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EXPLORING A PEDAGOGY FOR THE SUPERVISION OF PROSPECTIVE MATHEMATICS TEACHERS[1]

ABSTRACT. Our investigation explored a pedagogy for supervision through a case study of one prospective middle school mathematics teacher during her student teaching semester. Classroom observations by the university supervisor, teaching episode interviews between the supervisor and student teacher, and focused journal reflections by the student teacher were coordinated to challenge the student teacher's existing models of teaching. The emerging pedagogy of the teaching episodes, a central focus of this study, was characterized by (a) the use of open-ended questions that centered the student teacher in the process of sense making; (b) a shift away from the supervisor's direct, authoritative evaluations of the student teacher's practice; (c) a sustained focus throughout supervision derived from the student teacher's classroom experiences; and (d) an effort to maintain sensitivity to the student teacher's zone of proximal development. We found our approach to be coincident with the notion of *instructional conversation* (IC) advanced by Gallimore and Goldenberg (1992). The nature of the teaching episodes seemed to open the student teacher's zone of proximal development so that her practice of teaching could be mediated with the assistance of a more knowing other.

Few would seriously question the complexities of the student teaching practicum. The practicum reflects the integration of sometimes dissonant agendas of teaching and learning that ultimately define a community into which the student teacher is acculturated. It demands that the student teacher negotiate tensions imposed by the juxtaposition of school and university cultures in the context of a practice still in its infancy. It is from the overabundance of pedagogical beliefs and practices constituting these communities that the student teacher's practice emerges.

Despite these challenges, the practicum still promises the optimal setting in which knowledge of content and pedagogy coalesce in the making of a teacher. This opportunity naturally invites questions about the role of agencies associated with the practicum in effecting teacher change. Of particular interest here is the place of university supervision. Specifically, does supervision act as teacher *education*, or does it instead confirm the student teacher's pre-existing habits of teaching by focusing on peripheral issues of practice? More importantly, how can supervision function as teacher education? Research on the supervision of student teachers has produced a continuum of responses to these questions. Whereas the

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more skeptical suggest that we abandon supervision altogether (Bowman, 1979), others argue that we must fundamentally alter the way we supervise if we are to effect real change in the ways that student teachers teach (Ben-Peretz & Rumney, 1991; Borko & Mayfield, 1995; Feiman-Nemser & Buchmann, 1987; Frykholm, 1996; Richardson-Koehler, 1988; Zimpher, deVoss & Nott, 1980).

THE ROLE OF SUPERVISION: EDUCATION VERSUS EVALUATION

Historically, university supervision has tended toward more evaluative rather than educative interactions with student teachers. That is, traditional supervision may be more closely described as an assessment of the student teacher's existing habits of teaching, buried within an attention to classroom bureaucracy, rather than prolonged interactions purposed to challenge those existing habits. Quite possibly, this emphasis is a reflection of the chronological placement of student teaching at the end of academic teacher preparation. It might also reflect the dilemma that supervisors are sometimes inadequately prepared to seriously challenge a student teacher's ability to teach a particular subject. Furthermore, case loads that leave little time for one-on-one interaction between the supervisor and student teacher often relegate the supervisor to an evaluative role. However, Feiman-Nemser and Buchmann (1987) challenged us to reconceptualize the practicum, and hence supervision, as preparatory to future learning, that is, as educative rather than simply evaluative. Zeichner's (1996) admonition that we "view the practicum as an important occasion for teacher learning and not merely a time for the demonstration of things previously learned" (p. 216) echoes the need for an educative approach to the supervision of student teaching.

Research indicates that an educative approach is not currently assumed in all supervisory relationships. In an investigation of guided practice interactions between university faculty, cooperating teachers, and student teachers, Ben-Peretz and Rumney (1991) pinpointed the lack of professional reflection provided by support personnel. They found that the authoritative demeanor adopted by supervisors was met with passivity from student teachers, with the result of little change in practice. Borko and Mayfield (1995) found that supervisors focused on superficial aspects of teaching, such as paperwork, lesson plans, and behavioral objectives, and avoided in-depth discussions about content and pedagogy, and thus, offered student teachers no specific directives on how to change their practice. Concluding that supervision seemed to exert little influence on

student teachers' development, they proposed that supervisors should actively participate in student teaching and "challenge student teachers' existing beliefs and practices and model pedagogical thinking and actions" (p. 52). Although these recommendations might be seen to conflict with the physical parameters, such as time, that constrain supervision, a strictly evaluative approach does not seem to engender substantive change in teaching. In short, active participation in student teaching will require more than peripheral commitments by the supervisor but could result in a practicum that functions as teacher *education*, not just teacher *evaluation*.

Why should we consider an approach to supervision that challenges student teachers' models of teaching in the context of their practice? First, it is within the demands of the classroom that a student teacher's internalized models of teaching are most readily revealed (Feiman-Nemser, 1983). Such models, a legacy of the "apprenticeship of observation" (Lortie, 1975) realized through one's years of schooling, will persist throughout the practicum if left unchallenged. Indeed, the assumption that desirable teaching habits necessarily derive from the activity of student teaching is challenged by existing research. For instance, Feiman-Nemser (1983) cited studies in which successful student teaching was most often equated with the achievement of utilitarian goals affiliated with classroom management. This perspective on successful teaching could likely impede any designs by teacher education programs to infuse theory into practice. Feiman-Nemser (1983) and Feiman-Nemser and Buchmann (1987) also reported that student teachers tend to imitate the persona of the school community into which they are acculturated. Such behavior, which might reflect the specific habits of the cooperating teacher or the more general attributes of the school bureaucracy, could persist in the absence of supervision that challenges student teachers' models of teaching.

Taken together, these findings suggest that the way we conceptualize supervision portends the nature of teacher development during the professional semester. It is the supervisor who is most able to "provide support and guidance for student teachers to integrate theoretical and research-based ideas from their university courses into their teaching" (Borko & Mayfield, 1995, p. 517). However, meaningful supervision rests on reinterpreting the role of supervisor as teacher. Sporadic visits by a supervisor whose primary function is to evaluate peripheral characteristics of teaching seem to be an ineffective route to changing practice (Borko & Mayfield, 1995; Frykholm, 1996).

From this position, we explored the nature of *educative supervision* during one middle school mathematics student teacher's practicum. By educative supervision, we mean supervision that prioritizes the devel-

opment of a student teacher's practice through prolonged instructional interactions with and extensive classroom observations by the university supervisor. Additionally, we defined it to include but not be limited to evaluations by the university supervisor. We conceptualized educative supervision within the Vygotskian (1978/1934) tenet that the supervisor, as a more knowing other, can guide the student teacher's development to a greater extent than the student teacher can alone. This notion, theorized by Vygotsky as the *zone of proximal development* (ZPD), is unique in that it "connects a general psychological perspective on [the individual's] . . . development with a pedagogical perspective on instruction" (Hedegaard, 1996, p. 171). As such, the ZPD supports the use of intentional instruction (not just the practice of evaluation) during supervision.

But what might this instruction resemble? Although student teaching is one of the most widely studied components of formal teacher preparation, the influence of supervision on teacher learning, and the educative forms it might take, is still unclear (Borko & Mayfield, 1995). In particular, understanding what educative supervision resembles within a framework that reflects our current ways of knowing remains virtually unexplored. As such, our central question in this study was What does it mean to supervise from a theoretical orientation that situates the student teacher as an active constructor of his or her knowledge about teaching?

METHODS

Within the grounded-theory paradigm (Creswell, 1998), our goal was the development of a model or explanation inherent in the phenomenon being studied, i.e., educative supervision, that suggests how one might supervise a student teacher if the purpose is to challenge his or her practice of teaching. This focus necessarily guided our data collection and analysis. That is, our process involved repeated visits to the student teacher's school interspersed with ongoing, informal data analysis for the purpose of understanding and describing the nature of educative supervision. Formal data analysis of descriptive categories about educative supervision emerging from the field began after data collection was complete.

In order to study the nature of educative supervision, the head author became the university supervisor of Mary Ann (pseudonym), a prospective middle school mathematics teacher. At the time of the study, the supervisor was a doctoral student in mathematics education and was conducting research on various aspects of the development of a student teacher's practice during the practicum. This particular study grew out of that research (see also Blanton, Berenson & Norwood, 2001). The

dual role of supervisor/researcher was adopted because it offered an inside perspective to understanding supervision. That is, analogous to the genre of research in which researchers become classroom mathematics teachers (e.g., Ball, 1993; Lampert, 1992), the supervisor in this study became the teacher in a classroom in which learning to teach mathematics was the content. Moreover, the supervisor's advocacy of reform-based mathematics teaching prompted an introspection about the practice of a supervisor that ultimately became the central question of this study.

Mary Ann, who was in her final year of a four-year teacher education program, had successfully completed her academic studies and was eager to begin the student teaching semester. Assigned to a seventh-grade mathematics classroom in an urban middle school, she was paired with a veteran teacher whose approach of sharing her own wisdom of practice without stifling Mary Ann's ideas led to a positive, open relationship between them. In particular, the cooperating teacher worked to familiarize Mary Ann with the rudiments of planning lessons by offering insights and techniques that she had found useful in her own instruction. She was enthusiastic about what she saw in Mary Ann's practice and the direction in which it was developing. She was supportive of the university supervisor's sustained interactions with Mary Ann, commenting at various points that she and Mary Ann were both learning from each other.

Data Collection

During the student teaching practicum, Mary Ann met weekly with the university supervisor for what we conceptualized as a constructivist teaching experiment (see e.g., Steffe, 1983, 1991). According to Steffe (1983), the teacher's role in such an experiment is to challenge the model of the student's knowledge and examine how that model changes through purposeful intervention. In our case, the supervisor took on the teacher's role, and the student teacher was seen as the student. Each prolonged conversation between supervisor and student teacher was considered to be a teaching episode, that is, one session of the teaching experiment.

Each visit by the supervisor consisted of a three-hour sequence that began with an observation of Mary Ann teaching a general mathematics class. Field notes taken during this observation focused on classroom interactions that reflected the nature of Mary Ann's thinking about teaching mathematics. Immediately following the observation, Mary Ann collaborated with the supervisor in a one-hour teaching episode to help make sense of these interactions. In particular, Mary Ann's thinking about the interactions, what these interactions suggested about how students learn mathematics, and how subsequent lessons might be modified, were

discussed. The visit concluded with a second classroom observation of Mary Ann teaching another general mathematics class. The second observation provided the opportunity to document short-term changes in Mary Ann's practice as she taught the same subject to a different class immediately *after* a teaching episode. The supervisor arranged each visit with Mary Ann prior to the event.

In addition, Mary Ann was asked to keep a personal journal in which she reflected on what she had learned about her students, about mathematics, and about teaching mathematics subsequent to each visit by the supervisor. Other written artifacts such as lesson plans, activity sheets, and quizzes were collected at each visit. At the conclusion of each visit, the supervisor audiotaped personal reflections about Mary Ann's emerging practice and how future visits could support her development. More generally, by combining the supervisor/researcher roles, the researcher was able to engage in ongoing informal reflections about what it meant to be an educative supervisor. In all, there were eight supervisory visits followed by a separate exit interview. In addition, two clinical interviews with the cooperating teacher were conducted in order to explore the cooperating teacher and student-teacher partnership. Each visit, documented through field notes and complete audio- and audiovisual recordings of the teaching episodes and interviews, along with supporting written artifacts, provided the data corpus for this investigation.

Data Analysis

From the teaching episodes with Mary Ann, complete transcripts of four representative episodes were selected for further analysis. The selections were made based on an earlier analysis of discourse in Mary Ann's classroom (see Blanton, Berenson & Norwood, 2001) from which four visits by the supervisor were selected as indicative of development in her practice. The teaching episodes analyzed here occurred during those visits. In particular, transcripts were coded by conversational subject with a speaker's turn as the basic unit of analysis. Categories identified by the coding process were based on what we perceived as the primary thrust of a speaker's comment and included mathematics pedagogy, general pedagogy, mathematical knowledge, knowledge of student understanding, classroom management, and teacher-student relationship. For example, Mary Ann's description of the use of a balance scale to develop students' conceptual understanding of solving linear equations was coded as *mathematics pedagogy* because it demonstrated a principle in how she taught mathematics. That is, the use of a concrete apparatus to contextualize the

abstraction of solving symbolic linear equations was important to her in the development of students' understanding. She explained:

> It's kind of hard for them to understand solving equations, especially negatives and positives cancel each other out, so what we did is we used the balance [scale] with rainbow cubes and put [cubes] on each end. . . . They looked at it, they saw it, take it away, you know if you took something from one side, then you had to take it away from the other side or the scale was not balanced. So we worked for probably a day and a half on understanding why we do the things that we do. . . . I was always taught just move that around, subtract it, and I never understood why we do that, why does it work? So by seeing it on the balance, like, I took a Kleenex and covered up five cubes . . . so that was their unknown.

As another example, her comment "I've been trying really, really hard, you know, for [a student] to like me. I want . . . all of my kids to like me. Of course they're not going to like me sometimes when I have to discipline and stuff." was coded as *teacher-student relationship* because it addressed Mary Ann's attentiveness to and perception of her relationship with her students.

The teaching episodes were then quantified by a word count to determine the emphasis given to each subject code and to establish the amount of conversational time used by the university supervisor and the student teacher. Transcripts from classroom observations and Mary Ann's journal reflections were used to corroborate changes in Mary Ann's practice as a result of the teaching episodes. One visit (hereafter referred to as the "problem-solving day") was selected as an exemplar of the supervisory model of observation, teaching episode, observation presented here. Transcripts from the teaching episode on this visit were analyzed for characteristics of the supervisor's pedagogy that promoted change in Mary Ann's teaching. Data from the other teaching episodes were subsequently analyzed to determine if these characteristics were representative of those visits as well. That is, once assertions had been generated about characteristics of the supervisor's pedagogy from the problem-solving day, the remaining transcripts were analyzed in order to see if the identified characteristics were reflected in the other teaching episodes. In particular, each conversational turn was analyzed for the nature of the questions asked by the supervisor (e.g., open-ended), the nature of the supervisor's voice (e.g., authoritative vs. facilitative), the supervisor's adherence to a thematic focus, and the supervisor's sensitivity to Mary Ann's development. Specific excerpts from transcripts on the problem-solving day and one of the other teaching episodes (the "pattern-finding day") are included here to substantiate our findings.

A PEDAGOGY FOR TEACHING EPISODES WITH MARY ANN

In this section, we describe the nature of the teaching episodes with Mary Ann and what the supervisor observed about her own practice in these episodes that seemed to promote change in Mary Ann's practice.

Classroom Experiences as Entries to Teaching Episodes

Gallimore and Goldenberg (1992) maintained that "students must be 'drawn into' conversations that create opportunities for teachers to assist, . . . including activating relevant prior knowledge" (p. 209). Indeed, our immediate challenge with Mary Ann was to bring her into conversations that would activate and build on her existing knowledge about teaching mathematics. An advantage of supervision is that it can use the context of the student teacher's practice to scaffold his or her emerging ideas about teaching. For instance, the student teacher's classroom experiences reveal much about his or her relevant background knowledge, particularly internalized models of teaching, which the supervisor can exploit to challenge the student teacher's thinking.

We include the following excerpts from the problem-solving day to illustrate the use of an observed classroom experience to draw Mary Ann into conversation about, and subsequently analysis of, her practice. We begin with an episode that occurred in Mary Ann's classroom during the supervisor's observation prior to the teaching episode. During this observation, Mary Ann began a lesson on "working backwards" as a problem-solving technique by giving students the following problem to solve during individual seatwork:

Problem 1: I'm thinking of a number that if you divide by three and add five, the result is eleven

After several minutes, Mary Ann asked Evelynne to explain how she got her (correct) solution.

1 Evelynne: Well, I started out with what you told us and then I put 3 as the divisor. And then you said the answer plus 5 and it equals 11. So, I put 5 plus something equals 11 and that was 6, and so 6 times 3 is 18, and that's how I got it.

Mary Ann repeated Evelynne's comments, then continued her lesson on working backwards.

2 Mary Ann: O.K. We're going to look at something a little different. . . . We're going to use a method called working backwards. O.K.

(referring to Problem 1) we said that the result is 11, so we have 11 here (Mary Ann writes this on the overhead projector [OP]). Then we said add 5 and divide by 3, and the result is 11. O.K, when we decide to work backwards, we have to go through and [change every operation] to its inverse. Remember we've been talking about inverse and opposites. So what's the inverse of add?

3 Class: Subtract.

4 Mary Ann: Subtract. So we'll subtract 5 [from 11]. What's the inverse of divide?

5 Class: Multiply.

6 Mary Ann: Multiply. So we'll multiply [11 – 5] by 3.

After Mary Ann got a correct response of 18, she wrote a similar problem on the OP for the class to collectively solve:

Problem 2: I'm thinking of a number that if you divide it by 3 and then add 5, the result is 13.

7 Mary Ann: So what should I do first just to get an idea of what we're talking about?

There was a long pause during which no one responded.

8 Mary Ann: Does anybody know how we did the last one?

Again, no one responded.

9 Mary Ann: O.K., we want to work backwards. So what have we got to do when we work backwards? What was the word that we used when we talked about what we've got to do with all of these?

10 Student: Inverse.

11 Mary Ann: Inverse. O.K., so we have to take the inverse of the operations. . . . O.K.? So what are we going to do with the 5? Add it or subtract it?

12 Class: Subtract.

13 Mary Ann: Subtract. We're working with the inverse. We're working with opposites. O.K., then are we going to divide or multiply by 3?

14 Class: Multiply.

15 Mary Ann: Multiply by 3. O.K., that's step two, to write down everything that's the inverse. And it's very important that you keep the same order. You have to keep the same order as the problem. (Mary Ann continues to write the mathematical pieces of this conversation on the OP.) O.K., step three is to actually solve the problem. What are we going to do? Somebody tell me the first step. Terence?

16 Terence: Thirteen minus 5.

17 Mary Ann: Thirteen minus 5. O.K., and 13 minus 5 is?

18 Terence: Eight.

19 Mary Ann: Eight. Now what am I going to do? Andrea?

20 Andrea: Eight times 3.

21 Mary Ann: Eight times 3, and what is 8 times 3?

22 Andrea: Twenty-four.

23 Mary Ann: Twenty-four. So that's my answer. I ask you what number did I start with [and] you'll say what?

Students offered no response, which prompted Mary Ann to repeat her question:

24 Mary Ann: The problem says "I am thinking of a number." What number am I thinking of?

At this point, students called out several different answers, leading to Mary Ann's frustration that they, with the exception of a few students, did not seem to understand despite their responses to her questions. In exasperation, she tried to get students to respond:

25 Mary Ann: What did we just solve? What answer did we just get? Look up here (indicating the OP).

It was this classroom experience that the supervisor used to draw Mary Ann into a discussion about her practice. From the discourse, the supervisor inferred that Mary Ann's focus was on students' procedural understanding of the task, and this focus had determined the way the whole-class discussion played out. It was the supervisor's intent to use this event to initiate Mary Ann's sense making about her practice. The excerpt chronicled below occurred in the subsequent teaching episode and refers to the whole-class discussion about Problem 1 and Problem 2.

26 Supervisor: Once you began talking with students, they began to answer your questions. At first, they seemed hesitant. You had gone through the problem (Problem 1) and then you started asking them "What do you do next?".

27 Mary Ann: Right.

28 Supervisor: Then they started answering your questions (see, e.g., 3, 5, 10, 12).[2] Do you think they understood the problem or the steps they were supposed to do?

29 Mary Ann: I think they understood the steps. I totally agree. Because I really didn't focus on understanding the problem as much as I should have, and now that you bring it up, I know I didn't. It was pretty much the steps. But I don't . . . these kids just have a really hard time. If you don't know how to divide, it's going to be hard for your level of thinking to [figure out how to solve the problem]. So, really, I just did [this lesson] to get them by these two sections, because they're not going to see this. They're not going to use that [technique of "working backwards"].

30 Supervisor: So apparently you think there's a better way to solve this type of problem?

31 Mary Ann: Now I think that [Problem 1] makes more sense than "Johnny went to the store and had, you know, twice as many . . . as last year." I think they were beginning to see [how to use "working backwards" as a problem-solving technique], because it was pretty much everything [Evelynne] did when she showed me how she solved her problem. I didn't bring that out but I should have. . . . She worked backwards in her mind, but she just didn't realize she was working backwards.

Later, we will explore more from this teaching episode. For now, our point is to illustrate the use of a classroom event to draw Mary Ann into a conversation that focused on her thinking, not the supervisor's conclusions. We found that classroom experiences became the nexus between theory and practice in teaching episodes with Mary Ann, effectively opening her ZPD and drawing her into conversation with the supervisor. In particular, bringing specific classroom experiences to Mary Ann's attention during the teaching episodes became a hook (Gallimore & Goldenberg, 1992) for her to openly analyze her practice. Conversely, she became visibly passive when referents beyond the scope of her own experiences, for example, the

supervisor's analysis of Mary Ann's teaching or the supervisor's experiences as a student teacher, were introduced. As a caveat, we emphasize that the student teacher's classroom experiences are merely a point of departure from which the supervisor may solely evaluate that student's practice of teaching. However, we contend that this alone can engender a passive environment with no certainty that the student teacher will subscribe to our theories of teaching.

Open-Ended Questions as Prompts for Sense Making

We further found that the nature of the supervisor's questions about Mary Ann's classroom experiences prompted her sense making. Gallimore and Goldenberg (1992) argued that "when known-answer questions are asked, there is no need to listen to a child or to discover what the child might be trying to communicate" (p. 209). We assert that in the context of supervision, the exclusive use of evaluative comments and known-answer questions constrains the need to listen to the student teacher. Thus, an imperative of teaching episodes with Mary Ann became to avoid the singular use of these types of questions and comments. As a result, the balance of questions posed to Mary Ann were open-ended, with the expectation that Mary Ann would justify her thinking about teaching mathematics and her consequent actions in the classroom, not passively respond to a supervisor's prompts. We include here representatives of the types of exploratory questions that evolved throughout the teaching episodes. Although we do not suggest that the list is exhaustive or entirely original, we share these questions as significant in the supervisor's effort to maintain the role of facilitator and Mary Ann's role as sense maker. In Table 1, we contrast the tenor of these questions with what we see as their possible evaluative counterparts.

The Supervisor's Voice

Our emphasis on open-ended questioning necessarily limited instances of direct teaching by the supervisor. For us, this balance was rooted in the belief that students are more likely to teach in ways they are taught (Borko & Mayfield, 1995; Feiman-Nemser, 1983). In practice, this meant that we could not simply *tell* Mary Ann how to change her teaching in order to move beyond the show-and-tell paradigm we had observed (e.g., 7–22). In this, we did not assume that Mary Ann would necessarily make a connection between the supervisor's own practice during the teaching episodes and her resulting classroom practice. The goal was instead for the supervisor's practice to be intellectually honest. Thus, moving away from an authoritative voice, the supervisor used "prompting, modeling,

TABLE 1

Open-Ended Questions That Emerged During the Teaching Episodes and Possible Evaluative Counterparts

Open-Ended Questions	Evaluative Counterpart
"You taught this lesson twice today. What changed about the way you taught it the second time?"	"The second time you taught this lesson, you did the following differently . . . "
"How are you going to teach this lesson differently?"	"You need to teach this lesson differently in the following way . . . "
"What did you learn about your students from teaching this lesson?"	"You seem to have the following belief about students . . . "
"Did students have any difficulties that you did or did not anticipate?"	"Students didn't understand what you were doing in this part of your lesson."
"How did that [classroom experience] affect your teaching?"	"I noticed that you did the following as a result of this [classroom experience]."
"How do/would you handle that type of situation?"	"The next time this occurs, you should do the following . . . "
"What do you see as your biggest difficulty?"	"Your biggest difficulty is . . . "
"What was the most memorable thing that happened in class today?"	"The most significant thing I observed today about your teaching is . . . "
"Do you think that technique was effective? Why?"	"Your technique seemed ineffective. I would recommend that you try the following . . . "
"How do you balance the use of hands-on activities with whole-class discussion?"	"You need to use more hands-on activities. There's too much lecture."
"What did you learn today about mathematics?"	"I observed that you have the following (incorrect) conception about mathematics."
"How would you handle a similar situation in the future?"	"In the future, you should do this instead . . . "
"Do you think there's a better way for students to solve these problems? If so, what?"	"I think you should use the following approach in problem-solving . . . "
"Why do you think this [belief about mathematics] is true?"	"You should have the following perception about mathematics . . . "
"At one point in your lesson, you said . . . . What were you thinking?"	"At one point in your lesson, instead of doing X, you should have been doing Y."
"How would you describe a successful classroom?"	"I think a successful classroom has the following characteristics . . . "
"What did you want students to understand in this lesson?"	"Your goals for this lesson seemed to be . . . "

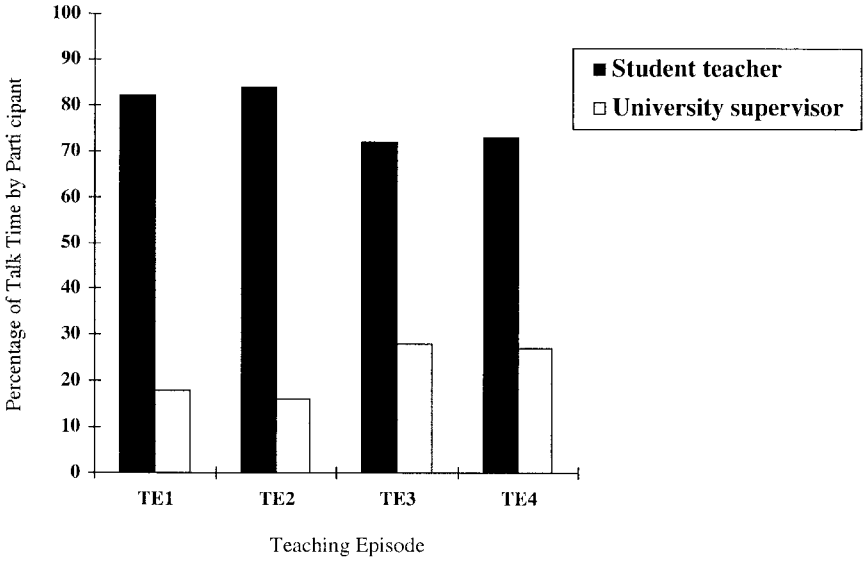

Figure 1. Conversational time used by participants in the teaching episodes (Note: Figure 1 represents percentages of time a given participant spoke during a teaching episode. Percentages are based on word counts.).

explaining, ... discussing ideas, [and] providing encouragement" (Jones, Rua & Carter, 1997, p. 4) to give structure to teaching episodes. Thus, Mary Ann was encouraged to construct her own solutions to conflicts in her practice (e.g., 32–39). In fact, throughout this episode and in the analysis of other episodes, we observed shifts in the supervisor's practice away from evaluative conclusions about Mary Ann's classroom experiences. Instead, the supervisor used Mary Ann's experiences as a catalyst for engaging her sense making about teaching. What seemed to emerge for Mary Ann was a sense of ownership that heightened her willingness to implement alternative approaches.

The supervisor's voice shifted not only in demeanor and intent, but also in quantity. Figure 1 illustrates the amount of conversational time used by Mary Ann during the teaching episodes with the supervisor. The results provide evidence of the supervisor's intent to maintain a facilitory role that kept Mary Ann at the center of discourse. That is, although the data depicted in Figure 1 do not address the nature of the teaching episodes per se, they do confirm that the supervisor did not control discourse in conversations with Mary Ann.

An Educative Focus for the Teaching Episodes

There is a risk that perfunctory evaluative visits with a student teacher will lack the depth of focus engendered through instances of genuine teaching. Gallimore and Goldenberg (1992) argued that "to open a zone of proximal development . . . , a teacher has to intentionally plan and pursue an instructional as well as a conversational purpose" (p. 209). During the initial visits with Mary Ann it became clear to us that the supervisor needed to establish a teaching focus for the episodes throughout the practicum that would directly address Mary Ann's specific needs as a novice teacher. By the third visit (the problem-solving day), the supervisor identified a thematic focus regarding the nature of discourse in Mary Ann's classroom that emerged after a mathematical task or question had been posed.[3] The supervisor's observations prior to this visit revealed classroom discourse which served predominantly as a "passive link in conveying some constant information between input (sender) and output (receiver)" (Lotman, 1988, p. 36). Through these *univocal* interactions (see Wertsch & Toma, 1995), Mary Ann funneled students toward her interpretation of the problem at hand.

This focus for supervision grew out of the supervisor's effort to listen to and reflect on Mary Ann's teaching and find a focus issue for mediation relevant to her practice. Although there might have been other areas for focus, it became clear from the supervisor's classroom observations that the nature of classroom interactions, particularly what mathematical problem-solving looked like in Mary Ann's classroom, would be an appropriate area in which to challenge her practice. What was significant, at this point, was that Mary Ann's practice of problem solving with her students reflected what we found to be her thinking about the nature of mathematics:

> I know that math is one big word problem because one thing builds on another. But I don't look at it like that. I look at math as just operations you go through, just like a series of steps. You have to step on this step before you get to the next one.

Given this, it was not surprising to us that she enacted a step-by-step approach in her teaching (e.g., 7–23). What ultimately became the focus of supervision, namely, how to verbally engage students in mathematical problem solving, was seen as intrinsically bound to her knowledge about the nature of mathematics.

The educative focus on the problem-solving day. The third visit presented an opportunity for assisting Mary Ann in cultivating *dialogic* classroom discourse, that is, discourse that could serve as a thinking device by which new meaning could be generated (Lotman, 1988; Wertsch & Toma, 1995).

As we described earlier, during the supervisor's first observation on this particular visit Mary Ann began a lesson on working backwards by giving students a problem to work individually. After a short pause, Mary Ann began to dole out hints until a correct solution appeared. After a student shared a procedure for obtaining this solution (1), Mary Ann began a step-by-step account of how to work backwards to find the answer (2–6, 7–23). Elsewhere, our analysis of the full classroom observation showed that she had interpreted students' questions univocally, that is, as a result of a breakdown in communication (see Blanton, Berenson & Norwood, 2001). Moreover, she asked cognitively small questions (e.g., [What is] thirteen minus five? What is eight times three?) in order to align students' thinking with her own. As Mary Ann equated student feedback with understanding, her frustration surfaced when the class unsuccessfully attempted to solve a similar problem (24–25).

The perturbation that Mary Ann experienced from this interaction seemed to grow out of her confusion that students did not understand what she had carefully explained. In our interpretation, this left her at a pedagogical impassé. The challenge for the supervisor in the teaching episode that followed and in future episodes was to use this experience to scaffold Mary Ann's incipient notions of mathematics as a problem-solving activity in which students struggled with unfamiliar problems and justified their ideas through mathematical discourse with each other and Mary Ann. In essence, the challenge was to help Mary Ann create a classroom discourse in which dialogic and univocal interactions dualistically existed. Throughout the teaching episode on the problem-solving day, the supervisor focused on how Mary Ann might alter the way the class approached problem solving (42–49). When it seemed that the supervisor's prompts were beyond Mary Ann's ZPD, that is, when Mary Ann could not be hooked into the conversation and instead shifted the topic to one of classroom management (see 42–45), the supervisor steered to related subjects (e.g., Mary Ann's perception of problem solving in mathematics) that would probe Mary Ann's thinking and draw her back into conversation about engaging students in problem solving. This type of threaded conversation seemed to scaffold Mary Ann's thinking about teaching because it allowed her to appropriate an idea through multiple interactions over the length of the teaching episode.

Multiple interactions on the educative focus for supervision. The educative focus provided an instructional purpose in supervision that continued throughout the practicum. Having identified the thematic focus of supervision on the problem-solving day to be the nature of mathematical discourse

in Mary Ann's classroom, the supervisor's goal was to build on that theme and see how or if Mary Ann subsequently attended to mathematical discourse in her classroom. The pattern-finding day, which occurred four weeks after the problem-solving day, represented one of the more significant moments when this discourse took place. For the lesson on this day, students worked in dyads to investigate the number of diagonals in various polygons. Geoboards were used to model the specific cases. After tabulating students' results for a triangle, quadrilateral, pentagon, and hexagon, Mary Ann asked students to find a pattern in order to predict the number of diagonals in a heptagon. Here, our purpose is to share an excerpt from the teaching episode on that day in order to analyze the continued interactions on the selected educative focus.

32 Supervisor: What was the point [of the lesson]?

33 Mary Ann: The main point is that this was a problem-solving strategy. It was to be able to set up a table, which is what we did up here. It was to be able to do a diagram, which is pretty much what they did. And then it was to see a pattern. Remember, we saw the pattern about the difference, you know, increased by one.

34 Supervisor: This is a very important process.

35 Mary Ann: Right. The two problems they were assigned tonight were dealing with this same thing.

36 Supervisor: I really liked this activity. You're using manipulatives, you're gathering information, and you're developing patterns. Going back to what we've been talking about with mathematics as problem solving and letting [students] struggle with the problem, you got to the point where you were going to find the pattern, and you said something like, "OK, we're going to find the pattern", and then you asked . . . leading questions such as "What is the difference between these two numbers?".

37 Mary Ann: What I meant to do, and I didn't write it on my lesson plan, and I knew I'd forget it if I didn't write it, is I was going to try and have them . . . like, we had the object here, the sides here, and the diagonals here. (Mary Ann drew a polygonal figure on a piece of paper, recalling what she had written on the OP earlier.) You have to kind of narrow things down for them sometimes, so I was going to ask them to look at this column (indicating the column containing the number of diagonals) and form some kind of prediction of what the

next numbers were going to be based on these numbers. And then I would have to give them some type . . . I would say, "There's a pattern forming in this column, can you find out what it is?".

38 Supervisor: That would be super.

39 Mary Ann: Right, and I just didn't because I didn't write it on my lesson plan and I kept looking at the time and I was like, we have got to get through this. So that would probably be a better way, because then they could come up with . . . because it's just like that day in third period (referring to the problem-solving day) that I tried it and the kid solved it!

40 Supervisor: Is this something you might try in the next period?

41 Mary Ann: Yeah.

We infer from Mary Ann's comments (37, 39) that her intent was to center students in the activity of problem solving, but she was detracted by extraneous factors, e.g., time. Instead, as alluded to by the supervisor's observation ("you asked . . . leading questions such as 'What is the difference between these two numbers?' "), Mary Ann had enacted a whole-class discussion about the number of diagonals in a polygon that was more univocal than dialogic in essence. The supervisor's purpose was to revisit the educative focus and draw Mary Ann away from this univocal exchange. Now that Mary Ann already had experiences in her repertoire, such as the problem-solving day, less intentional instruction was needed by the supervisor. For instance, it was Mary Ann who suggested the alternative approach to finding the pattern for the subsequent lesson (37). Additionally, her comment "because it's just like that day (the problem-solving day) in third period" suggests to us that she was connecting her classroom practice on these two days in her own thinking. It is significant for us that she made these connections during the teaching episode.

It seemed to us that, through the interchange (32–41) that continued to build on the educative focus, the supervisor was able to reinforce Mary Ann's commitment to a kind of classroom practice that would include meaningful mathematical discourse. In the lesson subsequent to the teaching episode on the pattern-finding day, Mary Ann worked to include more dialogic discourse in her exchange with students, encouraging them to "hypothesize and justify their thinking with mathematical evidence in order to solve a non-routine problem, . . . (positioning herself) as an arbiter of students' ideas, obligated to solicit students' strategies and explanations as a platform for resolving mathematical questions

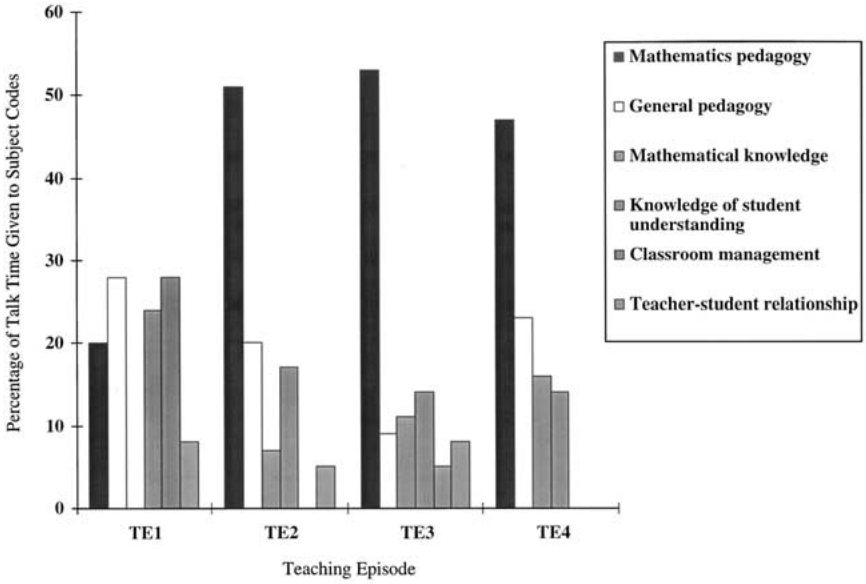

Figure 2. Conversational time given to subject code during teaching episodes (Note: Figure 2 represents percentages of time the specified subject code was discussed in a teaching episode. Percentages are based on word counts.).

and extending students' mathematical thinking" (Blanton, Berenson & Norwood, 2001, p. 239).

More generally, Figure 2 depicts the emphasis in the teaching episodes placed on conversations about various aspects of Mary Ann's teaching. For example, conversations that addressed principles of teaching not specific to mathematics were coded as *general pedagogy*; conversations that addressed Mary Ann's understanding about teaching mathematics as well as how she taught mathematics were coded as *mathematics pedagogy*. In particular, these data illustrate that mathematics pedagogy dominated the supervisor's conversations with Mary Ann during the teaching episodes. Conversely, Figure 2 suggests that discussions about the peripheral issues of school bureaucracy (e.g., classroom management) received little emphasis in the teaching episodes. Although it might be argued that such issues may of necessity dominate supervision in the case of other student teachers, we point out that our conceptual focus throughout the practicum was to influence Mary Ann's teaching, specifically, to help her cultivate dialogic classroom interactions. Had our purpose in supervision been solely evaluative, we would have missed the opportunity to challenge Mary Ann's practice of classroom discourse. As such, peripheral issues were addressed as needed, but not at the expense of our purpose – to educatively supervise Mary Ann's practice.

Sensitivity to Mary Ann's ZPD

We take the amount of conversational time used by Mary Ann (see Figure 1) to indicate that her contributions were a priority in supervision. Moreover, in order to be responsive to her ideas we needed to be sensitive to her ZPD as well. The following dialogue was excerpted from an instance of intentional instruction in the teaching episode on the problem-solving day. We include it as an illustration of the supervisor's effort to maintain sensitivity to Mary Ann's ZPD while guiding her thinking.

42 Supervisor: Is this the kind of problem (i.e., Problem 1) where you could let two or three [students] work together, and try to figure out how to do it, and see what kind of method they come up with?

43 Mary Ann: That could be an idea. Maybe I could let them work with the person beside them.

44 Supervisor: Do you think that is even feasible? If so, why or why not?

45 Mary Ann: Two heads are always better than one, and the kid next to you might be thinking of one way, but might be stumped on how to do the next. But you might be able to help him figure that out. The only thing is that I don't know if they (her voice trails off). We'll see, though. That might be a way to try. I don't know if they can handle that, talking to each other. . . . They're just talkers, all the time. Maybe if I show them that they can have some freedom like that.

Mary Ann's uncertainty toward this suggestion was manifested as concern over classroom management. The supervisor's role then became to redirect the conversation so that it was within Mary Ann's ZPD. In other words, the supervisor inferred that the notion of students working in groups of two or three and solving a problem without step-by-step directives from Mary Ann did not seem to be in her conception of teaching at this point because Mary Ann was unable to engage in a discussion about it (the conversation shifted to classroom management – (45)). Thus, maintaining sensitivity to Mary Ann's ZPD involved connecting her concerns about students' behavior with the alternative instructional approach being negotiated (46).

46 Supervisor: Do you think they can handle working with a problem that they can't figure out, trying to solve a problem in that sense?

47 Mary Ann: I think they would be more apt to keep their attention on that problem if they're working with somebody rather than working by themselves.

Again redirecting the conversation, the supervisor probed Mary Ann's understanding of the role of problem solving in mathematics. We maintain that this activated her background knowledge of and about mathematics and was therefore within her ZPD and continued to draw her into conversation. Later in the episode, the supervisor revisited the previous topic (42).

48 Supervisor: Would you be comfortable, for example, if you came [in class], . . . threw out a problem, and [let] students work it for a while, and try to figure out how to come up with a solution?

49 Mary Ann: Yeah. That's how I'm thinking about starting the next class. We'll have to go over homework first because they're having a quiz on that tomorrow. And then just have [Problem 1] up on the board, and then tell them to solve it. Don't introduce anything about working backwards.

In this case, transcripts strip the dimensionality of dialogue. Mary Ann's claim, "That's how I'm thinking about starting the next class" (49), was spoken with a sense of reflection and ownership which stood in sharp contrast with her initial reticence (45). It should also be noted that this remark (49) occurred over halfway through the one-hour teaching episode, after much attention had been given to Mary Ann's thinking about mathematics as problem solving and the nature of interactions that surrounded a problem posed in class. Although one might argue that a didactical approach to supervision would have been more efficient, we seriously question if it would have led to Mary Ann's commitment to try an alternative strategy. However, the nature of the teaching episode seemed to open her ZPD cognitively and affectively, thereby producing at least a short-term commitment to change.

After the Teaching Episode

On the problem-solving day, Mary Ann seemed to extract from our approach of facilitating rather than directing her development a commitment to modify her practice (49). Moreover, we sensed that the supervisor's presence in Mary Ann's classroom after the teaching episode was an additional support (if the plan did not work, Mary Ann could share the responsibility with the supervisor). Mary Ann began her lesson as we had planned (42–49). Departing from her previous strategy, she placed students in dyads in order to solve the problem that had been assigned as individual seatwork in her earlier class. Removing herself as the sole authority, she

delayed closure so that students would attempt to communicate mathematically with each other. As one of the students began explaining her group's strategy for solving the problem during the subsequent whole-class discussion, Mary Ann commended the student, "You just taught our lesson for today!" Mary Ann's expression told the story that her journal reflection later confirmed.

> Teaching this [to the first period class] was a real eye-opener for me. I think I totally confused my students completely. I tried to show them steps without letting them think about the problem themselves. . . . [The next class] was different. After [the university supervisor] and I talked about the lesson and going over several suggestions, things seem [*sic*] to run much smoother. Instead of throwing information out, I let them figure the problem out in their own style. . . . To my surprise, one of my students performed the problem exactly as the strategy suggested. Boy, was this a memorable event. The pressure was lifted off of me. . . . Once the students saw how one of their peers was able to solve the problem, things were a lot more clear to all. I learned that having a student come up with the solution means more to the others than the teacher giving a long, drawn-out lecture.

From our observations, the problem-solving day was a first step in Mary Ann's attempts to interact dialogically with her students. Moreover, we take her reflection as evidence that the teaching episode on that day helped to mediate her development within her ZPD. The reflection shows not only a clear shift in Mary Ann's thinking about what role students should play in solving a mathematical problem, but also that mediation by the university supervisor was a factor in this. In particular, Mary Ann's comments confirm what we described earlier concerning her view of mathematics as a step-by-step process that was ultimately reflected in her teaching ("I tried to show them steps without letting them think about the problem itself"). The reflection also indicates a shift in what Mary Ann was beginning to value in how students did mathematics, that is, letting students "figure out the problem in their own style" rather than the teacher "throwing information out." Although the supervisor did not have access to this reflection on the problem-solving day, the shared events of this day mirrored Mary Ann's reflection and served to focus the supervisor's attention on challenging Mary Ann's conception of what the classroom activity of mathematical problem solving might resemble.

INSTRUCTIONAL CONVERSATION AS A PEDAGOGY FOR EDUCATIVE SUPERVISION

We view as a significant finding in our study that what seemed to emerge as a pedagogy of supervision with Mary Ann is coincident with the notion of *instructional conversation* (IC) advanced by Gallimore and

Goldenberg (1992). In an investigation of elementary students' reading comprehension, Gallimore and Goldenberg mutually negotiated ten characteristics of IC: (a) activating, using, or providing background knowledge and relevant schemata; (b) thematic focus for the discussion; (c) direct teaching, as necessary; (d) promoting more complex language and expression by students; (e) promoting bases for statements or positions; (f) minimizing known-answer questions in the course of the discussion; (g) teacher responsivity to student contributions; (h) connected discourse, with multiple and interactive turns on the same topic; (i) a challenging but nonthreatening environment; and (j) general participation, including self-elected turns. It was consequential for us that IC was not a predetermined pedagogy for our teaching episodes with Mary Ann, yet many of these characteristics mirrored our own approach.

In addition, IC is rooted in a sociocultural perspective, which reflects our own assumptions about teaching and learning. In particular, IC stems from a cultural ethos that emphasizes the use of narrative in an individual's development. Gallimore and Goldenberg (1992) and Rogoff (1990) described it as a primary means of assisted performance in preschool discourse between parent and child. One's way of life, embedded in picture books and bedtime stories, is taught through conversation in the context of familial relationships. Although formal schooling may seem far removed from this setting, the essence of IC is a promising technique in that context as well. Gallimore and Goldenberg (1992) recognized that, traditionally, this form of teaching abates in school because teachers are more likely to dominate interactions and students are less likely to converse with their teacher or peers. They maintained that part of the difficulty of IC in formal learning contexts is that it requires teachers to shift from an evaluative role grounded in "known-answer" questioning, to a facilitory role in which they elicit students' ideas and interpretations. As we experienced, such difficulties are no less present in the case of university supervision, where the supervisor is cast in the role of teacher and the student teacher becomes the learner. Thus, although it is difficult to establish a direct link between IC and conceptual development (Gallimore & Goldenberg, 1992), we conclude that IC does suggest an alternative pedagogy for educative supervision in that it captures the essence of the type of supervision that emerged in this study.

CONCLUSION

We have investigated what it means to educatively supervise one mathematics student teacher. In the process, we found that it is possible to

effectively challenge a student teacher's practice of teaching, and we suggest that the nature of the teaching episodes in supervision became a conduit for change in Mary Ann's practice. In particular, the teaching episodes required that the supervisor move beyond the type of practice described in the literature (see, e.g., Ben-Peretz & Rumney 1991; Borko & Mayfield, 1995) in which supervisors focus on superficial aspects of teaching, assume an authoritative demeanor with the student teacher, and generally do not provide the type of professional support that is essential for a student teacher's development. Instead, we found that by replacing direct, authoritative evaluations of Mary Ann's practice with more open-ended questioning that remained sensitive to her ZPD, and by pursuing a particular teaching focus that derived from her own classroom experiences, the supervisor was able to support Mary Ann's development. Weaver and Stanulis (1996) argue from a sociocultural perspective that mentors should

> provide opportunities for a student teacher to drive lessons, shift instructional strategies, and alter content; . . . [they should] encourage a student teacher to engage in dialogue about teaching practice; . . . and [they should] work hard to elicit a student teacher's understanding instead of relying on [their] own understanding (p. 28).

As we reflect on Mary Ann's case, these words further capture our intent and our practice in educative supervision.

We note that in exploring a pedagogy for the teaching episodes with Mary Ann, it seems that our findings were less about content than pedagogy. Shulman (1987) defined pedagogical content knowledge as "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction" (p. 8). In Mary Ann's case, we see this knowledge domain as including her understanding of how to take a mathematical problem or task and orchestrate a class discussion in a way that promoted the activities of argumentation, conjecture, and student justification. In linking mathematics and pedagogy, the supervisor tried to mediate what Mary Ann saw as the step-by-step nature of mathematics and teaching mathematics to an understanding of teaching mathematics that included those processes originally missing from her repertoire of classroom discourse. In general, it could be that the novelty of the classroom setting for student teachers forces more of the attention of the supervisor and student teacher on the pedagogical side of this knowledge domain rather than the mathematical side. In Mary Ann's case, content alone did not become a critical point of discussion. Her teacher education program included a heavy emphasis on mathematics, with courses in discrete mathematics, statistics, the development of proof,

geometry, and calculus (two semesters). Instead, the focus was on how to handle that content in class discussions.

As we have described, our approach to supervision (a) supports a focus for supervision related to the student teacher's developing practice; (b) emerges from the student teacher's conflicts in practice; (c) provides for successive transformations of a concept through multiple interactions on a topic; (d) allows the student teacher ownership of solutions; and (e) encourages the student teacher's risk-taking in his or her practice. In a more critical treatment of our approach, we characterize here what might be seen as its more problematic aspects. First, identifying the focus for intentional instruction during supervision should perhaps have been an explicit part of the supervisor's conversations with Mary Ann. Although this was not an intentional oversight by the supervisor (especially given that the practice of identifying a thematic focus itself emerged through supervision), it seems that the student teacher would have a deeper sense of ownership in change if he or she had a greater role in deciding about a focus for instruction. Further, knowing how to pursue that focus in terms of the timing of interventions and the structure of the teaching episodes was a continual dilemma. It was not always clear when to direct Mary Ann's thinking and in what way that should occur. More research is needed to understand the trajectories of learning that characterize a student teacher's development in the context of university supervision. We also recognize that more research is needed to determine if change in a student teacher's practice can be generative and self-sustaining. That is, would change continue beyond the student-teaching semester?

From the supervisor's experience, shifting the focus to listening to Mary Ann was much more challenging and time-consuming than a typical summative evaluation of her practice would have been. Moreover, it was difficult to accept the tenuous nature of her development without crowding it. It struck us that there first needs to be a serious commitment by the supervisor to relinquish an authoritative role. In essence, this requires a paradigm shift that is no less important or difficult than what we ask of classroom mathematics teachers in shifting from traditional forms of teaching mathematics to reform-minded practices. As we found, part of this shift will require the use of open-ended questioning. Although we have included the open-ended questions that evolved through the teaching episodes (see Table 1), more research is needed on the nature of questioning associated with educative supervision.

Although the supervisor met with Mary Ann on a regular basis, there was still much occurring in Mary Ann's practice during the interim periods which made it difficult to establish a link with previous lessons that could

be used to move Mary Ann's practice forward. Nevertheless, the weekly intensity and focus of the supervisor's interactions with Mary Ann and the particular structure of a three-hour visit – a classroom observation before and after the teaching episode – did provide a sense of continuity that we speculate does not occur through random visits by a supervisor. Moreover, the supervisor inferred through informal exchanges with Mary Ann that the supervisor's presence in her classroom as she implemented instruction planned during the teaching episodes encouraged her efforts. Because time constraints imposed on supervision make such a process arguably quixotic, we question if a professional *semester* is an optimal time frame in which to effect long-term change in a student teacher's practice. We concur with the growing belief that student teachers are better served by teaching fewer classes over a longer period of time. This would not only structure time for reflection, but it might address the difficulties supervisors face when they try to impact the practices of numerous student teachers in a brief period of time.

In retrospect, the dual nature of the role of the supervisor/researcher in this study did affect the dynamic of the supervisory relationship. In particular, our dependency on Mary Ann's participation caused the supervisor to be less authoritative (and thus to experience the value of this). Additionally, the inquisitive nature of research induced a more probing stance than the supervisor might otherwise have had. Ultimately, the approach here required the supervisor to draw simultaneously on multiple roles as a researcher, interviewer, and teacher. In general, supervisors might not be prepared to do this. Thus, we must make decisions as a professional community as to what role we expect supervision to play in a student teacher's development and how we can build the structure that will provide this.

Certainly, factors other than university supervision contribute to a student teacher's professional growth. Moreover, these factors might limit, or even negate, the influence of the supervisor. Understanding how they coalesce in the making of a teacher is at best a delicate process. As such, this investigation reflects a first attempt to explore that process through the supervisor's lens.

NOTES

[1] The study is based on the dissertation research of the first author under the direction of Sarah B. Berenson and Karen S. Norwood.

[2] Numbers indicate paragraphs in the protocol.

[3] Blanton, Berenson and Norwood (2001) provide a more exhaustive analysis of the nature of discourse in Mary Ann's classroom.

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