TALKING COUNTS' PROJECT RESOURCE PACK FOR TALK AND MATHS AT KS1

SECTION 1: INTRODUCTION

This resource pack is the culmination of a research project, Talking Counts, based at the Graduate School of Education, University of Exeter and funded by the Esmee Fairbairn Foundation. The project examined the use of Exploratory Talk in mathematics at Key Stage 1. Teachers involved in the project commented on how the children blossomed in confidence and improved in their mathematics over a relatively short period of time. The ideas, methods and resources used are identified and discussed in this resource pack.

The aim of the project was to investigate how talk could be developed with younger children who did not necessarily attain well in mathematics. The children were often seen as the 'quiet ones' who lacked a secure understanding of the mathematics they were working with. We proposed that encouraging the children to talk about their mathematics would help them to secure that understanding.

There is a current national concern to continue to raise achievement in mathematics and recent policies suggest the need to enhance pupils' conceptual understanding of mathematics and confidence with mathematical ideas (Williams, 2008). There has also been an increased interest in the effective use of talk in the mathematics classroom (Ofsted, 2006; QCA, 2007) and the proposed new primary curriculum suggests that children should work both "individually and collaboratively to explore ideas..." and to "articulate their thinking in discussions" (QCDA, 2010, p.45). Encouraging young children to work in this way requires a different pedagogy and for some teachers this may mean learning new skills in the classroom.



The use of talk in the mathematics classroom has long been seen as important but research shows that much of the discourse still follows the traditional initiation-response-feedback (IRF). One of the main findings from these studies is that it is the teachers who almost always ask questions and that the children answer them. It is also known that, whilst children are seated in groups, they may not always be working collaboratively. Many teachers are aware that children's group talk is not always effective in supporting learning for various reasons such as these:

- The most assertive or confident person making all decisions
- Members of the group ridiculing one another's ideas
- Members of the group listening but not contributing

- The group disagreeing with each other and unable to resolve the conflict
- Disputes about seating arrangements
- Informal, 'playground' talk
- Members of the group blaming one another when things do not go the way they planned
- Individuals deciding to leave the group

Research studies have demonstrated that explicit strategies can be used to teach children how to talk together more effectively (Mercer, Wegerif and Dawes, 1999) and that collaborative talk improves thinking and learning skills generally as well as supporting children's achievement in mathematics (Mercer and Sams, 2006).



Lucy Herring, Countess Wear Community School, Exeter

What is Exploratory Talk?

Several researchers such as Robin Alexander and Robert Fisher have promoted a dialogic approach to education. Our idea is that dialogic education is not just about teaching through dialogue it is *teaching for dialogue*.



One way to support teaching for dialogue is through the notion of Exploratory Talk (ET). Originally talked about by Douglas Barnes in the 1970's, and later promoted by Neil Mercer and his colleagues, Exploratory Talk is where pupils engage critically but constructively with each other's ideas. They may make proposals which can be challenged and counter-challenged, but if so they have to give their reasons and offer alternatives. In defining the effectiveness of talk Neil Mercer has identified different types of talk:

Disputational talk : characterised by disagreement and individualised decision- making: There are a lot of interactions of the 'Yes it is! – No it's not!' kind The atmosphere is competitive rather than co-operative

Cumulative talk: speakers build positively but uncritically on what the other has said:

Everyone simply accepts and agrees with what other people say Children do use talk to share knowledge, but they do so in an uncritical way Children repeat and elaborate each other's ideas, but they don't evaluate them carefully

Exploratory talk: partners engage critically but constructively with each other's ideas: Everyone listens actively People ask questions People share relevant information Ideas may be challenged Reasons are given for challenges Contributions build on what has gone before Everyone is encouraged to contribute Ideas and opinions are treated with respect There is an atmosphere of trust There is a sense of shared purpose The group seeks agreement for joint decisions

(Mercer, 2008)

These ideas formed the basis in our project for developing effective talk within mathematics with young children of mixed abilities. Many of the teachers on the project thought they were doing talk already but soon realised it was not exploratory, the children were not really talking together, discussing, exploring or sharing. As one teacher said:

'I did have talk in the classroom but the children weren't actually talking in a focused way and quite so openly. It was more we would sit down and do this activity, then hands on aspect, then we would move on have a quick talk about it on the carpet together or at the table and then you go away and write about it.'

Mia Harrow, Two Moors Primary School, Tiverton.

What we were asking teachers to do was to reconceptualise the use of speaking and listening that was already common in their classrooms. To support children in being active listeners, listeners of ideas who are able to interpret and ask questions about the ideas. To support children in being active speakers who are able to do more than repeat explanations, children who are able to articulate their own ideas and to give reasons.

.....they're definitely talking about their maths more, rather than just saying it's this answer, they're definitely thinking about what they're doing more and trying to talk about what they're doing.

Gill Stafford, Heathcoat Primary School, Tiverton

SECTION 2: DEVELOPING EXPLORATORY TALK WITH YOUNG CHILDREN IN MATHEMATICS

Research in the UK and Mexico has shown that children can be taught to talk more effectively and that this use of talk raises attainment. Neil Mercer and Lyn Dawes have developed explicit strategies to support children in developing exploratory talk as part of their 'Thinking Together' project. <u>http://thinkingtogether.educ.cam.ac.uk/</u>

These strategies were used as a starting point with the teachers in the 'Talking Counts' project.

this is the talking scarf. no one may speak unless they the the are wearing talking scarf NO TALKING WITHOUT THE TALKING SCARF

It was recognised that we *needed to prepare* children to talk together effectively using the following:

Explicit intentions Raising awareness of talk Direct teaching of basic talk strategies Creating and agreeing a set of 'ground rules' Introducing talk vocabulary

This was done in stages:

Stage 1: Introducing talk

Teachers found that they needed to spend some time in Stage 1 with the children developing speaking and listening activities in order to support the introduction of talk. The number of sessions varied but teachers of younger children or children with less advanced language skills needed more sessions, in some cases more than six sessions were used.

Stage 2: Introducing prompts for good talk

Many teachers saw the term 'Ground Rules' as restrictive and would mean setting up yet another list of 'rules' in the class. Instead teachers looked at using phrases such as 'Prompts for good talk' or 'Good ways of talking'. As suggested by the 'Thinking Together' project teachers found that the best way to develop the prompts was with the children and using the language of the children. Teachers felt the aim was to empower the children and many started with prompts to help children feel comfortable about talking together before asking the children to challenge each other.

Stage 3: Developing the use of talk in mathematics

One of the aims in developing understanding in mathematics is to move beyond the use of facts and skills in routine tasks to developing fluency in using mathematical ideas within *rich* tasks. By rich tasks we mean tasks that are not 'exact repetitions of

exercises that have already been practised' (Cockcroft 1982). Such tasks will have an element of the 'problematic' about them and encourage children to use facts and skills to solve the problems in novel ways. What we are aiming for is for children to work mathematically rather than just doing' mathematics.

Anne Watson has talked about developing tasks in mathematics that help children to 'learn mathematics better'; 'become better at learning mathematics' and 'feel better about learning mathematics' (Watson, 2006).

We have found that the development of collaboration and exploratory talk has helped to achieve these aims. As children collaborate and reason together this has helped them to see mathematics as the 'communication of ideas' rather than the routine manipulation of symbols and procedures. They can test out their application of facts and skills and this helps them to understand the mathematical ideas.

"It's certainly affected their learning, I think they've made a better progress, I think they have a better understanding of mathematical concepts."

Lucy Herring, Countess Wear Community School

Approaching mathematical tasks in this way can mean a 'bumpy ride' for children. There is not a readymade solution for them to follow. Many children are uncertain of how to tackle such tasks independently. We found that children were more able to tackle such tasks when then they worked collaboratively.

'They seem more confident with their number... quite often you get let's follow the pack kind of thing... but they're not, they're very much a case of 'well that's what I think, I will listen to others as well'. And it has become more consistent... they are talking to each other before they give the answers.'

Justin Vernon, Topsham Primary School

Working in this way also increased the children's confidence.



Gail Lowe, Marldon C of E Primary School

In Section 3 we set out the different activities that teachers used at each of these stages but before looking at these you might want to consider the following key findings that the teachers found useful in developing these ideas in their classrooms.

Planning for talk in the classroom

- 1. Grouping the children:
- **a.** Use of trios or 'thinking threes'. Teachers found that the use of trios encouraged the use of ET more than working in pairs. Teachers found that in the trios the quieter children were more empowered. When the talk became stilted there was often one child who came in with a new idea or view to support a discussion. If groups were larger than three the discussion as a group became less manageable and some children were left out. If class is normally organised in groups of six then these can easily be split into two groups of three to support the talk.
- b. Seating arrangements. Teachers experimented with different ways of seating the children to ensure that one child did not feel left outside the group. It seemed to work best if the three children were arranged at the end of a single table, but other arrangements also had some success:



- c. Trio membership. The sessions worked well with mixed ability as well as similar ability. However if the range of ability was too wide then it was found that one child might dominate and solve the problem with limited discussion or that one child might find the mathematics and the ideas inaccessible. Many of the teachers spent some time developing the trios that worked best according to personality as well as ability. The children then learnt these as their 'talk groups' or 'thinking threes' and would move into these groups when required by the teacher.
- 2. Whole class or not: The aim would be to use talk and maths with the whole class to promote a common ethos and way of working in mathematics lessons. Some of the teachers introduced talk in this way from the start. Other teachers introduced talk with a focus group. Both formats worked well and saw successful sessions. With younger children it seemed to be preferable to focus on a group at a time when they were ready (ie following introductory talk activities) with the teacher mediating and adjudicating to prompt the talk. With older children the prompting of talk could be done as a whole class with objective(s) related to talk. The teacher would then intervene at times to monitor and prompt. The objective(s) for talk were then reflected on as part of a plenary.
- 3. When and how often? Teachers in the project used talk sessions in mathematics twice a week as part of their mathematics lessons. The talk activities could be used for a short introductory activity (a quick puzzle as a mental/oral starter for

5-10 mins) or as a longer problem solving activity (20-30 mins). The younger children managed better working on short activities but older children were able to work in groups of three for more sustained periods on problem solving activities. In some classes it was found that the children became used to this way of working and would automatically use talk even though the lesson did not focus on this.

Key ideas to think about:

- The younger the children the more introductory talk sessions they may need.
- Start with short sessions such as 5 minutes and gradually build up to more involved and longer activities.
- Establish activities with simple formats (minimum equipment and minimum recording).
- The same format can be repeated in different contexts so that children focus on the talk and not the organisation of the activity.
- 'Ground rules' or 'prompts for good talk' should be in 'child speak' and reflect the age of the children involved.
- Reinforce the prompts for good talk before each talk session, continue to model good ways of talking during the session and encourage children to reflect on their use of talk.
- Initially focus on one or two aspects of talk. Make these clear to the children and encourage the children to reflect on their use of the focused aspect of talk.
- Involve teaching assistants and other adult helpers in modelling talk and supporting the children's use of talk.

SECTION 3: EXAMPLES OF ACTIVITIES

STAGE 1: INTRODUCING TALK TO YOUNG CHILDREN

A place to start is with speaking and listening. Teachers used many of the activities available to them as part of Speaking and Listening <u>http://nationalstrategies.standards.dcsf.gov.uk/node/84856</u> and Social and Emotional Aspects of Learning (SEAL). <u>http://nationalstrategies.standards.dcsf.gov.uk/primary/publications/banda/seal</u>

Why it is important to listen:

• Class Teacher and Teaching Assistant model good and bad listening.



Modelling with the teaching assistant. Who is going to be the other listener?

- Use of puppet. The puppet is new in school and does not know how to listen. Children to think of rules to give to puppet about good listening
- Teacher thinks of a child in the class, rest of class asks questions to work out who the teacher has thought of. For instance are they a boy, are they a girl, do they have brown hair ... Whoever guesses the right child takes the next turn in thinking of a child in the class.
- Teacher reads the children a story on the carpet (the Gruffalo) and asks them to draw a picture of it based on the description that the teacher read.

Circle games:

- A child is picked by the teacher to go into the middle of a circle. Child says their name and talks about an action they can do (hop on one foot) then does it. Rest of class follows. The teacher then picks someone else.
- Child in middle of circle says their name then says 'I want to swap with' . All the children need to listen to respond quickly.
- Child in middle of circle. Around the circle other children have to say something positive about the child in the middle. At the end the child in the middle needs to recall 3 things said about them and repeats them. Child in the middle then chooses new child to replace then giving a reason why they made that choice.
- Bear and Honey Game. Child (the bear) lying down eyes shut in middle of circle with tambourine (the honey).



Isn't it funny how bears like honey Buzz, buzz, buzz. I wonder why he does Go to sleep little bear, don't you peep little bear

Another child is chosen by teacher to take away the tambourine, child in middle has to guess who took by listening to the sound of tambourine and where it had come from. Once right child picked then becomes bear in the middle with the honey.

Introducing talk with listening:

• Drawing aliens. In trios each child has a picture of an alien (downloaded from Clipart). Children take it in turns to describe their picture to the other two in trio who draw what they hear. They then compare with the picture that speaker has described. How well has the talker described the picture, how well have the children listened? Change over until all aliens are used.



It's got four tentacles on its legs

This can be repeated with pictures of different themes – flowers, houses. Children to talk about the detail (What colour is the door of the house?) and children to listen carefully.

- Sounds game. In trios listen to recorded sounds (skipping, sheep, water running). Children to take turns to say what they think the sound is as the other children listen to ideas.
- 'Chit -Chat' table. Children invited to bring in a toy or something special. They are invited to the table with two friends to talk about why it is special. The friends listen to what they say and ask questions. How does your friend know that you are listening? This can also be modelled with a puppet. How do you know the puppet is listening?

- 'I like/dislike' game. In trios children have pictures of characters, objects such as lettuce, fish, cats, bikes and activities such as colouring in. Ask the children to talk about whether they like or dislike the characters, objects or activities and to say why they like them using the word because. The two friends to say whether they think the same or different and to say why using the word because. Reinforce the idea that it is ok not to like the same thing and to think differently. This can be modelled with a puppet if children feel that this is too personal.
- Fairy tale characters on a sheet of paper (Little Red Riding Hood, Jack and the Beanstalk, Little Red Hen and Puss in Boots). In trios each child in turn has to choose in their head a character. The other children then have to ask a series of questions of this child so as to ascertain which character has been chosen eg Is it a boy? Does he have a hat on? Is it an animal? Questions should have yes or no answer. Not allowed to just ask is it the character.

What is the purpose of talk?

• Introduction by teacher about the purpose of talk, when we talk and why we talk. Why do we talk? Who is a good talker? Teacher displays pictures from Powerpoint .





What is going on in the picture? Why might they need to talk? Children in trios suggest other times when they need to talk.

- Make a class list of talking words (chatting, sharing, explaining, moaning).
- Use of SEAL pictures or download from internet. In trios children look at people/children talking in different situations (people at a birthday party, people meeting each other in the street, children spoken to by their teacher). Children to think about what they may be saying in the pictures. What sort of talk is happening in the picture? Why do they think this? Use the word because.



What sort of talk are they doing?

• What sort of talker are you? Class discussions about talkative people/ quiet people. What do you think you are? Who do you like talking to and why? Is there anyone you don't like talking to?

Beginning talking in trios:

• Speaker, listener and recorder: Use of pictures that provide a scenario. Each child takes a turn in each role with a different picture each time. The speaker describes what is happening in the picture; the listener is active and asks questions; the recorder recalls the discussion and the conclusion to report (can write down conclusion if appropriate). Recorder reports back to rest of the class. Children reflect on who was a good listener, who was a good talker.



What's she doing? Where's she doing it? What is she feeling?

• Drama and role play: Teacher gives scenario such as phoning a friend to make arrangements to meet in the part. On child the talker starts the phone call, second child as the listener and responds to the phone call, third child as observer. Use with other scenarios such as making sandwiches discussing what sort of bread and filling. Reflect with whole class – who has been a good talker, listener?

Asking questions:

• Teacher models asking questions with Teaching Assistant or with puppet.



What can we find out about Tommy's pet rabbit?

- In trios each child talks for one minute on a subject such as pets, TV programs, what did at weekend, the other two ask questions such as 'Why do you like it? Where? When? How? What is your favourite?' then move onto next child.
- As a class make a list of 'good' questions. Identify the vocabulary for asking good questions.

STAGE 2: INTRODUCING PROMPTS FOR GOOD TALK

The aim is to develop the prompts with the children building on the previous activities and the class list of talk words and good questions. In some cases teachers found that the children were slow to come up with good prompts or they focused on rules from the classroom generally (no hitting or shouting) in this case activities were used to support this.

Developing the prompts:

- Children to reflect on which questions they found helpful and encouraged them to talk to each other. How can they help each other to think about their ideas?
- Teacher develops list of prompts based on children's own ideas and uses these to produce a set of cards with a prompt on each card (with some wildcards). Children in trios choose three prompts that they thought were important. The teacher then uses the three favourite prompts from each group to develop the list.
- Children working in trios. Each group has five straws to arrange in as many different ways as they can. Aim for the group is to identify phrases that they use to help each other. Teacher to listen and 'collect' phrases. Use phrases to develop 'Ways of talking as a group'.

Examples of 'Prompts for good talk' or 'Ways of working as a group':

Example 1	Example 2
 Why don't we try this? Do you agree? What do you think we should do? Is that right? How about? I have a different idea What else could we do? So do we all agree? I am not sure can you help me Why do you think that? 	 Everyone must feel comfortable Listen to everyone Have a reason for your answer Ask questions What does everyone think? Look at the person speaking Help each other Everyone must agree Speak clearly
 <u>Example 3</u> I thinkbecauseDo you agree? I am not sure about thiscan you help me? What do you think? 	

Reinforcing the prompts for good talk:

Teachers found it helpful to focus on two or three prompts (or even just one key word or phrase with young children or limited language skills). These focus prompts can be set as learning objectives. Reinforce them at the beginning of the talk group session, model their use during the group work and reflect with the children on their use of these in a plenary.

Displaying prompts for good talk:

Teachers found it more effective to display these as prompts when the children were focusing on the use of talk rather than keeping them on permanent display. This was done in various ways:

• Older children provided with list of the key prompts on the table where they are working. This did not have to be the complete list but could focus on the prompts for that session.

• Teacher models how to use the prompts.



Teacher: I showed you how to use the words Child: You borrowed that one 'Can you help me?' Teacher: Yes, we're allowed to borrow them.

• Display the list on a movable board that is positioned for whole class when focusing on talk or placed next to the children who are working in their 'thinking threes' that day.



- Display on the wall in an area of the classroom that is used for 'thinking and talking' groups.
- With young children have separate cards with the different key words/prompts. The focus prompt were used with the group for them to point to and repeat the phrase. For example the focus prompt for a session might be to use the word 'because' or to use the term 'I agree' or 'I disagree'.



Do you agree or disagree with me?

Agreeing and disagreeing:

Some children saw the terms 'agree' and 'disagree' in an emotive or judgemental way.

- Instead of the terms 'I agree' and 'I disagree' to use the terms 'I feel the same' and 'I feel something different'.
- Model use of phrases 'I am not sure about that', 'I have a different idea so why not try my idea', 'Yours is a really good idea but can we try my idea?'
- Model with Teaching Assistant or with group of children who have managed this well.
- Model disagreement with use of puppet so children can practice the use of phrases in a non-confrontational way.

Taking turns or not:

Taking turns is not always appropriate in Exploratory Talk as it may stop the flow of ideas. However if young children are unused to talking collaboratively then it might be advisable to use this as a strategy in early stages. Once children are more comfortable about talking together the rule of 'taking turns' can be revised to 'giving a chance for everyone to speak'. During the project even the quieter children did find they had the confidence to contribute and the need to take turns did become less important.

Encourage children to reflect on talk and collaboration:



What did you use? And why was it helpful?

Which rules helped? Which ones were difficult? Did your trio work well together? What doesn't make a good member of your trio? (For example children who get distracted.) How to help someone in your group who does not work well? Children can be encouraged to support each other: *'I know you find this difficult but we are here to help you'.* Children to role play support of group members, again this can be modelled with a

Adapt and evolve the rules:

puppet.

'Prompts for good talk' or 'Ways of working in a group' should not remain static. They can be adapted and developed as the children become more established in working collaboratively.

STAGE 3: DEVELOPING THE USE OF TALK IN MATHEMATICS ACTIVITIES

The role of the teacher in using talk in mathematics is key to developing effective talk. The teacher should act as a 'discourse guide' (Mercer and Sams, 2006) and thought needs to be given on when and how to intervene. How to support children to articulate their thinking to each other? How to encourage them to ask each other why and seek agreement? Part of the prompting by the teacher can be to encourage children to use words such as 'if', 'so', 'because'. With young children this can mean the teacher is mediating and adjudicating with one group to model this way of working. With older children the teacher mediation can be less frequent and children can be asked to reflect on their use of key words and questions.

Same and Different: Using the word 'because' (Reception children)



A reception teacher used sorting tasks to help the children

realise 'same' and 'different' and to encourage the use of the word 'because'. In this way the teacher's role was to mediate and adjudicate with the group to model use of talk, to encourage the children to identify 'same' and 'different' and to explain why.

The Toys' Picnic

Eight toys are going on a picnic. They each need a place setting with a cup, bowl and plate. These are different colours – yellow, white and black. Each place setting has to be different.



How are we going to make it different?

Talking about the settings – same or different:

Teacher: Can you find any the same? Child 1: Those Teacher: Tell me why, tell my why. Child 1: Because those have to be two (points to two the bowls and plates that are the same colour) and those have got to be different (points to the cups).

Teacher: What about these two – same or different? Child 2: Different Teacher: Why? Child 2: Cos they are Teacher: What makes them different? Child 3: They've got white and orange plate.

One toy does not have a place setting the children start to put one together:

Teacher: Now we've got yellow plate, black bowl but here we've got yellow plate black bowl, black cup. What cup are we going to put on instead? How are we going to make it different? Child 2 picks up black cup

Teacher: If you use the black cup what will happen? Child 2: It will be the same.

The teacher models reflection of the activity:

Teacher: What did you have to think about? Child 3: They're all different. Child 2: These two are the same and these are different. Child 1: If I put it yellow on there and black on there it would be different.

Teddy Bears' Outfits

The reception teacher repeated the activity in a different context, this time with Teddies' outfits. Each teddy has a different outfit – shorts, T-shirt and hat:



Should the bears be wearing the same or different? Use your word 'because'



T: Why are they the same?Child 1: Because that and that and that. They're two purples, and that is two oranges. That is two purples.T: So what are we going to have to do?Child 2: Swap 'em.



T: Do you think these bears are the same or different?Child 3: Different ok.T: Why do you think they are different?Child 3: Because the trousers aren't the same.

Developing talk through introducing a problem (Year 1 and Year 2)

We found that if the task was too closed (how much is 5p and 10p) then children who just know the answer will complete the task and see no reason to explain to the others. We also found that if the activity repeated a method modelled by the teacher then there was little opportunity for talk. The children used talk more if the task asked them to use their mathematics in a novel way.

One group was given the task of solving word problems following the method the teacher had modelled in identifying key terms. The children worked collaboratively and helped each other to solve the problems but there was little discussion. The teacher then set a word problem that involved two stages. The children had not experienced such a problem before and this is when the discussion started.



Child 1: Oh that's a hard one. Child 2: It's a take away and an add, I think. Child 3: Yes I think we are going to have to add Child 1: How can we do it? Ok 52 takeaway 3 and add ten

Using activities with more than one solution (Year 2 children)

Some teachers felt that to get the best talk you could set tasks that had more than one solution or could be solved in a number of different ways.

Bean Bag and Buckets: (from Mathematical Challenges for Able Pupils in Key Stages 1 and 2 <u>http://nationalstrategies.standards.dcsf.gov.uk/node/85260</u>)

There are 4 buckets with different scores 1,2,3,4. Dan has 3 bean bags. Dan throws each bean bag into a bucket. He is allowed to throw more than one bean bag into each bucket. How many ways can Dan score 6? How many ways can Dan score 9? What other scores can you get? What is the highest score that Dan can get? The children are asked to agree a solution for each question.



Child 1: Right so the highest score at the moment is four, so if you wanted to make six, you would have to throw that in twice, a bean bag in twice, wouldn't you? Child 2: Four and four would be higher

Child 3: Eight, that's three and three, six, so if you wanted to get six what could you throw?



Child 1: You could put two of them in the three score one, well one of them and then another, so you could make six

Child 2: I know a different way to get six, you can get two and then get one then you can get the three (?) 'cos two and one makes three and then add another three makes six

Child 3: I know one, but you might not agree with it, the highest one that you could get, I think you could have four and four

Child 1: But that doesn't make nine, but you could add other scores to that

Checking number bonds - do you agree? (Year 1 and Year 2)

Many of the activities with KS1 children encouraged them to develop beyond simple procedures. The children had some awareness of the procedures used such as strategies for adding or subtraction. However they were not always able to use them accurately in execution. The nature of the tasks often encouraged the children to carry out the strategies with more accuracy or move towards more sophisticated strategies. In several examples children who used count all strategies for addition became more confident in using the addition as facts to solve the problems.

Domino Rectangle Task (Year 1 children)

Children find pairs of dominoes the two adjoining ends add to 6.



Dominoes are then used to make a rectangle where each adjoining pair of ends adds to 6. Children to agree that adjoining ends add to 6. Does the last domino placed also add to 6? If not, how to solve this? This can be repeated where the adjoining ends add to 7.



In one group the children worked together to check they made 6 each time.



Child 1: Do you think that's going to make 6? One and zero? Child 2: No



Child 1: Well get a six then. A six like that.

Magic Square Task (from Nrich website) (Year 2 children)

The traditional Magic Square problem requires that the digits 1 to 9 are placed on a 3x3 grid so that each row, column or diagonal adds to the same number.

To simplify one teacher used the problem using only the digits 1, 2,3 (3 ones, 3 twos and 3 threes) in the squares. Each row, column and diagonal had to add to the same number. This activity can also be found at the Nrich website: <u>http://nrich.maths.org/1819</u>.

Each trio was given a blank grid and digit cards (3 ones, 3 twos and 3 threes). The children were asked to work together to find a solution. Do they agree the solution works? Is there another way of solving the problem?



Child 1: 1 and 2 there. No, that one there and the three there and one there and another 2 there. Child 2: 4 now we need to make 4 Child 1: No we need the one there Child 2: and I'll put a three Child 3: 1, 2, 3 six. That's six Child 2: 1, 2, 3; 3, 1, 2 Child 3: That's six. Are you just making six all the way?

One Big Triangle (from Nrich website) (Year 2 children)

In this activity the children use smaller triangles to make one big triangle so the numbers that touch on the small triangles add to 10. See the full activity at <u>http://nrich.maths.org/192</u>



Do you agree you should count them up to make sure they make ten?



Seven and three is ten. Good work!

The role of talk in testing children's assertions and misconceptions (Year 2 children)

The activities worked best when children had some experience of the concepts, symbols and vocabulary involved. We found that the context of the task and the use of talk, in particular prompting children to agree, led the children to explain what the concepts, symbols and vocabulary actually meant for them. The need to agree on an answer required all the children in the trio to understand how the answer is achieved. Here are two examples of where children were seen to use terms within the classroom mathematics but the use within a problem tested their understanding.

One trio of children had seemed familiar with counting in 5's and would join in class activities but it became apparent that they could not explain why they were counting in fives within a problem.

Ten Houses

This activity is based on one presented by BEAM materials. It asks children to make houses out of 5 sticks:



The children soon realised you could make 2 houses out of 10 sticks and 3 houses out of 15 sticks. The teacher then asked if they were to make 10 houses how many sticks would they need? The children cannot agree if they need 50 sticks or 100 sticks. The teacher intervenes to encourage two of the children to explain why they think it is 50.



First they explain by counting in fives using ten fingers.
Teacher: OK. So why were you counting in 5s?
Child 2: because if you count in 5s it will easily make 50
Teacher: Ok but why are using ten fingers?
Teacher: (to Child 1) Do you know why they counted 10?
Child 1 shakes head
Teacher: No? (to child 2) Can you explain why you used 10 fingers? Why did you count ten lots of five?
Child 2: because we needed to make ten houses



Teacher: Ok ten houses. How many sticks did you need to make one house? Child 2: 5

Teacher: So why are you counting in 5s now

Child 2: because there is 5 sticks in a house

Teacher to Child 1: Is that what you were going to say as well? Cos there's 5 sticks in a house. So are we all agreed that counting in 5 ten times using ten fingers is a good way to work out how many sticks we need.

The Caterpillar task

The same group of children were also tested in their understanding of half when they were working on this problem:

Each caterpillar has a starting number (6, 10, 13).



Starting with this number the rule is: If the number is even halve it, if the number is odd add one. So if start with $6 \rightarrow 3 \rightarrow 4 \rightarrow 2 \rightarrow 1$; if start with $10 \rightarrow 5 \rightarrow 6 \rightarrow 3 \rightarrow 4 \rightarrow 2 \rightarrow 1$; if start with $13 \rightarrow 14 \rightarrow 7 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$. How long are the caterpillars? Why are they different lengths?

Children have blank caterpillars. Using starting numbers up to 20 what is the longest caterpillar you can make? What is the shortest? Children to agree which numbers to try for the start number and explain why.

The children knew the number fact for half of six and half of ten, but then they came to half of eighteen. They could not agree on what this would be. Two of the children think it is seven.



Child 3: I'm not happy about that number, can we talk about it? Child 2: We thought it was seven because if you try to half eighteen it wouldn't be ten because that would be half of twenty, it couldn't be nine because you couldn't do that. It would be seven.



Child 1: You could work it out with your fingers. If you add seven more it is seven add seven.

Child 3 (checks on fingers): It would be fourteen. Teacher (to child 2): What do you think now? Child 2: It would be fourteen.

Matching representations with word problems (Year 2 children)

Children were able to review their understanding of visual representations such as the Empty Number Line (ENL) by matching them to word problems.

First the children working in their trios were presented with the problem:

There were 10 worms in the mud, a boy came and took 4 of them away. How many are left?'

Children in their trios to agree on two different ways they could represent this problem and record the two ways on a white board.

Whiteboards were then shared in the class and children explained why they chose the two representations.

The teacher then asked the children to decide the most efficient representation. Children in trios are presented with a second word problem:

A girl found 2 snails and 6 slugs how many mini beasts did she find altogether? Children in their trio to agree on the most efficient representation and record on their white board.



We could use a dot and a circle. Which one do you think?

Next each trio is given an envelope with 4 different representations on the ENL and 4 different word problems:

There were 10 worms under a stone, a bird took 4 of them away.

20 ants on a leaf, 5 more came along how many altogether

15 flies on a cake, 5 more came along

A ladybird has 4 legs how many legs will 4 ladybirds have.

The children in their trios to agree which representation matches to each word problem.



Child 1: Twenty and five, we need the add one. Child 2: Is it that one? Child 3: We're going to have to read that to make sure it is right.

Finally the teacher gave the children this jotting on the ENL.



In their trios the children were to agree on a word problem that would match the jotting on the number line.



Child 1: There were 24 dolphins swimming in the sea altogether and then...

Child 2: Three more came along...

Child 1: Three more came along, how many is there now?

Some examples of other maths activities used in the project:

Sorting and matching activities (Reception and Year 1)

Lucky Dip: Children in their trios take turns to lucky dip from a bag of assorted objects. As they make a collection of objects the group has to decide how to sort them. Which criteria to use? Could be size, shape or other attributes. As more objects are lucky dipped children to decide if they can add them to a group. Teacher asks why put in that group and children have to explain their choice using 'because'. **Sorting and sequences events:** Children in their trios sort cards of different events (waking up, getting dressed, going to sleep, eating and watching TV...) into order. Some events can occur at different times (such as watching TV) so encourages talk. Children to explain why they have put the cards in that order using the word 'because'.

Ladybird Activity 1 (Year 1)

Teacher models the different ways that 3 spots can be arranged on the two wings on a ladybird. Children to suggest different ways and to check that the total number of dots is always 3. In their trios children find how many ways 4, 5 or 6 spots can be arranged on the two wings. Children to agree that their solutions are correct and to agree that they have found all the possible ways.

Dice Activity (Year 1)

Children in their trios explore the ways that the dots on dice or dominoes are arranged. Why are they arranged in these ways? Which other ways could they be arranged? Would this help you to find the number on the die? Teacher then introduces the need to make a die with numbers 7 to 12 on the faces. How would the children arrange the dots for these numbers? Do some arrangements make it easier to find out the number on the die? Children to agree on an arrangement and explain why they think the arrangement would help to find the number.

Guess my number (Year 1)

In their trios, one child chooses a number (teacher to decide limit – up to 20 or up to 50) and writes it on a post-it note without telling or showing the other two children. The other two children have to ask questions that will have the answer yes or no (such as is it odd? is it less than..?) Children to agree which question to ask and so have to decide what makes a good question. This activity can be led by Class Teacher or Teaching Assistant so that the three children discuss together.

Is it right or wrong (Year 1)

Each trio is given a sheet of paper divided into two columns: one column has a tick and the other column has a cross. Each trio is given an envelope containing set of cards with addition calculations (these can be differentiated) some with correct solutions (6+4=10) but some with incorrect solutions (3+3=7). Children take it in turns to pull out a card. In their trio the children agree whether the solution is correct or not and place in the appropriate column. Children can have materials that they would normally use to support them (cubes, counters, Numicon, number lines...) The activity can be used with different operations.

Domino Worms (Year 1)

In their trios children to arrange dominoes to make 'worms'. The challenge is to use 3, 4, 5... dominoes to make a 'worm' where the total number of dots in the worm adds to 7, 10, 12 ...



Ladybird Activity 2 (Year 1)

The activity can be introduced to the whole class with pictures of the ladybirds cut out to model. In the garden there are two sorts of ladybirds – black ladybirds with red spots and red ladybirds with black spots. The black ladybirds have four red spots and the red ladybirds have seven black spots. If there are two black ladybirds how many spots do they have? If there are two red ladybirds how many spots do they have? If the two black ladybirds and the two red ladybirds landed on the same leaf how many spots would there be altogether? On another leaf there were three ladybirds - one red ladybird and two black ladybirds. How many spots have these ladybirds got altogether?

In trios children are given red and black ladybirds and pictures of leaves. The children are asked to find ladybirds that will add to 16 spots altogether. Children to agree that they have 16 spots. Can they find other ways of making 16 spots? Explain why? Repeat with number of spots totalling 14.

Fill in the blanks (Year 1 and Year 2)

Each trio is given a sheet of paper with an unknown addition and digit cards 1 to 9.



Using the digit cards the children work together to fill in the blanks to make an addition calculation with the correct solution. This can be done using the digit cards only once. How many solutions can you find? The children need to agree that they have found all the solutions and why. Alternatively each trio can be given 10 (or more) cubes and find solutions. This can be varied using the digit cards more than once and can be repeated with other operations. More blanks can be introduced in different formats to explore adding three or more single digit numbers or blanks can be used to represent two digit numbers.

Many of the teachers also found the following resources useful:

Nrich http://nrich.maths.org/public/

BEAM Free resources online (<u>http://www.beam.co.uk/freeresources.php</u> BEAM To buy resources online <u>http://www.beam.co.uk/buyonline.php</u> Mathematical Challenges for Able Pupils in Key Stages 1 and 2 (NB this is not just for able pupils) <u>http://nationalstrategies.standards.dcsf.gov.uk/node/85260</u> Devon Education Services, 'Think Maths' available from <u>http://www.deseducation.org/eshop/search_products.asp?eshop=1</u> Numicon <u>http://www.numicon.com/</u>