PUPIL-PUPIL TALK WITH YOUNG CHILDREN IN MATHEMATICS

Carol Murphy
University of Waikato
carolmm@waikato.ac.nz

INTRODUCTION

The project, funded by the Esmee Fairbairn Foundation, was carried out in the south-west of England and aimed to develop strategies to support young children (aged 6 to 7 years old) in developing effective talk in small group work. Studies have indicated that in England the traditional initiation-response-feedback (IRF) still dominates in most mathematics classrooms (Kyriacou & Issitt, 2008), and that group work is rarely used strategically (Kutnick, Ota, & Berdondini, 2008; Blatchford, Galton, & Kutnick, 2005). Teachers do not plan for pupil-pupil interactions and pupils have little support in how to interact effectively. Although the children may talk to each other regarding instructions on how to complete a task they often end up working on the mathematics individually. In addition, talk in small groups in England is often directed by the class teacher; this is prevalent in professional development courses using 'Guided Group Work' (DCSF, 2010).

From an alternative perspective, the intention of collaborative group work is for pupils to communicate, share ideas and meanings. Barnes (1976) termed such talk as 'exploratory talk' where children 'sort out their ideas'. Exploratory talk is unrehearsed and may not rely on the use of correct mathematical language. Mercer, Wegerif, and Dawes (1999) further developed the notion of exploratory talk in small groups, where talk is used between pupils as "a way of using language effectively for joint, explicit, collaborative reasoning" (p.97).

Previous research has shown that explicit teaching strategies based on the notion of exploratory talk have supported reasoning in verbal tasks (Rojas-Drummond, Perez, Velez, Gomez, and Mendoza, 2003; Mercer, Wegerif, and Dawes, 1999) and in attainment in mathematics (Mercer and Sams, 2006). These studies have been carried out with older pupils and are causal in nature. Such studies can be seen to treat the pupils as a homogeneous group where they all respond to classroom interventions in the same way Black (2004). They have tended to look at the product of group work, that is, how the talk changed and what the pupils attained. They have not analysed the learning that took place during the small group talk. Other studies have examined how pupils' interactions build on mathematical ideas, for example Sfard and Kieran (2001), but these have not been part of intervention studies.

Little research has been carried out with lower attaining young children and the problems that might be associated with the development of such talk. If it is seen that pupil discussion supports understanding, then this would seem an equitable goal for lower attaining pupils. It would also seem advantageous to work with younger children. An argument is that young children have not yet become part of the school mathematics community and hence have not yet been rooted into traditional classroom practices.

THEORETICAL PERSPECTIVES

The examination of young children's collaborative group work and discourse is related to a social perspective of learning and to neo-Vygotskyan theories of concept formation where language is seen as a mediating tool for learning. Understanding or development of concepts happens within the context of their (the concepts') meaning in the social world. Talk in mathematics from a social perspective suggests that interactions are not windows to see into individual minds (Lerman, 2001) as children explain their mathematics to others but interactions are seen as "discursive contributions that may pull others forward into their increasing participation in mathematical speaking/thinking, in their zones of proximal development" (p. 89).

In identifying children's learning in mathematics, the focus is on children's active engagement with mathematical ideas and objects. Freudenthal (1983) termed mathematical activity as the 'doing' of mathematics in relation to mathematizing where mathematical tools are discovered and organised in their application to problems. Mathematization is further seen as moving within the world of mathematics, involving abstraction from the mathematical tools to an understanding of concepts.

From this definition children are learning to think mathematically by organising mathematical tools and also by abstraction of concepts. Exploratory talk is defined as joint, collaborative reasoning. In introducing strategies for supporting exploratory talk, the aim is to examine whether this promotes pupil-pupil talk and if the talk is seen to hinder or support the children's engagement in mathematics and mathematization.

THE STUDY

The project was based on a design experiment (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003). Twelve teachers participated in the project over two school terms. Two development teachers worked with the research team during the first term to develop strategies to introduce exploratory talk and to trial mathematical tasks. These initial strategies were then disseminated to ten 'transfer' teachers who continued to develop the strategies and trial mathematical tasks over the second term.

Each of the ten 'transfer' teachers was asked to select six focus children and to engage these children in independent group work at least twice a week. This was managed in two smaller groups of three children. Lessons were video-taped in each

class over the term. These video tapes included a focus of one of the triads as they worked on a group task in each of the lessons.

Methodology

Other studies have been causal in nature and, in order to control variables, group tasks have been imposed by the researchers and the teachers may have been given prescribed lesson plans. In this project the interest was in how the use of talk emerged as part of the teachers' classroom practice. The intervention was not seen in a technical way that was separate from the everyday life of the classroom (Carr and Kemmis, 1993). The approach was of a more practical perspective. The researchers worked with the teachers to develop their practice. In this way the project followed an interpretivist methodology in understanding a social phenomenon. The teachers were encouraged to use explicit strategies but not in a prescribed way. They were encouraged to develop and use tasks as they saw appropriate within the context of their classroom. This gave a diversity of approaches that could be used to examine problems and constraints that may have been experienced by the teachers and to identify issues concerning the children's engagement.

Data collection

The teachers were interviewed regarding how their views on how talk had changed in the classrooms and if they felt this had supported the children's learning. Video-tape material from two lessons, one at the beginning of the project and one at the end, were examined and analysed qualitatively. A narrative of each lesson was used to set the context. Then coding of the independent group talk of each triad in both lessons was carried out, using NVivo, in relation to talk about mathematics, talk about managing the task (what to do), and talk about cooperating in a group (who was doing it). The talk was further coded to show whether the children were completing a shared task and if it seemed that the talk gave rise to opportunities for learning (Cobb, 1995).

RESULTS

In this short paper I present a summary of the results of the intervention based on the interviews and the analysis of the video data.

Four teachers had used independent collaborative group work as part of their existing classroom practice. Other teachers had used 'Guided Group Work' but were able to make a distinction between this and the independent group work.

> 'quite often we would do things as a group of six sat around a table, you know, pretty much with me there instigating the talk, you know, sat there in the middle of them.'

The teachers also realised that the children had often been working as individuals even though they were seated in a group. The teachers reported more difficulty in encouraging collaboration where the individual work had been more prevalent.

'...the children adopt a selfish approach to their work. Often they want to show me what they can do they don't want to help other members of the class'

In one class there had been a move away from individual work and 'guided group work' to independent collaboration. In the first lesson the teacher had modelled and directed the children to make two-digit numbers. All talk and explanations were between the teacher and the pupils. The teacher appeared to be checking their understanding. That is, using the talk as a 'window' to their minds. In the second lesson the children were working independently to find number bonds to 10.

Eve: 8 add 2, no we've done that one. We've done 9 add 1

Brenda: Eve, 6 add 4

Eve: That's 4

Brenda: 1, 2, 3, 4, 5...6 It's 4 add 6, 6 and 4

The children are choosing the examples to use and one could say they have more ownership of the mathematics they are doing.

The teachers talked about a positive impact on the children's attainment and also on affect, with improved confidence mentioned frequently. However a review of the coding from the video materials suggests that the proportion of talk focusing on mathematics was often less than half and that this did not appear to change over the two lessons. Other talk on cooperation saw children treating the task as a game with consequent language associated with taking turns. In one class the children were working independently in the first lesson but cooperation and turn taking had dominated their talk.

(Problem: Picture of two baskets with twelve eggs in each, the children were asked to write a calculation to match the picture)

Emma: Ok, you said two

Olwen: That's alright, if you don't want two...

Olwen: Well you think that, Emma don't! You put what you think and then I'll put what you think, then Diane puts what she thinks

In the second lesson talk on cooperation diminished and the children's talk in mathematics showed them attempting to reason their strategy in order to arrive at an agreed solution

(Problem: 'Ten worms were in the mud, a boy came and took four of them. How many were left?')

Olwen: There was ten worms

Emma: There was ten worms, I split them, no you split them, so you can take away like three then take away a two

Olwen: No four, he took four

Emma: I know but you can take away like a three then take away one. Then you'd have 1 2 3 4 5 6

From Freudenthal's definition of mathematization, mathematical tools are discovered and organised in their application to problems. In the first example Eve and Brenda are discovering and organising numbers that add to ten. There is no reasoning for their use but they select their own mathematical tools and apply them. In the second example Olwen and Emma are selecting the tools and applying them but there is no shared use, the children select their own mathematical tools and do not reason why they have used these. In the second lesson Emma is reasoning why her solution is correct. In doing this the children are moving within the world of mathematics.

CONCLUDING REMARKS

Although the teachers had been positive about the children's learning and attitude, pupil-pupil talk in mathematics did not increase and talk that gave rise to learning opportunities did not always increase. However where teachers changed to more independent work the strategies did support the young children in developing ownership, and in selecting and applying the mathematics. Where children were already involved in independent work the strategies helped to decrease talk related to turn taking, to talk that encouraged them to reason why their strategy should be used.

Although often short and infrequent there were instances of children making decisions, having a shared view rather than individual turn taking in a group. This required the children to reason and to move within the world of mathematics.

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