"I'D BE MORE LIKELY TO TALK IN CLASS IF …": SOME STUDENTS' IDEAS ABOUT STRATEGIES TO INCREASE MATHEMATICAL PARTICIPATION IN WHOLE CLASS INTERACTIONS

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Abstract This paper reports on some exploratory research with a single class of students. They were given the opportunity to express their views on a variety of teacher strategies used in whole class interactions. The students' responses highlight that developments in the curriculum which support a more problem-based, exploratory approach would be welcomed, particularly if accompanied by opportunities for sharing ideas. This would reduce the shame, public and private, generated by 'getting it wrong'. Gender and class issues are mentioned but not discussed.

There is considerable interest currently in the UK about the use of whole class teaching in mathematics. This interest has been provoked both by international comparisons (see Jaworski and Phillips 1999) and by government policy (see Brown *et al* 2000). Previously, there appears to have been an identification of this practice with a traditional, expository approach to learning, with discussion only occurring in the context of small group work (cf Groves and Doig 1998). However, some teachers are re-examining their use of whole class interaction, trying to include in the ensuing talk opportunities both for a more personally dialogic response from students and also for a more equitable one.

As a contribution to this debate and concentrating on the affective dimension, we offer the reflections of some school students on their experience of whole class questioning and what they feel would make their mathematics education a more participatory experience for them. Our concern with increased participation stems not simply from a concern with equity but also because of a belief that participation itself is a defining aspect of learning (Lave and Wenger 1991). We note, however, that the value of increasing participation is dependent on just what it is that is being participated in. Research on the different 'classroom traditions' (Cobb *et al* 1992) or 'social practices' (Boaler 1997) that can be found in mathematics classrooms suggests that interactions are not necessarily mathematical. Such research has tended to focus on paradigmatic cases of different types of classrooms. This approach is valuable in highlighting the importance of differences between such types but it is important to recognise the way in which particular classrooms may *share* features of the different 'typical cases'. We believe that the evidence presented in this paper tends to support this view.

Analysis of the student experiences we report here reflects that their experience of secondary school mathematics has been predominantly that of exposition plus

routine practice, within which mathematics essentially consists of questions to which there is a right or wrong answer. However, the students did report experiences of different types of interaction. We are encouraged that the students, in expressing their desire for greater participation, often focused on those aspects of their experience which are more commonly found in 'inquiry' classrooms (Cobb *et al* 1992). In reading about the difficulties that the students report, it is important to keep in mind that some of their comments refer to their experience of secondary mathematics teaching in general rather than to their current experience and also to acknowledge that they valued the teaching they were receiving. Their difficulties are despite this.

We choose to represent here the responses of the students themselves for a number of reasons (cf Angier and Povey 1999). Because we are interested in the affective dimension, it seemed to us sensible to work directly with the insights the students were prepared to share since, phenomenologically, they have privileged access to their own feelings. We wished also to be part of a developing tradition that seeks to listen carefully to what school students have to say, inviting them to contribute to the construction of knowledge about schooling. We share the view that

> … young people are observant, are often capable of analytic and constructive comment, and usually respond well to the responsibility, seriously entrusted to them, of helping to identify aspects of schooling that get in the way of their learning. (Rudduck *et al* 1996, p8)

The context of the research

The research findings presented here arose out of collaborative work undertaken by a student teacher (Peter) and a researcher (Mark) working together to support Peter in developing reflective aspects to his practice. They were focusing on issues to do with mistake making and teacher questioning in whole class situations. Questioning of pupils, either directly using the grammatical form of a question or by other forms of cued elicitation (Edwards and Mercer 1987), is a prevalent feature of whole class mathematics teaching. A particular interest was in exploring and developing alternatives to 'hands up' as a form of answering.

Peter's final teaching practice was in an 11-18 school in a semi-rural area on the edge of a large conurbation. The school has a comprehensive intake with respect to gender and class but is almost exclusively white. Results in external examinations are near national averages. This research reports on the views of a class of twelve-year-olds, a 'top set', consisting of 12 girls and 17 boys. The decision to ask the class about their experience of whole class interaction arose from an initial discussion that occurred during one of Peter's lessons when Mark was present.

Peter introduces the day's topic – revision of formulas for n^{th} term of a series. He asks the class to spend a moment individually thinking about the topic to see what they can remember and invites those that "have some thoughts" to put there hands up. About four or five hands are raised. He then asks the students to discuss in pairs. Nearly all students seem to be involved in this and the discussion seems to be centred on the topic.

He now asks again for people to put their hands up if "they have any ideas". There are now perhaps 6 or 7 hands up. Peter comments that lots more should have something to say, he indicates two girls as an example "you were saying some really interesting things". Looks a little perplexed as to why there were not more hands up. I intervene and refer to the implicit question, that "who has some thoughts" also implies "who wants to say something".

Peter picks this up and asks again for hands up but this time saying he won't ask anybody to share, nearly all put their hands up. He asks the class why the difference. One boy responds, his comments include "people don't want to make a mistake, they might look stupid" (Mark's field notes)

An interesting discussion followed which raised a number of issues and it was decided to continue the dialogue with the class about some of them.

Data collection and interpretation

A number of sources provided data for analysis. The story from the earlier lesson was re-told to the students and responses were invited. Peter devised a short questionnaire, completed individually, that focused on the students' willingness to answer questions in class. The students, working in groups, completed an exercise devised by Mark. This involved them in ranking statements about possible strategies a teacher might use after asking the class a question against three criteria: the frequency in which the situations occurred in mathematics lessons; how nervous they felt in the different situations; and how helpful the different means of responding were to their learning. The reasons for using this instrument were twofold. First, students' behaviour in whole class interactions is socially focused and the intention was to reflect this. Second, Mark and Peter wanted to explore the potentially transformative effect of such discussion in helping to develop a community of mathematical practice (Winbourne and Watson 1998).

The students' responses to these sets of data were collated. The answers to the open question in the questionnaire were analysed initially on the basis of an open-coding of meaning units and these generated some more general themes on the basis of which a summary in the form of a class letter was prepared. The results of the sorting exercise were summarised and compared. Following this, seventeen of the students were interviewed in single gender groups about the class' responses. The data collection as a whole attempted to develop a cycle of interpretation in which the pupils' initial responses were interpreted and then this interpretation was the subject of further discussion and validation by the students. Details of the analysis of the questionnaire are presented elsewhere (Boylan and Lawton 2000): here, drawing principally on data from the interviews, we lay out some of the themes which emerged.

Emergent themes

The nature of the curriculum

Much of the discussion reflected the fact that, in the eyes of the students, most whole class interactions centred on questions to which there was a correct answer, already known to the teacher, which they were also expected already to know. This interpretation of what it means to be asked a question in mathematics infuses the interviews with the students so strongly that it might be difficult to imagine teacher or student conceiving interactions in mathematics classrooms differently. The only alternative apparently considered to the right answer being required is that a wrong answer can be helpful too. Although immediately recognisable by mathematics teacher and mathematics student alike, such an outlook does not, of course, permeate the rest of the curriculum.

- Because if you take RE, there's not like no definite answers for RE questions, like - but in maths there's - most of them are definite answers, so they might not be as confident if they know that, if they get it wrong, then they're definitely wrong, kind of (boy interviewed by Peter)
- In other subjects you get it read out, you take the answers from a book, you have it written down in front of you (girl interviewed by Mark)

When, in the questionnaire, the students were asked to choose the part(s) of the lesson in which they felt most involved, the results suggested that they wanted to move beyond the sort of mathematics curriculum which had dominated their previous experience.

Part of lesson	Boys	Girls	Total
Exercises	4	6	10
Puzzles	11	9	20
Questions	1	0	1
Quizzes	0	1	1
Discussions	9	2	11
Group activities	1	0	1

These responses were explored in the interviews. Both boys and girls were positive about the effect of 'puzzles' on the curriculum. Both groups wanted the puzzles incorporated into the topics they were studying and both made a spontaneous connection between the value of 'puzzles' and the fact that they permitted, and indeed provoked, discussion.

- I think [the puzzles] they've got to - they've got to have some sort of maths in them, and they've got - you want to try and get them more related to - if you're doing like a topic, then try and get them more related to the topic - so you can put a little bit of that in so it'll help them learn …
- Yeah, 'cause that's a bit more exciting and you get to have a bit of investigation

- You want a variety - you want a variety of sort of things - so you don't want straight maths all the time - you want puzzle maths - a bit of discussion in there, so - make it easy to learn and more helpful to learn (boys interviewed by Peter)

- *Did you put 'puzzles' [in the questionnaire]?*
- I think it's mainly because, like, they can have a go at things and if they don't understand it they can, like, confer with other people and ask the teacher
- I think they enjoy it more as well
- It depends which type because, like, if you're doing one subject that you can't really have puzzles on them - so it's, like, better to do questions. But on others - like with sequences - I think it's better to do puzzles on them
- I think it's better to do it on that topic because, if you go onto something else and then you come back to it, you forget all about it (girls interviewed by Peter)

We note two things about these responses. First, the students clearly differentiated between the sort of thinking generated by 'puzzles' and what they saw as the demands of 'questions' in mathematics lessons. At the same time they found it hard to conceive of an approach to learning in which 'puzzling' was the norm and where they were actively engaged in the construction of their knowledge.

- *What would be better would be to try and help you to be able to see questions a bit more like puzzles, where you have to puzzle it out for yourself?*
- I don't understand
- I don't know
- Try and puzzle out things? You mean work things out? (boys interviewed by Mark)

Second, the girls, who had not connected 'discussion' with personal involvement when answering the questionnaire, nevertheless were motivated by the opportunity to 'confer'.

'Discussion' as part of the lesson

Because previous research had indicated that where an opportunity for talk is part of the students' experience it is welcomed (for example, Povey and Boylan 1998), we were initially surprised by the girls' relative lack of enthusiasm for 'discussion' as 'part of the lesson' in their answers to the questionnaire. However, their responses in the interviews offered a different view. Both groups of girls said that they were keen to discuss their mathematics: they were emphatic about this and returned to the assertion several times even when the interviewers intended to move on.

- *If you could imagine your maths teaching to be different, how would you make it different?*
- I think I'd make it more discussions
- I'd make it so you could, like, talk about an answer with your friends and then answer
- Talk about it before you answer (girls interviewed by Peter)
- I think it would be better if we could discuss amongst like, in a little group, and be together instead of on your own because some people just don't know answer (girl interviewed by Mark)

We believe that the girls had interpreted 'discussion', in the questionnaire, as a whole class interactive session with dialogue consisting only of public exchanges between individual students and the teacher, with the desired student response confined to offering right answers. Thus the girls' responses in the questionnaire reveal the way in which the discourse of what counts as a discussion has been constructed in their classrooms. As suggested by earlier research (for example, Boaler 1997), the discussion they valued was exploratory, seeking after shared knowledge. What is perhaps less well documented is that this was also the type of discussion described and valued by the boys.

- I prefer to get it discussed and then see what other people think and then see where they're coming from
- Yeah, 'cause if you discuss it with someone then you know that someone else is thinking along the same lines as you after your discussion
- You're more confident then
- You're more confident
- You've got it right, because more people are thinking (boys discussing with Peter)

- I think it's better to discuss it
- More people answer
- It gives you more ideas so you understand it more fully before you answer
- Another thing is, like, if you discuss, like, if you don't understand it then your friend, like, who you're sat with, knows how you learn and they can, like, explain it in a way that you'd understand it straight away (girls interviewed by Peter)

'Getting it wrong'

What many of the boys and all of the girls talked to us about was the public shame of getting an answer wrong in the question-response-evaluation context in mathematics lessons.

- 'Cos they're, like, kind of embarrassed. If they're - some people are kind of embarrassed if they get it wrong
- If you get it wrong in front of the whole group and you're - when you don't get the right answer then people think that you're totally rubbish at maths
- If you get it wrong, everyone thinks you're not very good (boys interviewed by Peter)

- I think quite a few questions are asked, but people don't like to answer if they get it wrong, 'cause there's quite a few ways you can do things - and there's quite a few answers to quite - to some questions. And they don't like getting it wrong
- I think if you don't know the answer and, like, somebody points at you straight away that makes you feel worse than if you do know it and they ask you
- Well, I wouldn't put my hand up if I thought it was wrong, or I weren't, like, totally certain (girls interviewed by Peter)

This links to the theme of security and vulnerability discussed elsewhere (Boylan and Lawton 2000). What we want to point up here is the debilitating experience, also, of private shame, felt by both boys and girls.

- You could talk to the person sitting next to you, and you and your partner could agree on an answer and then at least if you're getting it wrong someone else is getting wrong as well, so no one can take mick out of just you
- But not everyone takes the mick out of you, some people just feel embarrassed, you might just be feeling bad or something
- You feel sick and tired
- There's no one taking the mick out of them, they're just feeling bad about it (boys interviewed by Mark)
- Kids think of it in a different way because they don't like being wrong. Like most of them think, most of them like being right, but if they put their hand up and get something wrong then they don't like it. Not, like, they don't like other people seeing them get it wrong, but they don't like it themselves, because it makes them feel as though they don't know anything (girl interviewed by Peter)

Unfortunately, there is not room here to discuss two of the gendered aspects of the students' responses. First that of public shame, experienced by girls much more than boys as making participation not worth the risk. Second that of 'shouting out' by some of the boys, experienced by the girls as making participation not worth the battle and as unhelpful by many of the boys (see Zevenbergen 2000 for an important discussion about this issue related to class). Nor is there room to discuss the students' unhappiness with the 'top set' experience and its the associated pace (Boaler 1997; Boaler, Wiliam and Brown 2000) which surfaced strongly despite being outside the researchers' agenda. But both the themes of 'discussion' and of 'getting it wrong', and also these themes to which we only have space to allude, can be seen as representing a desire on the part of the students to have different social practices in the classroom. In turn, the nature of these social practices influences and is influenced by, indeed, in part, constitutes, the nature of the mathematics.

Conclusion

With this class of students, we encountered no opposition to whole class interactive work in itself: indeed, as seen above, group activities *as such* were not experienced as engaging. When given the opportunity to discuss their experience of whole class interactions, the students selected those aspects which allowed them to participate more fully, both socially and mathematically. The students preferences and suggested changes to classroom practice point to a community of mathematical practice which gives time and opportunity for the construction of a more shared knowledge in the mathematics classroom and for a more 'spacious' pedagogy (Angier and Povey 1999).

The students could point to features of their experience that hinted at the possibility of such a pedagogy even if this was in the context of a generally transmissive orientation. This indicates the way in which small changes of practice can begin to create the space for greater participation and for a different pedagogy to be developed even within such an orientation. For example, the idea of discussing with

someone next to you before making a public contribution, considered in the sorting exercise, re-emerged strongly in the interviews. This is a relatively simple practice to arrange in mathematics classrooms. It does not, in itself, make a major change to the epistemology of the classroom but, in a small way, it recognises the legitimacy of mathematical authority for oneself and other learners. These students also say that it means they would be more likely to participate.

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