The impact of interactive whiteboards on teacher–pupil interaction in the National Literacy and Numeracy Strategies

Fay Smith*, Frank Hardman and Steve Higgins
University of Newcastle upon Tyne, UK

(Submitted 3 December 2004; conditionally accepted 21 February 2005; accepted 10 March 2005)

The study set out to investigate the impact of interactive whiteboards (IWBs) on teacher–pupil interaction at Key Stage 2 in the teaching of literacy and numeracy. As part of the National Literacy and Numeracy Strategies, IWBs have been made widely available as a pedagogic tool for promoting interactive whole class teaching. In order to investigate their impact, the project looked specifically at the interactive styles used by a national sample of primary teachers. A total of 184 lessons were observed over a two-year period. Using a computerised observation schedule, teachers were observed in literacy and numeracy lessons, with and without an IWB. The findings suggest that IWBs appear to be having some impact on the discourse moves used in whole class teaching, but this impact is not as extensive as that claimed by the advocates of IWBs. Lessons which used IWBs had a faster pace and less time was spent on group work. The implications of the findings for classroom pedagogy, teachers’ professional development and future research priorities are considered.

Introduction

Since their launch in the late 1990s, a major feature of the National Literacy Strategy (NLS) and National Numeracy Strategy (NNS) has been an emphasis on direct, ‘interactive whole class teaching’. It is suggested that more interactive forms of whole class teaching will play a vital role in raising literacy and numeracy standards by promoting high quality dialogue and discussion and raising inclusion, understanding and learning performance (Reynolds & Farrell, 1996). In the NLS Framework, successful teaching is described as ‘discursive, characterised by high quality oral
work’ and ‘interactive, encouraging, expecting and extending pupils’ contributions’ (Department for Education and Employment [DfEE], 1998, p. 8). Similarly, the NNS Framework states, ‘high-quality direct teaching is oral, interactive and lively ... in which pupils are expected to play an active part by answering questions, contributing points to discussion, and explaining and demonstrating their methods to the class’ (DfEE, 1999, p. 11). In both strategies, therefore, interactive whole class teaching is not seen as a return to a traditional ‘lecturing and drill’ approach in which pupils remain passive, but as an ‘active teaching’ model encouraging dialogic forms of teaching.

More recent research on how the power of classroom talk can promote and enhance children’s learning has focused on the concept of ‘dialogic teaching’ (Alexander, 2003; Mercer, 2003). Here the essential features of a dialogic classroom are that it is collective (teachers and pupils addressing the learning task together), reciprocal (teachers and pupils listening to each other to share ideas and consider alternative viewpoints) and cumulative (teachers and pupils building on their own and each others’ ideas to chain them into coherent lines of thinking and enquiry). Alexander (2004) argues that the term dialogic teaching should replace both the vagueness of ‘interactive’ and the organisational restrictiveness of ‘whole class teaching’. Dialogic teaching also resonates with terms used by authorities in the field of language and learning who draw on the theoretical work of Vygotsky and Bakhtin (e.g. Barnes & Todd, 1995; Wells, 1999; Mercer 2000). Research into dialogic teaching suggests that classroom talk can take a variety of forms and functions, leading to different levels of pupil participation and engagement, and to higher levels of pupil achievement (Nystrand et al., 2003; Mercer et al., 2004).

However, research suggests that the strategies have done little to change traditional patterns of whole class interaction, with teacher questioning and feedback only rarely being used to assist pupils to articulate more complete or elaborated ideas as recommended by the strategies (Mroz et al., 2000; English et al., 2002; Hardman et al., 2003; Smith et al., 2004). The research shows whole class teaching in the strategies is still dominated by what Tharp and Gallimore (1988) call the ‘recitation script’. Sinclair and Coulthard (1975) first revealed that in its prototypical form teacher-led recitation consists of three moves: an initiation, usually in the form of a teacher question, a response, in which a student attempts to answer the question, and a follow-up move, in which the teacher provides some form of feedback (very often in the form of an evaluation) to the pupil’s response. This three-part exchange, or IRF, structure, is particularly prevalent in directive forms of teaching and often consists of closed teacher questions, brief pupil answers which teachers do not build upon, superficial praise rather than diagnostic feedback, and an emphasis on recalling information rather than genuine exploration of a topic. Recitation questioning therefore seeks predictable correct answers and only rarely are teachers’ questions used to assist pupils to more complete or elaborated ideas.

As part of the NLS and NNS, the Department for Education and Skills has been promoting the use of interactive whiteboards (IWBs) in primary schools throughout England. IWBs are large, touch-sensitive boards which are connected to a computer
and a digital projector which projects images from the computer screen onto the boards. IWBs are a relatively new technology to education, having been originally developed to satisfy needs identified in office settings (Greiffenhagen, 2000). Consequently, the available literature is limited to a number of reports and summaries of small-scale research projects undertaken by individual teachers, schools and higher education institutions. There are also descriptions of 'good' practice and teaching experience published in teacher-oriented journals and newspapers/magazines.

One of the main claims made by commentators in relation to the use of IWBs as a tool of pedagogy is that they can promote an 'interactive' class. For example, in its review of the literature on IWBs, the British Educational Communications and Technology Agency (BECTA, 2003, p. 3) states that students are motivated in lessons incorporating an IWB because 'students enjoy interacting physically with the board, manipulating text and images', thereby providing 'more opportunities for interaction and discussion'. Similarly, Levy (2002) suggests that IWBs motivate pupils to offer answers to teachers' questions because of the strong visual and conceptual appeal of the information that is displayed, and because of the way they allow pupils to physically interact with the board in search of those answers. The scale of the IWB is also seen as enabling the visual information to be more easily shared, thereby drawing the class together.

Ball (2003) argues that the IWB is bringing about changes in traditional teacher/pupil discourse because, like the teacher, it is able to both find and provide answers, thereby shifting some of the power away from the teacher. Goodison (2002) suggests whiteboards add a social dimension to learning because pupils can share knowledge publicly and learn by making mistakes together. Similarly, Glover and Miller (2001) found that pupils, particularly boys, relished making PowerPoint presentations 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 reported that they also enjoyed the opportunity to see and discuss other pupils' work.

The most widely claimed advantage of the IWB is that it motivates pupils because of its capacity for quality presentation incorporating large visual images, which satisfy the expectations of pupils already immersed in a world of media images (Glover & Miller, 2001; Levy, 2002; Richardson, 2002; BECTA, 2003). Pupils interviewed by Levy (2002) reported that their lessons were quicker, and more fun, whereas teachers felt pupils were kept involved in lessons because of the anticipation and interest for what would appear next on the whiteboard. Teachers in Miller and Glover's study (2002) also felt that pupil interest in learning was enhanced because of the element of surprise that IWBs can bring to lessons. The opportunity for pupils to present and discuss work was also seen as improving attention and engagement in the learning process (Kennewell, 2001; Burden, 2002; Miller & Glover, 2002; BECTA, 2003).

Given the lack of empirical evidence to support many of the assertions made about the benefits of IWBs in promoting teacher–pupil interaction, this study set out to investigate their impact on the interactive core of whole class teaching in the NLS
and NNS with Year 5 pupils. The study was therefore designed to test the claims that IWBs can be used as a pedagogic tool to promote interactive forms of learning and teaching, thereby changing traditional patterns of whole class interaction and discourse. The sample was carefully structured so that we could also investigate effects beyond the short-term (by observing the teachers using IWBs one year later); compare the use of IWBs in Year 5 and Year 6 classes; and explore whether there were any gender differences in terms of who initiates or receives discourse moves.

**Research design**

**Background to the project**

As part of a national pilot project undertaken by the Primary National Strategy, IWBs were installed in Year 5 and Year 6 classes in 12 to 15 schools in each of six local education authorities (LEAs). A team from the Centre for Learning and Teaching at Newcastle University was contracted to research the impact of the introduction of the new technology on teachers' use of the IWBs, on classroom interaction, on teachers' perceptions, pupils' attitudes and pupils' attainment. Their impact upon classroom interaction was studied through a series of structured observations, the views of teachers and pupils through interviews, use through teachers' weekly records of IWB use and the impact on pupils' attainment through their performance in national Key Stage 2 tests. This article only focuses upon the observational strand of the project.

**Objectives**

Our objectives for the observations were as follows:

- Objective 1: To what extent are there differences in classroom interaction when a teacher uses an IWB compared to when they do not? And is there an interaction effect with subject area (literacy/numeracy)? (This objective was tested in 2003, and provided baseline data for the next objective);
- Objective 2: The IWBs were newly integrated into the classroom in 2003: would an extra year with an IWB change classroom interaction in any way?
- Objective 3: Are there any observable differences in classroom interaction between Year 5 and Year 6 pupils, when an IWB is being used?

This overall design is further summarised in Figure 1. Each of the objectives relate to the cells in Figure 1 as follows:

- Objective 1 uses all data from Cell 1;
- Objective 2 uses all data from Cell 2 with matched data from Cell 1;
- Objective 3 uses all data from Cells 2 and 3.

**Sample structure**

In 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 an
IWB to teach numeracy, and once without; once using an IWB to teach literacy, and once without. This enabled us to investigate differences in classroom interaction between those teachers using IWBs and those not. Our sample size was also large enough to compare literacy and numeracy lessons and to examine any interaction effect between medium used and subject area (see top half of Table 1). This relates to Objective 1.

In 2004, we observed a further 70 lessons (see Table 1), 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 IWBs. Fifteen 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 IWBs, and enabled us to see if an extra year with an IWB changed classroom interaction in any way. Therefore, the same 15 teachers were observed teaching literacy and numeracy in three different situations: (1) 28 non-IWB lessons in 2003 (baseline); (2) 30 IWB lessons in 2003; and (3) 30 IWB lessons in 2004.

This comparison relates to Objective 2. This was treated as a matched sample (rather than truly related) because we had literacy and numeracy data for each teacher, and also because the teachers taught a different Year 5 class in 2004. Typically, therefore, a one-way ANOVA was used in the analyses; with a Bonferroni post-hoc test used to identify where significant differences lie. The Bonferroni
correction is a statistical adjustment used when making multiple comparisons: it reduces the likelihood of finding a statistical difference simply due to chance.

The classes we observed in Year 5 in 2003 moved into Year 6 in 2004. We observed a sample of these Year 6 classes with their new teachers (20 teachers in total: 14 female, 6 male). Again, we observed these teachers twice across literacy and numeracy (40 lessons in total). With these data we were able to compare Year 5 and Year 6 teaching to see if there were any pedagogical differences between the age groups when using an IWB. For this comparison, we compared the 40 Year 6 lessons with the 30 Year 5 lessons observed in 2004. This relates to **Objective 3** (see bottom half of Table 1). An independent t-test was used for these analyses.

The six LEAs involved in the pilot project were selected by the Primary National Strategy and these LEAs in turn chose or invited about 12–15 schools to be part of the pilot project. Within this opportunity sampling frame the specific schools from each LEA and then the individual teachers (where there was more than one teaching in Year 5) were selected for observation using computer-generated random numbers.

**Method used**

Observations were carried out using a computerised observation schedule developed by the research team known as the Classroom Interaction System (Smith & Hardman, 2003). A continuous sampling method was used. The coding scheme uses *The Observer* software (Noldus Information Technology, 1995) to log the number of different types of discourse moves made by teachers and pupils. This was done using a handheld device about the size of a calculator. This computerised system enabled us to observe the lessons in real-time and was quicker than traditional paper and pencil methods because the data were instantly stored, and therefore available for immediate analysis. The system has been shown to be reliable (both for inter- and intra-rater reliability). An in-depth discussion of the Classroom Interaction System can be found in Smith and Hardman (2003).

The computerised system logged (for each teaching exchange): the actor, the discourse move and who the receiver was. It therefore primarily focused on the three-part IRF structure and gathered data on teachers’ questions, whether questions were answered (and by whom), and the types of evaluation given in response to answers. It also recorded pupil initiations in the form of discourse moves made by teachers and pupils. The system recorded whether teacher questions were *open* (i.e. defined in terms of the teacher’s reaction to the pupils’ answer: only if the teacher will accept more than one answer to the question would it be judged as open) or *closed* (i.e. calling for a single response or offering facts). Responses were coded according to whether a boy or girl answered or whether there was a choral reply. Teacher feedback to a pupil’s answer was coded according to whether it was praised, criticised, or accepted. The system also captured two alternative strategies in the feedback move: *probes* (where the teacher stayed with the same child to ask further questions) and *uptake* questions (where the teacher incorporated a pupil’s answer into a subsequent question).
Findings

Sample characteristics

Just before each observation took place, we recorded some contextual data about the class: class size, number of boys and girls, number of pupils with special educational needs (SEN). The figures given in Table 2 are for both 2003 and 2004. The average class size was 27.5; the boy/girl split in each class was roughly half and half; and the average percentage of SEN pupils in the class was 13.6%. As the standard deviations indicate, these means disguise the variation which occurred from class to class.

On average each lesson lasted 59 minutes (the range went from to 41 to 80 minutes, SD=0.09 minutes). Most lessons (180 out of 184) were observed in the morning (most schools teach the literacy hour and numeracy lessons before midday).

Overview of lesson sections (whole class, group and individual work)

With regard to Objective 1, IWB lessons contained about 5 minutes more whole class teaching ($t=3.24, p<.01$) and 5 minutes less group work ($r=-2.11, p<.05$). No subject area differences were found (e.g. numeracy lessons did not have more group work than literacy lessons). When the teachers were observed again in 2004 using IWBs (Objective 2), there was a marked increase in the choppiness of a lesson: there was more switching between whole class work and individual work, while the frequency of group work stayed the same. A one-way ANOVA, followed by a post-hoc Bonferroni test, found this to be significant (whole class: $F=5.49, p<.01$; individual: $F=5.33, p<.01$). Also, the fact that there was less group work in the IWB lessons in 2003 than the non-IWB lessons became more pronounced in 2004 ($F=3.37, p<.05$). The total drop in the amount of time spent on group work from 2003 (non-IWB lessons) to 2004 (IWB lessons) was 7 minutes and 24 seconds. No differences were found between Year 5 and Year 6 teachers (Objective 3).

Frequency of discourse moves

The rate (number per hour) for each discourse move was calculated for all 184 lessons. In terms of purely teacher-initiated moves, the most frequent included

<table>
<thead>
<tr>
<th>Table 2. Class data for the sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Class size</td>
</tr>
<tr>
<td>Boys</td>
</tr>
<tr>
<td>Girls</td>
</tr>
<tr>
<td>SEN</td>
</tr>
<tr>
<td>Boys (%)</td>
</tr>
<tr>
<td>SEN (%)</td>
</tr>
</tbody>
</table>
explaining (135 per hour), closed questions (62 per hour), evaluation (62 per hour),
and direction (51 per hour). Throughout the observations our focus was upon the
teacher: but we also analysed 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).

Table 3 shows differences between those lessons which used IWBs and those
which did not.

A one-way ANOVA (followed by a Bonferroni test) found eight discourse moves
to be significantly different between the three groups. In those lessons which used an
IWB 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 IWBs had been in use for over a year—an embedding effect.
Similarly, some of the changes observed after one year of IWB use were not observed
the next year (there was an initial increase in pupil presenting, fewer pauses and
fewer interruptions in IWB lessons). Fewer pauses and uptake questions were
observed in the lessons which used IWBs.

Significantly more closed questions and fewer open questions were asked in
numeracy lessons (t = 9.43, p < .001; t = -4.99, p < .001, respectively). This concurs
with our findings in a previous Economic and Social Research Council 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.

Table 3. Rate of discourse moves by medium used and year of observation

<table>
<thead>
<tr>
<th></th>
<th>No IWB 2003</th>
<th>IWB 2003</th>
<th>IWB 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Open question</td>
<td>19.7</td>
<td>28.5</td>
<td>24.8</td>
</tr>
<tr>
<td>Closed question</td>
<td>62.7</td>
<td>36.6</td>
<td>72.9</td>
</tr>
<tr>
<td>Repeat question</td>
<td>10.6</td>
<td>8.0</td>
<td>13.9</td>
</tr>
<tr>
<td>Uptake question</td>
<td>25.8</td>
<td>26.1</td>
<td>6.5</td>
</tr>
<tr>
<td>Probe</td>
<td>20.3</td>
<td>13.2</td>
<td>19.6</td>
</tr>
<tr>
<td>Evaluation</td>
<td>46.2</td>
<td>23.7</td>
<td>42.7</td>
</tr>
<tr>
<td>Explain</td>
<td>164.9</td>
<td>38.2</td>
<td>164.1</td>
</tr>
<tr>
<td>Direct</td>
<td>44.5</td>
<td>25.9</td>
<td>47.8</td>
</tr>
<tr>
<td>Refocus</td>
<td>16.5</td>
<td>13.3</td>
<td>14.3</td>
</tr>
<tr>
<td>Pause</td>
<td>24.6</td>
<td>12.3</td>
<td>18.4</td>
</tr>
<tr>
<td>Interrupt</td>
<td>2.3</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>General talk</td>
<td>0.4</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Present</td>
<td>24.3</td>
<td>23.2</td>
<td>35.2</td>
</tr>
<tr>
<td>Answer-pupil only</td>
<td>113.6</td>
<td>32.9</td>
<td>126.4</td>
</tr>
<tr>
<td>Choral response</td>
<td>5.1</td>
<td>6.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Spontaneous contribu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.7</td>
<td>8.4</td>
<td>10.3</td>
</tr>
</tbody>
</table>

Note: * indicates those differences significant at p < .05; ** p < .01; *** p < .001.
With regard to Objective 3, some differences were found between Year 5 and Year 6 classes. In the Year 6 classes there were more uptake questions, more pauses and more choral responses; there were also fewer explanations and fewer answers from the pupils.

The data relating to rate need to be taken into account alongside the duration data (presented later), since rate data take no account of how long a discourse move may last. For example, Year 6 pupils may have given fewer answers in terms of rate, but their answers may have been more protracted.

**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 Table 3 seems to reveal a quicker pace in the IWB lessons in 2003 compared to the non-IWB lessons, and then again in 2004. An independent t-test found no difference in pace between IWB lessons and non-IWB lessons in the first year (2003), but a difference was found in the second year. A one-way ANOVA, then Bonferroni, found a faster pace in the IWB lessons in 2004 compared with the non-IWB lessons in 2003 ($F=6.83, \ p<.01$). IWB lessons consisted of, on average, 96 more discourse moves per hour (a 17% increase in pace). Table 3 shows that the discourse moves which are contributing to the faster pace (more moves per hour) mainly include: open questions (over twice as many in ‘IWB 2004’ compared to ‘No IWB 2003’), answers (32% increase) and evaluation (56% increase).

Numeracy lessons were faster paced than literacy lessons (16% faster; $t=3.45, \ p<.001$). Also, Year 5 lessons were faster paced than Year 6 lessons (10% faster; $t=2.06, \ p<.05$).

**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 each discourse move (each discourse move’s total contribution to the entire whole class section, e.g. if explaining took up 5 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 hypothetical lessons: in both lessons, answers lasted on average 3 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.
Mean durations and percentage durations for each discourse move are shown in Table 4 (for all 184 lessons).

Again, this table concurs well with our previous research, 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 hour), closed questions (62 per hour), evaluation (62 per hour), and direction (51 per hour). 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 seconds). A typical pupil answer lasted for 4.4 seconds. Looking at the last column, we 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.

Figure 2 shows differences between those lessons which used IWBs and those which did not, over both years of the study. With regard to Objective 1 (impact of the IWB during the first year of use), four significant differences were found: answers took up more time (percentage duration) in IWB lessons compared to non-IWB lessons (20% as opposed to 14%, $t=5.46$, $p<.001$), and pauses were briefer in IWB lessons ($t=-4.28$, $p<.001$). Uptake questions and explaining took up less time in IWB lessons ($t=-3.42$, $p<.01$ and $t=-2.42$, $p<0.05$, respectively).

After a year of use (Objective 2), the data revealed a rather different pattern of classroom interaction. Again, a one-way ANOVA and Bonferroni were used to investigate this. The initial increase in the percentage duration of answers from pupils observed in 2003 settled back down: there was no significant difference.

Table IV. Mean duration and percentage duration for each discourse move

<table>
<thead>
<tr>
<th>Discourse move</th>
<th>Mean duration (secs)</th>
<th>Percentage duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open question</td>
<td>4.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Closed question</td>
<td>3.5</td>
<td>5.8</td>
</tr>
<tr>
<td>Repeat question</td>
<td>4.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Uptake question</td>
<td>3.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Probe</td>
<td>2.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Evaluation</td>
<td>4.7</td>
<td>7.5</td>
</tr>
<tr>
<td>Explain</td>
<td>12.2</td>
<td>27.8</td>
</tr>
<tr>
<td>Direct</td>
<td>8.1</td>
<td>9.4</td>
</tr>
<tr>
<td>Refocus</td>
<td>6.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Pause</td>
<td>5.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Interrupt</td>
<td>12.0</td>
<td>0.5</td>
</tr>
<tr>
<td>General talk</td>
<td>6.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Presents</td>
<td>9.9</td>
<td>16.9</td>
</tr>
<tr>
<td>Answer</td>
<td>4.4</td>
<td>16.5</td>
</tr>
<tr>
<td>Choral response</td>
<td>10.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Spontaneous contribution</td>
<td>7.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>
between IWB and non-IWB lessons (see Figure 2). Taken together with the finding that the rate of answers has increased in IWB lessons, it is clear that answers during IWB lessons are frequent, but brief.

The initial decrease in the amount of pauses and the amount of teacher explanation was short-lived (both increased again in 2004). Only 3 discourse moves were found to be significantly different (when comparing IWB use in 2004 to those teachers not using an IWB in 2003): there was more evaluation in IWB lessons compared to non-IWB lessons ($F=16.48$, $p<.001$); uptake questioning (as observed in the first year of use) still had a lower percentage contribution in IWB lessons compared to non-IWB lessons ($F=11.38$, $p<.001$); and presentations from pupils also had a lower percentage contribution in IWB lessons ($F=3.13$, $p<.05$).

Closed questions contributed to 9.5% of a numeracy lesson but only 3.4% of a literacy lesson ($r=9.86$, $p<.001$). Open questions contributed to 3.1% of a literacy lesson but only 0.9% of a numeracy lesson ($r=-6.65$, $p<.001$). Presenting from pupils ($r=-3.56$, $p<.01$) and uptake questions ($r=-2.31$, $p<0.05$) both had larger percentage contributions in literacy lessons; and teacher direction had a larger percentage contribution in numeracy lessons ($r=2.23$, $p<.05$).

With regard to Objective 3, only one difference was found between Year 5 and Year 6 classes: there was more explanation in Year 6 classes (33% of whole class time) compared to Year 5 classes (27%) ($r=-3.14$, $p<.01$).

**Gender data**

In addition to basic information such as frequency and duration of each discourse move, we also gathered further data about the initiators and receivers of moves. For
example, if the teacher asked an open question, we recorded the recipient of the question (the whole class, a male pupil, or a female pupil).

With regard to Objective 1, tests were carried out to see if there were any differences between IWB lessons and non-IWB lessons for the gender data. None were found. For example, boys were no more likely than girls to answer in IWB lessons, or vice versa. Similarly, no gender differences were found between subject areas. A repeated measures ANOVA was used to see whether another year with an IWB made a difference. Earlier it was found that uptake questions were less likely in IWB lessons: the ANOVA revealed that the teachers using IWBs after a year of use tended to focus their uptake questions on the whole class rather than an individual pupil (F=7.45, p<.001). No gender differences were found between the year groups.

Discussion

The article set out to investigate the impact of IWBs on whole class teaching in the NLS and NNS. The findings suggest that IWB lessons contained more whole class teaching and less group work than non-IWB lessons and this was true for both numeracy and literacy lessons. With regard to the frequency of discourse moves, the lessons which used IWBs had significantly more open questions, answers from pupils and evaluation. These three moves together (the typical IRF structure) all contributed to a faster pace in the IWB lessons (an increase of 16%).

The frequency of answering in IWB lessons was higher, but the percentage contribution of these answers to the lesson remained the same: answers during IWB lessons are therefore frequent, but briefer than answers given in non-IWB lessons. The percentage contribution of evaluation in IWB lessons increased compared to non-IWB lessons. Uptake questioning and presentations from pupils had a lower percentage contribution in IWB lessons. No gender differences were found between IWB lessons and non-IWB lessons, and there was no interaction effect between gender, IWB use and subject taught.

Overall the findings suggest that IWBs are having some impact within the classroom, but our results are wide ranging. As discussed earlier, the emerging literature is promising and generally supportive of IWBs. While our findings support some of the claims being made for IWBs, they do not suggest a fundamental change in teachers’ underlying pedagogy. As in earlier studies of whole class teaching in the NNS and NLS (Mroz et al., 2000; English et al., 2002; Hardman et al., 2003; Smith et al., 2004), teachers spent the majority of their time either explaining or using highly structured question and answer sequences. The recitation script (Tharp & Gallimore, 1988) was even more evident within IWB lessons. One positive impact is that the initiation move was more likely to be in the form of an open question within IWB lessons—but this positive finding was somewhat diminished by the briefer answers from pupils within IWB lessons. The emerging literature suggests that IWBs engage pupils more than conventional whole class teaching (BECTA, 2003). Whilst we have found more recitation scripts within IWB lessons, and faster pace (as also
reported by Levy, 2002), the increase in these apparent indicators of engagement appears to be at the expense of more protracted pupil answers. More evaluation was found within IWB lessons, but uptake questions (feedback which goes beyond evaluation of a pupil's answer and makes connections with other contributions during the lesson topic) were less frequent.

Our findings were not supportive of earlier research in two main areas: pupil presentation and gender differences. While pupils were found to present more in IWB lessons during their first year of use, this effect did not last into the second year. Therefore the opportunity for pupils to present and discuss work may be a short-term benefit. Also, no gender differences were observed between the two types of lesson. Boys may relish making PowerPoint presentations in front of their peers (Glover & Miller, 2001), but we did not observe a higher occurrence of this within IWB lessons. Within IWB lessons, the balance of boy/girl contributions was no different to non-IWB lessons.

While it could be argued that the IWB is a useful presentational tool to have in the classroom, the findings suggest that such technology by itself will not bring about fundamental change in the traditional patterns of whole class teaching. It seems that many of the commentators reviewed in the opening section of this article have been seduced by the technology and assumed that IWBs will add motivation and change much of the ritualised teacher–pupil interaction that goes on in schools. As our findings show, traditional patterns of whole class interaction persist despite the emphasis on interactive whole class teaching in the national strategies and the introduction of IWBs in the English primary school classroom.

The findings also raise questions about the effectiveness of the in-service training programmes that have accompanied the implementation of the NLS and NNS, and introduction of IWBs into the primary classroom. Extensive ‘top-down’ staff development materials and accompanying in-service programmes have been developed in which ‘model’ lessons are presented to teachers. However, as Alexander (2004) argues, they point to the need for different approaches in order to change habitual classroom behaviours and traditional discourse patterns. As Earl et al. (2003) suggest, changing pedagogic understanding and practices remains a major challenge in securing the long-term effectiveness of the strategies (Earl et al., 2003). Moyles et al. (2003) suggest a more ‘bottom-up’ approach is required in which monitoring and self-evaluation become a regular part of in-service training in order to bring about changes in the way teachers interact with their pupils, thereby giving teachers a degree of ownership of the process of school improvement. Similarly, Joyce and Showers (1995) argue that teachers need extended opportunities to think through new ideas and to try out new practices, ideally in a context where they get feedback from a more expert practitioner and continue to refine their practice in collaboration with colleagues. Observation, coaching and talk-analysis feedback may be useful tools for professional development whereby sympathetic discussion by groups of teachers of data (systematic observation, video recordings and transcriptions) derived from their own classrooms could be an effective starting point for critical reflection. Such an approach could provide supportive interactions
with peers through modelling and feedback in order to change traditional patterns of whole class interaction necessary for responsive teaching.

It seems clear from the evidence and discussion presented in this article that IWBs will not provide some technological fix in order to bring about fundamental change in the underlying pedagogy of whole class teaching. More extensive research needs to be carried out into ways of effectively supporting teachers in their professional development in order to promote more reciprocal forms of teaching to increase the opportunities for extended teacher–pupil interactions. IWBs may have an important part to play in this process and further research needs to be carried out to discover when and how the IWB should be used to facilitate more active pupil involvement. There is also a need for more research to provide comprehensive evidence, for both teachers and policy makers, that interactive styles of teaching encouraging more active pupil involvement can produce significant gains in learning.

Acknowledgement
The authors would like to thank the Centre for British Teachers (CfBT) for their funding of this research and the Department for Education and Skills for their support with the research project. Thanks also go to Kate Wall, Ian Hall and Heather Smith who undertook the classroom observations.

References


