachers and pupils in terms of the problems and issues encountered when using IWBs in real-life educational settings, and focus on:

- Training and Support;
- Logistics.

The literature review has revealed a clear preference for IWB use by both teachers and pupils. It remains unclear, however, as to whether such enthusiasm is being translated into effective and purposeful practice. For the use of such technology to be justified it must be used in ways which promote more effective learning above and beyond that which is possible when teaching with other kinds of projection technology or with ordinary whiteboards.

## Section 7: Discussion and conclusions

The evaluation described in this report set out to investigate the impact of the use of electronic or interactive whiteboards (IWBs) in literacy and mathematics lessons in primary schools which were involved in the 'Embedding ICT in the Literacy and Numeracy Strategies' pilot project. In this project IWBs were installed in Year 5 and Year 6 classes in 12-15 schools in each of six Local Education Authorities (LEAs): Cumbria, Bracknell Forest, Lewisham, Oxfordshire, Redcar and Cleveland, and Wakefield. In each of these LEAs a local co-ordinator was appointed as an IWB Consultant to manage the project and to provide training and support to the teachers involved. The pilot project ran from Autumn 2002 to Summer 2004.

The evaluation, undertaken by a team based at the Centre for Learning and Teaching in the School of Education, Communication and Language Sciences at Newcastle University, investigated aspects of classroom interaction through a series of structured observations, the views of teachers through interviews, teachers' records of IWB use, pupils' views and the impact on pupils' attainment through their performance in national Key Stage 2 tests. In addition, a literature review was undertaken to support both the pilot project and the evaluation. The preceding sections in this report describe the research approaches for each of these areas and detail the findings for the impact of the use of this technology.

Broadly the picture that has emerged is that IWBs do have a significant impact upon primary classrooms. The perceptions of those involved are the most clearly affected. Both the teachers and their pupils are overwhelmingly convinced that the introduction of the technology was positive. These views are particularly strong in the areas of pupils' enjoyment of lessons and engagement with what was being taught. Overall, the most positive findings were identified in the area of pupils' attention and motivation. These findings confirm the broad positive outlook found in the literature reviewed for the project and reported in Section 6 above.

The pilot project was also clearly successful in supporting teachers in embedding the use of ICT in their teaching of literacy and mathematics. After some preliminary technical and logistical issues (summarised in an earlier baseline report (Higgins, *et al.* 2003)) the teachers describe increased confidence in using ICT in their lessons, they report greater use of software where they have developed or adapted resources to use in their lessons and their pupils describe the advantages of seeing the use of the computer modelled for them on a daily basis in terms of their own ICT skills. Initially IWBs were used in about two-thirds of literacy and mathematics lessons rising to nearly three-quarters of these lessons a year later.

A number of positive themes also emerge from the analysis of classroom interaction. There was an increase in some kinds of interaction, such as open questions or aspects of questioning where the teacher pursues pupils' responses ('uptake' questions) or asks them to develop or explain their ideas ('probes') which are associated with effective teaching and learning (e.g. Nystrand and Gamoran, 1991; Muijs and Reynolds, 2001). An overall increase in the pace of lessons, frequently cited in school inspection reports (e.g. OfSTED, 2004) might be taken similarly as a positive indicator of the impact of the introduction of IWBs. The

perceptions of teachers and pupils seem to confirm the benefits of these changes in classroom interaction in the way they identify increased involvement and better attention paid by pupils in these lessons. These advantages might perhaps be broadly characterised in terms of being benefits for teaching in the project schools: the positive response from teachers and pupils; the increased use and confidence in ICT; and an increase in some of the features of classroom interaction associated with effective teaching.

The impact of IWBs is harder to identify in terms of pupils' learning. Initially it appears that there was a small but statistically significant gain in the IWB project schools attainment in mathematics and science after a few months of use by their teachers. However for the next year group who had been in classes where IWBs were used for at least a year and a half no similar benefit could be identified.

A further question then arises. If there have been benefits for teaching, why have these not had an impact on their pupils' learning? There are a number of possible explanations worth exploring. It may be that there are real benefits in terms of classroom interaction and discussion, but that the positive effect of these interactional or verbal changes have not been translated into written improvements (at least as measured by the national tests). On this interpretation the use of IWBs needs further development to ensure that any positive benefits are translated into pupils' individual written or test performance. Some support for this interpretation might be adduced from the very slightly greater impact on IWB pupils' performance in the writing section of the English tests where it could be that more explicit modelling of the writing process on IWBs has transferred to pupils' own writing. Following this interpretation the positive reactions from the teachers and their pupils about the benefits of representing information visually or with multimedia may indeed support or 'scaffold' their learning. However this may be a double-edged sword: the support may enhance the number and length of pupils' answers, but the success in responding to teachers' questions (particularly with the support provided by the information on the IWB) may not translate into improved understanding or into their individual work when such information is no longer available.

Another possibility is that the impact of the IWBs in changing aspects of classroom practice may have been at the expense of other more effective practices. The evaluation focused on what the teachers did with IWBs rather than what they stopped doing. As a whole the IWB schools were already performing above national average so any changes were alterations to what was already effective practice in the schools involved. If this is the case then it may be that the teachers were seduced by the technical rather than the pedagogical potential of the IWBs.

It could also be that the motivational aspects of the IWBs and the pupils' obvious enjoyment of lessons may have misled the teachers into thinking that more learning was taking place than was actually the case (as with the longer whole class sections). Following this analysis it is possible to argue that the teachers' conviction that IWBs are effective is some kind of 'halo' effect (Thorndike, 1920) inferred from the increased attention and motivation. On this interpretation the extension of the whole class sections of lessons (which were on average about 5 minutes longer in IWB lessons) may have been at the expense of individual and

group work, perhaps encouraged by the way that the whiteboard holds pupils' attention.

The data presented in the report do not allow for a clear case to be made for any of the possibilities outlined above. It may be that some of these factors were influential and limited the impact of what has been acknowledged as positive benefits from this kind of technology both in the literature review and by the teachers and pupils in this project. Other factors than those documented in the report or captured by the research may also have had an effect.

Of course it is also possible that the effects identified by the teachers and pupils are either not as significant as they seemed, or that the perceived effects are not as beneficial as generally thought. One area, for example, where there is conflicting information in the data presented above is in the impact of IWBs on boys and girls. About 40% of the teachers believed that they had a more beneficial effect on boys in their classes. In general the pupils were more divided in what they thought, falling into four broad groups: first that there were some changes in IWB lessons and that specific pupils were chosen more than other pupils to answer questions; second that boys were more involved; third that girls were more involved or last that everyone is equally involved. The lesson observations showed that there were no significant differences between IWB and non-IWB lessons in terms of gender in the patterns of interaction recorded. There are indeed a number of significant differences generally (such as boys being more likely to be the target of comments about their behaviour than girls) but this was the case for all lessons. Finally, the attainment data indicated that again, although there were differences in the impact of IWB on pupils in the pilot schools, the gender of the pupils was not an important factor in this. Low attaining boys may have benefited slightly in terms of their writing performance, but this was also the case for low attaining girls. Perhaps the issue here is that classrooms are extremely complex places and that when change occurs, what you notice, is, at least to some extent, determined by what you are looking for or expecting.

## **Summary**

The introduction of the technology, training in its use and the support of the IWB consultants were all rated highly. There can be no doubt that the introduction of IWBs had a real impact on the primary classrooms where they were introduced. The response of the teachers and pupils involved in the project has been overwhelmingly positive. Both were convinced that these changes were improving the teaching and learning in lessons where they were used. The observations confirm that there were significant differences in patterns of classroom interaction, both as the teachers learned to use the technology and a year later as IWBs became more embedded in literacy and mathematics lessons. The indications from these observations also suggested that the changes in questioning by the teachers and the responses from their pupils were consistent with the kinds of interaction associated with effective teaching. The attainment data at first suggested that the impact of the introduction of IWBs was associated with improvements in children's learning. However these gains were not found in the second year suggesting that the early improvement was due to the initial intervention or that sustained improvement is harder to achieve, especially in high performing schools.

## References

- Abrams, G. and Haefner, J. (1998). S.H.O.W.M.E.: Spear-Heading Online Work in Mathematics Education, [www.thejournal.com/magazine/vault/A2029.cfm](http://www.thejournal.com/magazine/vault/A2029.cfm)
- Austin, N. (2003). Mighty White. *The Guardian*. London.
- Ball, B. (2003) Teaching and Learning Mathematics with an Interactive Whiteboard *Micromaths* 19(1), 4-7.
- BECTA (2000). It's White in Front of You!, <http://top.ngfl.gov.uk/content.php3?content/d958737537.html&f=0>.
- BECTA (2003). What the Research Says about Interactive Whiteboards, [www.becta.org.uk/research](http://www.becta.org.uk/research).
- Beeland Jnr, W. D. (2002). Student Engagement, Visual Learning and Technology: Can Interactive Whiteboards Help? *Annual Conference of the Association of Information Technology for Teaching Education*, Trinity College, Dublin.
- Bell, M. A. (2001). Update to Survey of Use of Interactive Electronic Whiteboard in Instruction, [www.shsu.edu/~lis\\_mah/documents/updateboardindex.htm](http://www.shsu.edu/~lis_mah/documents/updateboardindex.htm)
- Bell, M. A. (2002). Why Use an Interactive Whiteboard? A Baker's Dozen Reasons!, <http://teachers.net/gazette/JAN02>.
- Billard, D. (2002). Interactive Skeletons Promote Writing. *Literacy Today* (30).
- Birch, J. (2003) Using an Electronic Whiteboard, [www.bucksict.org.uk/Downloads/DownloadDocs/Curriculum/Whiteboard.doc](http://www.bucksict.org.uk/Downloads/DownloadDocs/Curriculum/Whiteboard.doc)
- Blane, D. (2003). Access Across the Board. *Times Educational Supplement*. London.
- Boyle, J. (2002). Virtual Magic. *Times Educational Supplement*. London. Buckingham LEA. Developing the Use of Interactive Whiteboards, [www.bucksict.org.uk/Effective/Whiteboards.htm](http://www.bucksict.org.uk/Effective/Whiteboards.htm) (June, 2003).
- Burden, K. (2002). *Learning from the Bottom Up - the contribution of school based practice and research in the effective use of interactive whiteboards for the FE/HE sector*. Learning and Skills Research - Making an Impact Regionally Conference, The Earth Centre, Doncaster.
- Canterbury Christ Church University College (Faculty Learning Technology Team) (2003). *Briefing Paper on the Application of Interactive Whiteboards to Learning and Teaching* Canterbury Christ Church University College, Learning and Teaching Enhancement Unit.
- Carson, L. (2003). Board Work, Not Boring. *Times Educational Supplement*. London.
- Carter, A. (2002). Using Interactive Whiteboards with Deaf Children, [www.bgfl.org/bgfl/activities/intranet/teacher/ict/whiteboards/index](http://www.bgfl.org/bgfl/activities/intranet/teacher/ict/whiteboards/index).
- Clemens, A. et al (2001) Math Intervention "SMART" Project (Student Mathematical Analysis and Reasoning with Technology), [www.smarterkids.org/research/paper10.asp](http://www.smarterkids.org/research/paper10.asp).
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates
- Cogill, J. The Use of Interactive Whiteboards in the Primary Classroom: what is effective practice and how does this relate to effective practice in teaching with ICT? *Becta Research Conference 2003: Proving Effective Practice with ICT*, TUC Congress Centre, London. Available at <http://client.cant.ac.uk/research/julie-cogill/> (September 2003)
- Damcott, D., Landato, J., Marsh, C., Rainey, W. (2000). Report on the Use of the SMART Board Interactive Whiteboard in Physical Science, [www.smarterkids.org/research/paper3.asp](http://www.smarterkids.org/research/paper3.asp) .
- DfEE (1998) *The National Literacy Strategy. A framework for teaching*. London, DfEE.
- DfEE (1999a) *The National Numeracy Strategy. A framework for teaching mathematics from reception to Year 6*. London, DfEE.
- DfES (2003) *ICT and Attainment: A review of the literature*. London, DfES.
- DfES (2003) *Survey of Information and Communications Technology in Schools*.
- Drage, C. (2002) Interactive All the Way. *Times Educational Supplement*, London.
- Edwards, J.-A., Hartnell, M., Martin, R. (2002). Interactive Whiteboards: Some lessons from the classroom. *Micromaths* 18(2), 30-33.
- Ekhaml, L. (2002) The Power of Interactive Whiteboards. *School Library Media Activities Monthly*, XVIII(8), 35-37.
- Elvers, G. C. (2000). The Digital Whiteboard as a Notes-Taking Aid, [www.smarterkids.org/research/paper1.asp](http://www.smarterkids.org/research/paper1.asp) .
- Esarte-Sarries, V. & Paterson, F. (2003) Scratching the Surface A typology of Interactive Teaching. In: Moyles, J.; Hargreaves, L.; Merry, R.; Paterson, F. & Esarte-Sarries, V. *Interactive Teaching in the Primary School digger deeper into meanings*. Open University Press, Maidenhead.

- Frey, J.H.a.O., S.M., *How to Conduct Interviews by Telephone and in Person*. First edition ed. 1995. Thousand Oaks, Sage Publications.
- Gage, J. (2002) So What is an Electronic Whiteboard? *Micromaths*, 18(2), 5-7.
- Galton, M. And Williamson, J. (1992) *Group work in the Primary classroom* London: Routledge and Kegan Paul.
- Glover, D. and Miller, D. (2001). Running with technology: the pedagogic impact of the large scale introduction of interactive whiteboards in one secondary school. *Journal of Information Technology for Teacher Education*, 10(3), 257-276.
- Goldman, S.R. (2003) Learning in complex domains: when and why do multiple representations help? *Learning and Instruction*, 13, 239-244.
- Good, T. And Brophy, J. (1991) *Looking into classrooms* New York: Harper.
- Goodison, T. (2002a) ICT and attainment at primary level. *British Journal of Educational Technology*, 33(2), 201-211.
- Goodison, T. (2002b) Enhancing learning with ICT at primary level. *British Journal of Educational Technology*, 33(2), 215-228.
- Goodison, T. (2002c) Learning with ICT at Primary Level. *Journal of Computer Assisted Learning*, 18, 282-29.
- Granger, C. A., & Morbey M. L. (2002). Factors Contributing to Teachers' Successful Implementation of IT. *Journal of Computer Assisted Learning*, 18, 480-488.
- Greenwell, L. (2002) Physical Education: an interactive approach, [www.mirandanet.ac.uk/pubs/greenwell](http://www.mirandanet.ac.uk/pubs/greenwell)
- Greiffenhagen, C. (2000a) From Traditional Blackboards to Interactive Whiteboards: a pilot study to inform system design. *Conference of the International Group for the Psychology of Education, Hiroshima, Japan*.
- Greiffenhagen, C. (2000b) Interactive whiteboards in mathematics education: Possibilities and dangers. *Paper presented at WGA 11 (ICME-9), 2. The use of Technology in Mathematics Education*. Available at <http://wen.comlab.ox.ac.uk/oucl/work/cg/pub/icme9/>
- Greiffenhagen, C. (2002) Out of the Office into the School: electronic whiteboards for education, <http://web.comlab.ox.ac.uk/oucl/work/christian.greiffenhagen/pub/boards/> .
- Hardman, F., Smith, F. And Wall, K. (2001) *An investigation into the impact of the National Literacy Strategy on the literacy learning of pupils with special educational needs in literacy in mainstream primary schools: A report for The Nuffield Foundation*, Newcastle: University of Newcastle upon Tyne.
- Higgins, S., Clark, J., Falzon, C., Hall, I., Hardman, F., Miller, J., Moseley, D., Smith, F. and Wall, K. (2003) *Embedding ICT in the Literacy and Numeracy Strategies: Evaluation Status Report March 2003* Newcastle Upon Tyne: Newcastle University.
- Higgins, S. , Clark, J., Falzon, C., Hall, I., Hardman, F., Miller, J., Moseley, D., Smith, F. and Wall, K., (2003) *Embedding ICT in the Literacy and Numeracy Strategies*, Evaluation Update Report, September 2003, Newcastle Upon Tyne: Newcastle University.
- HMIE (2004) The use of ICT in learning and teaching.
- Jamerson, J. (2002). Helping All Children Learn: Action Research Project, [www.smarterkids.org/research/paper15.asp](http://www.smarterkids.org/research/paper15.asp).
- John, M. (2002). Can One Size Fit all? *Times Educational Supplement*, London.
- Johnson, C. (2002). The Writing's on the Board. *EC&T*(September 2002), 58-59.
- Kennewell, S. (2001) Interactive whiteboards – yet another solution looking for a problem to solve? *Information Technology in Teacher Education*, 39, 3-6.
- Latham, P. (2002) *Teaching and learning mathematics: the impact of interactive whiteboards – Results of the North Islington Education Action Zone RM Easiteach Mathematics Project*. BEAM Education, London.
- Lavrakas, P.J., *Telephone Survey Methods: Sampling, Selection and Supervision*. Second Edition ed. Applied Social Research Methods Series, ed. L.B.a.D.J. Rog. Vol. 7. 1993, Newbury Park: Sage Publications.
- Lee, M. and Boyle, M. (2003) *The Educational Effects and Implications of the Interactive Whiteboard Strategy of Richardson Primary School*. Richardson Primary School, ACT, Australia.
- Levy, P. (2002). Interactive Whiteboards in Learning and Teaching in Two Sheffield Schools: a developmental study, [www.shef.ac.uk/eirg/projects/wboards](http://www.shef.ac.uk/eirg/projects/wboards) .
- Malavet, P. A. (1998). Interactive Whiteboards: The technology of the future, working with traditional pedagogical methodology, <http://nersp.nerdc.ufl.edu/~malavet/> .
- Mayer, R.E. (2003) The promise of multimedia learning: using the same instructional design methods across different media. *Learning and Instruction*, 13, 125-139.



- McGivern, Y. (2003) *Collecting Quantitative Data*, in *The Practice of Market and Social Research*. Prentice-Hall, Harlow, England, p. 132 -152.
- Miller, D. and D. Glover (2002). The Interactive Whiteboard as a Force for pedagogic Change: The experience of five elementary schools in an English authority, *Information Technology in Childhood Education Annual*. [www.aace.org/DL/index.cfm/fuseaction/view/paperid/9117](http://www.aace.org/DL/index.cfm/fuseaction/view/paperid/9117)
- Morrison, D. (2003). From Chalkface to Interface - the impact of the Interactive Whiteboards in the history of the classroom, [www.ngflscotland.gov.uk/nq/Chalkface.asp](http://www.ngflscotland.gov.uk/nq/Chalkface.asp)
- Mroz, M.A., Smith, F. & Hardman, F. (2000) The discourse of the literacy hour. *Cambridge Journal of Education*, 30(3), 379-390.
- Muijs, D. & Reynolds, D. (2001) *Effective Teaching: Evidence and practice* London: Paul Chapman Publishing
- NAACE (2001) *ICT and Literacy*. NAACE  
<http://www.naace.org/resourceView.asp?menuItemId=2&resourceId=190> (September 2003)
- NFER (2001) *Information and Communications Technology (ICT) in the primary school*, Digest No.11, Autumn 2001.
- NFER (2003) *Primary school headteachers' views on participating in research*, Digest No.15, Autumn 2003.
- Noldus Information Technology (1995). *The Observer, Base Package for Windows, Reference manual*, Version 3.0. Wageningen, The Netherlands: Noldus.
- Nystrand, M. & Gamoran, A. (1991) Student engagement: when recitation becomes conversation, in H. C.Waxman & H. J.Walberg (Eds) *Effective Teaching: current research* Berkley, Ca: McCutchan).
- OfSTED (2002) *ICT in Schools: Effect of Government Initiatives*. London: HMSO
- OfSTED (2004) *Standards and Quality 2002/03 The Annual Report of Her Majesty's Chief Inspector of Schools* London: HMSO
- Richardson, A. (2002). Effective Questioning in Teaching Mathematics using an Interactive Whiteboard. *Micromaths* 18(2), 8-12.
- Salinitri, G. & Smith K. (2002). The Aural Enabler: Creating a way for special needs kids to participate in the classroom lesson, [www.smarterkids.org/research/paper12.asp](http://www.smarterkids.org/research/paper12.asp).
- Seufert, T. (2003) Supporting coherence formation in learning from multiple representations. *Learning and Instruction*, 13, 227-237.
- Sinclair, J. And Coulthard, M. (1992) Towards an analysis of discourse in: M. Coulthard (Ed) *Advances in Spoken Discourse Analysis*, London: Routledge.
- Smith, F., Hardman, F., Mroz, M. and Wall, K. (2004) Interactive whole class teaching in the national literacy and numeracy strategies. *British Educational Research Journal*, 30(3), 395-411.
- Smith, A. Interactive Whiteboard Evaluation, [www.mirandanet.ac.uk](http://www.mirandanet.ac.uk) (November 2002)
- Smith, H. (2001) Smartboard Evaluation: Final Report, [www.kented.org.uk/ngfl/whiteboards/report](http://www.kented.org.uk/ngfl/whiteboards/report).  
Tameside Education. Interim Report on Practice Using Interactive Whiteboards in Tameside Primary Schools. [http://www.tameside.gov.uk/schools\\_grid/ict/whiteboards.pdf](http://www.tameside.gov.uk/schools_grid/ict/whiteboards.pdf) (June 2003)
- TechLearn. Interactive whiteboards in Education. (February 2004)  
[http://www.jisc.ac.uk/uploaded\\_documents/Interactivewhiteboards.pdf](http://www.jisc.ac.uk/uploaded_documents/Interactivewhiteboards.pdf)
- Thomas, A. (2002) The White Stuff. *Times Educational Supplement*, London.
- Thomas, A. (2003) Little Touches that Spell Success. *Times Educational Supplement*. London.
- Thorndike, E.L. (1920) A Constant Error on Psychological Rating, *Journal of Applied Psychology*, 4:25-29.
- Virtual Learning. Interactive Whiteboards Case Studies: new tools, new pedagogies, new learning? [http://www.virtuallearning.org.uk/whiteboards/case\\_studies.pgf](http://www.virtuallearning.org.uk/whiteboards/case_studies.pgf) (June 2003a)
- Virtual Learning. Interactive Whiteboards: new tool, new pedagogies, new learning? [http://www.virtuallearning.org.uk/whiteboards/Views\\_from\\_practitioners.pdf](http://www.virtuallearning.org.uk/whiteboards/Views_from_practitioners.pdf) (June 2003b)
- Virtual Learning. How do Interactive Whiteboards Enhance Learning? [www.virtuallearning.org.uk/whiteboards/Learning\\_theories.pdf](http://www.virtuallearning.org.uk/whiteboards/Learning_theories.pdf) (June 2003c)
- Virtual Learning. Interactive Whiteboards: an approach to an effective methodology. [http://www.virtuallearning.org.uk/whiteboards/An\\_approach\\_to\\_an\\_effective\\_methodology.pdf](http://www.virtuallearning.org.uk/whiteboards/An_approach_to_an_effective_methodology.pdf) (June 2003d)
- Walker, D. (2002a). White Enlightening. *Times Educational Supplement*. London.
- Walker, D. (2002b). Meet Whiteboard Wendy. *Times Educational Supplement*. London.
- Walker, D. (2003a). Quality at the Dockside. *Times Educational Supplement*. London.
- Walker, D. (2003b). Breath of Life. *Times Educational Supplement*. London.
- Warren, C. (2002). Interactive Whiteboards: an approach to an effective methodology, [www.virtuallearning.org.uk/whiteboards/An\\_approach\\_to\\_an\\_effective\\_methodology.pdf](http://www.virtuallearning.org.uk/whiteboards/An_approach_to_an_effective_methodology.pdf).



- Weimer, M. J. (2001). The Influence of Technology such as SMART Board Interactive Whiteboard on Student Motivation in the Classroom, [www.smarterkids.org/research/paper7.asp](http://www.smarterkids.org/research/paper7.asp) .
- Weitz, J., *Telephone Interviewing*, in *The International Handbook of Market Research Techniques.*, R.J. Birn, Editor. 2002, Kogan Page: London. p. 177.
- Wiggins, J. and A. Ruthmann (2002). Music Teachers' experiences: Learning through SMART Board Technology,
- Wood, C. (2002). "Interactive Whiteboards - A luxury too far?" *Teaching ICT* 1(2).