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ELEMENTARY TEACHER TALK IN MATHEMATICS STUDY GROUPS

ABSTRACT. In this article, the author examines the character of the conversations generated in an elementary teacher group as they worked on mathematical problems together and analyzed their students' work. Two distinct forms of talk — *exploratory* and *expository* — were found. The first type of talk occurred most prominently when discussions centered on the teachers' own mathematical work and the second type when conversations centered on that of their students. By examining closely the few occasions when the groups' expository talk turned exploratory, the author explores how both the nature of the tasks and the range and type of facilitator conversational strategies can play significant roles in promoting and interrupting these conversational patterns to educational ends.

KEY WORDS: teacher talk, mathematics teacher groups, teacher professional development, teacher discourse communities

1. Introduction

The primary concern of this article is elementary teacher study groups focused on the teaching of mathematics. These kinds of groups have become relative commonplace in mathematics education and are intended to provide teachers with occasions to work together on developing their own mathematical understanding, as well as with opportunities to expand their knowledge of students' mathematical thinking. This approach to the professional development of teachers is consistent with contemporary learning theories that root teacher learning in authentic teaching practice and in collaborative conversations about those practices (see, Putnam and Borko, 2000). This invokes a manner of working similar to those proposed for engaging K-12 students in discourse communities in their classrooms.

While such collaborative group work has become a popular form of professional development for teachers, there is little documentation on what goes on in such groups (Wilson and Berne, 1999). Furthermore, it is not clear how such groups can grow into professional communities that support teacher learning. It is, for instance, not at all evident how (or perhaps even why) a group of teachers who work within the same school would engage in such conversations. Yet, as in any learning community, it seems

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likely that the success of such learning opportunities depends appreciably on the quality of the conversations that are generated. However, just as in other educational settings, good conversations do not simply happen, nor do they always happen.

Researchers who have studied the organizational and social structures of schools suggest that open and critical conversations are rare among schoolteachers (Lortie, 1975; McLaughin and Talbert, 2001). The culture of privacy and isolation that still prevails in many US schools (though not in many Asian countries — see, for instance, Britton et al. 2003) presumes that being a good colleague means *not* asking or giving advice about classroom practice, and works against the very definition of teacher *community*. Putnam and Borko (2000) concur and warn that: “New kinds of discourse communities for teachers, while potentially useful tools for improving pedagogical practice, also may introduce new tensions into the professional development experience” (p. 9).

A growing body of mathematics education research has begun to document the complexity associated with forming and sustaining such instances of teacher communities (e.g. Arbaugh, 2003; White, Sztajn, Hackenberg, and Snider, 2004). Among other things, such studies report on the teachers’ perspectives on their participation in teacher study groups (as well as on design features that made it possible for them to sustain it). Other studies have sought to explore the connections between participation in such groups and changes in the participants’ knowledge, beliefs and teaching practices (e.g. Klein and Jackson, 2003; Kazemi and Franke, 2004).

The larger teacher development and research project of which my work forms a part involved a facilitated, school-based, mathematics teacher study group operating at each of four elementary schools with close ties to the elementary teacher preparation program at Michigan State University (Crespo and Featherstone, 2001, 2002, 2003). Each group facilitator was a mathematics education instructor in this program.[1] The project involved both approaches to researching mathematics teacher groups that I identified earlier and aimed to understand teachers’ manner of participation in these groups and how such participation both supported and militated against teacher learning within them. In this piece, however, I focus solely on the teacher group I have been facilitating and researching, reporting more on the nature of the conversations of the group over time than on how the participants’ knowledge or beliefs were affected. I do so in order to make progress with the following question: “What do study group conversations reveal about the challenges of and possibilities for enhanced teacher learning about mathematics and its teaching?”

2. STUDY-GROUP TASKS AND PHASES OF ACTIVITY

One thing that is specific about mathematics is what has been referred to as its 'high modality' (Chapman, 2003), namely the strength of the notion of *rightness* in the academic discipline. I was attuned to this feature of the school subject and was interested in how it would play out in the group. Consequently, some of the mathematical tasks were shaped in order to bring the teachers up against this feature in non-standard ways, including the illustrative example I discuss in the next section. I turn now to examine the nature of the tasks upon which the group was invited to work, as well as the general manner in which the group functioned.

There were essentially two sorts of group meetings. In the first type, the facilitator would provide a carefully selected mathematics problem that the teachers worked on together during the meeting and which they then adapted into variant tasks across their respective grade levels (Crespo, 2002b). Between this and the subsequent teacher meeting, the teachers' students would then work at versions of this task in their respective classrooms. At the next meeting, the teachers would bring back student work on the particular task variations, reporting on student classroom activity (and this activity comprised the second type of meeting).

Our project acronym for this sequencing of tasks was SATRR (*Solving, Adapting, Teaching, Reporting and Reflecting*)[2]. This sequence was developed from an account (Simon, 1994) of the interactions and sequencing of tasks and contexts for mathematics teacher learning (which Simon terms 'learning cycles'). In particular, The SATRR model elaborates Simon's sixth learning cycle, the cycle that focuses on 'teaching'. Each of Simon's learning cycles consists of three phases – exploration, identification, and then application or extension – whereas the SATRR model uses five phases and makes a distinction between mathematical and pedagogical explorations within this cycle. One way of reading the results of the present article is that they complicate Simon's and other models of professional development (e.g. lesson study) that presume uniformity of conversational possibilities between the various types of professional development tasks and contexts. I come back to this point later in this article; here, I focus on illustrating the group's activity and, consequently, the learning opportunities offered to the teacher participants.

The SATRR problems were chosen with many of the U.S. National Council of Teachers of Mathematics (NCTM, 1991) criteria for worthwhile tasks, such as problems that generate opportunities for mathematical discussion and exploration of substantive mathematical ideas. In addition, they were selected or constructed to be adaptable to different elementary grade levels (K-4): to that end, I ensured the main mathematical content of each one did not fall within the actual curriculum or textbook of any specific grade. More specifically, during the *Solving* phase of the SATRR cycle, teachers discussed and started to analyze their own solutions and solving strategies to the given problem. The teachers then explored ways to *Adapt* the problem to their K-4 students and considered what mathematics (in both content and process terms) children might learn from a lesson based on a grade-adjusted version of the problem. In the intervening weeks between meetings, each teacher *Taught* a mathematics lesson based on the work done in the study group, posing her version of the problem in her classroom and collecting samples of students' work.

At the next meeting, the members moved into the *Reporting* and *Reflecting* phases: discussion focused on the teachers' accounts of what happened in their classrooms and then on an initial analysis of student work that the teachers had found revealing, thought-provoking, inadequate or otherwise noteworthy. The teachers also explored what was challenging, what they felt they had learned and what they would like to try next. Once the sequence of meetings was underway, we usually managed to fit both the RR phases of the previous problem and the SA phases of the subsequent problem into a single meeting. During the first two years of the project, the group completed nine SATRR cycles — four during the first year and five during the second.

2.1. *Opportunities for learning in SATRR groups*

To illustrate the SATRR cycle, as well as to indicate some opportunities it offered for teacher learning, here is a brief account of the group's mathematical and pedagogical explorations of a pizza problem (an altered-modality variant of one found in NCTM, 2000, p. 199), which the group worked on during its third meeting.

José ate half of a pizza.
Ella ate half of another pizza.
José said that he ate more pizza than Ella,
but Ella said that they both ate the same amount.
Use words and pictures to show that both could be right.

At first glance, it may not be easy to see how this problem could generate interesting or substantive conversations about mathematics, about students or about teaching. Mathematically, the problem seems straightforward – Ella is right if the two pizzas are the same size and José is right if his pizza is larger. However, for young students to reach this conclusion is no trivial matter, as it speaks to a common and well-documented conceptual difficulty in the comparison of fractions – that of establishing the unit size and the size of the respective wholes before comparing two or more fractions (see, for example, Streefland, 1978). It also keys into the complexity and conceptual sophistication concealed behind the apparently straightforward terms ‘more’ and ‘same as’ (see, for instance, Walkerdine, 1988).

A closer look at the task reveals that this is not an ordinary mathematical word problem either. For one thing, the problem explicitly asks the solver “to show that both could be right”, rather than asking for a single answer or to find out which of the two is right. Secondly, the question can be open to plural interpretations – are we to show that both could be right *at the same time*, are we to consider how each of the word problem’s protagonists could *think* they were right or are we to talk about under which circumstances either (or both) could *be* right?

This problem generated substantive conversations in all of the teacher groups. In my group, for example, teachers discussed how they thought their students would work on this problem and agreed that the most challenging aspect of the problem for their students would be to justify that *both* Ella and José could be right, rather than to show one of them to be right and, hence, presumably the other necessarily to be wrong. They also thought that their students would respond with the ‘typical’ solution (the one alluded to earlier). At the subsequent meeting, when discussing what they had learned about their students’ thinking, each teacher had and took the opportunity to report on and start to analyze solutions generated by their own and others’ students. The second-grade teacher, for instance, reported how a student in her class argued for a solution the teachers had not previously considered.

> The next kid came up and drew two pizzas the same size [something the group had been focusing on as they reported], but one of them cut into fourths and one of them cut in half. And said that both Emily and Joey were right [one change this teacher had made was to use names of students from her own class in the problem], because Emily is right because they both ate the same amount of pizza but Joey was [also] right because he ate more pieces of pizza than her.

This teacher also mentioned a student in her class who had next said that depending on how the pizza was cut, either side-to-side or top-to-bottom, one amount was more than the other. It was this latter offering that drew her pedagogic attention and she shaped the subsequent discussion around this misconception.

> So I said, “Well you know circles are sometimes really hard to tell, let me make a rectangle so your pizza is a rectangle, and we made two identical-size rectangles and I said, “So what you’re saying is that if I cut the pizza this way that’s half, Joey ate that half, you know like I did them like that.” [illustrates with drawing] I took his idea and applied it to that and then asked, “Which one of those two ate more pizza?” and almost all the kids said, “This one”. And so I actually got out, you know, a piece of, two pieces of equal-size, you know, rectangle-size paper and cut

them in half and showed them how, "Gee, here's Emily's piece that was this way. What if I cut it and put it like this? What do you notice about them?" They were fascinated; they were like, "Oh, they are the same."

When I asked Ann why she had focused on this student response rather than the earlier one, she replied, "That's a good question. I don't know. I have to think more about it". While on this occasion Ann did not have a response, in later meetings she became the most prolific declarer of her pedagogic reasoning, always following a description of a teaching decision with a rationale. The unanticipated student responses provided repeated reasons for the teachers to describe examples of their pedagogy, thereby making them available to the group for further consideration and discussion. However, one striking fact about the group was that, throughout these first two years together, it was only myself who ever asked questions about their teacher purposes and intentions in their classroom accounts, instead of simply requesting clarification of some aspect. I return to this pattern of interaction later in this article.

In addition to illustrating the phases adopted by this project, the foregoing account also serves to suggest that the group I studied was indeed engaged in substantive professional conversations. Other sources of data (e.g. observations of the teachers' teaching practices over the years, yearly surveys, and interviews) collected for the larger project also provide evidence that the teachers' experiences in this group had been both positive and having some effect on their teaching practices. However, as the facilitator, I was not always satisfied with the group's conversations, feeling initially unsure why some of them felt productive while others did not; nor was I clear about what to do to change the course of an unsatisfying conversation. This led me to focus on the conversations that did take place in this teacher group.[3]

3. Some Background, Analytic Detail

The teacher group that is the focus of this study met once every three or four weeks for two and a half hours during school time (the project grant paid for substitute teachers). The elementary school (covering grades K-4) is situated in an urban setting, serving a community of low-income families of diverse ethnic and linguistic backgrounds. The group was composed of seven (initially, eight) K-4 teachers – all Caucasian – from the same school (out of a full-time classroom teacher cohort of eighteen) who volunteered to participate in the project. It is important to note that for all of the participants this was their first time participating in a long-term and school-based professional development experience that involved them in conversations with their colleagues around mathematics and students' work. Six (seven, initially) of the teachers were female and one was male. Two of the teachers had been teaching for over 20 years, two had 6–10 years of teaching experience, and three of them were in their second or third year of teaching. (The eighth initial member was a special education teacher who was transferred to a different school at the end of the first year of the project.)

For the purposes of this article, my data analysis mainly focused on: (a) the transcripts of the group conversations during the first two years (prior to my becoming aware of certain conversational patterns in the group and actively seeking to interrupt some of them) and (b) the 'meeting highlights' written in my journal, which summarized the main topics of conversation, questions and puzzlements that I experienced. The other facilitators and our discussions during our monthly project meetings were also instrumental in providing a sounding board during the period of analysis.

The analysis of the data focused on examining the group conversations for patterns of interactions and how these served to promote and constrain teachers' professional learning. Theoretical accounts guiding the analysis included situated learning perspectives, such as Wenger's (1998) exploration of learning communities, and those theories of teacher learning which emphasize the social nature of cognition (see Putnam and Borko, 2000). In addition, because the nature of learning in discussion groups is discourse-based, several discourse-analytic frames, such as "turn-taking", "participant's involvement" and "disagreements and consensus" (Cazden, 1988; Tannen, 1989), were used to uncover conversational patterns and explore whether and when teachers would openly and publicly admit ignorance or confusion, or disagree with one another.

A major assumption in the analysis of the data was that opportunities for teacher learning and change in a community of learners, such as teacher groups, depend a great deal on the participants' willingness to share their ideas and to examine their own and their peers' ideas critically. Hence, particular attention was paid to participants' disagreements and challenges of each other's ideas, as well as to the participants' talk that revealed uncertainty, surprise and confusion. These elements have long been considered instrumental to the personal construction of knowledge and to a community's generation of knowledge.

Guided by these theoretical lenses, the analysis of the study group conversations focused on three main conversational elements: (a) expressions of surprise, doubt or confusion, which were taken as indicators that a particular idea was new to the individual and of their willingness to share their thinking out loud; (b) expressions of disagreement (with attention to what and why), which were taken as indicators of participants' willingness to challenge each others' thinking; (c) participants' involvement used as indicators of collaborative talk, by looking at the frequency and length of speaking turns as well as conversational strategies such as interruptions, overlapped speech, and repetition (noting what and when), such as when a group member repeated word-for-word what somebody else said, which is a conversational strategy people use in order to understand better what has been said.

The analysis of the data began by organizing the transcripts by SATRR cycle and undertaking a thematic analysis of each phase. This was followed by a more in-depth analysis of the participants' involvement (number of speakers, number of turns taken, length of the turn) and the conversational elements identified earlier that stood out because of their frequency or unusualness for a particular segment of conversation. After this analysis had been done for each cycle, I turned to identifying patterns of similarity and difference across all of the cycles and segments of conversations. This analysis was first carried out by myself and later by two separate research assistants, who were asked to identify what they noticed in a selection of transcripts, followed by a search and sort for similar patterns across the collection of transcripts. Excerpts of transcripts were also brought to the project meetings for discussion and analysis with the other project facilitators.

4. Some conversational patterns in study group talk

A close look at the discourse generated in the teacher group revealed that teacher learning in SATRR groups, and other such discussions among teachers, is not as simple as the previous section featuring 'the pizza problem' may suggest. The analysis revealed important differences in the pattern of the group's talk when teachers were engaged in discussing mathematics and when they talked about their teaching practice and their students' work. Each of these types of group activity generated distinct patterns of talk and involvement by the participants. When doing mathematics, the teachers' talk tended to be very interactive with participants interrupting and disagreeing with one another, freely and unprompted. Yet, when the focus of the conversation shifted towards their practice and their students' work, the conversation tended to be less interactive and less collaborative, as one speaker would speak at a time, uninterrupted, in a monologue style.

In his studies of classroom talk, Barnes (1976) noted similar differences in students' talk. He noted that students tended to engage in what he termed "exploratory talk" during their group discussions and then changed to a "final-draft" talk when the teacher visited the group. These two kinds of talk, Barnes suggested, mark "a distinction between different ways in which speech can function in the rehearsing of knowledge" (p. 113) and observed that both uses of language have a place in education. In describing the differences between these two forms of talk, Barnes pointed out that exploratory talk reveals ideas as they are thought out in the course of their expression and is characterized by expressions of tentativeness (such as hesitations, rephrasings, false starts), hypothetical or hedged expressions (*might be, could happen, probably*) and a low level of explicitness (vague language). Final-draft talk (what I here call *expository*), by contrast, reveals ideas that have been thought out in advance and can be characterized by polished and explicit expositions of ideas. Barnes further noted that "final-draft language is the contrary of exploratory: far from accompanying (and displaying) the detours and the dead-ends of thinking, it seeks to exclude them and present a finished article, well-shaped and polished" (p. 109).

4.1. *Study group talk when discussing mathematics: Exploratory talk*

I noticed the two kinds of talk Barnes described before I encountered his work and called them 'exploratory' and 'expository' talk (Crespo, 2002b). I have since drawn on his descriptions to further characterize these patterns of teacher talk. I found that teachers' exploratory talk occurred most prominently when the group focused on their own mathematical work during the 'solving' phase of the study group structure. This talk was very interactive and collaborative and the tone of the conversation was also more playful and less formal. These findings are elaborated next, but I first consider the following excerpt of talk around the 'doing of mathematics' during the aforementioned pizza problem.

The teachers in the featured group are: "Jenny" (Kindergarten), "Nell" (Grade 1/Grade1-2 teacher), "Ann" (Grade 2/Grade 1–2 teacher), "Denise" (Special Education - a member of the group only during the first year), "Marie" (Grade 3); "Penny" (Grade 3), "Brian" (Grade 4/Grade 3–4 teacher), and "Leigh" (Grade 4). Three teachers (Nell, Ann, and Brian) were 'looping teachers', meaning that they taught the same group of students for two years following them to the next grade.

Sample of talk when discussing mathematics

Sandra: It looks like we're ready to share. Who would like to start?

Nell: I can explain this. José could be right if the two slices of pizza are different. If José had a large pizza and Ella has a small pizza, they both ate half. Then José would have eaten more pizza because there is more pizza in the large than there is in the small. Does that make sense? Okay. Do you want me to do the next one? [*Looking at facilitator who nods her to go ahead*]. Ella could be right if they both have the same size pizza then they both had the same amount because they will be the exact same size pizza.

Ann: They could both be wrong because if Ella's pizza were bigger than José's pizza then they would both be wrong. Ella could have eaten more pizza than José.

Marie: They'd both be right if his pizza was bigger so he ate more but they're both right because they both get half.

Sandra: Did you all follow what Marie said?

Brian: I don't think that's right.

Leigh: What did you say Marie? I didn't follow.

Marie: They're both right from the standpoint that José's pizza was bigger than Ella's. So he felt he ate more but then she felt they ate the same because they both ate, they actually both ate half of their pizza . . .

Brian: . . . but not the same amount.

Marie: Half is half. You have half and I have a half.

Brian: But that doesn't mean the same amount.

Marie: Half is half.

Leigh: Okay I see what you're saying. It doesn't matter. Half is half. Okay.

Denise: I did it a little differently. I definitely see the size pizza but I kind of took it that you don't know that Ella has a whole pizza like she could have had half of like an already eaten pizza you know what I mean. So a half of a half pizza, but she thinks she had half (giggle) and José (giggle) had half of his whole pizza.

Marie: Oh my!

Ann: Also if both pizzas were the same size to start with but it was half gone when she started eating then she would have had less than . . .

Sandra: . . .she would have had half of the remaining pizza, but . . .

Leigh: . . .she would have a quarter.

Ann: . . .would have a quarter.

Sandra:: Anybody thought about it differently? [*waited*] Ann also had another theory?

Ann: That they both could be wrong if the pizza that Ella had was bigger than José's pizza to start with. So the possibility could be that they are both wrong.

Marie: But we are supposed to show they are both right.

Ann: But it didn't say you couldn't though.

Leigh: That both could be right?

Ann: I don't think they both could be right at the same time.

Brian: No, that's what I was confused about.

Ann: I say José could be right or Ella could be right but they both can't be right at the same time.

Brian: Yes that's right.

Sandra: According to Marie they could be.

Marie: It's half. It's just that the half is bigger.

Brian: But they're not the same amount, the same amount.

Ann: If Ella says they both ate the same and it stopped right there, I can buy into it. But "same amount" means how much, I mean it's a quantity, speaking to a quantity, not . . .

Sandra: If I wouldn't have written, oh, "the same amount" but just said that they ate the same would that . . .

Marie: We would have trouble with that too.

In terms of the structural features of the teachers' discourse around their own doing of mathematics, I noted the very public and explicit disagreements that were uttered. The speakers, for instance, explicitly objected to another person's assertions when they disagreed using "but," "no," and "I don't think so." Notice, for example, in the first excerpt above that there were thirteen instances of explicit disagreements (lines 14, 19–21, 37, 38, 40–42, 46–50, 53). Brian explicitly disagrees with Marie's solution ("I don't think that's right") and Ann also disagrees with Marie later on. Marie disagrees with Ann's idea that both could be wrong and later with my (Sandra's) and Ann's attempt to understand what's causing the confusion (reading the problem's question differently: "same" or "same amount").

In addition, the teachers' talk seemed more tentative and improvised rather than a polished (or finished draft) exposition of ideas. Nell asks, "Does that make sense?," which acknowledges that what she is saying might need clarifying or revising. Denise's giggles while explaining her solution, and Marie's explanation becomes more elaborated as others keep challenging her ideas. That is to say that, when discussing mathematics, the group seemed to be involved in figuring things out together and extending, perhaps even revising, their ideas as they talked. The focus of such conversations seemed to be on the analysis of everyone's solutions, rather than on simply reaching or agreeing on the right answer. Furthermore, the teachers readily used phrases that indicated confusion, uncertainty, and exploration of ideas such as "maybe," "what about," "I'm not sure" or "I didn't follow."

The group's high level of involvement was another prominent characteristic of this talk. The number of speaking turns and multiple speakers on the same topic provide some evidence of this. In addition, there were numerous instances in the 'exploratory talk' transcripts where the speaker and listeners showed intellectual involvement (Tannen, 1989). For instance, there were multiple occurrences of speakers using phrases that suggested they were seeking or showing involvement for the purpose of understanding what others had said, such as "Does that make sense?", "You know what I mean?", "What did you say?" and "Okay, I see what you're saying". There were also many examples of other forms of involvement, such as when the participants interrupted, overlapped or finished each other's sentences. In the first excerpt above, after Denise offered her solution, Ann rephrased it and, before she could complete her sentence, both Leigh and myself interrupted and finished her sentence. In addition, multiple instances of 'repetition' (e.g., when Leigh repeats Marie's solution in line 23) were uncovered in the teachers' exploratory talk. This, as Tannen suggests, is a conversational strategy used by speakers in order to check for understanding or better understand what has been said.

4.2. *Study group talk when discussing students' work: Expository talk*

By contrast, when the conversation focused on reporting on their students' work, the structure of the conversation changed. The turn-taking pattern was different. When describing what their students did and what happened in their classrooms, each teacher took uninterrupted turns and presented with varying levels of detail and analysis what they had done, as well as what their students said and did, in relation to the mathematical problem everyone had tried. These teachers' narrations were expositions of an individual's interpretation with no invitation for dialogue or further interpretation of the described events. Also, no one except for the facilitator asked questions of the speaker, as illustrated in the following excerpt.

Sample of talk when discussing students' work

Jenny:	It was pretty interesting. I had, I read the problem to the kids and I said so what do you think about that, what do you think that would look like? So I had the kids talk. I decided I wasn't going to bring in the pizzas because I didn't want them to be the same size and I didn't want them to have different sizes so I didn't want to have predetermined solutions for them. I wanted them to come up with something. So this is what a couple of the kids drew. Kyleigh, she chose to come up and draw both pictures and then she drew the pizzas and I kept saying half of the pizza, half of the pizza. So you can see just one piece missing out each of the pizzas and she says well they both have the same amount cause Ella was right. I just thought that was a stitch. [. . .Then] Brandon came up and he drew José's picture of the pizza larger. But notice how he has the half, which I thought that was great and then Ella had the smaller pizza and cut it right in half. I thought it was really interesting. Then I was losing them (laughs) so we cut it off.
Sandra:	He thought that José could be right?
Jenny:	Right, that's how he showed that José could be right.
Sandra:	And the other one thought that Ella could be right but they had that one little piece?
Jenny:	Right. It's interesting when they say half and they show one of the pieces. So really they are thinking of same amount. I guess they're thinking of just a slice instead of you know, exactly I'm sure, of what a half is. I thought it was interesting.

Another interesting feature of the 'expository talk' transcripts was a lack of explicit disagreements; the words "but" and "no" were never spoken. Very explicitly spoken, however, were phrases by the main speaker that implied certainty such as: "I am sure," "must be," and "they really got it." Furthermore, there was no hesitation, overlap or interrupted speech. Notice how, in the above transcript, Jenny's responses to the facilitator's questions are stated very assuredly (as opposed to giggling in between sentences) and there is no explicit check for understanding ("does that make sense?"). Unlike what happened after the first teacher shared her thinking on the pizza problem, in this conversation no one offered a different way of interpreting or thinking about the reporting teacher's students' work. These features of expository talk can also be appreciated in the following excerpt.

Sample of talk when discussing students' work (Continued)

Ann:	[. . .] Most of them went right to the idea of wanting one of the two of them to be correct, either they were going to champion that Emily was right or they were going to champion that Joey was right. And then you know like "gee we're going to show it to you." And so I felt like I really had to nudge them to go "hey now that you, you know, you think that's right could it be right, could Joey had been right after all and what would have to happen?" The first kid that came up to prove drew the two pizzas the same size. Split them in half. They have the concept of half really well I mean I was really pleased to see that they showed the pizzas having the same size. The next kid came up and did the bigger pizza and the smaller pizza. Then I just went on to say you know "is there anybody else that got something different?" The next kid came up and drew two pizzas the same size but one of them cut into fourths and one of them cut in half. And said that both Emily and Joey were right because Emily is right because they both ate the same amount of pizza but Joey was right because he ate more pieces of pizza than her. [. . . *next portion of transcript focuses on the solution I discussed earlier where a student suggested that the having more or less pizza depends on whether the pizza was cut sideways or top to bottom* . . .]
Sandra:	Any questions for Ann? [*waited and looked around the table and saw the teachers shaking their heads*] I was actually curious that you chose to follow up on one solution and not any of the others. Why did you follow up on that one and not on the multiple slices one?
Ann:	Mmmhh, that's a good question. I'm not sure. I'd have to think about it. But yes that's really interesting.

A further feature that can be appreciated in both of the above transcripts is the amount of detail that the teachers were able to recall and report. Some teachers, for instance, were able to provide a chronological account of students' contributions or reproduce what the students said with great accuracy. Still others used "constructed dialogue" (Tannen, 1989) in their narrations, as Ann (featured earlier) had done, which may or may not represent actual dialogue, but serves to involve and engage the audience in one's story. It is both interesting and puzzling that these two conversational strategies that have potential for generating collaborative conversations (the use of 'images and details' and 'constructed dialogue') had quite the opposite effect in the teachers' talk about their students' work, which tended to be anything but collaborative.

5. Factors that Promote and Interrupt Patterns of Talk

In his analysis of factors that supported and constrained exploratory talk in the classrooms he studied, Barnes (1976) explained the manner in which an intimate or a distant audience constrains speech. He suggested that writing or speech will tend towards the exploratory or toward a final draft depending upon the speaker's or writer's interpretation (and awareness) of the audience they are addressing. Barnes offered the following illustration:

> A group of children working alone are likely to find exploratory talk available to them if they know one another well. Equal status and mutual trust encourages thinking aloud: one can risk inexplicitness, confusion and dead-ends because one trusts in the tolerance of the others. The others are seen as collaborators in a joint enterprise rather than as competitors for the teacher's approval. (p. 109)

Barnes's explanation sheds light on what happens to group conversations when a stranger or an outsider, more-knowledgeable other enters the group conversation. But in the case of the teacher group I have been discussing, while the facilitator (a university professor) could be considered the outsider and 'more-knowledgeable other', this did not seem to prevent the teachers from engaging in exploratory talk when solving a mathematics problem together. The suggestion that exploratory talk thrives in groups that have established intimate relationships and mutual trust also resonates with theories of learning in communities of practice (e.g. Wenger, 1998) and with observations of researchers of study groups about the conditions under which teacher groups become a teacher community (e.g. Grossman, Wineburg, and Woodworth, 2001). However, this explanation does not help to account for why it was possible for this particular group of teachers to achieve exploratory talk in the context of discussing mathematics while not doing so when discussing their students' work.

Seeking better to understand these conversational patterns, I returned to the transcripts for further clues. I paid specific attention to excerpts of conversations when the exploratory and expository patterns changed, in particular searching for instances when the expository talk turned exploratory during the group's discussions of students' work. I found only three clear instances of interruptions to the expository talk pattern (my criteria were at least two other teachers speaking during another teachers' reporting turn and the exchange lasting at least five speaking turns). My analysis of these interrupted patterns suggests two elements – nature of tasks and facilitator moves – as factors that played some role in promoting and interrupting the exploratory and expository patterns of talk in this particular group.

5.1. *An example of expository talk turned exploratory*

Before discussing these elements, here is an excerpt of the conversation that took place the first time that the pattern of expository talk associated with conversations around students' work changed. This first pattern break occurred during the fifth SATRR cycle. This meeting focused on the 'reporting and reflecting' phase (the second meeting of the second year), which happened after teaching the 'Write number sentences that equal ten' problem.[4] As on previous occasions, the conversation began with the teachers taking uninterrupted turns reporting what they had done in their class and what their students did that they felt was noteworthy, with the occasional question from the facilitator. That is, until the third grade teachers' report.

Marie and Penny reported together on their experiences and brought a mound of students' papers filled with number sentences. They were visibly pleased with this work, especially the fact that their students had constructed 'atypical' number sentences; that is, they had used large numbers, generated number sentences with more than two terms, and had number sentences with mixed operations. Marie read a number sentence with mixed operations and remarked on the students' accomplishment with the other teachers cheering on. This came to an abrupt end when the facilitator pointed out that, without inserting some parentheses, many of these mixed-operation number sentences did not really equal ten. This interjection immediately changed the expository talk into exploratory talk, with multiple speakers speaking very animatedly, voicing disagreements, and raising questions.

Sample exploratory talk while discussing students' work

	Study Group Conversation	My Commentary
Sandra:	Wait a second! This doesn't work. I mean if we go by the order of operation [. . .]. The numbers are $30 \times 2 - 10 \div 5$. If we don't have a parenthesis in there, the answer is not 10.	
Teachers:	Laugh	
Ann:	Excuse me, are we suppose to say "Taylor, there's no parenthesis in this number sentence, please explain?!"	Notice here that it is Ann not the reporting teachers (Penny and Marie) who takes the floor to express a bit of outrage. Notice that the rest of the conversation is not just between the facilitator and the reporting teachers.
Sandra:	I mean, we do the multiplication and division first and then the addition and subtraction	

	Study Group Conversation	My Commentary
Marie:	However they've learned, he's doing it from left to right.	
Sandra:	Right, right, he's doing it as if it were a word sentence because they haven't learned the order of operations yet, right? So 30×2 that's 60 minus 10 that's 50 divided by 5 is 10, if you go like a sentence. If you don't put parentheses in there the rules are that you do the multiplication and division first and then the addition and subtraction last.	
Nell:	60–2 so that would be 58. [overlap] Beeep (sound for wrong answer)	Nell uses humor to make a point.
Sandra:	[overlap] we have rules of operations because we can't have two different solutions.	
Marie:	But the grade level thinking right there is, his grade level thinking is good.	Marie continues to object to what to her seems to sound like a dismissing of the students' work for the sake of mathematical correctness.
Sandra:	I don't disagree with that, but, and I don't think necessarily that I would correct it or bring it up at all at this point.	
Jenny:	Good Grief	Note how Jenny enters the conversation to express objection to correcting the students and is joined by Nell and they jokingly make a point by playing out how this correction would sound.
Nell:	"Actually Taylor you see that whole page you just made... it's not right"	
Teachers:	Laugh	
Ann:	This is a third grader!	
Sandra:	When do we do order of operations?	
Ann:	First grade (joking)	Ann uses humor to make her point.
Leigh:	I remember doing it with my students (fourth graders) in the second half last year.	

	Study Group Conversation	My Commentary
Marie:	100 divided by 10 plus 30 minus 20 equals 10.	
Sandra:	I mean just the idea that he would think of all of those with the mixed operations it's wonderful. So you can see this would also be an opportunity to go there. That kind of a problem gives you the opportunity to get at the order of operations.	The facilitator again validates the teachers' point and draws attention to using this problem as an opportunity to introduce to students the order of operations.
Ann:	But wouldn't this be a much more meaningful context to teach it in because then you could say: "Now you know what this really seems like it gotta equal 10, I mean doesn't that makes sense to us? But, here's what the rule in the math books say, you have to do all the multiplying and all of the dividing first, and then you do your additions and subtractions.	Ann and Leigh join in to consider and play with the idea of introducing this content to students when the opportunity arises even if it is not part of the prescribed curriculum.
Leigh:	Could you put parentheses in the right spot to make it work?	
Sandra:	Oh yeah.	
Ann:	That's where you would want to go next.	

This conversation is quite different from the conversations that typically happened during discussions of students' work. This latter conversation resembled the exploratory talk that always occurred when the teachers discussed their own mathematical work on the problems. Notice in the above excerpt that there were multiple speakers and turns (12 of 23 speaking turns were from non-reporting teachers), including seven instances of explicit disagreement. These disagreements provided the opportunity to discuss mathematical content, namely the order of operations and use of mathematical notation, in the context of teaching practice – when is this introduced and how would we want to introduce it to students – that would not have been possible had disagreement not occurred. It also pushed the group to wrestle with a fundamental dilemma of teaching – how does one reconcile the dual commitments to the subject and to the students' mathematical ideas (Lampert, 2001). Next, I explore the ways in which the nature of the tasks and the facilitator moves help to promote and interrupt the conversational patterns uncovered in this project.

5.2. *More on the nature of the tasks*

The teacher group discussions I report here centered around two kinds of tasks – doing mathematics and examining students' work. These are, by nature, quite different. The mathematics tasks were worked out during the group's time together, whereas the work of analyzing students' work likely began individually at the time of teaching and long before the group's next meeting. This temporal distinction might explain why the conversations around these two kinds of tasks were so different. The effect of the temporal difference is apparent in the verb tenses used during the two kinds of conversations. When teachers discussed their own mathematical ideas during the *solving* phase of the SATRR cycle (and during the *adapting* phase), the conversation was mostly in present, future, and conditional tense – this is how I'm thinking about this and here's what I think my students might do. Whereas the conversations around the students' work (*reporting*) are mainly in past tense—this is what my students did and why I thought it was interesting.

Past-tense conversations are by nature not conducive to exploratory talk: what was (claimed to have been) done cannot be undone, and hence can seem to offer little opportunity to imagine and explore other possibilities. Furthermore, when past actions are presented in an assertive (rather than questioning or wondering) tone, they close off opportunities for collaborative conversations. Imagine, for instance, the conversational possibilities in Ann's account of her pizza problem if she had instead reported in a more exploratory mode: "Here are two solutions my students offered. I would love to hear what you would suggest I do with these."

Another difference between the two broad kinds of tasks is their relation to the individual teachers' domain of expertise. Consider, for instance, that the mathematics tasks that the facilitator brought to the meeting could not be identified as being the property or in the domain of any one particular grade level. Instead, the problems came from an outside source for the teachers to explore and decide on their grade appropriateness or ways to make them appropriate for their students. By contrast, the students' work that the teachers brought to the meeting came from their own classrooms and were the product of the grade-specific adaptations they had made to the problems. While the mathematics problems the facilitator brought to the group could be thought of as artifacts for uninhibited exploration, the students' work could instead be thought of as exhibits that offered evidence that something good had happened in the reporting teacher's classroom.

Considering the above – that the nature of discussing mathematics and discussing students' work in a teacher group – might predispose groups of teachers (elementary school teachers perhaps) towards having particular kinds of conversations, then it is interesting to examine why the pattern of expository talk while discussing students' work was ever interrupted. I now turn to examine what it was about the nature of the 'Number Sentences that Equal Ten' task that allowed the discussion about students' work to become exploratory. In the next section, I shall discuss facilitator moves, but here I focus on the mathematical task.

The 'write number sentences that equal ten' task has some interesting qualities that are worth noting. Like the 'pizza problem' discussed earlier, it is a problem that is simple to understand and then becomes more complex once one starts working on it. The problem asks the solver to generate number sentences rather than calculate them, which invites students to investigate patterns and relationships. As with the pizza problem, the students generated work that was surprising to the teachers: that is, the students generated solutions that the teachers had not thought about or produced themselves.

In contrast to the pizza problem, however, the third grade students generated mathematical work that took the group discussion beyond the mathematics that K-4 teachers typically teach in the elementary grades; in this case it was order of operations – a topic that the teachers in this group did not feel responsible for teaching. It is important to note that when the teachers themselves worked on this problem, they did not generate work that went beyond the boundaries of the mathematics content that could be considered to belong in the K-4 curriculum. Another indicator that this might be important is that the two problems ('Consecutive sums'[5] and 'Fair game'[6]) the teachers unanimously decided *not* to try with their students were problems that took the group beyond the boundaries of their elementary mathematics curriculum.

The consecutive sums problem provides another example that will help illustrate how a mathematical task that takes students beyond the mathematics that they study in a particular grade can help generate exploratory talk when teachers report and reflect on the work of their students on that problem. The consecutive sums problem was brought to the sixth SATRR cycle (fourth and fifth meeting of year 2) and it was rejected by all but one of the teachers in the group. After all of the teachers in the group had declined to try this problem in their class, Ann announced on a whim that she would give the problem a try with her second grade students and invited the group to visit her class during the next group meeting to see what would happen.

The group conversations after having witnessed Ann's consecutive sums lesson had the exploratory talk qualities I discussed earlier (this was the second time expository talk happened during reporting/reflecting phase). It was quite different from the expository types of conversations that typically happened during a reporting teacher's turn. It was especially different from the example of Ann's reporting on her pizza problem lesson. While it is true that the temporal constraint I alluded to earlier is ameliorated in this case (since Ann had no time to analyze her students' work prior to discussing her student's work publicly), the group could have also felt constrained by the very fact that we were 'guests' in Ann's class and so any sort of questions or disagreements could be construed as bad manners. I suggest then that because the consecutive sums problem was announced as inappropriate for students, including students in higher elementary grades, it allowed Ann (who then invited others to join her) to have an uninhibited and very public exploration of her students' mathematical thinking on this problem.

The mathematical content of the tasks explored in teacher groups, therefore, is important not only when planning a mathematical discussion but also in relation to the possibilities it might offer when discussing students' work. The analysis I offered in the foregoing suggests that when the study group mathematics tasks generate students' work that is within the mathematical content that is to be studied in the reporting teacher's particular grade level, then the conversations around students' work might more naturally fall into the pattern of expository talk. If the task generates students' work that lies in between perceived mathematical boundaries of what students at particular grade levels are expected to study, then the teachers' conversations around students' work may have a better chance of becoming exploratory (e.g. might generate a collaborative re-examination of students' work or provoke disagreement about how to analyze the work).

5.3. *Some facilitator moves*

In the foregoing, I have made a case for the importance of attending to the tasks' possibilities for promoting exploratory talk when discussing students' work. However, the task alone cannot support and sustain particular kinds of conversations. The facilitator of a teacher group plays an important role in promoting and sustaining the group discussions. Similar to teachers in their classrooms, the facilitator is in a position to introduce, sustain and encourage norms of discourse and participation. Facilitator moves, just as with teacher moves in classrooms, are meant to further the group's collective insight by, for example, pushing for elaboration of ideas, asking participants to comment on each others' accounts and asking others to comment on what made or did not make sense about what anyone said. A close look at the transcripts of SATRR conversations quickly reveals that facilitator moves that worked well during mathematical discussions did not always work well when facilitating conversations around students' work.

To promote and support discussions on a mathematics problem, the facilitator asked for volunteers in no particular order to share their ideas. Typical questions during this phase were both open and very specific. For example, to get ideas on the table, she used 'open' questions such as: *"Anybody thought about it differently?" "Have we found all the possible ways?"* or *"Is there a solution that we're still puzzling over?"* More 'specific' observations or questions served to draw the group's attention to similarities and differences in the solutions that were offered – "*Ann had a different idea,"* or *"Does this sound like what Brian said?"* – and issued challenges to help clarify ideas (e.g. *"doesn't it have to be a half of something?"* or *"is that a convincing explanation?"*). Moving the conversation along required little work on the part of the facilitator: in fact, the teachers did not wait to be asked in order to speak and contribute their ideas.

When facilitating discussions about the students' work, the group facilitator similarly asked in no particular order for volunteers to share. However, the group quickly fell into the pattern of reporting in sequence and taking an uninterrupted turn from the youngest grade to the oldest. The Kindergarten and first grade teachers tended to report through retelling particular things students said and did (in these grades, students are just developing their writing skills), whereas the upper elementary teachers tended to report by showing students' written work. These two forms of reporting demanded different kinds of facilitator moves that prior to this project I had not considered.

Facilitator moves when there were no physical records of students' work, such as in the examples of expository talk of the pizza problem, contrast with those made in the fourth transcript example illustrating expository turned exploratory talk. In the expository reporting of the pizza problem, the facilitator asked very specific questions, such as *"What did other kids say about that?"* This is a question that invites further description. Another specific question: *"Why did you choose to pursue this particular student's idea and not the other?"* invited Ann to analyze a teaching move she had just described, but it failed to generate exploratory talk. These very specific questions (in past tense), that press for richer detail and analysis about the reporting teachers' account of what had happened in her class, did not generate exploratory conversations. In contrast, the interjection that turned the expository talk to exploratory was a very specific observation, and in present tense (*"this actually does not work"*). In fact, this engaged the group in discussing the students' work more thoroughly and led them to have a conversation precisely about the same issue that could have been discussed around Ann's teaching move for the pizza problem – what do we do with students' work that is mathematically incorrect and why?

One difference, in addition to the mathematics generated by these tasks as I discussed earlier, is that in the latter example the group had physical records of the students' work to point to and make the object of public examination. However, the mere presence or absence of physical records does not fully account for this development, since there were a number of other occasions when such records were present and the group talk remained expository. Another difference between the two sets of transcripts is that the facilitator's interjection in the latter instance was not about anyone's teaching move but rather about the students' work. It is Ann who posed a question about teaching: *"Are we suppose to say 'Taylor, there's no parenthesis in this number sentence, please explain?"* At first, I wondered whether this mattered, namely that the 'outsider' to their school teaching community was not the one raising the question about pedagogy.

I further noticed that Ann's question was an open question posed in a hypothetical manner (though it did have a challenging tone with an "excuse me" to preface the question, which undercuts the conventional politeness marker). When I examined the third instance of interruption to the teachers' expository talk (during the seventh SATRR and at the sixth meeting of the second year), I noticed that the facilitator had asked the reporting teacher a similar type of open and hypothetical question: *So if you were to do this again, what numbers would you use?* This question, although it was asked to the reporting teacher (and it is a question about pedagogy), invited others to join the reporting teacher's deliberations about what might make a good version of the discussed problem for her students.

Another indication that the distinction between more open and more specific types of questions might be important can be appreciated by looking at the less-specific kinds of questions the facilitator often asked during the 'reflecting' phase – e.g. *"what was hard about doing this problem with students?"* or *"what did we learn about students that we didn't know before?"* In response to these 'open' (and in past tense) questions, participants would often reveal more about the problematic aspects of their teaching and what was puzzling in their students' ideas, details that were not revealed when they were in expository talk mode. Ann forfeited the opportunity to reason out loud or enlist the help of others to make sense of her teaching action when the facilitator's question specifically asked about one of her teaching moves (which was possibly interpreted as a challenge rather than a genuine question). Yet when the facilitator asked questions that were less specific to the narrated events, teachers who when reporting sounded self assured revealed more about their struggles and tensions. Below is Ann's response to the question *'what was hard about doing this problem with students?"*

I struggled with the chunk of time that you talked about too [referring to the Kindergarten teacher's earlier comment to this question]. We had six different pictures and solutions all over the board and when I finally cut it off I still had four or five kids with their hands up wanting to say something more and come up to the board. I mean I wanted to get some other things done in math and we had already spent I think twenty – five minutes on it.

It is likely premature at this point to draw a firm conclusion about the role that open and specific questions play in moving expository talk towards more exploratory conversations with different forms of reporting. I simply offer these examples more as an invitation for further examination of the kinds of facilitator moves that might turn expository talk towards exploratory conversations. Looking at only three examples of expository talk turned exploratory, it is difficult to isolate factors that may be at play, but my analysis (albeit limited to three occasions) suggests we can learn much by looking closely at the facilitator's moves. Especially, I would encourage attention to the kinds of *specific* (calling for richer description or analysis of an account) and *open* questions or interjections (calling for speculative or hypothetical analysis) used and how these invite or not a group of teachers to have exploratory conversations about their teaching.

The examples I have presented suggest that while specific and open questions seem to work equally well in promoting collaborative conversations about mathematics among groups of teachers (elementary in this case), this may not be so when conversations are more focused on pedagogy. My analysis also suggests that different forms of reporting (with or without physical records) call for different kinds of facilitator moves. It especially draws attention to how physical records make it possible for the facilitator and others in the group to make a specific observation or ask a specific question about the students' work that can turn expository talk into a collaborative conversation. These kinds of specific observations and questions seem to have a different effect when teachers report through recounting their teaching and student activity. In this mode of reporting (and for this particular teacher group), questions that were specific failed to generate exploratory talk; but the open types of questions were generally more successful at generating further reflective talk from the speaker and, in one clear example, turned an expository reporting turn into a collaborative conversation among the teachers in the group.

It is also noteworthy that, in the first example of expository talk turned exploratory, the teachers did not disagree with one another; instead, they disagreed with the outsider to their immediate teaching community. It is hard to tell how the unspoken norm of 'not disagreeing' might be broken (in this case when teachers report on their students' work), but researchers who have studied teacher groups over time by means of looking at when and how they might disagree consider this a milestone towards achieving a community of teacher-learners (Grossman et al., 2001; Pfeiffer and Featherstone, 1995). My analysis calls attention to the challenge of achieving exploratory talk when teachers report on their students' mathematical work and to the need for explicit structures and facilitator moves (e.g. deliberate use of open and specific questions with different kinds of records of practice) that can turn the group's talk towards exploring and not solely reporting on students' work.

6. Conclusions and Implications

The analysis of the different kinds of conversations that emerged in one particular teacher group while engaged in discussions around their own doing of mathematics and around their students' mathematical ideas offers many new insights into the challenges and possibilities of learning in teacher groups. One relates to the differences between the two types of talk uncovered in this study and the opportunities for teacher learning that each can afford. These forms of talk are important, because they open or close opportunities for intellectual and collaborative conversations around two of the most common activities of mathematics teacher groups—study of mathematics and analysis of their students' work.

That most teacher discussions about students' mathematical work tended to take the form of expository talk is highly problematic, for the reasons alluded to earlier. However, I do not mean to suggest that expository talk is itself problematic, something to be banned from all teacher discussions. This form of talk provides opportunities for the participants to share and listen to each other's ideas, to extend their repertoire of students' thinking beyond their own students (and grade level, if the group is cross-grade) and sometimes to glance at each other's teaching moves and pedagogical reasoning. The point here, however, is that expository talk is insufficient to help teacher groups become a learning community, one that helps group members re-think and revise their ideas about issues of practice, such as ways of looking at students' work or ways of getting at students' mathematical ideas.

The present study contributes to the growing research on teacher groups and the field's attempts to characterize teacher learning in such settings. In Grossman et al.'s (2001) extensive study of a secondary English teacher study group, for example, the authors offer a distinction between 'a gathering' and 'a community' of teachers. They distinguish a *pseudo-community* (members pretend agreement and avoid conflict) from a *community* of teacher-learners, claiming that any given group is at one of three stages (beginning, evolving, and mature) of development. However, my examination makes clear that these elementary teachers were functioning as a community while working on mathematical tasks, yet would have to be classified as a 'pseudo-community' by anyone listening to their pedagogic discussions, thus problematizing this distinction.

The present study also calls attention to the complex ways in which teachers interact with each other around content and pedagogical matters. This study's finding – that teachers' content-focused and pedagogic-focused discussions were quite different in form – complicate models of professional development that presume uniformity in the conversational possibilities among the various types of professional development tasks and contexts. Such models – in particular Simon's (1994) learning cycles and Stigler and Hiebert's (1999) lesson study – are designed to bring groups of teachers together to talk to one another about mathematics and mathematics teaching. While calling attention to the different kinds of learning opportunities that are available to teachers as they work together on different aspects of mathematics teaching, these models have not made explicit the conversational possibilities and conventional constraints that different kinds of professional development activities afford. As noted earlier, if the quality of such learning opportunities depends on the quality of the talk, then it is important to develop more explicit articulations of what teachers' conversations sound like and why around the various types of professional development tasks and activities.

Another contribution of this study is that, in general, when looking at teachers as learners, there are questions as to what extent work developed to describe and analyze classrooms carries over into these adult learning contexts. My use of Barnes's categories here, in order to capture a distinction I noticed in the participants' talk, would be a specific instance of a possible crossover. However, while Barnes's categories mapped well onto the two types of conversational patterns revealed in this study, his explanations regarding the factors that contributed to such talk did not help explain why such distinct forms of teacher talk occurred in the context of teacher groups. A closer look at the conversations that failed to follow the exploratory – expository patterns suggested a different set of factors. The analysis reported here only scratches the surface of the complexity of participating and facilitating teacher groups and it invites further investigation into the nature and character of the conversations that happen and could happen in such a setting.

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Notes

1. The rationale behind this project's design is that the establishment of a school-based teacher study group with a focus on inquiry into mathematics teaching *among the very teachers who mentor our teacher education students* would make it possible for the prospective teachers in our program to work with mentor teachers who are reflecting, studying, and innovating their mathematics teaching practice.
2. Previously, we used the acronym SPTIR (Solving, Posing, Teaching, Interpreting and Reflecting).
3. Other researchers of teacher groups have noted the importance of listening for teacher learning in their professional conversations with colleagues. Grossman et al. (2001), for instance, suggest that if teacher learning is happening within teacher groups, we should be able to hear it in their talk. Similarly, Wilson and Berne (1999) suggest: "knowledge entails skills, ways of talking and interacting, ways of observing and noticing things in the environment and the dispositions toward action and interpretation" (p. 179).
4. This problem came from the hypermedia materials housed at Michigan State University documenting Deborah Ball's teaching in a third grade classroom during 1989–1990 school year. In Ball's classroom, this problem generated substantive class discussions around a particular number sentence (200 – 190). It also led to the assertion that there is an infinite number of number sentences that equal ten, because any number minus itself plus ten ($x - x + 10$) equals ten.
5. The 'Consecutive Sums' problem (Burns, 1992) was brought to the third meeting of the second year. The consecutive sums problem asks solvers to find all the different ways of writing each of the numbers from 1 to 25 as a number sentence of consecutive addends. Discussions around the teachers' mathematical work was rich and exciting, but when the group turned to discussing how to *Adapt* the problem with their grade-level students, the teachers unanimously decided this problem was not appropriate for their students. The teachers' worried that their students would get stuck and frustrated when, for example, they could not find two consecutive addends for any even number, or that it would be hard to help them understand that some numbers (powers of 2) cannot be at all written as consecutive addends.

6. The ‘Fair Game’ problem (Burns, 1992) was brought to the eighth meeting of the second year of the group. The problem asks solver to figure out if the following game is fair or not: Two players are playing a game with dice. The players get points by adding the sum of the numbers on the two dice. If the sum is even, the even player gets a point; when it is odd, the odd player gets a point. The first player to get 25 points wins. Is this a fair game? The conversation about the mathematics of this problem was also very rich and animated, with teachers not agreeing on how to count the possible combinations of odd and even sums. Teachers again decided not to try this problem with their students. Some teachers, for example, were understandably worried that this problem would raise issues about the commutative property of addition for their students, considering that in terms of probability 2+1 and 1+2 are considered *different* in terms of counting combinations.

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