Interactive Whiteboards and Collaborative Pupil Learning in Primary Science

Abstract

This study evolved as the result of a direct partnership between the University of Cambridge Faculty of Education and the staff at schools within the Cambridgeshire Education Authority. It has been completed with funding from the Economic and Social Research Council, who aim to answer the central research question '**How do children use the Interactive Whiteboard when working together on science-related activities?**'

This article presents one element of this study and focuses upon the experiences at Sunny Days Primary School. In my research I found that the Interactive Whiteboard was not the sole focus of the learning, with the pupils themselves remaining at the centre achieving enhanced levels of scientific and social learning as a direct result of the increased quality of talk and collaboration that the Interactive Whiteboard afforded.

Throughout each activity the Interactive Whiteboard provided a stimulus for collaborative discussion and the resultant learning that took place, with pupils constantly referring to the images that were presented on the Interactive Whiteboard throughout each session. The use of these images was further enhanced by the fact that each image was presented on a large scale using a clear format for display.

Smaller paper versions would not have allowed for this quality of interaction between the pupils themselves and the resources that they were given and so I conclude that the Interactive Whiteboard is indeed a 'tool' for both activity and learning in the way that Warwick and Kershner describe.

Introduction

This article reports on the way that pupils made use of the Interactive Whiteboard during a series of three lessons, where collaborative learning in science was the primary focus. It comes at a time when educational researchers are considering the full potential of Interactive Whiteboards and are exploring in full the efficacy that such technology can have in the classroom.

One such researcher is Tim Rudd who in his non-academic 2007 Future Lab report asks "*What strategies might teachers, educators and developers put in place to allow learners greater input and ownership over the technology and its application*?" Sutherland *et al*. (2004) suggest one possible response in their remark that "*ICT tools may facilitate what would otherwise be impossible for pupils, contributing in this way to democratisation, access and inclusion in education*."

It has long been known that a social involvement in problem-solving activities is crucial for individual development (Vygotsky, 1978); with Warwick and Kershner stating that "*the idea of a 'tool' for activity and learning is a central aspect of social constructivism.*" In this context the term 'tool' can be taken to mean anything that promotes learning and could range from pupil voice, to the Interactive Whiteboard, to basic pen and paper.

The body of evidence and educational enquiry suggests that now is the time to investigate the full potential of Interactive Whiteboards with the key question being whether the introduction of Interactive Whiteboards in is one of replacement or transformation in the classroom.

Throughout my experience as a teacher the Interactive Whiteboard has played a significant role in the classroom. The ability to present information in a wide variety of visually stimulating ways in addition to the fact that pupil thoughts, opinions and ideas on a topic can be readily stored and retrieved for later use in the classroom has been revolutionary and has helped to meet pupils' diverse needs and learning styles in addition to maintaining pupil interest and enthusiasm. But, now at a time when teachers are familiar with the potential of the Interactive Whiteboard as a

'replacement' tool it is time to investigate the scope that the boards present in terms of classroom transformation.

There is a corpus of research that focuses upon the impact that the Interactive Whiteboard has had in the classroom. Wall, Higgins & Smith (2005) propose that "*Pupils commented on how the Interactive Whiteboard could be used positively in science*," also noting that "*Pupils mentioned the element of 'realism' and the demonstration capacity that the board brought*." However, as encouraging as this evidence is, these comments only suggest that Interactive Whiteboards are being used to replace chalk and whiteboard pens. Pupils who have undoubtedly noticed this have suggested avenues for reform in the classroom "*Many of the pupils expressed the opinion that the desire to use the Interactive Whiteboard was motivating although they feel this is not a strategy that is used enough*," Wall *et al*. (2005).

In line with this research, which suggests that pupils would relish the opportunity to use the Interactive Whiteboard themselves, other researchers have been investigating the role that collaboration plays with regard to learning in the classroom. A lead voice on this subject is Neil Mercer (2004), author of 'Thinking Together' who commented that "*We have also demonstrated the positive influence of Exploratory Talk on children's understanding of science and their attainment in formal science assessments*." However, in a later article, Mercer and Sams, (2006) cited contradictory academic research which suggested that "*observational research in British primary schools has shown that the talk which takes place when children are asked to work together is often uncooperative, off-task, inequitable and ultimately unproductive*."

Overall, this project aims to merge the motivational aspects of the Interactive Whiteboard that Wall *et al*. have identified (through listening to pupil voice) with all of the benefits that adopting a social constructivist approach to teaching and learning presents - pupils will be presented with an abundance of opportunities for collaboration and talk in line with the thoughts of Mercer *et al*.

Data Collection

The main research study was conducted ~ using a multi-method approach that included video analysis, pupil interviews and detailed analysis of talk and pupil interaction. For this article the main areas of interest are the nature of collaboration between the children and the Interactive Whiteboard and the way that the pupil talked to each other during each of the identified significant lesson episodes.

During the course of the Spring and Summer Terms in the 2007 – 2008 Academic Year the video data for this research was collected on location at Sunny Days Primary School (a single form entry primary school with approximately 200 pupils on roll, located in an EU designated area of social, economic and cultural deprivation) ~. The sessions filmed took place in a class of 30 mixed ability Year 5 and Year 6 pupils with all pupils working on the same learning objective and using identical visual stimuli. The key difference being that while the majority of pupils were working on paper based activity sheets one group of three pupils who were Year 5 at the time of filming (pupils aged 9 or 10 years old) used the interactive whiteboard to complete their learning.

Differentiation was achieved through mixed ability grouping with groups of three pupils working together as a 'talking trio' in the way that Mercer suggests should maximise collaborative learning. The data collected focussed solely upon those pupils using the Interactive Whiteboard and was collected in three main ways:

- Direct filming of the pupils as they were working,
- Live recording of the process as the pupils manipulated the interactive activities,
- Collection of the final Smart file outcome from each individual lesson.

Significant episodes were identified in each of the three filmed lessons with points of specific importance being transcribed and rigorously analysed. Whilst selecting and analysing each episode, specific attention was given to the learning of science, the success of collaboration, the quality of talk and the use of the Interactive Whiteboard.

Significant Episode One

Background Information

This was the first time that the three selected Year 5 pupils A, K and O (chosen because they each have a varying amount of scientific knowledge – ranging from a secure level 3 to an insecure level 5, are both individually and collectively talkative pupils and they present a confident persona meaning that they would not be phased whilst filming took place) experienced collaborative working at the Interactive Whiteboard. The session was based upon the QCA's How We See Things unit, with the specific learning objective being to 'Use scientific knowledge to solve a group task.' This objective was selected because it reinforced the need for all pupils the need to think together, thereby placing a strong emphasis upon collaborative learning.

Mercer and Sams, (2006) suggested that a "*A possible explanation for the doubtful quality of much collaborative talk is that children do not bring to the task a clear conception of what they are expected to do, or what would constitute a good, effective discussion.*" As a consequence of this I made sure that the pupils had a secure understanding of what they were expected to achieve without the need for direct teacher input, thus empowering the pupils and allowing them to focus upon the learning of science as opposed to the 'teacher's intentions'.

The Activity

The pupils were presented with a basic sorting activity (see figure 1) where they were required to classify a variety of different objects depending upon whether they felt they were 'light sources' or 'light reflectors'. Each of the objects was locked and set to infinite clone (Both locking and infinite clone are selections that can be made on the interactive whiteboard meaning that the original of each image is fixed in place but an infinite number of subsequent copies may be produced by dragging the cursor across the initial base image), so that the pupils could generate multiple copies if they felt the need to without disrupting the initial layout this simplified the task and made technical issues much less likely.

Use of the Interactive Whiteboard

Throughout the episode all three pupils used the Interactive Whiteboard very effectively; the fact that they were able to drag items to multiple locations supported their learning by virtue of the fact that they had a greater confidence as a result of the more obvious option to change their minds. At no point during the session or this

specific episode did the use of the Interactive Whiteboard become an issue, the pupils were not arguing over the equipment and it was there solely to facilitate their discussion through the use of visual stimuli as opposed to dominating the learning taking place.

The pupils presented a very good knowledge of the Interactive Whiteboard despite the fact that they previously had not used it as a learning tool intended for them personally. They had clearly watched the way that the teaching staff at Millfield Primary School had used the Interactive Whiteboard throughout their education and appeared to fully understand its functionality.

Quality of talk

The talk taking place throughout the episode was exploratory, with pupils questioning one another's ideas and building upon their scientific knowledge. The pupils worked through the images that they were presented with selecting those that they knew most about and using these as the starting point for their discussion. They started with the sun and the moon (see figure 1), because they knew that the sun was the light source and that its light was reflected by the moon (this is covered in the QCA's Year 5 Earth, Sun and Moon unit). At one point the pupils appeared to struggle with the term light source as they had to classify objects that they were less familiar with. A believed that a candle was a light source and O commented that she did not know. One pupil then said "*a light source is anything that lights up*" and this appeared to move on the whole groups understanding and confidence.

Throughout the episode a significant amount of paraphrasing took place, at one point K said that "*the moon makes the sun light up*" and O chipped in stating that "*it reflects the light from the sun*." This corrected K and made the learning that was taking place technically more accurate.

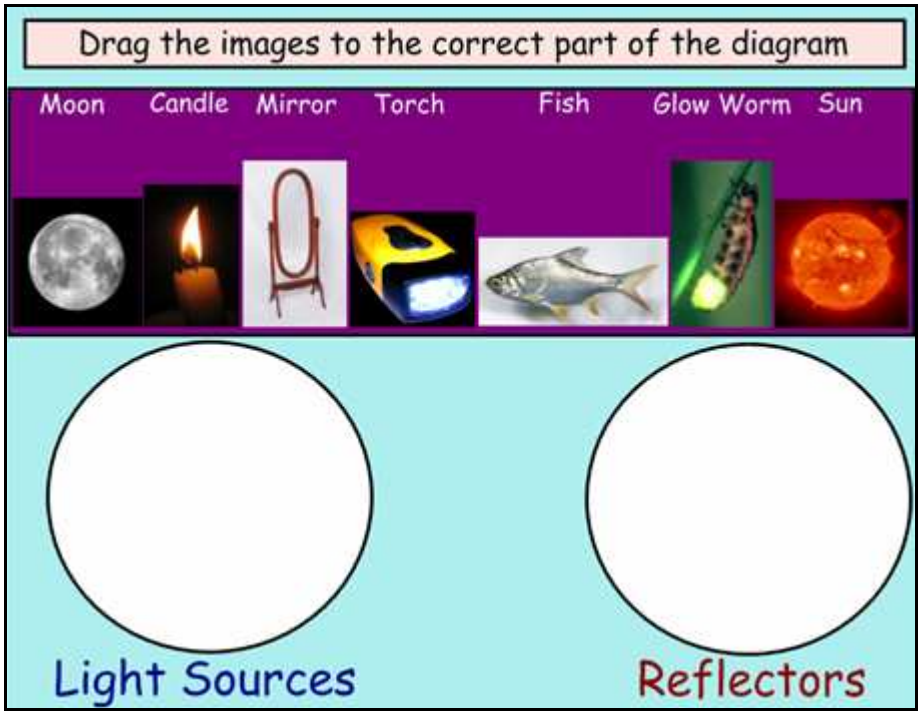


Figure 1 Basic sorting activity

Success of collaboration

The pupils collaborated most effectively when they were presented with an anomaly, in this case the glow worm which did not conform to the pupils set rules and ideas. This was the point at which the collaborative learning became most apparent. All three pupils were actively involved in the discussion, which moved on their learning. A initially commented upon the glow worm saying '*oooh, that one's hard'*. O then took over, stating that the glow-worm was a light source because it glows justifying her answer by highlighting the portion of the insect that glows and emits light.

At this point all of the pupils agreed with her and said that it was a light source by either verbalising their ideas or pointing to the circle that they felt it should be in. O then changed her mind deciding that the glow-worm could be considered as a both a reflector of light and a light source. At this point, K suggested that they place the glow-worm in the middle of the board (see figure 2). This was not a response that I expected to see, but it did lead to more discussion surrounding their placement of the glow-worm on the board. A then took K's suggestion one step further stating that the glow-worm should be placed in the middle because the light that it produces bounces off of its body.

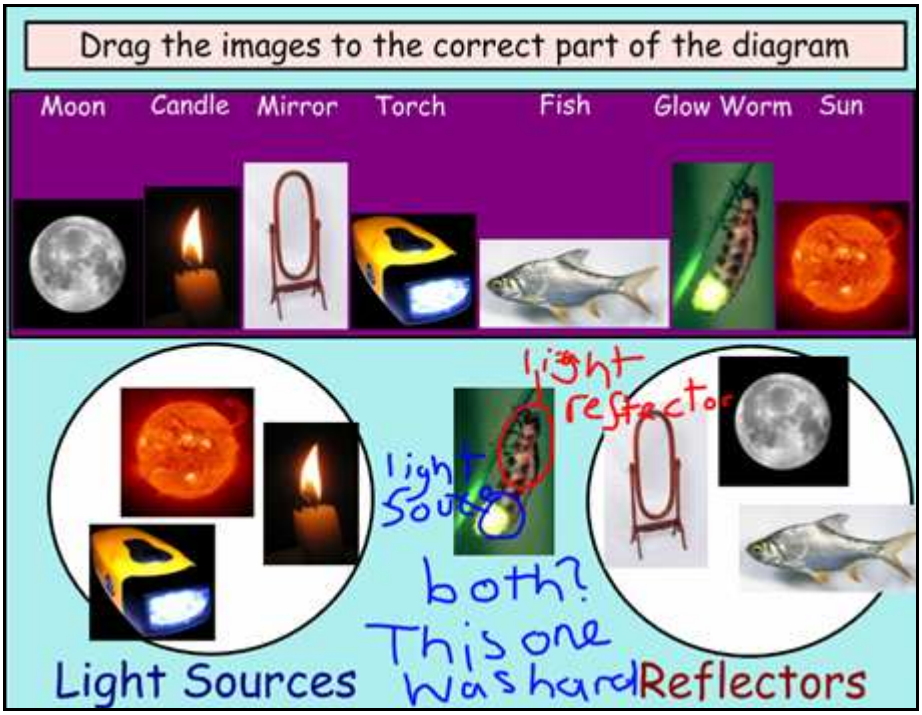


Figure 2 Pupil responses to the basic sorting activity

Learning of science

The board was set out for the pupils to drag items into the appropriate circle depending upon whether they were light sources or reflectors of light. The further development that the pupils made, by considering the fact that some of the objects (the glow-worm) could be both light sources and reflectors of light was not expected, but did highlight the exploratory nature of the discussion and the resultant collaborative learning of science that took place.

Significant Episode Two

Background Information

Again the three selected Year 5 pupils were to work collaboratively at the Interactive Whiteboard in order to work out a solution to a group problem. The session was based upon the QCA's Life Cycles unit, with the specific learning objective once again being to 'Use scientific knowledge to solve a group task.' This objective was selected for a second time because it reinforced the need to think together thereby placing a strong emphasis upon collaborative learning, based upon the belief that the scientific learning produced as a result would be of a higher standard also.

The Activity

This activity made use of the video facilities present on the Interactive Whiteboard. The pupils watched a brief video clip (Flowers and seeds) showing the stages in the growth of a plant and were then required to discuss and decide how a plant fulfilled each of the seven characteristics of life. In order to reduce potential conflict arising from pressure to identify all seven characteristics a 'Mr H says…' text box was included on this slide stating that pupils should not worry if they could not think of justification for more than three or four of the individual characteristics (see figure 3).

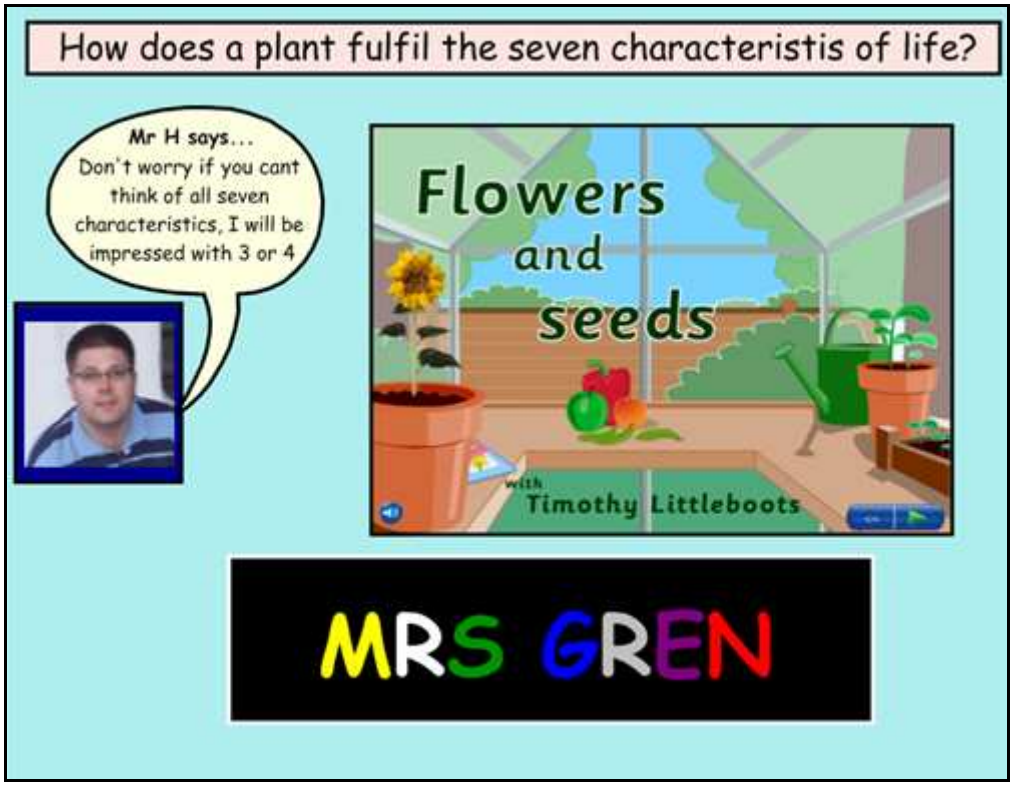


Figure 3 Activity focussing upon the characteristics of life

Use of the Interactive Whiteboard

The pupils' attention was totally focussed upon the activity on the Interactive Whiteboard. They used the visual clues that they were given and systematically moved through the seven characteristics of life in the order that they were presented on the Interactive Whiteboard (to facilitate the task the seven characteristics were presented in an acronym which spelled out 'MRS GREN' - see figure 3). A was able to extend the page so that it would accommodate all of their writing, and at one point K scrolled back to the top of the board in order to clarify what the activity required.

Throughout the selected episode there was no discussion regarding the 'facilities' that the Interactive Whiteboard had to offer, and the text was written by one pupil in the basic black pen, this illustrated the secondary nature that the technology had when compared with the engaging task that the pupils were asked to complete.

Quality of talk

The talk surrounding this activity was primarily exploratory. The pupils shared all relevant information that they were able to contribute. They even moved away from school taught knowledge using their own examples to support their observations. O took on the role of scribe for this activity, and though this was not discussed, neither A nor K commented on either the desire to write on the Interactive Whiteboard or the fact that they wanted a turn.

As a result of O's scribing role, there was a bias within the comments that she was contributing to the discussion, focussing more upon how she was going to present the information on the Interactive Whiteboard and the order that they should complete the task "*shall we like, list the things that they do then*?" and "*So a list, does it do M*?" than providing specific contributions to the scientific discussion that was taking place

Success of collaboration

During this activity the collaboration that took place occurred largely between A and K as a result of O's preoccupation with scribing. However, this is a role that was essential to the task and did not detract from the discussion that did take place.

As the discussion proceeded, the pupils' ideas and understanding were developed. The most successful example of this collaboration occurred when the pupils were considering the evidence which suggested that plants move. Here A took the lead in the discussion, with her opening comment, saying "*it does do movement doesn't it, because it grows,*" and then going on to say "*cause the roots spread out and the leaves grow*." At the mention of the leaves growing, K cut in saying "*on a sunflower, the leaves move in the direction of the sun.*"

Learning of science

The learning of science in this episode appeared to be restricted to K and A. The discussion which took place was sufficient for all pupils to develop an understanding of the fact that the leaves on plants moved during the course of the day in order to track the movements of the sun. However, as O was focussing upon the scribing of the earlier ideas of A (who mentioned the movement of the roots); she missed the later part of the conversation where K explained her ideas as outlined above (see figure 4).

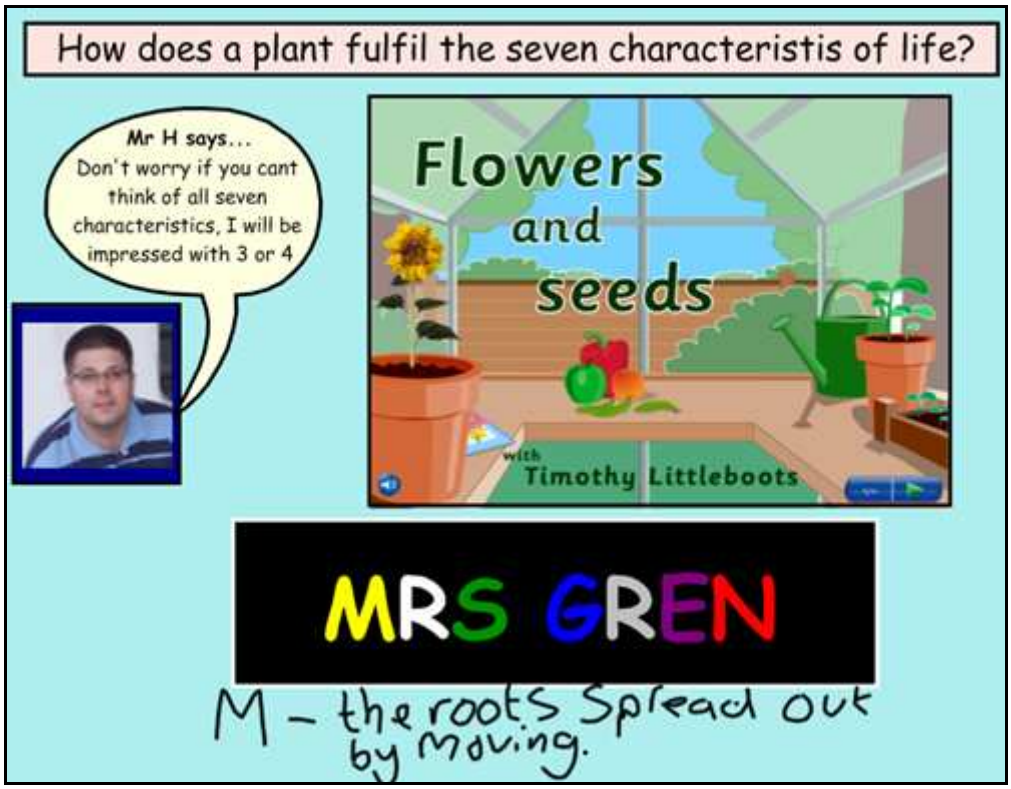


Figure 4 Pupil responses to the 'characteristics of life' activity

Conclusions

The evidence collected clearly points to the fact that the use of the Interactive Whiteboard as a collaborative learning tool in science has the potential to be a success. In order for the potential to be realised, a few essential steps must be taken into consideration and should be followed in line with recent academic research.

Where difficulties with the technology were encountered, the three students readily sought help from the class teacher or worked through the problem in a systematic way. This approach appears to contradict the findings of Bennett & Cass, 1989;

Galton & Williamson, 1992; Wegerif & Scrimshaw (cited by Mercer *et al*. 2006) who state that "*observational research in British primary schools has shown that the talk which takes place when children are asked to work together is often uncooperative, off-task, inequitable and ultimately unproductive*."

Throughout the activities that were designed for use on the Interactive Whiteboard attempts were made to scaffold the pupils' collective construction of knowledge. The most successful lesson episodes where the most significant collaboration and resultant learning of science took place occurred when there was no clear answer. The pupils enjoyed discussing ambiguous situations, where there was no clear right or wrong response, with each pupil contributing what scientific knowledge they possessed in order to achieve a group generated outcome. For this reason questions should be structured so as to provoke thoughtful outcomes.

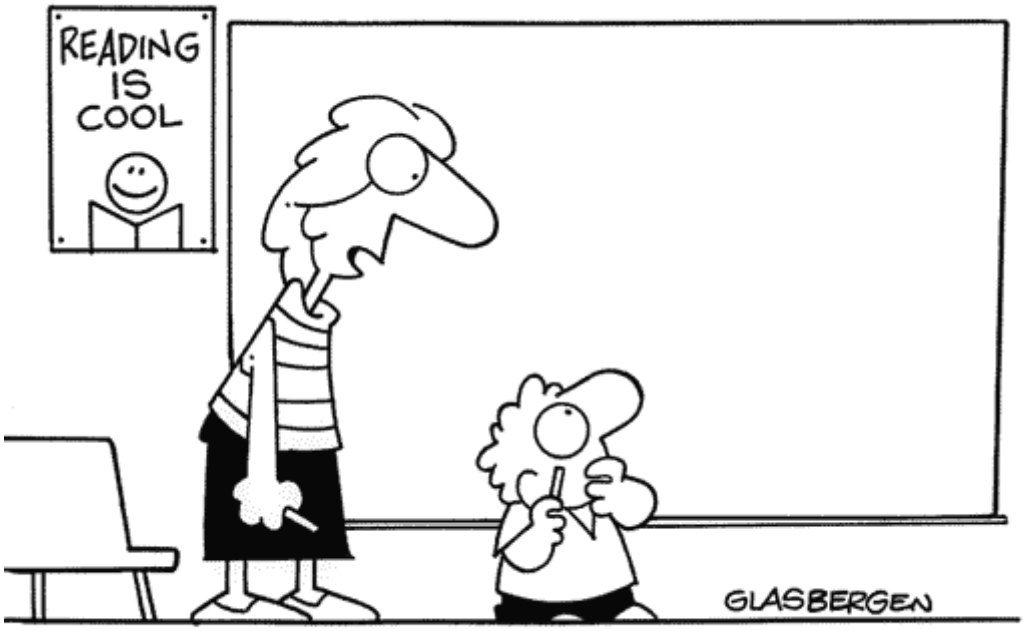
It is essential that all pupils acquire the basic skills required to engage with one another in an exploratory manner. For this reason all pupils must be acutely aware of the nature of exploratory talk and what both good talk and good group work look and sound like. The key characteristics include:

- all relevant information is shared;
- all members of the group are invited to contribute to the discussion;
- opinions and ideas are respected and considered;
- everyone is asked to make their reasons clear;
- challenges and alternatives are made explicit and negotiated;
- the group seeks to reach agreement before taking a decision or acting.

Wall, Higgins & Smith, 2005 state that "*pupils candidly describe their desire to use the board themselves*." This was certainly the case during the lessons filmed as a part of this project, with all three pupils seen to actively engage with their learning in addition to making the most of the opportunities that the Interactive Whiteboard presented.

In closing, Warwick and Kershner, citing Crook (1994) state that "*Pupils collaborate and learn in several different ways 'with', 'through' and 'in relation to' computers*."

also commenting that "*this provides a range of options for pupils' activity, participation and collaboration in the classroom.*" This study has only begun to explore the potential for the use of the Interactive Whiteboard as a tool to stimulate learners in a collaborative context. Further investigation must be completed if we are to answer the question of whether the introduction of Interactive Whiteboards is one of replacement or transformation in the classroom.



"There aren't any icons to click. It's a chalk board."