SPEAKING WITH AUTHORITY IN EPISODES OF MATHEMATICAL DISCOURSE

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In this paper we employ three interpretations of the ZPD to frame an analysis of episodes of teaching and learning in a year 7 mathematics classroom. The analysis is concerned with the way authority is constituted locally by the teacher and students within the norms of Collective Argumentation. In traditional classrooms, authority is assumed to reside in the teacher and texts whereas in Collective Argumentation, authority is attained through discourse practices that privilege socio-mathematical norms such as meaningfulness, communicability, and testability. We show how students in the classroom speak with unusual authority as they communicate and negotiate their claims.

INTRODUCTION

The zone of proximal development (ZPD) can be interpreted from three different but interrelated viewpoints. First, the ZPD can be characterised as the distance between a problem-solver's actual ability exhibited when working alone, and the problem-solver's potential ability shown during collaboration with a more-experienced other. With regard to the notion of authority, scaffolding tends to highlight a one-way transfer of expertise and status from the expert to the novice. Novices are assumed to gain authority as their practices match those of the established experts. Recent reformulations of scaffolding, however, have foregrounded the contribution of the novice alongside that of the expert in creating the ZPD, so that it is seen now as a co-constructed space where issues such as independence/dependence, leading/following, authority/compliance are negotiated by partners, and where the learning outcomes are neither totally predictable nor constrained by the predetermined goals of the expert (see Renshaw,1998).

Second, a "cultural knowledge" interpretation of the ZPD is based on Vygotsky's argument that mature concepts develop in educational institutions and communities through interweaving 'scientific' (mathematical) understandings with students' everyday understandings and experiences. This interpretation formulates the ZPD as being the distance between the cultural knowledge provided by an instructional context and the everyday knowledge and experience of a learner. With regard to the issue of authority, the institutional context of schools and classrooms where such interweaving of concepts typically occurs, provides powerful messages to both teachers and students about their respective roles. The ideal student is constructed most often as a receptive, attentive and respectful learner who is willing to follow teacher directions and complete assigned tasks to the teacher's satisfaction. The ideal teacher is constructed most often as a benign classroom leader who can transmit cultural concepts using efficient and effective methods. Here authority resides in the teacher on two levels, first in his/her role as classroom leader, and in the disciplinary knowledge that he/she is assumed to possess. To move beyond these perceived ideals can be difficult because teachers and students need to learn new ways to distribute authority more symmetrically in the classroom and school.

A third interpretation of the ZPD takes a "societal" or "communal" perspective. Following the work of authors such as Lave and Wenger (1991) this interpretation of the ZPD focuses on processes of social transformation rather than social transmission, and extends the notion of learning beyond the context of scaffolding and the local classroom, to include a consideration of the nature of pedagogy in relation to broader social, cultural, and economic factors. In this interpretation of the ZPD, authority is revealed in the social patterns of participation and influence that different individuals and groups achieve within an

institutional setting such as a classroom. These local patterns of influence and privilege are not regarded as merely random and incidental but as revealing social and cultural distributions of power. A recent example of this type of analysis can be found in Gee's critique of collaborative classrooms in relation to "new fast capitalist" discourses (Gee, Hull & Lankshear,1998).

In this paper, we are concerned primarily with the second interpretation of the ZPD – the cultural knowledge viewpoint. In our analysis of recent classroom episodes of collaborative mathematical inquiry, we captured students speaking with unusual authority as they challenged the teacher to listen to and respect their ideas. We argue that the students' confidence to resist the teacher's traditional voice of authority was supported by the culture of the classroom which privileged socio-mathematical norms such as meaningfulness, communicability, and testability. Clarifying the way that authority is achieved in the classroom has practical implications in terms of designing more collaborative learning environments. It also has implications for students' understanding of epistemology. In a classroom where authority is negotiated rather than imposed, open discussion of the appropriate criteria for accepting or rejecting claims is foregrounded. In such a classroom students are challenged to reflect on the basis for their claims and to appraise the claims of their peers in terms of agreed norms and practices.

METHODOLOGICAL APPROACH

To begin to address the issue of *authority* in mathematical inquiry we've employed Bakhtin's notion of voice. Voice provides a means of identifying processes of appropriation and resistance as the teacher and the students ventriloquate, revoice or challenge each other during collaborative activities. Voice also directs attention to the multiple stances or speaking positions that teachers and students adopt during their interactions. The teacher at times speaks as if he were a student, while students adopt the voice of the teacher as they attempt to influence the direction of the collaborative activity. The multiple and shifting voices of the teacher and students reveal also the way the institutional setting of the school and the culture of a specific classroom privilege interact to certain voices over others. The teacher and students seek to influence each other by speaking with authority, that is, by adopting what are situated and privileged voices in a specific classroom.

The specific classroom we investigated is a year seven classroom where students have been using "Collective Argumentation" to guide their mathematical activity. Collective Argumentation is organised around a key word format involving a number of processes - represent the task or problem alone, compare representations within a small group of peers, explain and justify the various representations to each other in the small group, reach agreement within the group, and finally present the group's ideas and representations to the class to test their acceptance by the wider community of peers and the teacher (see Brown, 1994).

COPYING, REMEMBERING, REVOICING: WHEN CAN I SPEAK WITH AUTHORITY?

Some of the dilemmas that we have noted with regard to authority are illuminated by considering the similarities and differences between processes of copying, remembering and revoicing. In a collaborative classroom ideas are often "in the air", so to speak, as students represent, compare, explain and justify particular points of view. Collaborative activities are premised on the assumption that students will work with each others' ideas. However, as we have noted(see Brown,1998), students can be sensitive to the notion of copying when working with each other's ideas. During one episode of Collective Argumentation, a small group of students was presenting their solution to a task when one of their classmates asked them if they had copied the idea from someone else. They

replied that they had not copied it, but had remembered the idea from a previous session. The students' distinction between copying and remembering provides insights into the nature of authority in this classroom. Copying implies that the group was neither the original author of the ideas, nor had the members of the group appropriated the ideas in a meaningful fashion. To retort that they had *remembered* it, is actually a subtle variation of the notion to copy, with the important difference, however, that the idea had been stored over time, retrieved, and seen as appropriate for use in this particular context. To remember in this way, therefore, implies meaningful appropriation and the students clearly felt that they could speak confidently and with authority about "their" ideas. This brief exchange between these students reveals an emerging awareness of epistemology, and an ability to legitimate their practices by drawing quite sophisticated distinctions.

Learning may occurs when students or the teacher use each others' ideas to advance the mathematical discourse. Summarising, paraphrasing and rephrasing ideas have been referred to by O'Connor and Michaels (1996) as "revoicing", and like us, they have noted the use of "so" at the beginning of an utterance as a salient marker of revoicing (see Renshaw & Brown, 1998). Teachers within collaborative classrooms are likely to employ revoicing quite often as they attempt to incorporate students' contributions into the ongoing discourse. A student whose contribution has been revoiced is positioned to make a judgment regarding its accuracy (Is this really what I said and meant?), relevance (Is it really appropriate in this context?) and acceptability (Now that I've heard what I said, do I still agree?). Students thereby acquire a particular kind of authority within the classroom discourse, because they are able to either assent to or challenge ideas accredited to themselves.

So, to conclude this section – the public and collaborative nature of knowledge construction during Collective Argumentation provides many opportunities for students to reflect on the basis of their claims, the origin and authorship of ideas, and to become aware of the socio-mathematical norms of meaningfulness, communicability, and testability as the basis of knowledge claims.

Authority in Collective Argumentation

Collective argumentation is based around social practices and shared norms that challenge the traditional authority framework of the classroom where the teacher is assumed to be in control and where students are expected to comply with teacher directions. These practices and shared norms take time to establish and require the teacher to constantly embody a different stance to issues of authority. There are times, however, when both the teacher and students may revert to more traditional voices or stances. To illustrate how Collective Argumentation can create a space for students to assume a dialogic position where views and ideas are retained through appeals to shared evidence and reasonable argument, a short extract from one episode of small group work is presented below. This episode is particularly interesting because it is the student who remains within the norms of collective argumentation and who resists the teachers momentary adoption of the traditional authority space.

We enter the dialogue where the students are attempting to find the area of an eight-pointed star enclosed within a square, and the teacher has joined the group to review their progress. Annie has employed a conventional representation to successfully solve the problem. However, her partner, Allan, has adopted an imaginative, but inadequate representation, which requires viewing the figure as two equivalent rectangles. Annie is exploring Allan's idea to see if it can be successfully adapted to solve the problem. Annie's attempt to work with Allan's idea demonstrates that revoicing can have an explicit instructional purpose. O'Connor and Michaels (1996) make the point that the 'revoicer' of a speaker's contribution often sees more significance in the ideas than the speaker was aware of. This clearly occurs in the following episode where Annie sees potential in Allan's idea where neither

the teacher nor Allan sees any. In fact the teacher demands that Annie cease her attempts to co-construct a response to the problem, and comply with his directions. Annie maintains her viewpoint in the final line of the transcript even after the teacher's insistence that she follow his directions – "I didn't ..."

(In the transcripts below the Teacher's words are in *italics*, Annie's are **bold**, and Allan's are normal text)

Teacher	*You've turned the eight-pointed star into two rectangles, but you're no longer measuring the eight-pointed star.*
Annie	**So what we did. I found the area of these little triangles and it was twenty-four centimetres squared. So I got that idea off mine and took it away from Allan's answer.**
Teacher	*No, that's not going to work. You just can't make things fit together. Okay? You can't get two different ideas and make them fit together.*
Annie	**No, I just knew that . . .**
Teacher	*Stop arguing and listen to me for a moment. You can't take his ideas and take your answer away from his answer. He's coming at the problem from a completely different perspective to what you are. You have to work with your ideas and convince him that your ideas are accurate.*
Annie	**I didn't take my answer away from his.**

In the dialogue that follows, the teacher and Annie re-visit the calculations evoked by her representation of the problem space, confirming Annie's answer that the area of the star is 40 square centimetres. The teacher then re-visits the calculations evoked by Allan's representation and compares the two results. Upon comparing the results the teacher concludes that even though Allan's idea is "beautiful" it "just doesn't work". The teacher then directs Allan to move onto the next problem - "Can you work the next (problem) out?" - and tells him to use Annie's idea to assist him.

In the above sequence the teacher had engaged a voice characteristic of the "expert" operating within the framework of pedagogical scaffolding. However, in response to the teacher's statements Annie maintains the argument that she is not simply subtracting her answer to the problem from Allan's answer ("I didn't take my answer away from his"), but combining his ideas with her ideas to solve the problem in a novel way ("So I got that idea off mine and took it away from Allan's answer"). This contradiction of the teacher's voice is not an act of defiance by Annie, but an example of a sociomathematical norm which Polya refers to as 'wise restraint' - where a mathematical point of view is not changed wantonly, without serious examination. Annie's mathematical voice resonates with the confidence of the knower, struggling to represent what she knows and to connect that to the knowledge of others - an emotionally risky resonance, but necessary to developing authority of voice (Kutz, 1990). Annie's desire to have Allan and the teacher appreciate her insight regarding Allan's representation persists in the following sequence.

Annie	**Okay, let's go with your idea.**
Allan	No.
Annie	**Yes.**
Allan	We don't have time.
Annie	**No, we're going to fix up your idea. We're going to find out where you went wrong.**
Allan	But it (the work-sheet) is wrecked.

Annie	**Allan, we'll do your idea. Can you draw that shape (the figure) please on the back (of the sheet)? On the back of this and we'll fix up your idea.**

(Allan commences to draw the problem figure on the back of the work-sheet. Teacher approaches the group.)

Teacher	*How are we going?*
Annie	**I know where he went wrong.**
Teacher	*It doesn't work!*
Annie	**I know, but I think it can.**
Teacher	*I'll get you another sheet.*

(Teacher gives the children a new problem sheet and leaves the group.)

In the above sequence, Annie first recruits Allan's participation in the co-construction of a solution by expressing confidence that his idea can be 'fixed' and by organising their work-space so that time can be used efficiently (working on the back of the work-sheet). Annie then recruits the teacher's tacit participation by her confidence ("I know where he went wrong"), affirming the teacher's argument that the idea does not initially work ("I know . . ."), and expressing faith in the status of the idea as being an important element of a co-constructed response ("I think it can").

Annie's stance continues to give direction to the discourse as the other participants (Allan and the teacher) take up reciprocal positions relevant to the norms of Collective Argumentation. The teacher's attempt to enforce his authority by adopting what may be referred to as the traditional teacher voice, has been successfully resisted by Annie's maintenance of the voices of Collective Argumentation. In the sequence below it is the teacher who now tries to follow Annie's definition of the task, grants her the status of the 'knower', and begins to work with her as a co-participant.

Annie	**Okay. Talk to me. Talk me through what you did.**
Allan	I went Oh! and got this here (a triangle) and put it here (points). Then I went Oh! and saw there was another one there and another one (both children reconstitute Allan's original representation).
Teacher	*But if you keep putting the parts which are not part of the star onto your rectangles, are you finding the area of the (indicates the area of the whole figure)? You've got a big problem with the middle anyway, because it overlaps (shades in the middle square that overlaps both big rectangles).*
Annie	**Ah ha!**
Allan	What are you doing?
Teacher	*But that can be solved by finding out the area of that square and taking it away once. That problem can be solved.*
Annie	**So you've got to find the area of the square . . .**
Teacher	*Yeah, we're not interested in that at the moment. But the question you have to ask yourselves is by putting these bits (the triangles) of the square which are not part of the star onto the end of this rectangle, are you finding the area of the star?*
Allan	No.
Teacher	*Or are you finding the area of the whole square (the figure)?*
Allan	We're kinda finding the area of the whole square.
Annie	**I'm not particularly worried . . .**

Teacher	*You are, you're finding the area of the whole square. Aren't you?*
Allan	Because we've got all these parts (the triangles) which were the square, on the end.
Teacher	*In other words you've turned the square into two rectangles. You've got the other problem here . . . that these two rectangles overlap here.*
Annie	**So we've got to take this square here (the overlapping square) away from our answer.**
Teacher	*So if you take that square there away from your answer you should get the area of the square which is sixty-four square centimetres. See if it works.*

In the above sequence, it is the teacher who is learning to master the children's definition of the situation, and it is Annie who speaks authoritatively in the teacher's voice as she asks Allan to "Talk me through what you did". It is Annie who revoices the teacher's ideas as a way of enlisting his appreciation of her original insight - "So you've got to find the area of the square . . .", and "So we've got to take this square here (the overlapping square) away from our answer." It is the teacher who signals his appropriation of Annie's mode of thinking by prefacing his final contribution with the word "so" - "So if you take that square there away from your answer you should get the area of the square which is sixty-four square centimetres. See if it works". In this sense, Annie may be said to be 'scaffolding' both Allan's and the teacher's engagement in the task, and to be sharing a symmetry of authority with the teacher which is rarely seen in primary classrooms (Edwards & Mercer, 1987).

CONCLUSION

In this paper we have explored the issue of authority from a sociocultural perspective, and related it to three interpretations of the ZPD. The *cultural knowledge* notion of the ZPD focuses on the classroom as the site of knowledge transmission and construction. A clear hierarchy of authority has been maintained in most classrooms, with the teacher assigned the institutional status both of "knower" and "leader", and students expected to enact the more compliant roles of "novice" and "follower". A sociocultural perspective challenges this classroom hierarchy by proposing more symmetrical, participatory and collaborative forms of interaction between teachers and students.

Collective Argumentation, which has been devised and implemented in an upper primary classroom over a number of years, provides a generative space for students and teachers to begin to adopt these new ways of interacting. In this space, students are expected to co-construct mathematical ideas relevant to various problems, and to communicate their ideas effectively not only within their small groups but to the teacher and the class as a whole. In these various communicative contexts, students have the opportunity to adopt different speaking positions, to speak as the "the knower", or "the explainer" and to lead the teacher and the other students to appreciate insights that they have developed.

In our analysis of a number of episodes of Collective Argumentation, we suggested that students were beginning to speak with authority in this classroom, and were beginning to adopt an epistemology consistent with sociomathematical norms – namely that ideas had to be meaningful (personally understood rather than just copied) communicable (able to be explained and represented for other members of the community to appreciate), and testable (able to be supported by logical argument and/or empirical demonstration). The insightful exchange between the students regarding the issue of *copying* versus *remembering* provided evidence that students were beginning to reflect on the basis of their arguments, and were becoming aware of the relevance of the sociomathematical norms for their small

group practices. They regarded copying as problematic because it implied reproduction without personal understanding, whereas remembering seemed legitimate because it implied transformation of the original idea and effective application in a novel situation.

The analysis of the interaction between Annie, Allan and the teacher addressed a number of important issues regarding the dynamics of authority in the classroom. A key episode shows Annie refusing to accept the direct command of the teacher "to stop arguing and listen for a moment". Annie is able to counter the teacher's authoritarian stance by drawing on a voice that has a privileged status in this classroom, namely, that speakers have the right to be heard if they have good reasons to support their views. If the teacher had insisted on compliance in the face of Annie's firm resistance, an authoritarian framework would have been reasserted, with the implication that the students simply had to listen and obey the commands of 'experts'. So, this episode suggests that both teachers and students find it difficult at times to remain within the collaborative classroom norms of symmetrical authority. It also reveals the complex interplay between institutional and local classroom cultures when collaborative forms of learning are introduced to replace traditional teaching methods. Institutionally, the teacher and students were more familiar with hierarchical roles and expectations, so the creation of the new culture required a joint effort to resist old practices and to regulate each other's adoption of the more symmetrical roles.

New practices cannot exist in a vacuum or be insulated either from the histories of the participants, or the influence of the surrounding institutional mileau. We have glimpsed in the episodes analysed above, the interplay of the personal histories of the participants and the institutional mileau of a typical school, as the teacher and the students struggled to maintain symmetrical authority relations, rather than return to the hierarchical authority relations so familiar to them.

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