EXPLORATORY TALK WITHIN COLLABORATIVE SMALL GROUPS IN MATHEMATICS

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This report describes one aspect of a wider research study on exploratory talk within collaborative small groups in secondary mathematics lessons. It outlines students' views of using collaborative activity to learn mathematics. The fuller research study explores the extent to which exploratory talk occurs in collaborative peer groups in secondary mathematics classrooms.

INTRODUCTION

The term 'exploratory talk' was first used by Douglas Barnes (1975) in his influential work *From Communication to Curriculum*. Barnes defined a particular type of talk observed between peers in classrooms that he argued was essentially different from the type of language used in interactions with the teacher (Barnes called this 'presentational talk'). Although Barnes' definitions clearly acknowledge a social aspect to learning, his view of learning is Piagetian so that the social arena within which this exploratory talk, and subsequent learning, takes place does not impact on his view of the psychology of the learning process.

The social arena within which learning takes place *does* influence Mercer's (1995) work on exploratory talk. He applies a Vygotskian view of learning in which language is described as a 'social mode of thinking' to his theory-building. Whilst Mercer is clear about the two separate perspectives: psychological (or thinking) and cultural (or communicating), he argues for their inseparability in functional classroom talk. This is based on what he describes as a neo-Vygotskian view of learning in which there is not necessarily a 'more learned other' involved in the discussion. Vygotsky (and followers of his model of learning) suggest that learning occurs when learners of unequal ability interact.

While this model of 'scaffolded' learning is useful, it fails to explain the learning that occurs among peers of equal ability. The theoretical model must therefore be redefined to accommodate such observed situations. Mercer argues that learning in these situations is based on children having to explain and justify their decisions to each other and describes exploratory talk as exhibiting these features. In his analysis of children's talk, Mercer (*ibid*) defines three types of talk:

- **Disputational talk** is talk involving disagreements and individual rather than collective decision-making. Exchanges are usually brief and consist of assertions or counter-assertions.
- **Cumulative talk** represents a building of ideas based on each other's suggestions aimed at providing a common consensus. Exchanges in this type of talk are usually repetitions, confirmations and elaborations

- **Exploratory talk** is characterised by critical but constructive engagement with each other's ideas. Challenges are justified and alternatives suggested. Joint agreement in decision-making is the end result.

(After Mercer, 1995 p104)

Despite such clear definitions, the examples that Mercer uses to illustrate these types of talk are scarce. One of the aims of the research study described in this report is to provide a more comprehensive data set of examples to define exploratory talk and determine whether Mercer's definition is appropriate to the secondary mathematics classroom.

COLLABORATING AND COOPERATING IN MATHEMATICS

For the purposes of this report, a distinction must be made between cooperative and collaborative small group work. For most studies in the literature, it is cooperative groups that are the focus because these are often set up experimentally for the purposes of the study. Damon and Phelps (1989) provide a valid description for the distinction of these two types of group activity:

> *In peer collaboration, a pair of relative novices work together to solve challenging learning tasks that neither could do on their own prior to the collaborative engagement ... Unlike cooperative learning, the children at all times work jointly on the same problem rather than individually on separate components of the problem. This creates an engagement rich in mutual discovery, reciprocal feedback, and frequent sharing of ideas. ... Peer collaboration simulates the challenges of discovery learning; but by providing the learner with a partner in discovery it places these challenges in a context of supportive communication and assistance.* (p 13)

Collaborative groupings occur more naturally in classrooms and are less contrived or constructed. The part of the research project described in this paper examines the views and opinions of students who had experienced collaborative small group work that encouraged exploratory talk as a means of learning mathematics. This was chosen as a focus because the literature provides little evidence about the experiences of students' learning experiences in small groups despite the greatly increased recording and analysis of discourse in mathematics classrooms over the past twenty years. One study, by Mulryan (1994) does involve interviewing students in secondary mathematics classrooms about their experience of working in *co-operative* groups. Mulryan found that the perceptions of high attaining students were more in line with those of their teacher than are those of low attaining students, something that might increase the gap between the higher and lower attaining students.

RESEARCHING STUDENTS' VIEWS OF COLLABORATIVE GROUPS

The research questions used by Mulryan's (*ibid*) were adapted for this study and are based around the following student perceptions:

- perceptions of the purpose and benefits of small group work in mathematics

- perceptions of teacher expectations for appropriate student behaviour during small group work
- perceptions of the characteristics of small groups that are important for successful groups
- perceptions of the extent to which individual and group accountability exist in small groups
- perceptions in relation to the stability of membership of small groups

Additionally, the opportunity was offered for more open comment by students on their experiences of collaborative small group work.

The students interviewed were from a Year 11 (15-16 year olds) low attaining class who had experienced small group collaborative work in mathematics lessons for the previous three years and were currently experiencing a more didactic teaching approach, a Year 10 (14-15 year olds) high attaining class who had experienced small group collaborative work for the previous two years and were currently experiencing a mixed approach of didactic teaching and small group learning, and a Year 8 (12-13 year olds) middle attaining class who had experienced two years of small group collaborative work for mathematics. Further details of the methodology can be found in other papers resulting from this research (see Edwards and Jones 2000, 2001, in press).

ANALYSIS AND FINDINGS

Following transcription of the audio tapes, each student's response was systematically coded for a particular category or categories. These categories were developed in an on-going way as new respondents contributed different categories until there was a stable set of categories. There were 25 grouped categories identified from the interviews. Five of these are exemplified below.

Putting work together/ contributing/ using different skills (described as a process). The relationship between working together as a process and working as a collaborative entity was distinguished in most accounts and across the ability range. For example, R (middle attaining year 8) says "you put all your ideas together, and by putting everyone's ideas together, you come up with good ideas and just get good knowledge". R (low attaining year 11) describes a similar experience, "and even if one person did say yeah this is the right answer, we wouldn't just write it down, you'd, you know, make it more deeper and everybody'd put more to extend the answer ..." and J (high attaining year 10) says "I think it was K came up with one idea once, and then we sort of started working on that and then other people, sort of, put in other ideas on top of it so we were always, sort of, building up ..... so I think its, sort of, all meshed together quite well". L (high attaining year 10) gives this theme as a reason for thinking that learning mathematics in groups is easier: "I feel it is always easier if we work in groups, cos we can, like, all contribute to things, instead of just having to do it on your own".

Friendship/ knowledge of collaborators/ stability of groups.

The degree to which each student knew her collaborators was an important factor affecting their comments about group work. Further probing about changes of group structure revealed that all students believed their performance in a group would be adversely affected by working with others who were not well known to them. Friendship seemed to provide successful working relationships in the view of all those interviewed. V (middle attaining year 8) explains "If you're not friends with somebody, umm, you might not get along with them, and they might start getting into a bit of an argument about the answers, and saying they're right and you're wrong, and you just get into a squabble". In response to a question about working with others in a group, R (low attaining year 11) says "I think we could have, you know, if we spent two or three weeks getting to know the people ... understand what sort of level they are, what they thought, but no others could be as good as working with some friends, its just, you know, we need to build a bit and then it will be OK". However, S (high attaining year 10) is not so confident about this "Even though I think I'd get to know other people better, and eventually you could work with everyone really well, I mean, people get along differently, I mean, you know, I'm not going to get on as well with some people as I might do with my friends,". At a similar ability to R, Z says of her collaborators "Because with them, I always got along anyway, ... we've been together four years ... that's fine" and J (high attaining year 10) says "if you get stuck, ... your friends generally, sort of, are on your wavelength, and so they can help you ... a lot more".

Allows the teacher to gain insights differently.

This theme, identified by J (high attaining year 10), is interesting in that it follows her description of the teacher 'listening in'. She provides some of her own analysis for why this would benefit a teacher. It is further interesting that she chooses an academic role rather than disciplinary role for the teacher: "umm ... I suppose you get a chance to hear us talking, ... I suppose it gives ... just gives you an insight into what we're doing, cos if we were working by ourselves, we wouldn't be talking so working in groups lets you, sort of, listen in". In the light of the previous theme, this comment is important in that it allows the teacher a recognised means into the 'informal' learning process occurring.

Enjoyment/ fun/ like/ interesting.

Despite the focus of the questions asked, the sense of enjoying collaborative group work was evident, and not just as a response to the open-ended question towards the end of the interview. At the highest attainment, S says "I mean it was fun, actually. I liked working with those people, so ...we got on really well,"; at the middle attainment level, V asserts "Its a lot more enjoyable to work in a group" and Z compares her collaborative work with her current situation thus: "we would have had a better time with three of us ... Now I'm on my own, its not good really".

Developing mathematical understanding.

This was a theme identified throughout the interviews though expressed in very different ways at each attainment level. In response to the teacher's purpose for using collaborative work, S (high attaining year 10) says "... it was a mathematical way of thinking about something ... I think that's what you wanted" and L says about the same question "To encourage us to ask about things we don't understand, instead of just worrying about it, always think things out". At the lowest attainment level, R says of collaborative learning "you understand the question better than you would just working by yourself ... because its like that, you get a deeper meaning, you know, you know what you're doing, you don't just skim it over the top, you can go into the question and know what the question's asking from you".

DISCUSSION

In general, there is evidence in the data from this study to support some of the assertions in the literature about the conditions necessary for effective collaborative group work (see, for instance, Damon, 1984). For example, students of high and middle attainment believed that groups should be of similar attainment; the role of helping each other has the effect of reducing the degree to which extremes of intellectual conflict occur, thus improving the effectiveness of the collaboration; knowledge of peers improved confidence to offer solutions and express opinions. However, some of the necessary conditions for effective collaborative group work are challenged: the ideal maximum of four students does not seem to be true for the highest attaining set of interviewees; the reformation of collaboration groups in classes was not a popular option amongst the students interviewed and all felt it would have adverse effects on their learning; the role of the teacher was viewed differently by those interviewed; the recognition of expert skills was viewed not as a deterrent to collaborative work but as a strength.

The data also indicate that there is support amongst students for the view that stable groupings improve collaborative activity and achievement. This supports the findings of Webb and Cullian (1983) and of DeCooke and Nelson-Le Gall (1989). Webb and Cullian argue that "the stability of interactive styles that relate to achievement suggests that once group compositions are established that promote interaction beneficial for achievement (e.g. answering students' questions) such groups may need little monitoring to prevent interactive patterns detrimental to achievement from emerging" (p 421). The evidence from interviews in this study which produce the themes relating to working together, contributing skills, friendship, knowing/ understanding each other, and helping behaviours provides support for such conclusions.

The evidence from this study of pupils' views challenges Mulryan's (*ibid*) findings. She describes high attaining pupils as being more in line with their teachers' perceptions than low attaining pupils. The evidence outlined above suggests that similar views about collaborative small group work are held by students across the full attainment range and that these views are generally consistent with those of their teacher. There is little evidence of differentiation of views on the basis of

attainment. Furthermore, the extent of consistency of pupils' and their teacher's views appears to be related to the length of time students are involved in collaborative group work.

The longer students have experienced collaborative group work, the greater the shared views with the teacher.

CONCLUDING COMMENTS

The differences between this study and that of Mulryan may be due to the differences in the types of group studied, the nature of the tasks undertaken by the students, and the forms of classroom talk taking place. Mulryan's research focused on *cooperative* small groups, whereas those in the study described here are *collaborative*. The evidence from both these studies emphasises the differing nature of the activity in collaborative and cooperative small groups and suggests that any interpretation of the results of research into small group work needs to take account of the type of group work taking place in the study classrooms.

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