Facilitating Grounded Interactions in Video Case-based Teacher Professional Development

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Abstract

The use of interactive video cases for teacher professional development is an emergent medium inspired by case study methods used extensively in law, management, and medicine, and by the advent of multimedia technology available to support online discussions. This article focuses on "grounded" discussions—in which the participants base their contributions on specific events portrayed in the case—and the role facilitators play in these interactions. This article analyzes the online exchange of messages in one school district that participated in a video case-based program of teacher professional development.

Literature review

Cases in Teacher Education

Twenty years ago a distinctive strand of literature on the roles and uses of cases in teacher education emerged (Merseth, 1996; Shulman, 1986). Inspired in part by the long-term use of cases in management and medical education (Barnes, Christensen, & Hansen, 1994), this literature strove to articulate how and why cases of teaching could be pivotal for teacher education. A point commonly raised was the importance to learn by reflecting in ways that stay in touch with the specific and local teaching situation:

> I envision case methods as a strategy for overcoming many of the most serious deficiencies in the education of teachers. Because they are contextual, local, and situated—as are all narratives—cases integrate what otherwise remains separated. (Shulman, 1992 p. 28)

Departing from the views of teaching as a process of applying theoretical principles and portraying it as a practical endeavor, many authors elaborate on the epistemology of "practical knowledge" (Fenstermacher, 1994; Shulman, 1986; Sykes & Bird, 1992), the growth of which has traditionally been associated with rich examples to reflect on

> Recent research on teacher thinking has broadened the conceptualization of the teacher from the one who operates with a narrow set of prescribed theories of propositions to one who defines his or her knowledge as situation-specific, context dependent, and ever emerging. . . . Teacher action derives from induction from multiple experiences, not deduction from theoretical principles. (Merseth, 1996 p. 724)

A key to working with case studies is attending to the particulars of their local and situated nature, noting circumstances that are often fleeting and elusive, and striving to experience how it feels to be in the described situation. "Grounding" refers to this type of attending and noticing. For example grounded commentaries and discussions of a case are rooted in the complexity of the experiences narrated by the case and embedded in the nuances of the portrayed events. Grounded discussions are possible when the case offers sufficient context and when the flow of the discussion is based on participants' interpretations of the events described by the case. It is our contention that discussions that remain ungrounded (e.g., those in which the actual case material is not used as evidence to support a certain interpretation) defeat the purpose of working with case studies, transforming them into occasions to repeat what the participants already know, obviating the need to question and learn new ways of seeing teaching and learning.

Several taxonomies have been proposed for different types of case studies and ways of discussing them. For example, Sykes and Bird (1992) propose that cases can be created and treated as (a) instances of theories, (b) problems for deliberate and reflective action, (c) material for the development of narratives, and (d) material for the development of casuistry, that is, the internal and tacit logic developed through the consideration of multiple cases. Shulman (1992) distinguishes between cases "as occasions for offering theories to explain why certain actions are appropriate" (p.3), cases as precedents for practice, similar to how "in the law . . . judgment stands officially as a precedent and demands the attention of other lawyers and jurists when they face analogous situations" (p. 5), and cases as "vehicles for inquiry and debate regarding proper ethical and moral behavior" (p. 7).

In all instances, what counts is not only the content and structure of the case itself but also the ways in which it is discussed. "It matters both what is discussed and how it is discussed" (Merseth, 1996, p. 727). Since discussions are central to the value of case studies in teaching and learning, this raises the issue of the facilitator's role and the ways in which he or she can productively steer the discussions. Within the literature most reflections on the role of the "discussion leader" highlight the tension between the facilitator's "agenda" and his or her ability to remain open to strands of discussion that emerge from the group itself (Barnett & Tyson, 1994; Merseth, 1996; Wasserman, 1994). Barnett and Tyson have identified three main roles for the facilitator: a) capitalize learning opportunities, b) promote consideration of diverse perspectives, and c) build on shared vocabulary and experiences. Welty (1989) argues that leading a face-to-face teacher discussion requires special skills for questioning, listening and responding. He proposes that a good discussion leader encourages a kind of "controlled spontaneity" that maintains a balance between freewheeling discussion and control, and conveys by example the importance of listening fully to achieve mutual understanding. Arcavi (2003) experimented with his role as facilitator by limiting himself to posing a family of questions, many of which prompted the group to conjecture what beliefs and goals might have motivated the case teacher to act as he did. Similarly, Levin (1993)analyzed her role in encouraging participant teachers to categorize their comments as either direct observations or interpretive inferences:

> As the facilitator I encouraged participants to clarify for themselves whether something was a fact or an inference by asking questions such as "Okay, how do you know that?" or "And so when you say that , Dana, is that your interpretation of what she meant by that?" . . . This format, and my probing whether something was a fact or an inference, had an effect on the way some participants thought about the cases both during and after the discussion" (p. 190).

Teacher professional development using video cases

Overviews of approaches to teacher professional development highlight the increasing use of video cases (Arcavi, 2003; Borasi & Fonzi, 2002; Seago, 2000; Sherin, in press; Stigler & Hiebert, 1997). Because of the unique power of video to convey the complexity and atmosphere of human interactions, video case studies provide powerful opportunities for deep reflection. However, the discussion of video cases does not always focus on this complexity and nuance, instead it often drifts into general comments in which the richness of video is irrelevant. How grounded conversations are achieved in online interactions is a pressing matter made more urgent by the rapid spread of Internet-based distance learning. How do participants learn to recognize and use "voice" and "tone" in written messages? Collison et al. (2000) describe major contrasts between onsite and online interaction:

> An online "interaction," however, takes on a different shape than its face-to-face counterpart. A talented lecturer or workshop leader is finely attuned to the

> nuances of his or her audience. But in the virtual world, there is no body language from which the instructor can gauge the interest of the participants and, consequently, adjust the tone or pace of the presentation. So accommodations in voice, style, and expectations must be made to support virtual facilitation.
>
> Online discussion areas offer many advantages you won't find in face-to-face settings. Text-based, asynchronous (not in real time) dialogue can, for instance, greatly extend reflection time; many facilitators and participants welcome the opportunity to compose thoughtful, probing contributions. . . . participants can access vast resources through hyperlinks for comparison or research within a dialogue.

Online interaction poses specific demands. Even those who are accustomed to leading case-based inquiry in face-to-face settings feel the need to make adjustments in moving from one learning environment to the other. Haavind (2000) illustrates two areas for adjustments:

In face-to-face classrooms, "if the first queries are met with silence, most instructors reword the question or add another question to spur response." Replicating this approach online may result in a "question mill" since all the questions confronting the reader demand equal attention, not just the last one.

In synchronous face-to-face discussions, summarizing is a common way to wrap up and create links with the next session, but often in online asynchronous environments such summarizing, rather than giving participants a sense of direction, closes the discussion.

Generalizing from Cases

Based on the literature and on our own past work, we suggest that using the particulars of cases as complex sources of evidence is at the heart of case-based pedagogy. Generating grounded interpretations is a condition for the possibility of learning from cases but not a guarantee of insight. Case-based discussions can be grounded while not being insightful or productive. On the other hand, lack of grounding makes case material superfluous and leads participants to be general and to reiterate their beliefs.[1] Ungrounded treatment of a case resembles the hypothetical doctor who does not inquire sufficiently about the patient's complaints, and proceeds to diagnosing and medicating almost immediately following a cursory exam. There are circumstances in which this behavior is justified; for example, when a patient has symptoms consistent with those of a widespread epidemic, the doctor may have good reasons for jumping to conclusions. But we can be certain that in these situations, the patients add little to the doctor's education; rather, they are made to fit pre-conceived categories. When the issue is professional education, lack of grounding is a fatal blow.

The core issue is how one generalizes from examples. In Nemirovsky (2002), we distinguish between formal and situated generalizations. Situated generalizations are those that remain woven onto examples, circumstances, and particular experiences. Formal ones are those that get detached from their concrete origins and stand on their own. In some domains, such as mathematics and computer programming, formal generalizations and ways of notating them are the heart of the matter. In others, such as education or law, situated generalizations take center stage. To convey the sense of how situated generalizations

[1] Some cases stimulate grounded interactions more than others by providing substantial context and a content that is unlikely to be solved by "pigeonholing" it. They tend to be border cases in the sense that they do not cleanly fit the learners' expectations.

operate let us introduce an everyday example: out of conversations with someone who has grown up in Mexico, we can conclude with some confidence that Mexicans use certain words and accents that are not standard in other Spanish-speaking countries. But it is important that when ascertaining Mexican's Spanish, we keep in mind the person we have talked to and his life story. For instance, upon encountering other Mexicans the fact, say, that our conversant grew up in Monterrey in a middle-class family would help us to perceive that some of his talk features characterize Monterreians of a certain time period and not all Mexicans. The bottom line is that domains where situated generalizations are crucial are those in which by dismissing the origins and contextual particulars what one gets are not generalizations but stereotypes.

Situated generalizations do not separate theoretic-general points of view from the examples and circumstances that serve as their evidence. We propose that developing new and richly situated generalizations is the main goal of case-based pedagogy. Grounded conversations create contexts that make possible the growth of situated generalizations.

Context for this study

Seeing Math Telecommunications Project

The Seeing Math Telecommunications Project is funded by a grant from the U.S. Department of Education to study the effectiveness of teacher professional development using online video case studies with elementary and middle school teachers. To develop the case studies and make them available online, the Concord Consortium partnered with Teachscape, an educational service that collaborates with school districts and states to create programs of professional development supported by Internet-based multimedia resources. To date the project has completed nine cases.[2] Each video case focuses on a concept from the National Council of Teachers of Mathematics standards that is typically difficult to teach or to learn, such as fractions, division with remainders, calculating the area of a triangle, or using data to make predictions. Seeing Math case studies use short video episodes to depict experienced teachers at work—teachers who are committed to reflecting on and improving the learning experiences of their students. The episodes serve as objects of study and a focus for participants' reflection on their own work. The central goal is to foster a reflective attitude among participating teachers about their own teaching and their own understanding of the mathematics they teach. The Seeing Math video cases provide a common body of classroom events, teachers' reflections, content experts' interpretations, and suggested teacher activities, which allow the participants to share stories, questions, and data about key mathematical and teaching ideas. They are not designed to lead participants to a specific conclusion or interpretation. Instead, the cases serve as a framework for grounded, and provocative discussions. The hope is that, like any good movie or novel, the cases are open to the viewer's interpretation.

Division with Remainders

The two teachers in this case teach the concept of division in a problem-solving context before introducing an efficient algorithm to find answers to division problems. It includes a selection of episodes from the fourth grade classrooms of Nancy Horowitz and Mary Beth O'Connor in the Springfield Public Schools, Springfield, and Massachusetts. Horowitz and O'Connor taught the same lesson to their students. Ms. Horowitz, the lead

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2 See a short explanation and video clip at http://seeingmath.concord.org/screenroom

mathematics teacher for the school, is one day ahead in the curriculum. The selected episodes occurred before the students became familiar with algorithms for calculating division with pairs of integers. Students had studied multiplication and the basic number facts associated with the "times tables" and had studied division as an inverse operation to multiplication, using whole numbers with integer answers. They had used arrays to investigate both multiplication and division of integers. In the video case the class discusses problems with a remainder using a single pair of numbers: 36 and 8. These activities are part of the school curriculum that Horowitz and O'Connor followed (*Arrays and Shares,* Investigation 2: Sessions 7 and 8 of the *Investigations in Number, Data, and Space*).

During the pilot phase of the Seeing Math project—the 2001-2002 and 2002-2003 academic years—four school districts participated in the Seeing Math courses. The Math Coordinators of these four school districts selected Division with Remainders as the first course offering for elementary teachers of their school districts. For the purposes of this paper, we have chosen to analyze the online postings in a discussion forum generated by the participants from the Rapid City (South Dakota) Public School District. Division with Remainders was offered three times with successive refinements in its management, which allowed the project to explore changes in the case discussions. We analyze postings from the first two course offerings.

Data and Methods

We base our analysis on the messages exchanged by the participants from the Rapid City Public School District during the spring and fall 2002 semesters. The first group included four self-selected elementary school teachers, three of whom were from the same school building. The second group consisted of 21 participants (16 elementary school teachers from 10 school buildings, and 5 student teachers from a partner university).

Both groups contributed to online discussions with frequency and responsiveness, and both had periodic face-to-face meetings. Our analysis is based on the complete documentation of the online interaction. In addition, we had access to written and oral testimonies of the face-to-face meetings from the district Math Coordinator.

We studied the online postings in the content discussion area. The corpus from the spring 2002 course interaction includes 31 messages; the fall 2002 course offering includes 194 messages, of which 176 were related to the content of the course. In spring 2002 and fall 2002 the majority of exchanges were organized in terms of a message posing a question, in almost all cases written by the online facilitator, followed by successive responses from the participant teachers. Messages that elicit responses in this way are "seeds," from which additional reflections grow. The interactions were mostly "radial," such that each facilitator's seed prompted a cycle of individual replies followed by another seed, and so forth. Given this structure, we based the organization of the analysis on seeds and types of responses. We identified seeds that elicited grounded responses and those that did not. In order to determine the origins of patterns, we examined selected postings in detail

Spring 2002 Semester

We began by differentiating between postings that referred to the video case classroom from those that referred to the teachers' own classrooms. We also differentiated between general references to ideas and classrooms, and references that identified or described particular moments and events in the case study. To facilitate these distinctions we defined the following types of postings categories:

- General Remarks
  Type A = Postings in which the participants express their general views about a certain matter

- General remarks connected to the case or the classroom

  Type C = Postings that refer to the overall quality of teaching shown in a video case
  Type D = Postings that refer to general characteristics of participants' own classrooms

- Grounded remarks

  Type B = Postings in which participants refer to specific events or utterances in the video case
  Type E = Postings that refer to specific events in participants' own classroom

During spring 2002, thirty one postings were originated by the facilitator and four teachers of the Rapid City Public School District. The distribution of types is summarized in Table 1:

	General Remarks	General remarks about the case or the classroom		Grounded remarks		
Type of entry	A	C	D	B	E	Total of content related postings
(Rapid City Forum)	14 48.3%	2 6.9%	12 41.3%		1 3.5%	29

Table 1: Distribution of messages during spring 2002 (one facilitator and four teachers from Rapid City Public Schools District)

Table 1 suggests that grounded messages were essentially absent. The following are two examples of entries coded as types C and D that provide a sense of the exchanges:

> I think that the questioning strategies and students responses [of the Division with Reminders case] allow the higher level students to gather more information on different processes that were used. I know that in my classroom through discussion and questioning my lower students tend to keep up with the higher level thinkers because instead of discouraging them I encourage them. They come up with many responses and maybe even push my upper level students to think a bit more.
>
> I have tried these methods in my classroom for the past month, thinking my students had a better understanding of division than they do. My higher students did well on this, but my lower students struggled. I think we as teachers have to take students from where they are and then build with them. Sometimes that even means to teach them differently and hope that they can identify their own misconceptions. My question is how long do we spend on this before we move on? As always a concern is: so much to teach and not enough time.

In the summer 2002 we offered a "net seminar" with course facilitators in order for them to share their observations on past courses and develop facilitating strategies for new courses. The facilitators agreed that discussions lacked grounded interactions, though facilitators also acknowledged that they had not been aware of the specific goals for the discussions: "It would have been helpful to have had a discussion at the winter meeting about the level of discussion you were anticipating or 'aiming' for. As facilitators, we could have framed questions to support and encourage dialogue around connecting specifics of the case with classroom practice."

One net seminar participant introduced the difference between face-to-face meetings and online interactions in that grounded commentaries were easier to elicit in face-to-face meetings: "Perhaps in an online environment, it is more difficult to reach a level of trust so that one is not at risk by expressing one's thoughts and experiences. It could also be that face-to-face interaction is more spontaneous, in contrast to online messages in which a single posting might result from a whole process of thinking what to say and overcoming doubts as to whether to post it or not. It could be that the difference is merely a matter of time, in other words, that it simply takes longer to feel 'at home' in an online community".

The facilitators agreed to change their facilitating strategies during the fall semester.

Fall 2002 Semester

There were 176 postings related to the content of the course, which were exchanged by the participants from Rapid City Public Schools District (see Table 2).

	General Remarks	General remarks about the case or the classroom		Grounded remarks		
Type of entry	A	C	D	B	E	Total of content related postings[3]
(Rapid City Forum)	75 34.7%	65 30%	39 18.1%	25 11.6%	12 5.6%	176

Table 2: Distribution of messages during fall 2002 (one facilitator and 21 participants from Rapid City Public Schools District)

The increased number of messages of types B and E that suggest grounded interactions is immediately apparent. The corpus includes 13 seeds. We identified each seed by a bracketed number corresponding to the order in our database:

[74] How is division with remainders taught in your classroom? What are the positive and negative aspects of the approach you are currently utilizing? [17 replies]

3 The sum of entries is greater than 176 because some messages belonged in more than one category. Percentages are calculated based on 216 entries that fit in the categorization.

[105] What statements did you hear in the introduction that caused you to begin reflecting on the traditional method of teaching division? Did anything Mary Beth or Nancy said "ring a bell" with you? [15 replies]

[120] (The post begins by describing The National Research Council criteria for "mathematical proficiency" to capture what it means for anyone to learn mathematics successfully.) What specific examples from the video would help you reach a conclusion about whether the instruction in Mary Beth's classroom would develop mathematically proficient students? What are the implications for your classroom instruction? [15 replies]

[136] Inquiry-based instruction changes the "traditional" role of the teacher. What have you observed in the videos that will help you redefine your role as a math teacher? [19 replies]

[157] How are Nancy's questions different from or similar to what you do in your classroom? What questioning strategies do you use? [19 replies]

[180] What do you know about the division process and teaching division through problem solving that you didn't know before? How will that knowledge be applied in your classroom? [27 replies]

[207] Do you remember watching the video case of the van problem? Nancy had a student who said, "Five can't be the answer because 5 isn't a factor of 36." That reminds me of the situations you are describing with your students. Do you feel that many students are less flexible because of their prior math experiences? Could that be a weakness associated with "naked number" computation with no context before concepts have been developed in problem solving contexts? [1 reply]

[209] The approach in these lessons is to establish conceptual understanding of division before practicing with an algorithm. (Not necessarily a "standard" algorithm.) The next set of lessons uses more complex numbers so that counting or grouping strategies will be more cumbersome, or even fail. What do you see as positive and negative aspects of this lesson design? [20 replies]

[232] Here is a problem. I'd like to know how you think: Nancy and Peggy each have a pan of brownies that are the same size. Nancy cut hers into 8 equal pieces and ate 3 of them. Peggy cut hers into 10 equal pieces and ate 4 of them. Whose pieces were bigger? How do you know? Who ate the most brownies? How do you know? [2 replies]

[236] What specific instances in the video case have provided you with an "aha" moment, or caused you to reflect on your math teaching? What might have been included in the video case to make it more helpful for you? [13 replies]

[250] The goal of the program is to provide web-based professional development for teachers using video cases. Presenting a window into the practice of selected teachers provides a starting point for participants to begin a larger exploration of their own practice. The profiled classroom is not presented as a recipe for emulation or exact replication but as a basis for you to reflect on your own classroom practice. How has the video case provided a basis for personal reflection? [10 replies]

[260] Wendy questioned whether the teacher would return to earlier multiplication lessons since students didn't seem to be making the connection. Did you observe Nancy

asking intentional, specific questions that would assist students in making that connection? How would the work in the upcoming lessons (see Lesson Plans) strengthen the multiplication/division connection? [4 replies]

[264] What did you find helpful and user friendly about the Division with Remainders course and website. What suggestions would you make to improve the course or the website. Your will be greatly appreciated and shared at our national meeting next week. Thanks! [1 reply]

We can classify the 13 seeds according to five criteria. The seeds marked “G” were the ones that generated grounded messages.

Seeds that invite teachers to describe how they teach

74	105	120	136	157	180	207	209	232	236	250	260	264
X												

Seeds that invite teachers to comment on something specific they saw or heard in the video case

74	105	120	136	157	180	207	209	232	236	250	260	264
	X	X G	X G	X G					X		X G	

Seeds that invite the teachers to evaluate the lesson in the video case

74	105	120	136	157	180	207	209	232	236	250	260	264
							X					

Seeds that invite teachers to explain ways of solving a mathematics problem

74	105	120	136	157	180	207	209	232	236	250	260	264
								X				

Seeds that invite teachers to evaluate the course for their TPD

74	105	120	136	157	180	207	209	232	236	250	260	264
					X G				X	X		X

In the following sections we discuss in detail the responses elicited by three seeds ([74], [120], and [180]). Appendix I includes the replies to seed [232] because they exemplify a distinct possibility for the grounding of interactions in ways of thinking mathematical problems.

Analysis of seed [74]

> [74] How is division with remainders taught in your classroom? What are the positive and negative aspects of the approach you are currently utilizing?

This seed generated 17 replies, most of which refer to the sequences of activities teachers conduct in their classrooms. The majority of the activities are described in one or two sentences. In a few cases they include examples of problems teachers use. Many then elaborated on the negative and positive aspects of what they do. The following are two examples of postings of this nature. Bold type highlights a descriptor that indicates the type of classroom activity they refer to. Italics mark examples of problems they use.

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[75] When I teach division with remainders I always take out the **manipulatives** and give the children blocks and ask them to put them into two groups. Immediately, they see that they have one left over. **I make problems and then I have the children make problems, too**. They like that. That makes them feel in control. They learn when they are doing and then I have the children explain their answers. I also always try to **relate division to real-life situations**. *There are two boys and five pieces of pizza. How many pieces does each boy get? Or better yet, put 10 marbles in three groups.* I want the children to think through the answers and be able to explain their answers. **Writing in a math journal** explaining what they did and why is also helpful.

The good thing about this approach is that they are actively learning--thinking, manipulating and hopefully learning. Being able to explain their answers or to re-teach it to someone else forces the kids to think and evaluate what they did. Maybe they will see if their answer makes sense.

The bad thing about this is that they can't use manipulatives on larger problems. What do they do then? Learning must transfer from the concrete to the abstract.

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[77] I usually started immediately after the multiplication unit and started with **algorithms with a missing factor**, (3 x ___ = 12), and then I switched to using **unifix cubes**. I would start with 20 or 30 unifix cubes in groups of ten, and give the kids problems like *how many groups or four are there in 20? The kids would then put the cubes into groups of four to find the answer. If I asked how many groups of six are there in 20, we had a discussion about the left over cubes.* After this I taught the kids how to solve a division fact by using **counters or dots with circles drawn around them**. From there I switched to teaching the kids **how to do the algorithms**.

The advantages of the way I did it was that there was a smooth transition to division from multiplication, and the kids had tactile and visual problem-solving experiences to fall back on.

The biggest disadvantage was that when we actually started long division, the students often lost the connection to the unifix cubes and the ideas they were beginning to internalize. Division became an activity of process memorization.

Only one posting referred to a specific event that took place in a classroom, although it describes it sparsely:

[80] One day my class was doing an economics lessons that required division although the students weren't aware of it at that time. I asked if anyone saw another way to solve or a shorter way. One student did. He saw the grouping and repeated subtraction (division) that was possible.

The entries include commentaries about general ideas on the teaching of division. For example:

[78] I enjoy teaching division and I try to make it positive for my students

[80] I knew students had to understand WHAT they were doing before the process made sense.

[82] We try to incorporate real-life situations and story problems whenever possible.

[83] If students are struggling with the concept of division then we will have guided math groups using manipulatives to help them.

[85] Most of my students are in a total math program with me and it's a skill that is usually too difficult for my students.

[88] I use many of the means to introduce division and division with remainders already discussed. I agree with the advantages and disadvantages. My weakness is teaching for understanding with the larger numbers.

[90] Houghton Mifflin does a nice job of using **manipulatives** to introduce division with remainders.

[93] In third grade, teaching division is related to multiplication, much like **fact families** in addition and subtraction.

Commentary

Seed [74] did not generate grounded replies. Participants did not include descriptions of specific situations that took place in their classroom or the case study classroom or anything on what particular students said or did. The positive/negative judgments alluded only to general values. This interaction suggests that general requests for how the participants teach, while possibly useful in other ways (e.g., to introduce themselves to the group), do not motivate grounded interactions. It is important to note that this lack of grounding does not imply that the interaction was pointless; in fact, it served as a valuable way for participants to get to know each other and to get a sense of common classroom practices (e.g. using manipulatives, word problems, etc.). Ungrounded contributions, in the form of general descriptions or opinion statements, may allow participants to become aware of what others think and do. They are unlikely to generate questionings and changes of perspective—the substance of professional development—but can be instrumental for building a sense of community and personal identity.

Analysis of seed [120]

> [120] The National Research Council uses the term "mathematical proficiency" to capture what it means for anyone to learn mathematics successfully. They view mathematical proficiency as having five strands: 1. Conceptual understanding (comprehension of mathematical concepts, operations, and relations). 2. Procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently, and appropriately). 3. Strategic competence (ability to formulate, represent, and solve mathematical problems). 4. Adaptive reasoning (capacity for logical thought, reflection, explanation, and justification). 5. Productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in self- competence). These five strands are interwoven and interdependent and have implications for how students acquire mathematical proficiency and how teachers develop that proficiency in their students. What specific examples from the video would help you reach a conclusion about whether the instruction in Mary Beth's classroom would develop mathematically proficient students? What are the implications for your classroom instruction?

This seed generated grounded commentaries. As an example, note the remarks included in message [124] (separated by us into distinct bullet points) referring to a specific event from the video case:

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[124] Mary Beth started by establishing a set that drew students into a challenging but fun group process. She spoke with the students instead of at them and did so with enthusiasm, energy, and active listening. It appeared that students had the opportunity to develop proficiency. Examples:

Students immediately knew what to do with the numbers 36 and 5 to create their story problem. Thirty-six represented the total number of objects, and 5 represented the number of friends. This shows a basic understanding of quantity and comparison of quantity (36 is greater than 5).

Mary Beth asked what the question would be. The answer came easily, i.e., how many does each child get? Students seemed to understand what relationship they had established between the total quantity and the number by which it was to be divided. They saw how they had chosen to represent each quantity (monsters and friends).

One student suggested representing the number of monsters by drawing an "m" rather than by drawing an individual monster each time. Use of symbols to represent quantity seemed easy for the students.

When faced with what to do with the 36 monsters and 5 friends, one student began sorting 36 among 5 by directing the teacher to draw an "m" under each friend's friend's face and "keep going until all the monsters are used." The student sorted one at a time representing an understanding of one-to-one correspondence.

The teacher asked if anyone saw a pattern emerging. One student responded that there would be one monster left. Another said quickly, "It's a remainder."

In the following example from message [126] the teacher points out how the problem posed by the teachers in the video case reverses the usual format in which the students are given a problem and they have to choose an arithmetic operation.

[126] The concept of division is given to the class when the teacher said, "...today is 36 divided by 5." The students really didn't have to choose an operation, but the class does indicate understanding by coming up with an appropriate problem with which to use the numbers.

Commentary

Seed [120] was remarkable for its generative power of grounded commentaries. A characteristic of this seed is that it not only asked for "specific examples," but ir also provided a criterion or an issue (e.g., the NRC definition of mathematical proficiency) in relation to which the particulars of the video case are to be selected. In other words, this seed suggests that it is not enough to ask respondents to be specific in their replies; it is important to also offer a perspective for the respondents to reflect on.

The interaction triggered by seed [120] suggests why grounded interactions have the potential to stimulate reflection and changes of perspective. For example, it is students are customarily asked to solve an arithmetic calculation posed as a word problem, but it is unusual for students to be given two numbers and an operation, 36/5 in this case, and asked to develop a corresponding story. By discussing this Story Making" activity, the participant teachers encounter the possibility of developing a *situated generalization* about arithmetic story telling, that is, they could embed this activity-idea in the particulars of Mary Beth's and Nancy's classrooms (e.g. "Students immediately knew what to do with the numbers 36 and 5 to create their story problem"), and in what their students said and discussed (e.g. "One student suggested representing the number of monsters by drawing an "m" rather than by drawing an individual monster each time."). In other words, by grounding their contributions in the case, the participant teachers were not limited to a general proposition (e.g. "third graders can create arithmetic stories"), but were able to build a body of knowledge about arithmetic stories enriched and held together by actual people, classrooms, and children's ways of thinking presented by the video case.

Analysis of seed [180]

> [180] What do you know about the division process and teaching division through problem solving that you didn't know before? How will that knowledge be applied in your classroom?

Seed [180] prompted participant teachers to ground their replies in their own classroom experiences resulting from their own work with situations similar to the ones presented in the video case.

Note in messages [204] and [205] that the teachers included a concrete account of their observations:

[204] I also work in a remedial type situation in two schools, and have experienced the same challenges with my students. We worked on the problem involving the 36 students taking the field trip using vans that could seat 8 students. When I asked them to make a graphic representation of how they would go about solving this problem they appeared to have no idea how to start. I had to move to a more direct teaching model to get them started on solving the problem. As they caught on to the idea, they started out drawing the vans and filed them with stick people. As they worked together, one of the students started adding numbers above the vans to keep a running count of the number of students being represented in each van, which I thought was a nice progression. When they realized they had left over students, they quickly determined they just needed to take another van, something I thought they would find more difficult. The next day we tried another problem, which they solved more rapidly than the first problem. Obviously they were more comfortable with the process the second time. Though the process was becoming a little easier for them, they still needed guidance in solving the problem. I think our students will always require more directed type modeling at the beginning of each new problem, but through my observations last week I know for the most part they are capable of acquiring a deeper understanding of division with remainders as well as other mathematical concepts.

[205] I have had fun with this new method of teaching division. I have noticed some kids stretch readily when being questioned and others are cognitively rigid, at least for the time being. I asked a high school special ed. student, to solve a problem in which he had to display pretty soaps in dishes. He had to figure out how many plates he would need if he put 4 soaps per dish, and there were 31 soaps in all. He really had no problem with the complexity of the numbers, but when he found that there were 3 soaps left over, he was ready to say that 7 plates were needed, remainder 3. After I asked several questions it became apparent that having 3 soaps sitting on the counter, not on a plate, was fine with him. When I finally led him to suggest using 8 plates, he would only agree if I added another soap. That's fine, but I am wondering about the unanswerable question. Why the rigidity? Is it the teaching methods that have been used? Is it an unfamiliarity with the inquiry method? Does he believe there is only one way to do math? Anyway, this is a lot of fun. With this student, I knew he could find the answer to division in this problem, but I was curious about his thinking. I will connect with him again many times and see where we go from here. Do any of you have any thoughts on this?

Commentary

Seed [180] elicited reflections grounded in the teachers' own classroom experiences. Note the differences between these postings and those generated by seed [74]. This disparity suggests to us that rather than a general request for "how you teach," what seems to prompt grounded postings is a request to discuss the participants' classroom experiences in light of the experiences in the video case. A grounded interaction does not have to exclude theoretical considerations, or general remarks, to the extent that they do not lose touch with the situations that brought them into consideration. For example, posting [204] concludes with this reflection: "I think our students will always require more directed type modeling at the beginning of each new problem, but through my observations last week I know for the most part they are capable of acquiring a deeper understanding of division with remainders as well as other mathematical concepts." This is not a self-standing or isolated remark; the teacher is comparing her students to Mary Beth O'Connor's and Nancy Horwitz' students, and observing out of her own experience that while she had to give more guidance, her own students were also able to create arithmetic stories. Posting [205] raises the example of a student who expressed, in the view of the teacher, an unusual "rigidity." At the same time, we are also given the specifics of the case and his concrete utterances, so that others can ascertain whether this is a common occurrence and whether it could be seen as an instance of "conceptual rigidity."

Conclusion

While the distribution of the five types of postings in the two semesters changed, we focused on those changes that seemed to relate to the issue of the grounded quality in the exchange. This choice reflects our view that taking the particulars of cases as complex sources of evidence goes to the core of case-based pedagogy as a condition for the possibility of learning.

In trying to understand the role of the facilitator to foster grounded conversations, we analyzed the messages posted in the spring and fall 2002 semesters from members of the Rapid City Public School District. We coded the 13 seeds by what they were calling for. [This sentence is unclear.] We prefer not to label the seeds themselves as grounded because what counts is what type of replies and reflections they tended to foster.

Our analysis suggests the following:

- Grounded discussions do not happen spontaneously, they need to be fostered and stimulated by facilitators.

- The request for participants to be specific is not enough to guarantee that they focus on particular vignettes in the case study or in their own experiences. Articulating a specific issue or criterion in connection to which participants are asked to be specific makes a principal difference.

- Asking for particular similarities and differences between the episodes in the video case and the teachers' own classroom experiences as they work on related activities appears to be a generative way to foster grounded interactions.

Grounded conversations are important starting points for case-based professional development. But they are no more than beginnings. Ultimately, the aim would be to engage the participants in articulating different interpretations and in discussing the extent to which the case material provides evidence and support for them. Along these lines, the point of grounding is to confront our own pre-conceived views and to learn to see situations in a new light. How this process of learning to see teaching and learning situations in a new light unfolds over time remains as a major research question for the field.

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Appendix I: Seed [232] and its two replies

We include this short exchange to record another form of grounding which, although unusual in this particular forum, can be of great significance for teachers' professional development: interactions based on different and personal ways of thinking about mathematical problems.

> [232] Here is a problem. I'd like to know how you think: Nancy and Peggy each have a pan of brownies that are the same size. Nancy cut hers into 8 equal pieces and ate 3 of them. Peggy cut hers into 10 equal pieces and ate 4 of them. Whose pieces were bigger? How do you know? Who ate the most brownies? How do you know?

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[233] This would be so much easier to explain with a drawing... or model but I'll try to explain how I thought about the problem. The problem also helped me reflect on why converting fractions to equivalent fractions with common denominators would be useful. Nancy's pieces were bigger because the more pieces something is divided into the smaller the pieces are so 1/8 is larger than 1/10. I could draw two identical rectangles and cut each in half. The halves of Nancy's brownies would then be cut in fourths, while the halves of Peggy's brownies would be cut in fifths. You could compare the pieces to verify that 1/8 is greater than 1/10. You could also convert both pieces to fractions with a common denominator (which I did after I had solved with a model) 1/8= 5/40 and 1/10=4/40. Using the same pieces you could see that Peggy actually ate more brownies because she ate 1/10 less than 1/2 and Nancy ate 1/8 less than 1/2. Also, the pieces could be laid on top of each other to determine who ate the most. (And Peggy, I'm glad you got more!) There's actually a great pizza riddle about this concept. Using the common denominators, 3/8=15/40 and 4/10=16/40, so Peggy ate more.

[234] I also used a diagram but I "superimposed" one on the other by dividing with two different colors. This way I was able to see the size differences easier than using two separate drawings. The fractional differences were small enough that an inaccurate drawing would not necessarily reflect the correct answer. Then I had to "do the math" just to satisfy myself. 3/8 = N/10. N = 3.7 so Peggy had more by eating 4/10

Commentary

These two postings were grounded because they went beyond stating a solution (e.g., "Peggy ate more brownies than Nancy") or a general procedure (e.g., "reduce to a common denominator and compare their numerators"). The postings describe the particular ways in which the participant thought about the situation and how they tried to recast the problem in terms that appeared to them intuitively easy to see. For example, by thinking of halves of the pan of brownies and explicitly stating that 1/10 is smaller than 1/8, posting [233] arrived at a concise conclusion: "Peggy ate 1/10 less than ½ and Nancy ate 1/8 less than ½." While this assertion might still be unclear to others, the writer of this posting offers a detailed account of her own thinking process. Posting [234] reflects a different strategy relying on visual comparisons; it includes the teacher noticing that unless the drawing is made accurately, the visual impression might not convey conclusive evidence.