Collaborative group work in mathematics: Power relationships and student roles

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Abstract

This paper is a report of work-in-progress on the first stage of an ethnographic study of students' experiences of collaborative learning in secondary mathematics classrooms. One aim of the study was to investigate the interaction of student gender and the social construction of mathematical competence in collaborative learning contexts. Students working in small groups on investigative activities were observed and videotaped, and key informants interviewed. One approach to analysing student-student interactions was to identify the discourses circulating in the classroom and the subject positions taken up by the students. This helped to throw light on some of the ways in which power is exercised within small groups of students working independently of the teacher.

Introduction

In this paper, I analyse and discuss selected data from the first of three planned case studies of collaborative learning in mathematics classrooms. In these studies, I am seeking to understand how students experience learning mathematics in collaborative settings. My principal interest is the social construction of mathematical competence and the ways in which the gender of the student impacts on, and is affected by, this experience. This paper is very much a report of "work-in-progress"-at the time of writing, data collection for the first case study has just been completed.

I use the term collaborative learning to refer to forms of classroom organisation in which students work together, in small groups, on a shared activity and with a common goal. In a review of research on a broad range of forms of cooperative or collaborative learning in secondary mathematics, Suri (1997) reported an overall positive effect both in the cognitive domain and in the social and affective domain. Other writers have also reported positive benefits of collaborative learning (see, for example, Brown, 1994; Damon & Phelps, 1989; Davidson, 1990; Webb & Palincsar, 1996). Partly as a consequence of such research, collaborative methods have been widely recommended in recent years as a strategy to enhance mathematics learning for all students (for example, Australian Education Council, 1991; National Council of Teachers of Mathematics, 1989).

Collaboration in mathematics has, however, been recommended as of particular benefit to girls. Among the reasons given for this are that working collaboratively rather than
competitively suits the preferred learning styles of most girls; girls generally have good communication skills and benefit from and enjoy discussion; small collaborative groups facilitate "connected" learning and support and encourage risk-taking; and collaboration results in a less hierarchical classroom (see e.g., Cordeau, 1995; Jacobs, 1994; Morrow & Morrow, 1996; Solar, 1995). Peterson and Fennema (1985) found that girls tended to achieve better in mathematics in a collaborative environment. More recently, Boaler (1997a; 1997b; 1997c) made a comparative study of two schools with very similar populations, one using an approach based on collaboration and open-ended inquiry, and the other a traditional textbook-based approach. In the first school, girls reported increased confidence and enjoyment of mathematics, whereas girls at the second school reported widespread disaffection, lack of confidence and a feeling that they were not being given a chance to understand.

The study reported here looks in detail at the group process, in order to understand and explain effects such as those described by Boaler. I have chosen to focus on senior students at the stage where they are beginning calculus, because it is around this time that they make key decisions on course selection affecting their post-school options and their future relationship to mathematics. These key decisions are predicated on students' evolving constructions of themselves as learners of mathematics.

The introduction to calculus involves a considerable increase in the complexity and level of abstraction in mathematics, and is a hurdle which many find difficult to jump. Furthermore, whether we like it or not, mathematics courses involving calculus play a "gatekeeper" role in determining access to many higher education courses and a broad range of occupations. This gives them an importance to students' futures far beyond the usefulness of the content.

**Methodology**

An ethnographic approach was adopted in order to observe students working in the natural classroom setting. Most lessons were videotaped to capture the interactions in as much detail as possible, and to allow for repeated viewing for purposes of analysis. Transcripts were prepared, including, as far as possible, descriptions of actions and body language. These were supplemented by field notes made at the time of each lesson. Data collection was carried out over a period of two terms, during which time two units of work on introductory calculus (17 lessons in all) were videotaped.

Interviews were conducted with individual students, with separate groups of boys and girls, with the teacher, and with two senior members of staff of the school. In addition, all students completed a questionnaire at the beginning of the study.

Using a combination of questionnaire results, field notes and discussions with the teacher, four boys and four girls were identified, and became "key informants" for the study. In selecting these students, my aim was to choose individuals who would differ as widely as possible on a number of key constructs: willingness to tackle challenge in mathematics, confidence in their ability to do well in mathematics, and enjoyment of mathematics. Observed behaviour in the classroom was also taken into account. During small group activities, the video camera was trained on a group containing one or more of the key informants, and a remote microphone recorded the group's discussion.

Within the limitations of the space available, I tried to be as unobtrusive as possible in the classroom. I checked with some of the students to find out how they thought the videotaping affected group interaction, and the consensus was that they tended to forget about the camera, most of the time. They said that if the camera made any difference to their
behaviour, it was that "We try to sound a bit more intelligent". This supported what I was able to infer from the videotape record.

Poststructuralist theory

Feminist poststructuralist theory offers a potentially useful approach to understanding the complexity of the classroom I have been observing and answering the kinds of questions I am posing. (Davies, 1994; Jones, 1993; Kenway & Willis, 1993; Kenway & Willis, 1997; Weedon, 1987; Weiner, 1994).

Post-structuralism is a term applied to a very loosely connected set of ideas about meaning, power and identity. It is concerned with the way in which meanings are made, the way they circulate amongst us, the way they are struggled over, the impact they have on our identities and actions. Post-structuralism is particularly interested in the connections between meaning and power. (Kenway & Willis, 1997, p. xix)

According to post-structuralist theory, discourses determine who has the right to speak and be heard, and what can legitimately be said, and what counts as knowledge.

Discourses, according to Foucault, are ways of constituting knowledge, together with the social practices, forms of subjectivity and power relations which inhere in such knowledges and the relations between them. ... The ways in which discourse constitutes the minds and bodies of individuals is always part of a wider network of power relations, often with institutional bases. (Weedon, 1987, p.108)

Multiple, often conflicting, discourses circulate in any classroom, some dominant, others subordinate. These discourses make available to teachers and students a variety of subject positions, some of which are empowering and some not. As students in a classroom struggle to make meaning of the mathematics they are doing, they are at the same time making meaning about what it is to learn mathematics, and constructing their mathematical subjectivities. We can think of students as taking on different roles in the classroom drama. But these roles (or subject positions) are not fixed. They shift and change depending on the context, the other people with whom the student is interacting, and the discourses which are called into play. As Weedon suggests,

The principles of feminist poststructuralism can be applied to all discursive practices as a way of analysing how they are structured, what power relations they produce and reproduce, where there are resistances and where we might look for weak points more open to challenge and transformation." (Weedon, 1987, p. 136)

Poststructuralist theory takes a step beyond the over-simplified, essentialist explanations sometimes offered for gender differences; from any tendency to treat girls as a single group, ignoring differences of social class, ethnicity, language, history and many other contextual factors; and from the tendency to consider all males as oppressors and all females as victims (Weiner, 1994).

Two classroom snapshots

Snapshot 1: Collaborative investigation

Students are scattered around the room in groups of three or four, boys and girls working together on a mathematical task designed to help them develop some of the introductory concepts of calculus. They have not been taught a particular method for solving this
problem, but are drawing on their general knowledge of mathematics and problem-solving, as well as on recent classwork.

The level of background noise is fairly high, as students discuss with one another within their groups, but the level of engagement with the task is also very high. Occasionally, the voice of one student or another stands out, as someone becomes excited about a new idea, or tries to emphasise a point in the discussion, but there is no pattern to this—both male and female voices can be heard speaking confidently, explaining and justifying their assertions. The teacher circulates around the groups, checking progress, and asking questions designed to help the students clarify the problem, and to focus on key aspects which may facilitate breakthroughs. At one point, she is heard to exclaim "Well done!" and students in other groups notice this and remark on it.

The members of one group pause briefly, having reached a resolution of part of the problem, and look around the room. A boy calls out to a friend in a nearby group, "What ho, Stevo, have you got the equation?", and reports back to his colleagues "They haven't even found the equation yet!".

After about twenty minutes, the teacher warns the class to get ready to present reports on their work. Five minutes later, discussion is stopped, and a girl is asked to come to the board and present her group's solution to the first part of the task. This is followed by some questions, both from the other students and from the teacher, which are answered with confidence. Two more students come out and repeat the process, explaining solutions to different parts of the task. When one reporter is unsure how to answer a question she has been asked, she looks towards her group, and one of them is able to help out. The solution to the final part produces considerable disagreement, and a heated whole-class discussion ensues. This continues even after the bell rings, indicating the end of the period, and also the end of the school day. The teacher brings the lesson to a close, promising to come back to this point the next day. Most students pack up their books and go, but a group of girls and boys remain behind for several minutes, still arguing, explaining, and writing or drawing on the blackboard as they attempt to justify their assertions.

Snapshot 2: Teacher-led lesson

Students enter a room in which the tables and chairs are arranged in four straight rows, facing the front. The boys all choose to sit in the front two rows, and the girls sit in the two rows at the back of the room. The teacher writes a list of questions on the board, and the students work on them silently while she moves around, answering questions and giving help.

After about fifteen minutes, a student is asked to write his solution to the first question on the board, and the teacher then asks "What does that mean?". In the discussion that follows, the boys in the front row take a greater part than most of the other students. While others sit with their hands up, waiting to be called on to speak, the boys in front are so close to the teacher that she can easily hear everything they say, and they do not bother to raise their hands. It is easy for them to call out answers to questions, to make comments, or to ask questions of their own. When the teacher ignores them, and asks another student, their comments become louder. Occasionally, the class answer a question in almost in chorus, but the chorus is dominated by the voices of these boys.

More questions are written on the board, and the class return to individual work. There is occasional quiet discussion between neighbours, but mostly the lesson progresses in silence. After a further period of discussion, again dominated by the boys at the front, the
teacher summarises the conclusions they have reached, and writes some notes on the board for the students to copy into their books.

Classroom discourses

Both of the lessons described above involved the same class, and the same teacher. While the majority of lessons in this class take the form of collaborative inquiry, as described in the first snapshot, from time to time the teacher feels it necessary to consolidate the ideas that have been developed through group work, and devotes a lesson, or part of a lesson, to more traditional "teacher-centred" mathematics teaching.

The class participating in the case study was an accelerated Year 10 mathematics class in an independent coeducational high school in a major Australian city. The class was selected for the study because the teacher uses a collaborative inquiry approach in teaching introductory calculus. It was not easy to find teachers who use this kind of approach on a regular basis at this level (Barnes, 1998). The high-stakes end-of school assessment system and the expectations of students, parents and school authorities, constitute a discourse which exerts strong pressure on anyone teaching at this level to conform to conventional "tried and true" teaching methods. The requirement to "cover the syllabus" and leave plenty of time for revision at the end of the course makes it extremely difficult for teachers to adopt an approach which might be seen as innovative or experimental.

Discourses of the school and the education system

For the majority of mathematics teachers in this school (and in most other schools), mathematics is perceived as consisting of an established body of knowledge and techniques, with the teacher as the expert whose job is to transmit these to the students. In this s/he is supported by a "good" textbook, which the students can consult if they miss a lesson or do not understand the teacher's explanations. The authority to define what is acceptable as knowledge lies with the teacher and the textbook. Learning mathematics is seen to be a highly competitive activity, in which the ability to get correct answers quickly is highly valued. Central to one's mathematical identity is performance in tests and examinations which define those who are "good at maths" and those who are not. The message to students is that you learn mathematics best if you listen to and absorb the teacher's explanations, and make sure that you have plenty of practice in solving problems using the methods you have been taught. This is the discourse which Klein (1998) has called "mathematics-as-usual".

Within this discourse, the subject position of "good student" identifies someone who works hard, hands assignments in on time, and sets work out neatly. Understanding is valued, but is seen to be achieved through memory and effort. What really counts is getting the right answer, preferably by the method taught. Another subject position within this discourse is that of "mathematically able student" or the student with "flair" (Walkerdine & Girls and Mathematics Unit, 1989). Such students are able to solve problems quickly, often using non-standard methods. Because of their perceived ability, their breaking or challenging of the rules may be tolerated, or even rewarded. Other positions may be that of "disruptive or uncooperative student", and "weak student" or "slow learner" of whom little is expected, and whose opportunities to learn are consequently restricted.

The discourse of collaborative learning

The teacher in this study has worked hard, and with great success, to introduce to the class a counter-discourse of collaborative learning. Within this discourse, students are constituted as capable of constructing (creating) mathematical knowledge for themselves, as they work
together with their peers to solve complex problems. Storylines include "You learn mathematics best by talking about it with others, sharing ideas and insights" and "Everyone is capable of having good mathematical ideas, so it pays to listen to what each member of the group has to say. Someone who thinks differently from you, or who has different background knowledge, may be able to provide the missing link which will help you to solve your problem".

Certain student roles are part of the discourse of collaborative learning: at the beginning of group work, the teacher will often ask groups to choose someone to be the reader, to read out the question and make sure that everyone understands what is asked, someone to be the recorder, and someone to be ready to report on the group's findings.

Within this discourse, the subject position of "good student" is rather different from that described above. A good student focuses on the task, engages in discussion and tries to reach a consensus. S/he attends to the contributions of other group members, and makes an effort to understand their point of view, and to link it with the views of people. S/he clarifies the group's solution, and is prepared to explain it to the rest of the class. Similarly, the subject position of "uncooperative student" can also be rather different. Within this discourse, a student who chooses to think things out on his (or her) own, and is not interested in communicating ideas and solutions, is as disruptive of the expected class process as one who is noisy or engages in off-task talk.

Other discourses

In addition to these, discourses associated with the peer culture also play a part in the classroom. These include the many and various activities and interests which occupy the students outside the mathematics classroom, the values which they promote, and the ways in which students are defined, or define themselves, through these activities.

A discourse about leadership also plays a significant role in the school. The provision of opportunities for leadership features in the school's promotional literature. Some students in the class have been appointed to leadership positions, which include responsibilities for organising certain student activities. These students have a high profile in the school, and come to be seen as leaders by their peers.

Student positioning in small group work

Students in this classroom, as I have described, are located within a web of intersecting and often conflicting discourses. Each of these provides a range of subject positions which students may take up, but not all positions are available to all students. A close look at some small group discussions may help to reveal some of the ways in which students mobilise the discourses circulating in the classroom to their advantage, and some of the ways in which they are constrained.

The symbols used in the transcripts are explained below:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>--</td>
<td>interruption, including self-interruption</td>
</tr>
<tr>
<td>//</td>
<td>simultaneous speech</td>
</tr>
<tr>
<td>(...)</td>
<td>indecipherable utterance</td>
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Adam

Adam, John and Selena were working on an activity which asked them to interpret graphs of car journeys and find average and instantaneous speeds for different sections of the graph. Adam began by reading out the first question.


The above is a small, but fairly representative, section of the transcript. It shows how, at the start, Adam took charge of the worksheet with the questions and the graph. He read out each question in turn (lines 2, 18), and generally Selena and John answered them, while Adam wrote down the answers. When John and Selena began to speculate about possible reasons for the different speeds (lines 16, 17, 19, 23) which went beyond the questions asked on the sheet, Adam brought them back to the task by reading out the next question (line 18) and persisting with his attempts to answer it (lines 20, 22) until eventually John turned his attention to it (line 24), whereupon Adam asked how to work it out.

A similar pattern continued throughout the episode: the majority of Adam's utterances were either reading out a question from the worksheet, repeating an answer already given by one of the other two as he wrote it down, or asking the others a question: "Do we count that?" "How do we do it?" "What does that mean?" Throughout the interaction, Adam controlled the discussion, determining when the group would move on to the next question, and returning to a previous question if he was not satisfied that he understood how the answer had been obtained.

Within the teacher's discourse of collaborative learning Adam has adopted the roles of both reader and recorder. When interviewed he revealed himself to be less enthusiastic about mathematics and less confident in his mathematical ability than either John or Selena. As he said, "I just find it really hard to stay interested, and stay tuned in class ... often I feel like I don't understand it, much." He greatly prefers group work, "I guess it makes it more interesting, easier to learn. ... If there's something you don't understand ... you can talk to someone else in the group and they can explain to you and then you get back on the right track." By positioning himself as both reader and recorder, Adam helped himself to "stay tuned". As he wrote down each answer, he appeared to be thinking about what he was writing, and asked further questions if he did not understand. At the same time, he was
astutely avoiding having to do much hard thinking—he just asked the questions, and John and Selena answered them.

Adam would not have been able to maintain his dominant role in the interaction without the acquiescence of John and Selena. However, Selena is fairly new to the school and comes from a non-English-speaking background. Although her English is excellent, she has expressed some lack of confidence ("I find I'm not very good at expressing what my thoughts are"). And John, although a good problem solver, and quick to grasp new ideas ("I usually tend to pick up the maths fairly quickly when we're learning it") is not so good at explaining his solutions in writing. Thus the division of roles in this group was convenient for everybody.

There is an additional factor which may have contributed to Adam's controlling position in the group. Adam belongs to the group of boys who sat in the front row during the whole-class lesson described earlier, and dominated the teacher-student interaction. One of the girls, without prompting, described this group as "the louder ones", but I have come to think of them as "the lads". During small group work, from time to time, one of these boys would call out to a mate in another group. Sometimes this was about the work they were doing, "Hey, Martin, what's the formula for ... ?" but more often it was some form of banter or play. If this became too loud, the teacher put a stop to it, but nevertheless the effect was that this group of boys tended to dominate the classroom space more than any other group.

In a group interview, Adam explained, "... even when we do sometimes talk and muck around a bit, we still sort of work through the problems, and so we might not be working as constantly as other groups, but we still get through it." Asked if they thought that some people might be distracted by their "mucking around", the group agreed, "Some do" and one boy added, "But as our marks show, not us."

When a group of girls were interviewed, they described how they experienced the behaviour of these boys during group work:

Girl 1: The guys sometimes tend to think 'it's okay if we don't do our work', cos it's the cool thing not to do our work, and sometimes-- Girls: [murmur of agreement] --the girls do it-- Girl 1: --if you've got two girls, they end up doing it and the boys sit there talking about footy or blokey sorts of things. Girl 2: And occasionally they come in and try to put a few suggestions and then start talking about their stuff again.

The girls were insistent that this applied only to some of the boys, and only some of the time. But these observations point to an assumption on the part of this group of boys that "their stuff" is of interest to everyone, or that their interests are more important. My interpretation of these observations is that Adam and his mates have positioned themselves within a discourse of hegemonic masculinity, in which the predominance of their interests, needs and wants is seen as natural. From this perspective, it would have seemed natural to Adam that he should take control of the group discussion, and use this control to avoid having to do too much thinking.

**Jacqui**

Jacqui is recognised as a leader within the school: she is a House Captain, and has some other responsibilities as well. Discourses associated with leadership have helped to shape her identity within the school—how she perceives herself, and how she is perceived by other people—and these ideas accompany her into the mathematics classroom. Observing Jacqui in a variety of different groups, I noted that she generally played a major, but not dominating, part in the interaction. She was ready with suggestions about how to start a problem, with
questions when she did not understand something, and with answers to others' questions when she did. Her ideas and explanations were sometimes confused, but she always participated fully in the discussion. She showed herself not only to be a good leader, but also, when appropriate, a good follower.

In interview, Jacqui admitted "I enjoy maths, but it's not exactly my favourite subject." She later acknowledged that she felt some responsibility for making sure that everyone in the group understood, "If I understand the problem, and others don't, yeah I'll help them, by leading them, but other times we sort of all try and work it out, either ourselves, or discuss it, or I'll ask for help, or, so at the end of the day, we all understand the problem." On an occasion when other members of her group expressed reluctance to be reporter, Jacqui volunteered to do it. Against this background, it is interesting to study the interactions in one particular group of which Jacqui was a member.

The class had been set, as an investigative activity, the task of finding the turning points of a function. Although the students knew how to find derivatives, and that derivatives can be used to find the gradient of a curve at any point, they had never been taught a method for finding turning points.

At the beginning of the lesson, the teacher assigned students to groups, and while they were moving to their places, began to discuss what she wanted them to do. Robert and John were quickly in place, and began at once to think about the problem. John got out his graphics calculator, and began to use it, and Robert began writing. After a moment, John showed his calculator to Robert, and they spoke quietly together. Meanwhile Jacqui was watching the board, and listening to the teacher. The following transcript includes both whole-class and within-group talk.

1. Teacher: Now, ... I don't want you to use completing the square ... I'm asking you to use consideration of calculus ... First of all, an ideal thing to do would be to do what, with that?  
2. [As she speaks, Robert begins to write, while John watches]  
3. Students:[confused chorus of voices]  
4. Teacher: Sorry?  
5. Student1:(Try and get it into) the f of x form.  
6. Student2:Do the derivative.  
8. Robert: [Finishes writing, sits back, turns to John, and smiles] Found it!  
9. [John changes position to look closely at what Robert has written, pointing at it with his pen. Jacqui is watching the board.]  
10. Students:[unclear]  
11. Teacher: We could, but what we're trying to do is to work out where the turning point is, //of that graph using calculus, rather than using completing the square. 12. John: //You've got to, you've got to sub three and a half into that. Put three and a half into the formula. // [Pulls out his calculator again] 13. Teacher: Okay, you have about fifteen minutes. 14. Jacqui: [Turning to the boys] What's she asking for? I can't remember how to do it. We should try sketching it and see what it looks like. 15. [The boys ignore this remark.] 16. Teacher: Okay, where do you start, what do you do, start thinking about what you should be doing. 17. Robert: [To John] ( ... ) the gradient is going to be zero. [Emphatically]

The interaction between Robert and John began as soon as they were seated in their places. It was mostly silent, involving writing, or entering something on the graphics calculator, and showing it to the other. The teacher did not signal the class to begin work until line 13, and repeated the instruction in line 16. However Robert had already claimed to have found an answer to the first part of the task (line 8) and John had pointed out what was required to complete it (line12).

When Jacqui finally entered the discussion (line 14) she made a suggestion which might have been entirely appropriate in different circumstances, but was totally irrelevant to John
and Robert. They had moved far beyond trying to understand what was being asked, and were absorbed in calculations, and thinking about how to check their result. They ignored Jacqui's comment and she was marginalised within the group.

A little later, Jacqui asked the boys to explain to her what they were doing:


Robert: //the turning point is going to be zero, right, the gradient, so you just find out, whatever--you put in a value, whatever's going to make it zero //and that's negative three and a half. 29. John: //So now I get negative thirty two point seven five. 30. Jacqui: And therefore you can work it out? 31. John: This is stupid, I think I'd better check it. Um, x squared plus seven x plus four. 32. [To Robert] While I'm doing this, you can explain to me how you got four as the y-value. 33. Jacqui: Can you substitute it back in, substitute it back in there? 34. John: That's what I'm suggesting you do. 35. Robert: Yeah you do, you do. You substitute back in. How the hell did I do that once? 36. John: Yes, I was wondering where you got that from. 37. Robert: How the hell did I get four? You sub negative three and a half-- 38. Jacqui: --Do you substitute back into the original equation? 39. Robert: Did you sub negative three and a half? 40. John: Yeah negative three and a half.

The transcript shows that Jacqui asked repeatedly for explanations (lines 25, 30, 33, 38). The boys either gave rather cryptic answers (lines 26, 27, 28, 34, 35), or ignored her completely (lines 31, 32, 39, 40). They were more concerned to find and correct an error they thought they had made in their calculations.

In this discussion, Jacqui was consistently marginalised by these two boys, although on other occasions in different groups, she played a full part in the interaction, and at times positioned herself as group leader.

Talking to John and Robert, I learned that they were close friends, who often worked together. Both were fairly quiet, and John in particular seemed to prefer rather cryptic forms of communication—a few words or a gesture. Because they knew one another well, Robert was able to understand these. Both enjoyed challenging problems, and my interpretation of this incident is that they were much more focused on the problem and finding an answer than on the social context and explaining what they were doing.

Jacqui found herself positioned as an outsider by the two friends, and there was little she could do about it. She tried her usual approaches: suggesting how they might start, and asking questions when she did not understand what they were doing, but these had little effect, because the boys were absorbed in their calculations, and the challenge of resolving an obviously wrong answer. She interpreted their behaviour as competitive, wanting to be first finished, and John confirmed this, saying that he did get pleasure out of being "the first to find the answer". He also perceived Jacqui as slow to understand, which may explain why he made little effort to explain things to her. Robert was simply very focused on getting "the answer" and on keeping up with John "because he does go extremely fast, and it's hard for me to follow. Sometimes I go oh oh oh slow down, John." While Robert at least was aware that Jacqui had been marginalised, he was unaware of the extent of this. His description of the incident ran as follows: "And Jacqui, Jacqui understood that we'd solved it, and she just needed to know how, really. And then when we explained to her, she just went 'oh, fantastic', and then she was able to do it as well." This is Robert's reconstruction. However, there is no evidence on the videotape that such a conversation ever took place.
Discussion

In introducing a collaborative inquiry approach in her mathematics classroom, the teacher, in the words of a senior member of the school executive, is "really fighting a culture". Any students who, from time to time, seek to resist the teacher's approach are able to mobilise the discourse of "mathematics-as-usual" in support. This can be seen in the refusal of some students to value, or even take seriously, any activity which they do not perceive as contributing to their end-of-year mark. It is also to be observed in competition between groups-for example, the competitive attitude revealed by the remark "They haven't even got the equation yet". And it is demonstrated by students like John and Robert who value answers above explanations or justifications.

Furthermore, the teacher feels pressured by her colleagues always to leave the room as she found it, which means that in nearly every lesson time is wasted by the need to arrange the furniture at the start and re-arrange it at the end. It is, in part at least, because of the power of the discourse of mathematics-as-usual that the teacher feels it necessary to conduct whole-class discussion lessons from time to time, to ensure that the students have consolidated the new ideas developed in the inquiry lessons, and that they have some notes and practice exercises to take home.

In the first group interaction discussed, the discourse of collaborative learning was not seriously in conflict with the other discourses brought into play. Adam was able to take on the roles of reader and recorder, allowing him to control the group's discussion; John was able to give advice and tell Adam what to write, from his position as "able student"; and Selena was able to contribute to the discussion and make suggestions about how to interpret the graph, and so begin to shift her positioning from that of outsider and newcomer towards one of competent and knowledgable student. Thus a convergence of discourses served to constrain the positions available to the students in this interaction, but in this case the interests of everybody involved were served.

Jacqui was usually able to position herself as a "good student" within the discourse of collaborative learning, but the boys were marching to a different drummer-the challenge of a problem that interested them, and the desire to find "the answer" as quickly as possible, and not to be bothered with explanation, justification or correct ways of setting out solutions. They were drawing on the discourse of "mathematics-as-usual", and John in particular was claiming the status of an "able student". As a consequence of these conflicting discourses, there was poor communication between the students, and the group process was ineffective.

Jacqui's marginalisation in this case did not seriously affect her construction of her mathematical identity, because she recognised the interaction with John and Robert as belonging to a discourse of competitive achievement, which she rejected, "It's kind of weird because they're like happy to do it all by themselves, and they'll want to be the first to finish it, and they're not really into interacting with the other members of the group." Further, she was able to draw on many other successful interactions, especially those with a group of girls she had worked with, and she sees herself as mathematically competent, capable of making a worthwhile contribution to a group's solution of a problem or their developing understanding of a new mathematical concept.

Conclusions

This project is still in an early stage, and no firm conclusions can be drawn from the present analysis, which deals with a only small subset of the data. However, the work done so far suggests that a feminist poststructuralist approach will be able to provide useful insights into
interactions within collaborative groups, and the ways in which students construct meaning, not only of mathematical content, but of the place of mathematics in society, and of their own relationship to mathematics now and in their futures.

A comparison of the two snapshots suggests that the use of collaborative inquiry approaches in mathematics teaching can do much to decrease the influence of dominant groups of male students on classroom interactions. In the whole-class context, it is easy for one group of students to exert an influence on classroom processes which is out of proportion to their numbers. In the context of the discourses about gender relations in the wider society, this influence may appear to completely natural and to require no correctional action. Yet such a situation may have serious long-term effects for the mathematical learning of other students. For example, domination of the classroom by one group of males may act to decrease the confidence of female students and less-assertive males.

Where a collaborative inquiry approach was used in this classroom, there were still opportunities for dominant males to exercise power, but these appeared to be greatly reduced. The discourse of collaborative learning includes an emphasis on inclusiveness and on valuing different talents and skills. This has potential to help female students, and less assertive male students, position themselves in ways which are empowering for them, and allow them to exercise greater control over their own learning. Further analysis may reveal patterns in student interactions. It is hoped that this will make it possible to identify key features of collaborative learning environments which help to ensure effective group processes, and hence support all students in learning effectively, developing confidence in their mathematical competence, and increasing their enjoyment of mathematics.

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References


