THINKING ALOUD TOGETHER

Frank Monaghan discusses his research into collaborative thinking in the primary mathematics classroom.

Thinking Together is a project that began at the Open University in the mid 1990s and grew out of research that showed that children benefit from explicit instruction on how to talk in groups. Its fundamental premise is that the ability to communicate effectively is a key skill that lies at the heart of educational success. A crucial goal arising from this is to enable teachers and children to conceptualise talk as 'thinking aloud with others'.

Thinking Together and mathematics

Rupert Wegerif and Lyn Dawes, two of the *Thinking Together* team, point out that:

> 'Maths is not only a way of thinking inside an individual mind; it is also a kind of language. That is, maths can offer a form of social communication between people. To become fluent in that language, as with any language, children need guidance and opportunities to practice.' (2004: 102)

This principle has guided the work of the project team. Working in collaboration with the SMILE Mathematics Centre, the aim of the project was to develop approaches that would enhance teachers' ability to further their pupils' skills in talking and thinking in the mathematics classroom. This has led to the publication of a set of guidelines, lesson plans and professional development packs for use with a variety of SMILE software at KS2 (Sams *et al.*, 2004).

Group work and effective talk

Group work is central to the endeavour. Collaborative work is generally considered a good thing for students to do. Sadly, however, it is also well known that these good intentions are not always matched in classroom practice, where students may well be found working *in* groups but not *as* groups. What the research and classroom experience of the *Thinking Together* team and teachers has shown is that the key features of effective talk are that:

- everyone is encouraged to contribute
- everyone listens actively
- ideas and opinions are treated with respect
- information is shared
- challenges are welcomed; reasons are required
- contributions build on what has gone before
- alternatives are discussed before decisions are taken
- the groups work towards agreement before an action is taken
- it is possible for participants to change their mind
- discussion is understood to be a way of learning.

Inevitably, these 'truths' are as evident in the breach as in the observance and our research has led to the identification of three types of talk commonly found in the classroom when students are engaged in group work.

Disputational talk

This type of talk is characterised by assertions, disagreement, short exchanges between participants in which there is little evidence of any explicit reasoning. Typical of this sort of talk will be the proliferation of utterances such as, 'That's wrong, it goes there, stupid', 'You're wrong, I'm right, end of story', etc.

Cumulative talk

This type of talk is characterised by self-repetition and elaboration leading to uncritical agreement, again with little evidence of shared meanings being created. It is at least calm and non-aggressive. It often arises when groups are organised on the basis of friendship. Typical utterances would be, 'Okay, well I suppose we might as well . . . '

Exploratory talk

This type of talk occurs when partners engage critically but constructively with each other's ideas. Statements and suggestions are offered for joint consideration. These may be challenged and counter-challenged, but challenges are justified and alternative hypotheses are offered. In exploratory talk, knowledge is made publicly accountable and reasoning is visible in the talk (Wegerif and Mercer, 1997). Typical utterances will be, 'I think x because ...', 'Is there another way of looking at it?'.

Exploratory talk is the most likely to result in the features of effective talk described earlier, but why is it so uncommonly evidenced in group work? The simple answer is that students are rarely explicitly taught how to engage in this kind of talk.

The study

The study (conducted in six primary school classes in London and Milton Keynes) involved the use of SMILE software. We held two training sessions for the teachers to introduce them to the programs and the *Thinking Together* approach and then developed a series of lesson plans in collaboration with them aimed at introducing students to the approach and the mathematics lessons in which it would be applied.

Lesson One: Talking about talk

The aim of this lesson is to help the students learn to talk about talk and so they discuss such questions as:

- Who thinks they are a talkative person?
- Who thinks they are a quiet person?
- Who do you like talking to? Why?
- When are you asked not to talk? Why?
- Why is it really helpful to be able to talk?
- What sort of things can we do by talking together?

They work in groups of three, using a set of cards showing people engaged in various types of talk and are asked for their ideas about what sort of communication is taking place. They practise talking and listening to each other about a topic of their choice and feedback to the whole class. In groups, they discuss a set of words related to talk such as, *decide*, *persuade*, *interrupt*, *discuss*, *listen*, *argue*, *reason*, etc. The lesson ends with a plenary discussion on what makes a good talker and listener and how these skills might be useful.

Lesson Two: Agreeing the ground rules for talk

The lesson begins with an introduction to the idea of 'ground rules' as basic rules everyone can agree to, including in the classroom. They work in groups of three with a set of cards containing potential rules and are asked to decide on four they think are most important and to add a further two of their own. The outcomes are shared and they agree on a single set they will use as a class.

It is interesting to note how well they accord with the features of effective talk identified previously and the rules the students developed in each class were all remarkably similar.

Class 5D Rules for Talk

1. Everyone should have a chance to talk
2. Everyone's ideas should be listened to
3. Each member of the group should be asked
   - What do you think?
   - Why do you think that?
4. Look at and listen to the person talking
5. After discussion, the group should agree on a group idea

Example of a card

Lesson Three: Practising the ground rules

The lesson begins with a plenary in which the children are asked to recall the ground rules they have agreed. The lesson objectives are shared with the students with an emphasis placed on applying the ground rules for talk in a mathematical context. The students then work on a computerised version of magic squares. They do this in groups of three and the teacher's role is to monitor and intervene in their activity, always keeping the focus on using the ground rules for talk. The plenary requires the students to report back on how they solved the problems and how they organised their group work. They are also asked to comment on how well they used the ground rules.

Subsequent lessons follow a similar pattern, starting with a review of the ground rules; an introduction to the objectives (which always include a 'talk' objective) and the activities; group work around the computer; and a plenary to discuss the outcomes. In these lessons, students worked on SMILE activities involving strategy games as they make discussion essential and also allow the students to play against the computer rather than each other, an aspect of the programme that will be discussed in further detail later.

Outcomes

The role of the teacher

Teachers provide a key role in modelling appropriate language and behaviour. In the following extract the teacher models both the sort of language and the conduct that is aimed for:

Extract 1

1 Teacher Anything else I might hear?
2 Students I disagree because.

3 Teacher 'I disagree with you because,' good, well done. Esme?
4 Student 1 Have we got any more ideas to share?
5 Teacher 'Have we got any more ideas?'
6 Maybe they're not the only moves we can do. Maybe there are different ideas?
7 Student 2 Don't think in your head, think aloud.

Another crucial role for the teacher is that of monitor. Moving around the classroom, the teacher is able to observe points at which an intervention would help, as in this extract:

Extract 2

1 Teacher: Can I ask you a question? Did you place your counter in the middle?
2 J,T&C: Yes.
3 Teacher: Brian was the only one of you three who said you should ...
4 Have you changed your idea about that?
5 J: Yes.
6 Teacher: Why?
7 J: Because then you can go anywhere.
8 You can go there, there and there ...
9 Teacher: What do you think Claire?
10 C: If you do it (4,4) you've got more chance. You can do it
11 anyway. You can block the computer too.

The teacher is not only checking their mathematical strategies and ability to justify their reasoning, she is also making explicit the advantages of thinking together. In addition to this sort of direct intervention, teachers have also found other ways to reinforce the ground rules such as attaching post-it notes to the computers so that the children can refer to them during the lesson. This has the positive effect of providing an aide-memoire for students, which has also helped those with challenging behaviour by giving them a structure to work within.

Shaping a reflective community of practice

A further important feature of the approach is the use of the plenary to consider explicitly what happens during the lesson. This allows the teacher to foreground the talk targets and to review how successfully they have featured in the day's work. The following extract is taken from the end of a lesson:

Extract 3

1 Teacher Can you explain to people what you
2 were doing this afternoon G?
3 G: We were going round visiting the
4 people and seeing what we heard.
5 Teacher: Right. So I had four people who
6 were going round and they are going to help me judge whether or not we
7 gave good explanations because they
8 have been gathering evidence all through this afternoon's session.
9 They have been looking for all these phrases to see if we are using them
10 and from the looks of their sheets I think I'm going to have a really big
11 smile on my face the same as every
12 body else. Can you explain what you found out?
13 What sorts of things are we seeing?
14 Those people who have been monitoring?
15 H: 'That would be good because.'
16 Teacher: 'That would be good because'.
17 That's one we didn't even come up with here but which some people
18 were using really effectively to give reasons and back people up. Thank
19 you very much. A, what did you find out?
20 What was the most popular way of giving an explanation?
21 A: 'Because'.
22 Teacher: Simply 'because'. Okay. How many
23 times did you hear that this afternoon?
24 A: Eight times.
25 Teacher: Eight different times in just the
26 groups that you were listening to.

The teacher has handed over a level of control to the students by having them monitor each other's performance and gather evidence of how it conforms to expectations of their role as collaborative thinkers and mathematicians. The message is that the language they use is very important not just in its function as a medium of thought but also in its social function, as seen in her comment: '... give reasons and *back people up*' (lines 18-19, my emphasis).

The students and the computer

A classic feature of classroom talk is the three-part interaction IRF (Initiation, Response, Follow-up). This form of interaction is characterised by teacher control and tends to produce short utterances from students in response, involving little elaboration of their thinking. In the *Thinking Together* approach

we have developed the notion of IDRF around the computer:

- **I**nitiation – by the computer
- **D**iscussion – between the students
- **R**esponse – by the students together
- **F**ollow-up – by the computer

Computers, with their infinite patience, non-judgmental (inter)face and absence of expectations, enable the discussion phase to become a powerful space in which students can talk and think their way to a solution of a problem. The other major advantage is that by setting the students to 'play' against the computer, they have an external opponent, which reduces personal tensions within the group. This leads to some interesting consequences in terms of their view of the computer, which they tend to personify as male, as here:

Extract 4

1	B:	I knew he'd do that.
2	J:	I agree with (3,3) because then you can go there.
3	B:	Exactly. He'll go there.
4	C:	Doesn't really matter.
5	J:	But then we can block him. (3,6) I agree with (3,6).
6	B:	I agree definitely with (3,6).
7	C:	I agree because then you're blocking him all the way down there and then
8		he'll have to start something new.
9	B:	Exactly. And then we can go on with our line. Exactly. I agree.

There are a number of interesting features here. The opening statement, 'I knew he'd do that', positions the computer as a cunning adversary. This pattern occurs repeatedly in the data. In another extract a student commented, 'He does remind me of my computer. A lot.' showing just how intimate a relationship the students establish with the machine.

In the following exchange J and C show few signs of 'inter-thinking' (ie, using their own and each other's exchanges to jointly construct new knowledge) but C's final utterance, in which she sums up the advantages of the (3,6) move, leads to B acknowledging her rationale. Their use of the pronouns 'you' and 'we' emphasise both the individual contributions their partners are making and their collective identity as a team. At this point they are beginning to feel their way into a new discourse community, marked by their evidently 'novice' use of the language forms they have been newly introduced to.

Later in the same transcript there is a good example of the ground rules in action, inter-thinking and a creative use of terminology taken from chess.

Extract 5

1	J:	Wait there.
2	B:	We've checkmated him. Then go there (2,2).
3	J:	I agree with (2,2).
4	C:	Why?
5	B:	Because we checkmated him.
6	J:	Because we'll checkmate him and
7		then he'll have no chance of winning.
8	C:	Oh yeah. Now I'm getting it. (2,2).
9	J:	Then we'll obviously win.
10	C:	No, not obviously.

'Checkmate' is used here to mean block and this linguistic creativity is a common feature in the transcripts, which provide other examples such as 'the two-way trick', which was coined by one of the students to describe the placing of a counter in such a way as to leave a winning line open at two ends, thus ensuring victory. In lines 8 and 10, C indicates that whilst she now understands her partners' reasoning she does not necessarily agree with it. This is a good example of *exploratory talk* (as opposed to *cumulative talk*) as it shows the prime focus is on the development of the reasoning, rather on the maintenance of social relations.

Conclusion

The extracts provide evidence about the contribution that the *Thinking Together* approach can make to students' abilities to articulate their mathematical thinking and make it visible to both their partners and themselves.

Unexpected findings also emerged on the students' conception of the computer as a quasi human agent when engaging in activities and how this can be used to support the students in developing solidarity within their group as they seek to outsmart 'him'. This conceptualisation of the computer as a third thing (neither human nor entirely unhuman) allows the students to avoid the interpersonal tensions that frequently thwart effective group work in classrooms by allowing them to posit the computer as the 'enemy' rather than each other.

Above all, it has also shown how through the explicit teaching and agreement of ground rules for talk teachers can provide a solid basis for effective group work and reflective practice in their students. As Sfard comments (2001: 23), 'putting communication in the heart of mathematics education is likely to change not only the way we teach but also the way we think about learning and about what is being learned'.

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Note

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For a fuller discussion of the findings contained in this paper see: Monaghan, F. (2005) 'Don't think in your head, think aloud: ICT and exploratory talk in the primary mathematics classroom', *Research in Mathematics Education*, Volume 7, pp 83-101.

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