MATHEMATICS STUDENTS TRYING TO BE DEMOCRATIC

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Abstract: *After recording grade 6 students doing group work in mathematics class, we interviewed them to ask how they resolved conflicts. Every group told us that they voted, but we knew from the recordings that no group voted. Some groups told us that they took turns talking. Again, we knew better. However, when pressed the students told us that they stood up for their ideas. We knew from the recordings that they had done so. The difference between the students' apparent ideal practices and their actual practice prompted our reflection on the role of mathematics in democratic society, and on the pedagogical implications. Knowing mathematics is not enough. Democratic society depends on its people using mathematics in public discourse.*

43	Researcher:	When there are lots of ideas being said in a group how do you decide which one to listen to?
44	Nathan:	You vote.

When we asked a group of grade 6 boys how they decided whose ideas to listen to in their mathematics group work, they said they voted. But their story changed when pressed. In this paper we draw parallels between our conversations about authority with mathematics students and teachers. In particular, we look for alignment and differences between what students said about how authority worked in their group work and our observations of their group practices captured in audio recordings.

AUTHORITY IN MATHEMATICS CLASSROOMS

Authority is one of many resources teachers employ for control and has been defined in an educational context as "a social relationship in which some people are granted the legitimacy to lead and others agree to follow" (Pace & Hemmings, 2007, p. 6). This relationship is highly negotiable. Amit and Fried (2005), in their analysis of mathematics classroom interactions, noted that students rely on a web of authority relations with friends and family members as well as with the teacher.

Educational research related to teacher authority often makes distinctions between different types of authority (e.g. Amit and Fried, 2005; Pace and Hemmings, 2007). The distinction made between being an authority because of one's content knowledge and being an authority because of one's position (e.g., Skemp, 1979) is important—teachers are "an authority [of content] in authority [by virtue of position]" (Russell, 1983, p.30). Skemp noted that when authority is gained by position, authority is imposed: the teacher commands, students obey, and instructions are perceived as orders. In contrast, authority by knowledge involves being more like a "mentor." The authority is vested by virtue of the person's own knowledge; instruction is sought and is perceived as advice. Rival and conflicting values complicate authority relations because they are socially constructed in the service of a moral order (Pace & Hemmings, 2006). Moral order, in this case, was defined as "shared norms, values, and purposes" (p. 21).

Regardless of what kind of authority seems to be at play, Wilson and Lloyd (2000) contended that teachers need to develop an internal sense of authority, or a sense of agency, rather than rely on external forces in order to develop their own "pedagogical authority." Wilson and Lloyd made a parallel argument for how teachers help students develop their own sense of mathematical authority. That is, the same kind of reliance on internal authority can help students learn mathematics with meaning. As Schoenfeld (1992) pointed out, however, the development of internal authority is rare in students, who have "little idea, much less confidence, that they can serve as arbiters of mathematical correctness, either individually or collectively" (p. 62).

Povey (1997) advocated for promoting in students a sense of authority that relates to authorship, by splitting the word to highlight its root—author/ity: *author* and *authority* linked together "lead to the construction of an epistemology which recognizes each of us as the originator of knowledge" (p. 332).

DEMOCRACY AND MATHEMATICS

We believe that the kind of authority (author/ity) promoted by Povey (1997) is necessary for citizenship in a democracy. Jackson (1968) described the kind of student and citizen who emerges from the alternative: "He learns to be passive and to acquiesce to the network of rules, regulations, and routines in which he is embedded" (p. 9). Jackson argued that "The [student] must develop the habit of challenging authority and of questioning the value of tradition" (p. 9).

Mathematics, in particular, is a powerful tool for challenging authority. Ernest (2009) pointed to the sense that logic can trump authority: "In principle, mathematics is a highly democratic rational discipline in which knowledge is accepted or rejected on the basis of logic, not authority" (p. 59). Mathematics as a trump card is especially important because, as Porter (1995) pointed out, bureaucrats in democracies have developed skill with obscuring their decisions by justifying their initiatives using mathematics: "Quantification is a way of making decisions without seeming to decide. Objectivity lends authority to officials who have very little of their own" (p. 8). This is not a criticism of bureaucrats for, as Porter (1995) noted, "The appeal of numbers is especially compelling to bureaucratic officials who lack the mandate of a popular election, or divine right. Arbitrariness and bias are the most usual grounds upon which such officials are criticized" (p. 8). Rather, the recognition that democratic society is permeated with numbers compels us to promote author/ity for mathematics students. Knowing mathematical skills is note enough; students need a sense of the role of mathematics in democratic society, and of their potential to contribute to democratic discourse with their mathematical practices.

RESEARCH CONTEXT AND METHOD

Our conversations with students and teachers discussed in this paper are part of three years of engagement with teachers in Atlantic Canada who had expressed interest in attending to the way authority works in their mathematics classrooms. After interviewing each teacher at the outset, we recorded fifteen consecutive sessions of a mathematics class each chose for this recording. The group of teachers met with us approximately once every six weeks over the course of the research. Further recording was done in their classes when they wanted to try new things related to authority. In addition to video recording, we used voice recorders to capture more local audio of group work for selected class sessions. We also interviewed the participant teachers periodically and sometimes interviewed students in the classes that were recorded.

Our interviews with students described below were part of a grade 6 class in the second year of the research. Their teacher, Jill (names of participants are pseudonyms), wanted to record group work so we placed voice recorders at each group of desks while students engaged with tasks that had them working with tables of values and looking for patterns. We recorded group work for two consecutive days. About a week later, we interviewed selected groups. Each interview started with us playing for the group an excerpt from the audio recording of their work together. After this we asked a question relating to the mathematics they had done in the excerpted audio. From this we asked questions about how they made decisions. These were our root questions:

> How do you know whose idea to listen to and use?
> How do you decide who writes?
> Is it important to hear all the group members' ideas?
> If you are not understanding something, how do you decide who to ask for help?
> How do you know you are done with a problem?

The conversations with teachers, which, in our presentation and elaborated paper, we will compare to the student interviews come from our initial interviews with them. We have described aspects of these teacher interviews in Herbel-Eisenmann & Wagner (2009).

STUDENTS TALKING ABOUT AUTHORITY

When we interviewed Jill's students to ask them about their group work, ideas relating to democracy were part of each group's answers—for example, the excerpt involving Nathan, with which we introduced this paper. However, in each case the democratic practices they described had not actually been followed in their group work. Perhaps they described these democratic practices because they thought they would be good practices in such interpersonal interaction.

In the excerpt below, the four boys had just told us that they vote when there are multiple ideas to choose from. We questioned them on this because we knew they had not voted, but Nathan and his group-mates maintained their claim that they had voted. The following interaction countered this claim (R_1 and R_2 refer to us as researchers.):

61	R_1	What if [the vote is] three to one? So it's three to one, and Kevin you're the one. You say, "It's three to one so I'll just forget about it"?
62	Kevin	Yeah.
63	R_1	Yeah.
64	R_2	What if you think you're right though? What would you do?
65	Kevin	Um.
66	R_2	Let them put the wrong number down? Or would you say something?
67	Kevin	I'd say something.
68	R_1	Would you all say something if you thought you were right?
69	Connor	Yeah, try to convince them.
70	Chet	I would say, "This was my idea…"

We knew from listening to the recordings that this was true; these students had been working to convince each other of their ideas in the group work.

Another democratic principle claimed by three of the four groups was turn-taking. (Turn-taking is democratic because it has the potential for every voice to be heard.)

31	R_1	When you're working in groups there're lots of ideas. How do you know whose idea to listen to?
32	Brittney	We take turns.
33	R_1	You take turns. Were you taking turns or are you just saying that would be a good idea?
34	Brittney	Uh, that would be a good idea.

Although Jill's students valued some democratic principles—listening to each other and sharing power—they did not seem to have a sense of how mathematics might make a unique contribution to democracy (e.g. how logic can trump authority, cf. Ernest, 2009).

We do not think the students were trying to deceive us in any way. Rather, there seemed to be a blurry line between describing their practice and describing their idealized practice. This blurry line seemed to be further complicated because they had not thought much about their formulation of the ideal. When asked about power in their group work they resorted to the only system they valued for dealing with power—that is democracy.

REFLECTIONS

There are often differences between one's conception of one's actions and one's actual practice. In action research this is referred to as a "performance gap." In our interviews with mathematics students and teachers they seemed to like thinking of their practices as being more democratic than they actually were. We wonder what this means for teachers and teacher educators.

When there is a performance gap, the ideal practice may be better or worse than the actual practice. In the classroom described above, we think it is good that the students did not vote to decide which mathematical answer is correct. We also think that structured turn-taking would be counterproductive, though it would be valuable to listen to every group member when they had something to say.

The democracy performance gap suggests to us the necessity for explicit discussion in mathematics class about mathematics and democracy. Which democratic practices make sense in mathematics and which do not? Such discussion can make clear how democracy can be served with some deference to logic in discourse that precedes or critiques decision-making. Power relations, whether they are autocratic or democratic, can be challenged with clearly articulated arguments. Kevin, in the interview above, knew he would argue for his idea even when he was in the minority (losing the 'democratic' vote, albeit a fictional vote in this case). This kind of author/ity is important in democracy. Nevertheless, as Povey (1997) recognized, even logic or ideas about rationality warrant critique from students who carry author/ity.

Knowing mathematics is not enough. Democratic society depends on its people using mathematics in public discourse.

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