Catherine

Interactive whiteboards and collaborative pupil learning in primary science.

Introduction

I became involved with this project initially as I am an ICT coordinator and was looking at ways to develop the use of ICT across the curriculum. Working closely with my partner teacher, a science coordinator, we felt that this project would provide us with valuable opportunities to be at the forefront of developments in science and ICT teaching and learning at KS2. I was intrigued by the idea of using the Interactive Whiteboard (IWB) for collaborative group work. Before I became involved in this project I used the IWB mainly as a teaching tool during whole class teaching and only occasionally used it for small groups to play interactive games during maths lessons. I was keen to experiment with using the IWB as a learning tool and as a means of incorporating personalised learning in the classroom in order for the children to take more control of their learning. On a more personal level I found that the filming of the lessons enabled me to analyse both my teaching style and the learning taking place in the classroom.

I was teaching a year 4 class with 29 children in a mainstream Church of England Primary School in a village north of Cambridge. I was filmed teaching 3 lessons; one based on the Solids and Liquids topic and two based on the Habitats topic. I was fortunate enough to teach a very cooperative class of children who were very eager to learn and enjoyed taking on new challenges.

The initial part of the project involved developing the children's ability to work as a group. In order to do this I followed the 'Thinking Together' programme of activities (Dawes, Mercer and Wegerif 2004). The class were split into mixed ability groups of three children. Following the suggestions of the 'Thinking Together' programme, within each group there was a mixture of boys and girls, at least one child could read and write well and friendship groups were avoided. I worked my way through the 'Thinking Together'

activities and was very pleased with results. The children enjoyed working in their 'talk groups' and were very positive when I asked them to evaluate the group work sessions. Most notably they enjoyed working with people that they hadn't worked with before and they liked the opportunities to share ideas with one another. ~~ During each of the 'Thinking Together' tasks, I used photocopied sheets from the book for most of the groups but I set up an identical task on the IWB. I did this for a number of reasons. Firstly, it gave the children an opportunity to familiarise themselves with the IWB software, secondly, it enabled me to see which children worked well at the IWB and helped me decide which group to choose to be filmed. I was quite concerned that having a group working at the IWB would be a distraction to the rest of the class but I was pleasantly surprised to find that the other groups were engrossed in their own work and did not appear to be interested in what was happening at the IWB.

The children had often worked in groups before the project began but I found the 'Thinking Together' programme to be an invaluable resource in developing structured group work. At the end of the programme the children came up with a set of class rules for group work. These were displayed on the classroom wall and a copy was given to each group. During each subsequent group work session, the children were reminded of their rules and at the end of each session the children were asked to evaluate their use of the rules, to think about any rules they found particularly hard to follow and to have this as a focus for the next lesson. I found that this structured approach to group work created a very supportive atmosphere in the class and a safe environment in which pupils felt confident to share their ideas and work together to develop their knowledge. This classroom atmosphere reflects Biott and Easen's (1994) belief that in order to improve collaborative learning, 'it is necessary to create favourable classroom conditions, so that children value working together and have opportunities to give and experience help, support and challenge in their relationships with each other.' In order to develop their collaborative skills even further, the children worked with their talking partners in a range of other subjects including RE, PSHCE, literacy and geography.

The Se group of three children were chosen to take part in all three filmed lessons. This group consisted of two girls and a boy. Both K and S were of higher ability and E was of average ability, for their age group in science with respect to previous science assessments. ~~

The focus for the analysis of the project will be the nature and success of the children's collaboration. I have identified two key episodes in the lessons and this will form the basis of my analysis.

Episode 1

This lesson formed part of the year 4 solids and liquids topic. The theme of the lesson was separating materials and the main focus was on procedural understanding. Each group was given 4 different mixtures and were asked to decide which was the most efficient way of separating the mixtures - either using a sieve or filter paper and a funnel. Once they had made their decisions, the groups then had to try to separate the mixtures using their chosen equipment. They then had to discuss whether they had chosen the most appropriate equipment and give reasons for their choices. The group had to record their decisions on the IWB by dragging the pictures of their chosen equipment into a table. Once they had carried out each separation, they were asked to record on the IWB whether they had made the right decision by putting a tick or a cross on the table.

After the main task the group was given a number of challenges. They had to decide how they could separate a mixture of buttons and sand, sugar and water and a mixture of aluminium cans and iron paper clips. I explained that I didn't necessarily want them to carry out the separation, just suggest ways in which it could be done and also said that they may need equipment that wasn't on their tables.

An equipment table with the mixtures to be separated, sieves and funnels and filter paper, was placed in front of the IWB. The nature of this task meant that the IWB was used more as a recording device rather than a means to generate group discussion. It was clear that most of the discussion took place

around the equipment table and group members only turned to the IWB once a decision had been reached. The episode which I will focus on was taken from the second part of the lesson where the group were discussing how to separate the given mixtures.

It became quite apparent that the two more able children (K and S) in the group were very eager to solve the challenges and come up with solutions. There were a number of occasions where they had a discussion between themselves without explaining their reasons to the third child (E). They would then turn to the E, tell her what they had decided and then expect her to agree with what they thought.

Pilot lesson: 40 minutes 2 seconds.

S: Buttons and sand we should use a sieve yeah?	K and S turn to E at the equipment table.
K: I think you separate buttons and sand with a sieve. What do you think?	
S: The sand won't fit through those holes.	Looking closely at the holes in the filter paper.
K: Neither will the buttons.	The children here are suggesting reasons why the filter paper would not be used to separate buttons and sand as opposed to reasons why the sieve could be used.
S: The buttons won't fit through that or that.	Pointing to sieve and filter paper
S: The sand will fit through that	Pointing to the sieve
K: Yep. We need to clean out the sieve. So do you think the sieve?	S had already picked up the sieve before E was asked whether she agreed.
E: Yep	K records thoughts on the IWB while E and S carry out separation.

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I think that the difference between K and S phraseology when asking questions is quite interesting. In this extract, S said, 'Buttons and sand we should use a sieve, yeah?' He is obviously very clear about what he believes is the most effective way of separating the mixture and is keen for the other group members to agree with him so that he can carry out the separation. S uses 'yeah?' as a question, suggesting that he presumes that the others agree with him and provides little opportunity for others to challenge his ideas. E on the other hand opted for posing a direct question, 'I think you separate buttons and sand with a sieve. What do you think?' She clearly stated her thoughts and then directly asked the other children what they thought. This shows that K and S were both adhering to talk rule number 2, 'We make sure that everyone is asked what they think' ~~ but K was more open to discussion.

S and K continue their conversation by suggesting reasons as to why a sieve should be used to separate buttons and sand. E listens to the reasons but does not suggest any of her own. The final decision is made to use the sieve before E has agreed to it. When S points to the sieve and says, 'The sand will fit through that', having already established that buttons will not fit through the holes in the sieve, it seems that the decision is made to use the sieve to separate the buttons and sand mixture. This decision is not vocalised, nor is there verbal agreement by all group members but the absence of opposition suggests that all children agree. Again, it seems that the decision is made by S and K and they turn to E for confirmation of their agreement thus fulfilling all of the talk rules. All of this discussion took place around the equipment table and group members only went to the IWB to record their thoughts.

The group found it quite a challenge to separate sugar and water and this generated a considerable amount of discussion. This discussion initially took place while gathered around the equipment table but when it became clear that the equipment on the table could not be used to separate the mixture, the group moved over to the IWB. Both S and K used it to draw a diagram to show possible methods of separation.

Pilot lesson: 46 minutes 14 seconds

K: What does it look like? Draw it on the board.	All group members stood at IWB.
S: Sort of like a circle thing. Looking from above. It's got really tiny holes.	S draws on the board. K rubs it out.
K: Draw it from the side.	
S: It actually won't work.	S walks back to equipment table.
K: Wait we can put it outside on a sunny day and the water will dry up and the sugar will be left at the bottom	Draws diagram on IWB. I don't know where she got this idea from, whether she was listening to another group or that she just thought of it.
S: Well it could.	The other children appeared to be convinced by this idea and went to the teacher for reassurance that they were on the right lines.

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S began by drawing a diagram of a contraption with tiny holes to trap the sugar and separate it from the water. K did not agree with his idea and proceeded to rub it out without explaining to the group why she didn't agree. She prompts S to draw it from a different angle but he seems to realise that his idea would not work. K then took the pen and drew a clear diagram on the IWB of the heat from the sun evaporating the water, leaving the sugar on the dish. Once the diagram is drawn, S thought that this could possibly work; he goes to find the teacher for reassurance that their idea is correct. Again, E takes no part in this discussion; she does however take the pen to colour in the diagram on the IWB. This suggests that she is keen to take part in the group activity but does not have any new ideas of her own to offer.

I think this clip shows a number of advantages and disadvantages for the use of the IWB for collaborative group work. Ideas can be shared on the board, all of the group can see clearly and they can be altered or rubbed out at any point. This possibly helps ideas to flow and encourages the children to 'have a

go' without the fear of getting it wrong as, due to the nature of the IWB, mistakes can easily be rectified. Throughout the lesson, however, there were a number of occasions where one child drew or wrote something on the board and another child rubbed it out if they didn't agree rather than explaining why they didn't agree and coming to an agreed decision. Had they been sharing ideas on paper, they may have been a little more reluctant to change their ideas for fear of making a mess.

I think this lesson demonstrated that, through group discussion, the children were able to develop their scientific understanding. I doubt, had the children been asked to do the task individually that they would have achieved as much as they did. Rudd (2007) suggests that, 'The greater the degree of interactivity, the more likely we are to witness practices such as collaborative reflection, reflective scaffolding – characterised by two-way dialogue and active participation – greater opportunities for pupils to influence the direction and content of lessons and more collaborative co-construction of knowledge'. It was clear that, though discussion, the children (in particularly K and S) bounced ideas off each other and developed their knowledge. The children were given ownership of their learning and were at the centre of the learning process. It is hoped that this empowered them to discover for themselves through 'collaborative co-construction of knowledge', and in so doing, gave them a rich sense of achievement.

One may think that E did not benefit from the experience of being in the group due to the fact that she was often on the periphery of discussions. The excerpt below shows a discussion between the teacher and the group about how to separate sugar and water. It appears that having listened to discussions between K and S, E felt confident to answer the teacher's questions and begin to take part in the discussion.

Pilot lesson: 45 minutes 10 seconds

| T: So what do you think you could do? |
| S: Not sure. |

E: Can't put it in a sieve.
T: Why can't you put it in a sieve?
E: Cause otherwise it would be awful for the sugar to come out
S: It's too big
K: The holes are too big
T: The holes are too big still, right.

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Although E understood that the sieve could not be used to separate sugar and water she found it difficult to verbalise her reasoning. At this point she turned to her group members for support to help her explain her reasons. I believe that E did benefit from working in a group, possibly more from peer tutoring that from collaborative knowledge construction.

Episode 2

This lesson was the second of two lessons filmed from the year 4 habitats topic. The lesson task was to create a food chain and to give reasons for the positions of each organism in the food chain. The children were asked to position 8 organisms into two food chains in two different habitats. The group had hyperlinked photos of the organisms on the IWB which took them to a 'fact-file' screen within the document that provided information about the organism (description, habitat). The IWB group had to drag the pictures into the food chain and decide where the habitat was. All of the activity during this lesson took place at the IWB; the group worked through a series of tasks, all of which were explained on the notebook document ~~.

The second part of the lesson was to think of the features of an owl and then design a made up creature that could feed on an owl. This task was quite open-ended and there was no right or wrong answer. This part of the lesson generated the most group talk and the group was engaged for a considerable amount of time.

Lesson 2: 31 minutes 57 seconds.

K: Obviously it'll need wings cos owls have wings	All group members standing at IWB
E: Ooo eagles	E shows her agreement with K by suggesting an animal that has wings.
K: Yeah maybe eagles	Takes pen draws on the board.
S: Well…wait, wait, wait.	Takes rubber and rubs out K's picture of wings
K: It doesn't need to be perfect	
S: I'm not saying that, I'm just saying um that if it's gonna have eagles wings then it's not gonna be very big is it?	S getting a little frustrated.
K: Eagles are big though	
S: They're not, they're not, are they bigger than me? How big are they?	Questioning group members to clarify the reasoning
K: They're bigger than owls. They're wing span is two metres.	Justifying her decisions.

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This excerpt is just one example of numerous discussions during this lesson. Again, K and S seem to control the discussion and E merely agreed with their ideas. There was evidence of S getting frustrated with rash decisions being made without discussion and group agreement. This was also apparent on a number of other occasions during the lesson. This example shows disagreement between K and S and shows how they manage to come to agreement by asking each other questions ~~. It also highlights again, the children rubbing out each other's work without reaching agreement first, a theme that ran throughout the lesson.

The clip below shows the group discussing the body of their creature. S initiates the discussion by asking, 'What could the body be like?' K explains her thoughts to the group but S doesn't seem to listen to her – he is busy

thinking of this own ideas, meanwhile E is poised and ready with the pen waiting to draw the suggestion of the other two children. While K and S are discussing, E draws her own idea on the board which is immediately discounted by the others as a group decision had not been made.

Lesson 2: 37 minutes 8 seconds

S: What could the body be like?	
K: Maybe it could be an elegant body, not a fat body otherwise it won't be able to fly.	Justifying her thoughts with reasons.
S: What about…	
E: But it doesn't have any wings connected to it	Referring to the drawing on IWB (wings not touching tiger face)
S: What about um…a…	
K: Maybe like a frog's body…	
S: Nah, what about	Discounts K's thoughts without asking her to explain her ideas. E takes pen and starts to draw.
S: What are you doing?	
K: That's fat. Let's have a thin body.	
S: Wait…so we could have…stop drawing, we haven't decided yet.	Keen for the group to come to an agreed decision before writing on the IWB.
K: We could have a camouflaged body	

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I found that the children working at the IWB wrote much less than those working on paper. There are a number of possible reasons for this. Firstly, they could have found it difficult to write on the IWB – E complained of not being able to reach the top of the board and a lot of time was spent re-writing words. Could it have been that they were overly concerned with their presentation? As the only group working on the IWB, only their work would be

displayed to the rest of the class and so maybe they purposefully spent more time correcting spellings and perfecting drawings. They spent a long time discussing the features of the creature, drawing it on the IWB and then rubbing it out again. This issue was raised by Warwick and Kershner (2007) who suggested that the public nature of the IWB brought, 'elements of social evaluation into play (e.g. ensuring correct spellings)'. Could the nature of the IWB itself be to blame? All of the other groups in the class were given a pencil to write with. The group at the IWB had a choice of four coloured pens. This may seem trivial but in the eyes of a nine year old it seemed to create huge excitement! The IWB group spent time colouring in their creation whereas the children writing on paper just got on with explaining the reasons for the features of their creatures. In hindsight, this could have easily have been over-come by pre-setting all of the pen colours to black.

One major benefit of using the IWB for this particular lesson that the IWB group required a lot fewer resources compared with the other groups. While it was very time consuming creating the notebook file for this lesson, it seemed that the other groups were swamped with resource sheets and worksheets. Each of the fact-files seen on the IWB had to be reproduced for each group and also a sheet of paper with an explanation of the tasks was needed for each of the three parts of the lesson. Not only was this time consuming to produce, the tables seemed to be swamped with paper. One possible way of overcoming this problem would be to allow the other groups to work on laptops but then this raises the issue of not being able to draw freehand on the laptop. Maybe the laptop could display the fact-files and task explanations and the children recorded their ideas on paper.

This lesson generated a lot of good discussion and it was clear that the children were questioning each other's ideas and giving reasons for their responses. The children were also clarifying each other's understanding, if someone was struggling to explain something, other group members would re-word it using scientific vocabulary.

Conclusion

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The focus of this analysis was the nature and success of the children's collaboration. I think that the excerpts clearly illustrate a significant amount of collaboration between the IWB group members. It is also apparent that the two children of higher ability in the group shared most of the discussion and the child of average ability stayed on the periphery of the discussions. This does not necessarily mean that the K and S gained more from the experience than E. I think that she benefited from the support of her group members and it was clear that she had developed her knowledge and gained some understanding when I questioned her. It would be interesting to see, however, if the nature of the collaboration would have been different if the all of the children in the group were of similar abilities. Maybe E would have had more opportunities to share her ideas and maybe K and S would have stretched and developed their understanding even further.

Vygotsky believed that social interaction between peers and more knowledgeable others was essential in order for children to learn as '…learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers' (Vygotsky 1978). Vygotsky suggested that every learner has a 'Zone of Proximal Development' (ZPD). The ZPD is the distance between what a child can achieve independently (actual developmental level) and what they can achieve when working in collaboration with more knowledgeable others. Vygotsky suggested that tasks should be pitched within the ZPD of the child in order for effective learning to take place. With regard to Vygotsky's (1978) ZPD, could it be that the discussions which took place during the lessons were beyond the ZPD of E? Had she been working with children of similar ability, could she have made more sense of the task and taken a more active role in the discussions?

I think that both of the lessons featured in this analysis produced thoughtful group collaboration and this clearly impacted on the children's learning. I am unsure as to how much of this can be contributed to the use of the IWB rather than to the nature of the tasks themselves. I think that the use of the IWB reduced the reliance on paper resources, enabled the group to share their

thoughts and ideas easily and the novelty value was clearly enjoyed by the children. I don't, however, think that the use of the IWB *per se* led to effective collaborative learning. I think the open-ended, self-discovery nature of the tasks inspired the children to work together to develop their understanding. It may be that these tasks would generate a similar outcome had they been completed on a laptop.

I have very much enjoyed taking part in this project and I particularly liked the child-centred way in which the science lessons have been taught. The teacher input presented a stimulus for the group tasks which provided an opportunity for the children to learn and to discover things for themselves. This form of personalised learning is supported by Rudd (2007) who suggests that teachers need to give, 'greater consideration to learner's needs, placing them at the centre of, and more active in, learning processes and enabling them to have a direct impact on and choices over lesson and curricula content'. Whether the IWB should be at the centre of the personalised learning agenda remains to be seen but I firmly believe that there are significant benefits to promoting collaborative group work throughout the curriculum.

Bibliography

Biott, C and Easen, P (1994) *Collaborative Learning in Staffrooms and Classrooms*. London: David Fulton, 203 -9.

Dawes, L, Mercer, N and Wegerif, R (2000) *Thinking Together.* Questions Publishing Company.

Pollard A (2002) *Readings for Reflective Teaching*. London Continuum

Rudd, T.(2007) *Interactive whiteboards in the classroom*. Futurelab.

Warwick, P and Kershner, R (2007) '*Is there a picture of beyond?' Mind Mapping, ICT and Collaborative learning in Primary Science*. Open University Press. McGraw-Hill International

Vygotsky, L.S. (1978) *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press, 84-90