Enhancing mathematical thinking with an interactive whiteboard

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The project

"The school I teach in recently became a 'Technology College' and this meant that a range of new technology was available to use in the classroom. In particular, there was the opportunity to have access to interactive whiteboards (IWBs), class sets of laptops and video conferencing facilities. It was an exciting and challenging time to have this new technology and to use it with students for the teaching and learning of mathematics. I took advantage of this situation to apply for a Best Practice Research Scholarship to examine aspects of the use of this technology with more able students."

We chose to focus the research on the visual impact of IWBs in the classroom and an evaluation of the interactive software to deliver shape, space and measurement lessons. We recognised the need to find suitable resources and software to use with the IWB to both enhance mathematical thinking and to promote accelerated learning with these more able Year 7 students (11-12 year olds). It was anticipated that there would be an initial increased interest from the students using the new technology and, once this initial novelty factor decreased, it would then be possible to examine both the IWB software and its effect within the classroom.

We also wanted to develop a sound ICT classroom practice that satisfied the needs of both teachers and students. This came with the realisation that lessons would not necessarily be enriched solely by using the IWB. The enjoyment of practical lessons in the shape, space and measurement area of the curriculum could not be replaced by watching an example on the IWB, as we recognised that some lessons needed to be a 'hands on' experience.

The software

We selected Crocodile Maths as software suitable for working with shape and space and conducted a pilot study on lines and angles. This interactive software could show how the angles between parallel lines could change if the transversal was moved around the board. The visual example was most powerful and one which could not have been replicated easily using an ordinary whiteboard or overhead transparencies. Once the pilot study was completed, the next stage was to implement the use of Crocodile Maths more fully to teach the shape, space and measurement modules of the scheme of work. This involved the preparation of additional PowerPoint presentations.

"Initially, these presentations took a considerable amount of time to prepare but they became easier

with practice. With greater proficiency, I started to prepare my own interactive lesson starters and plenaries in Word. In addition, I used the IWB to access particular quality sites on the Internet, such as www.bbc.co.uk/schools, which provides a wealth of information for students."

Learning logs and interviews

We used 'learning logs' with these more able students in the pilot study as a means of gaining evidence of students' reaction to the IWB lessons and for identifying student progress. These were completed by students at the end of each lesson and gave them the chance to reflect on and evaluate their own learning and also proved a useful way for us to track student progress. These were so successful, we continued their use into the full study. Following the use of these learning logs, a sample of students was selected and interviewed. These one-to-one interviews were conducted to provide an opportunity for a more in-depth discussion about issues relating to the classroom use of IWBs. These interviews were audio taped and later analysed.

The students were open and truthful about the things they liked about the IWB, what they found useful in a lesson, what they didn't like and what they would change. Some of their comments about what they like follow:

"I really liked the IWB because they are quicker than writing things down"

"I think its better as, on an ordinary board, it can't move. On the IWB, it can move and you can see how things are done properly".

"The best part was the demonstration of things like enlargement"

"I like moving and matching the shape when under one square is a question and you have to find the answer under another"

"I think the best thing about it is that it can move so you can see how things are if you put it somewhere"

"I think the best thing is the games eg in pairs"

Further comments indicate some of the drawbacks and their suggestions for improvement:

"Sometimes the light means you can't read" (This comment referred to the projector light on the screen).

"I think you need a bit of patience and when you leave it alone and it goes back to the log in"

"Sometimes going on the internet is a pain – you can't read it"

"It needs to stay on instead of screen saver coming on"

"I think it should be voice activated so if the teacher wants something from it, she only has to say it. It'll be easier for the children because when it goes back to login, they only have to shout instead of running up and missing it"

The learning logs helped the students to focus on how they actually completed investigations and problem solving. There was a general improvement in the way students explained their answers to questions and they were able to give more detailed explanations about their investigations. The IWB motivated the students to get more involved in the lesson; there was always a volunteer to share their ideas with the class and this has not changed since. To see the examples of geometric shapes in a clear and comprehensible way has benefited students' understanding relating to areas of polygons. The following are comments from learning logs relating to lessons on areas of parallelograms and trapezia:

"I found this task enjoyable as I have only so far been taught to find area of triangles, rectangles and squares. I liked investigating the different ways of finding the area for different shapes".

"Today the easiest part of area of parallelograms was moving part of the parallelogram to another part to make a rectangle"

"I found this exercise quite helpful today It helped me because I know how to find the area of most shapes and I enjoyed the lesson. I now think I understand what we covered in today's lesson"

"I found this easy to pick up and understand and it was easier than I thought (learn better by drawing shapes, see triangles)"

"It was easy when we did things on the board, but the writing stuff was hard"

"I didn't quite understand one method of finding out the area of a trapezium but I understood the other method"

"I liked today's lesson because I understood it all. It was easy to learn. I never knew how to do this before"

In the interviews and in learning logs, students made many positive references to small group activity. They had been divided into groups and given various related problems to solve - in one case finding the area of quadrilaterals. The students would split up to form new groups, and teach the members of the next group. The task required each member of the group to make an input and, at the end of the lesson, one student from each group gave a presentation to the class on their findings. They found it challenging but were able to communicate their findings effectively to other students. They had preferred discovering the mathematical ideas for themselves and their dissemination to their peers showed high levels of mathematical thinking.

"I liked working in a group cos we can just get on with it and working together you get more done and we can all help each other out if one of us is stuck"

"I enjoyed working in a group. I enjoyed solving problems but I would have prefered having more info"

"I thought this lesson was great. I love working in groups. I enjoyed trying different numbers to make a number"

"I thought today's lesson was good. I like working in groups as long as I can pick who I'm with because then I'm not too shy to participate. I like solving questions"

"I enjoyed today's lesson. I liked working as a group and I liked answering the questions and I felt more confident as a group"

The use of learning logs and student interviews provided a comprehensive evaluation of the focus for this research. The student KS2 levels and CAT scores provided a base line for comparison of the end of unit test results. These were compared to the previous Year 7 results. Although it is difficult to directly compare two non-identical cohorts, these end of unit tests showed a slight improvement in the National Curriculum levels on the previous year.

Outcomes of the project

Crocodile Mathematics offers very good interactive diagrams. The sample models used for finding the area of parallelograms showed one triangle created from the perpendicular could be moved over to the other side to form a rectangle. This idea can now be visualised by the students when selecting the correct measurement to calculate other areas. The students soon became competent at selecting and dragging the shapes and text around the whiteboard. They liked the clear examples used by the geometric software and the ease of moving lines, shapes and text. Their evaluations of the IWB have been positive and they liked the way the software produced clear and understandable examples. The IWB has enabled the students to experience a wider range of examples and visual explanations of shape and space concepts.

The interactive keyboard was also used by students with Excel to give quick and clear graphs and diagrams, and to use quality Internet sites. Figure 1 summarises the responses to a student questionnaire about their perceived ease or difficulty with using each of these.

	easy				difficult	
Use of Laptops and Excel	1	2	3	4	5	
						total
Use of LT	10	9	1	1	2	23
Use of Excel	13	6	3	1	0	23
Confident to use spreadsheet	10	6	4	3	0	23
Confident to draw graphs	14	2	3	4	0	23
total	47	23	11	9	2	92

	easy				difficult	
Use of interactive web pages	1	2	3	4	5	
						total
use of laptop	9	8	2	2	2	23
mymaths.co.uk	6	8	4	4	1	23
mathslessons.co.uk	7	2	2	2	10	23
total	22	18	8	8	13	69

Figure 1

"This research facilitated the sharing of good practice with colleagues as well as the development and refinement of interactive lessons, starters and plenaries. There is recognition that the IWB, in some lessons, is a more useful resource than a projector for a Power Point presentation or simply as a non-interactive whiteboard.

The introduction of an IWB into my classroom generated a steep learning curve for me; not only did I have to be reasonably competent with the new technology but I had to be able to identify and solve any problems that arose. The students also had new skills to learn, as they were encouraged to use the IWB and software. As with any new technological initiative in the classroom, sometimes things did not go smoothly and the interruption from the screen saver was the first 'blip' to occur, which caused the class to chuckle, but this was soon corrected. However, when things outside your control happen, such as not being able to access a web page which had been previously available, or the network going down, then I had to have backup lessons and I learned not to rely on the technology. It was problems like these that the students naturally discussed in their evaluations. However, their feedback was mainly positive."

"In conclusion, although time consuming for me to produce interactive lessons, the student evaluations were so positive and rewarding, I continue to do this. The IWB is a good medium to generate class discussions; student interaction was limited when students worked independently on laptops using the same interactive software. There was evident improvement in mathematical thinking skills amongst students with the IBW and they were becoming more confident about discussing their findings. I also found that the students had become more confident and motivated by their mathematics. Their questions were more probing and displayed a deeper understanding of the mathematics they were learning. The medium of good software on the IWB encourages students to think for themselves."

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