

**Teacher Research Network**  
**Secondary Mathematics Profile Crosscase Analysis**  
**1999-2000**

### **Context**

Ten secondary teachers participated in the study. The four student teachers were candidates for licensure in mathematics, grades 5-12. One of the student teachers also was seeking a technology certificate, and one was also seeking licensure in physical education, grades K-12. The six inservice teachers' years of teaching ranged from one to three, with two at each level of experience. Four of the inservice teachers have mathematics, grades 7-12 licenses. One of the second year teachers was licensed to teach mathematics, grades 7-12 due to mathematics minor. She was also licensed in science, grades 7-12. One of the third year teachers has a mathematics license, grades 1-8.

Seven of the teachers taught in public schools in a city with a population of 85000. One taught at a K-8 school, three taught at 5-8 middle schools, two taught at a 7-12 school, and one taught at a 7-9 charter school. The eighth teacher worked at a private Catholic, college prep school. The ninth teacher taught middle and high school mathematics in a rural school. The tenth teacher worked at a 9-12 alternative learning center.

The grade level of the observed classes for this study ranged from seventh grade through 12<sup>th</sup> grade. Four of the observed classes were seventh grade mathematics classes, one of which was labeled advanced mathematics. Two of the classes were eighth grade mathematics classes that were labeled as algebra IA courses. Two of the classes were ninth grade algebra classes. One of the classes was a high school algebra II course. One class was a multi-age, 9-12 business mathematics course.

### **Knowing Mathematics Content**

The mathematics content discussion is divided into four areas: (a) opportunities for students to understand important, accurate, and appropriate content, (b) mathematics for all students, (c) opportunities for students to understand the nature of mathematics, and (d) teacher curriculum constraints and decisions.

Student opportunity for learning content connected to the state standards characterized the important, accurate, and appropriate content discussion. Lessons by Mr. Darin, Ms. Blue, Mr. Red, Ms. Green, and Mr. Cord focused on pattern, functions, and algebra content. For example, Mr. Darin's students factored equations and Ms. Blue's students created linear functions from numerical patterns. Mr. Evans, Ms. Rink, and Ms. Amanda addressed number sense and basic number operations content in their lessons. In addition, Ms. Rink and Ms. Amanda included data investigation content. Mr. Evans' students examined positive and negative numbers in the context of golf. Ms. Amanda's students collected living expense data and tried to determine whether finding a job or enrolling in college would be a better future choice. Students of Ms. Yellow, Mr. Cord, and Ms. Rink studied geometry, spatial sense, and measurement content. For example,

Ms. Yellow's students created three-dimensional models and drew a two-dimensional picture of the model. Mr. Cord's students designed a Martian colony and found the square and cubic footage of the structure.

Teachers did not use the phrase "mathematics for all" when completing instruments or while talking during interviews. They did, however, include ideas that were related to the concept of mathematics for all students. For example, Ms. Yellow used students' life experiences to facilitate all students learning mathematics: "I try to think about where is a seventh grader at in his life experiences, and try to intersperse things like sports and music." Ms. Blue recognized the importance of meeting students' different needs: "I feel the students will learn well by hearing, seeing, and doing the new material. So many areas need to be touched in order to provide a learning method for each kid." In addition, teachers' classroom actions suggested they were trying to promote all students' learning of mathematics. Ms. Green used a group activity involving the grains of rice problem to introduce the concept of exponential functions. Mr. Red encouraged student ownership of the content by having each student collect data on their heart rate and use the data as a context for understanding complex inequalities.

The teachers' definition of problem solving is one component for examining student opportunity for understanding the nature of mathematics. Seven teachers defined problem solving during their interviews (Mr. Cord, Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda). All teachers' definitions included the idea that problem solving was a process for finding a solution to a problem. For example, Ms. Amanda defined problem solving as "a method in which multiple steps may be used to find the solution(s) to a specific problem." Ms. Green defined problem solving as "being given a situation in which you need to come up with some type of solution and the process you have to go through to get to the solution. And solution doesn't necessarily mean a right or wrong answer, to me it's more of a process to get to an end result, and what that end result means." Additional comments by and observations of teachers showed that various types of problems could fit their process-for-finding-a-solution definition of problem solving. The types of problems included: (a) routine symbolic problems such as solve  $2x - 7 = 11$  and find the slope of the line that goes through two points (Ms. Blue, Mr. Red, Ms. Yellow), review problems (Ms. Blue, Ms. Clair), application word problems (Mr. Cord, Ms. Yellow), class discussions (Ms. Green, Ms. Amanda), in-class activities involving models (Ms. Rink, Mr. Evans, Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow), and projects (Mr. Cord, Ms. Green, Ms. Yellow, Ms. Amanda).

Examining student opportunity for understanding the nature of mathematics was also seen through the opportunities for students to engage in the other four process standards of mathematical connections, communication, representation, and reasoning and proof. Making the mathematics relevant through a real-world connection was evident in the classrooms of Ms. Rink, Mr. Evans, Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow, Ms. Amanda). Specific examples included Mr. Evans' use of golf to examine negative and positive integers, Ms. Rink's use of a square foot of grass to collect and analyze data, and Ms. Yellow's use of art techniques to examine geometry concepts.

Ms. Blue, Mr. Red, Ms. Green, and Ms. Yellow made specific references to the use of mathematical communication and representation as they talked about their teaching. For all of them, communication included the process of participating in oral discussions. Ms. Blue's oral discussion was limited to students' answering questions and identifying what step should occur next. The other three teachers also included students talking with each other in groups and presenting ideas to the class. Communication through forms of representation was seen in the use of numerical tables (Ms. Blue, Ms. Green), graphs (Ms. Blue, Mr. Red, Ms. Green), symbols (Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow), and two- and three-dimensional models (Ms. Yellow). Lessons of Mr. Red, Ms. Green, and Ms. Yellow showed that their students also had opportunities to engage in the process of mathematical reasoning. Mr. Red's students worked in groups to determine a process for graphing equations of line. Ms. Green's students made conjectures based on collected data and on numerical patterns. Ms. Yellow's students focused on developing their spatial reasoning skills as they worked with two- and three-dimensional models.

Multiple factors influenced teachers' decision about what content to teach. All of the teachers indicated they made decisions based on an organized set of printed materials. Ms. Amanda labeled this set of materials as coursework for each class; the other nine teachers referred to a published textbook. Mr. Evans and Mr. Cord used a curriculum identified as a reform curriculum. The other teachers used traditional textbooks. Three of the student teachers (Mr. Darin, Ms. Blue, and Mr. Red) and one of the inservice teachers (Ms. Rink) indicated they closely followed the textbook. Observations of Mr. Red indicated there were times when he supplemented the textbook. Mr. Evans, Mr. Cord, Ms. Green, Ms. Yellow, Ms. Clair, and Ms. Amanda used their textbook as a guideline and supplemented their book with various resources. These resources included: (a) other teachers' ideas (Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda), (b) the Internet (Ms. Green, Ms. Yellow, Ms. Amanda), (c) other textbooks (Ms. Green, Ms. Amanda), (d) self (Ms. Yellow, Ms. Clair, Ms. Amanda), (e) teacher stores (Ms. Clair), and standards (Mr. Cord, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda). Ms. Green and Ms. Clair identified both state and national standards as resources. When Mr. Cord, Ms. Yellow, Ms. Amanda talked about standards, they referred to the state standards.

Seven of the teachers stated that they made decisions about mathematics content based on their students. Mr. Evans, Mr. Red, Ms. Clair, and Ms. Amanda used feedback on assessments to determine which content and how the content should be addressed. Ms. Yellow, Ms. Amanda, and Mr. Cord used student life experiences as a basis for their content decision making. For Ms. Rink, students' preferences for type of instruction influenced their curriculum decision making. Her students preferred a lecture approach because it was faster and more straightforward.

### **Knowing Pedagogy**

The knowing pedagogy discussion is divided into four sections: (a) description of mathematics activities, (b) kinds of thinking used in classroom discourse, (c) teacher's roles in class and discourse, and (d) assessment. Six teachers defined activity during their interview (Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda). All

definitions except Ms. Blue's included ideas suggesting that student involvement was an important component of the definition. For example, Ms. Green defined a mathematics activity as "less lecture based and more student-centered learned...less teacher directed is the best way to say it." Ms. Amanda defined a mathematics activity as "a type of activity that allows students to use manipulatives and their math knowledge in a real-world context."

Three teachers' definition of an activity indicated that most any type of instruction could be considered an activity (Ms. Blue, Mr. Red, Ms. Yellow). For example, Ms. Blue defined an activity as "anything math related. An activity would be something that takes more than half the hour." Mr. Red stated: "Different activities appeal to different learning styles. I'd say lecture would be one activity. I'd say manipulatives would be an activity. It's just a different way of either learning the information or practicing the information."

The observations of and conversations with teachers provided information about instructional activities that occurred in the classroom. All of the teachers used lecture as an instructional format. Mr. Darin, Ms. Rink, Mr. Evans, and Ms. Blue predominantly used the lecture form of direction instruction. Each of them talked about wanting to do other forms of instruction, but felt constrained by their setting (a Catholic college prep high school, students' preference for lecture, time, and cooperating teacher's routine, respectively). A possible start of implementing other types of instruction was hinted at as Mr. Darin had students working in group to compare solutions, Ms. Rink talked about selectively using groups, Mr. Evans liked to include projects in his course, and Ms. Blue talked about wanting to do more hands-on activities.

The other six teachers indicated that the majority of their instruction was lecture-based (Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda). Ms. Green and Ms. Yellow explained that using a lecture format did not mean that only the teacher talked. Specifically, Ms. Green explained: "Even on lecture days, I would say it was probably 60% me to 40% student discussion." Ms. Yellow stated that "It's hard for me to classify just my teacher talk versus their manipulatives. I try to fuse it so there's no delineation between the two." Although Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, and Ms. Amanda used a lecture format for a majority of their instruction, their use of other methods indicated they tried to vary their instruction and to involve their students in the instructional process. Mr. Cord, Mr. Red, Ms. Green, and Ms. Yellow had students work in groups to do activities for developing mathematical ideas. Ms. Amanda stated that she had students work in groups when they were having difficulty. Used in both large group and small group settings, four teachers indicated that questioning was a form of instruction that facilitated student discussion (Mr. Red, Ms. Green, Ms. Yellow, Ms. Amanda). Students of Mr. Cord, Mr. Red, Ms. Yellow, and Ms. Amanda used hands-on materials to explore mathematics. Ms. Green's students used graphing calculators to explore exponential functions. Five teachers engaged students in mathematics through the use of projects (Mr. Cord, Ms. Green, Ms. Yellow, Ms. Amanda, Ms. Clair). Mr. Cord included projects to bring the real world into the classroom. Ms. Green, Ms. Yellow, and Ms. Amanda used project work to prepare students for the graduation

standards. Ms. Clair's projects were in-class activities selected to help students understand difficult topics.

The kinds of thinking and the types of discourse present in the classrooms were related to the instructional activities previously described. When the teachers used lecture, at least some part of the lecture process focused on the transmission of knowledge where students listened and took notes. During the various instructional formats such as lecture time, group work, and project work, teachers enabled students to demonstrate their thinking in various ways. Specifically, students asked clarifying questions (Ms. Rink), responded to questions concerning what should happen next in the problem (Ms. Blue, Mr. Red, Ms. Green) and explained their thinking processes (Mr. Darin, Mr. Red, Ms. Green, Ms. Yellow). Teachers also encouraged students to respond to each other's questions during discussion (Ms. Yellow, Ms. Amanda) and talk in their groups and generate ideas (Mr. Cord, Mr. Red, Ms. Yellow).

The discussion of the teacher's roles in the classroom and during discourse is based on six teachers' statements (Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda) and ten teachers' observed lessons. One of the roles used by all teachers was that of presenter of information. For example, Ms. Blue described this role as being one who "takes that knowledge and gets it across, and manages the class and manages the information." Ms. Clair described her role as a teacher as "presenting new concepts and then answering any questions." The role was prevalent for all 10 teachers when they lectured.

Four teachers took on the role of a facilitator (Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow). Mr. Red's and Ms. Yellow's statements illustrate the role of a facilitator. Mr. Red labeled this role as "coach": Sometimes you kind of have to be a coach....If you're doing group work, the teacher should be cycling around (this is your coach mode) and make sure they're on task." Ms. Yellow explained how she stepped back as students worked together: "If I see they are really going and understanding, then I quit talking, and walk around the room, and watch the thing evolve. This one talking to this one, and this one helping that one, then they become the teachers...then my role, what I try to do, is just assure them that they are on the right track, or try to point them in another direction."

Being a classroom manager was another teacher role identified by Ms. Clair, Mr. Red, and Ms. Yellow. Ms. Clair described this role as needing to keep students on task. Ms. Yellow characterized this role as teaching students to behave: "One of the very biggest parts of my job is teaching kids how to get here, get here on time, have their materials ready...how to behave in class, how to talk respectfully to adults and other children."

Ms. Green, Ms. Yellow, and Ms. Amanda stated that one of their roles in the classroom was making sure students felt comfortable in the class. Ms. Green's and Ms. Amanda's statement illustrated this role. Ms. Green stated: "It's my personal philosophy to make sure that the students feel comfortable and safe in my classroom. I don't want any of my students feeling like they don't belong, that they are stupid, that they are never going to get it." Ms. Amanda wanted to "make them feel wanted (a feeling most lack)"

The focus of the assessment discussion is on the ways that the teachers assessed student learning. All of the teachers except Mr. Darin talked about types of assessment they use in their classrooms. Six teachers talked about using oral questioning as a means of assessing student understanding of the material (Mr. Cord, Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair). Mr. Red's statement about the immediacy of feedback appeared to be true for the other teachers as well: "Class discussion gives me an immediate assessment of students' understanding of the material." Ms. Blue and Mr. Red both generated class discussion based on the use of warm-up problems at the beginning of the class period. Ms. Clair's description of oral questioning referenced the idea of assessing students by listening to their questions.

Eight of the teachers made reference to the use of observation as an assessment technique (Ms. Rink, Mr. Evans, Mr. Cord, Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Amanda). The teachers used this informal approach while walking around the room as students worked on problems and activities. Mr. Cord and Ms. Yellow made specific references to including participation points as part of their grade. It seemed that participation meant being involved in both the class discussion and the class activities.

Homework assignment from the textbook or as a worksheet was one type of written assessment the nine teachers used (Ms. Rink, Mr. Evans, Mr. Cord, Ms. Blue, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda). The teachers' general references to homework suggested that this assessment consisted of routine problems. Eight of the nine teachers (all except Mr. Cord) made a specific statement indicated they used written tests. Like the homework, these tests predominantly focused on routine problems. One of the student teachers, Ms. Green, used the student teaching time to experiment with implementing different forms of tests. Specifically, she explained: "I did different types of assessment as far as testing goes. I did the traditional in-class one-hour test. I did some group work. I did some open book, open note tests, take home test. I tried some different assessments since it was my student teaching experience. I wanted to see the value of what worked and what didn't." Ms. Green indicated this experiment was a valuable experience and that she still needed to decide what type of assessment was best.

Five of the teachers also made references to using assessments that required students to apply their knowledge in a more open-ended manner than is possible with a written exam (Mr. Evans, Mr. Cord, Ms. Green, Ms. Yellow, Ms. Amanda). Ms. Green made a general reference to using graduation packages to give students an opportunity to show what they know in a form other than a test. Ms. Yellow and Ms. Amanda made specific references to graduation packages that they modified and implemented in the areas of geometry and business mathematics, respectively. Mr. Evans' comments suggested that he used projects to assess students on their ability to work interesting problems (e.g., wooden bridge project). Mr. Cord used projects to bring the real world into the classroom. He used checklists and rubrics to assess students' work.

### **Knowing Students**

The knowing students discussion is divided into three parts: (a) ways in which activities are appropriate, (b) students' roles in fostering the discourse in the classroom, and (c) ways in which the teacher manages the social aspects of the classroom. The manner in which activities accommodated the range of ways in which students learn was one part of the appropriate activity discussion. Discussion of four teachers' observations illustrated different modes of learning (Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow). All four teachers included learning through oral discussion. For Ms. Blue the oral discussion occurred in a whole class setting. Mr. Red, Ms. Green, and Ms. Yellow incorporated oral discussions in a whole class setting and in a small group setting. The four teachers also included activities that consisted of different learning modes such as numerical tables (Ms. Blue, Ms. Green), graphs (Mr. Red, Ms. Green), hands-on (Ms. Yellow), kinesthetic (Mr. Red), and symbolic (Ms. Blue, Mr. Red, Ms. Green).

Building on students' interests was another component of whether activities were appropriate. Observations of six of the teachers showed that they used a real-world context for the mathematics discussion (Mr. Evans, Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow, Ms. Amanda). For example, Mr. Evans used the game of golf to explore negative and positive numbers. Mr. Red used student heart rates as a setting for understanding complex inequalities.

The discussion of students' roles in the classroom and during discourse is based on five teachers' statements (Ms. Blue, Mr. Red, Ms. Green, Ms. Clair, Ms. Amanda) and all teachers' observed lessons. Ms. Clair's description of the role of students in the classroom included all aspects of the role that is portrayed in the teachers' classrooms. Ms. Clair stated: "The student's role is to LEARN, whether by watching, listening, asking, writing, doing, explaining, or all of the above." At times, teachers expected students to be passive learners as they listened and took notes. Ms. Blue's description of students' role in the classroom illustrated this situation: "They are to responsively use their time to take notes because usually the clues I give them they can just take right into their homework." Since all teachers used a lecture format, students in all ten classrooms took on this passive role at some time. The lecture process also included students responding to teachers' questions about answers to problems, what should happen next in the process, and whether they understood the process.

Six of the teachers expected students to take on the role of an active learner that was partly responsible for directing classroom discourse (Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda). In a large group setting, these teachers expected students to participate in discussion by asking questions of the teacher and of each other. Ms. Amanda's characterized this situation by stating that students should "participate in open discussion." When students worked in groups, teachers expected students to help each other learn as they worked cooperatively on activities while using materials and asking each other questions (Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow, Ms. Amanda). Mr. Red's description of his expectation of his students seemed to describe the expectations of all five teachers: "If you're doing group work, be part of the group, don't just sit and watch things happen, make them happen."

One aspect of the management of the social aspects of the classroom was instructional grouping strategies used by the teachers to promote mathematics learning. Observations showed that all teachers used a large group format and that some of them used a small group format (Ms. Rink, Mr. Evans, Mr. Cord, Mr. Red, Ms. Green, Ms. Yellow, Ms. Amanda). Ms. Rink and Mr. Evans used small groups sparingly explaining that their students did not always work well in groups and that they were not sure how to use groups in the most appropriate way. Ms. Amanda used groups when students were having trouble with the material. The other four teachers used groups when students were working on activities.

Comments from Mr. Red, Ms. Yellow, Ms. Green, and Ms. Amanda showed that they encouraged student participation of and risk taking by all students through focusing on facilitating students' comfort in the classroom. Mr. Red, Ms. Green, and Ms. Yellow made positive comments to students to encourage students to share their ideas in class. Ms. Yellow explained her reasoning for using positive comments: "I want to give them a positive answer that is you are on the right track. Because I don't want to say NO to a student, because that shuts them down." Ms. Yellow's description also characterized Mr. Red's and Ms. Green's interactions with their students. Ms. Green and Ms. Amanda emphasized the importance of showing respect in their classroom as a basis for student participation.

### **Establishing an Environment**

Management of physical facilities and resources and insuring physical safety in the classroom were the two parts of establishing an environment. The profiles contained a minimal amount of information that fit into these two categories. With respect to the management of the physical space of the classroom, Mr. Red, Ms. Green, and Ms. Yellow appeared comfortable when students either worked in groups with desks moved together or individually in their desks arranged in rows. Mr. Evans was most comfortable with students working in desks seated in a row. Students did move their desks together during work time, but Mr. Evans did not use group work as part of instruction. He explained that "learning to work in a group is definitely not...something that just comes naturally to kids...it's something they need to learn to do." He stated that he is not sure how to help students learn how to work in groups. Observations of Ms. Rink showed that she usually had her students working in desks that were seated in rows. She did, however, state that she often had students sitting in groups, but her classroom desks were in rows to facilitate classroom management for her student teacher. As suggested by having students sit at tables, Mr. Cord was comfortable with his students sitting and working in groups. Ms. Blue worked within her cooperating teacher's system of students sitting in desks in their rows. She explained, however, that her preference would be to put pairs of desks together and arrange them throughout the room facing in different directions.

Although teachers did not make direct comments about appropriate use of tools while they were in the classroom, it seemed they had previously established expectations for proper use of the tools (Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow). In addition,



teachers walking around the classroom as students worked addressed any potential problems. Physical safety in the classroom was interpreted to include emotional safety. Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, and Ms. Amanda all stated during interviews that students teasing each other was not tolerated.

### **Developing as a Teacher**

The developing as a teacher section consists of three areas: (a) ideas that have contributed to the individual's development as a teacher, (b) teachers' self-reflection on teaching, and (c) professional development opportunities. Seven teachers identified various situations that have influenced their development as teachers (Mr. Cord, Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda). All of the teachers identified teaching experience as an important component of their development. The three student teachers (Ms. Blue, Mr. Red, Ms. Green) and two of the inservice teachers (Mr. Cord, Ms. Clair) stated that it was their student teaching experience. Ms. Yellow, certified in science and mathematics, felt that her science student teaching experience more than her mathematics student teaching experience helped her develop as a teacher. Ms. Amanda labeled the teaching experience as experience in the classroom. Ms. Blue (50%), Mr. Red (60%), and Ms. Clair (50%) identified student teaching as the most important idea that has contributed to their development. Ms. Blue and Mr. Red also identified other teaching experiences such as practicum experiences (Ms. Blue, Mr. Red), summer teaching (Ms. Blue), and tutoring (Mr. Red)

All of the teachers indicated that their university courses helped them develop as a teacher. The teachers categorized the courses in different ways. These categorizations included: (a) mathematics methods courses (Mr. Cord), (b) mathematics methods and general methods courses (Mr. Red), (c) teacher preparation courses (Ms. Blue, Mr. Red, Ms. Green, Ms. Yellow, Ms. Clair, Ms. Amanda), and (d) mathematics content courses (Ms. Clair, Ms. Amanda).

Ms. Yellow, Ms. Green, and Mr. Cord stated their life experiences fostered their development as a teacher. For Ms. Yellow, life experiences included her experiences as a mother as well as other life experiences. In Ms. Green's situation, life experiences were referring to childhood and school experiences. She identified her experience as a mother as a separate category. Mr. Cord did not elaborate on his definition of life experiences. Ms. Green (33%) and Mr. Cord (50%) indicated that life experience has had the most influence on their development as teachers.

Talking with other teachers was another factor that influenced individual's development as a teacher. Ms. Yellow explained that she talked with other teachers in her building and met with district-wide, grade-level teachers on a regular basis. These interactions provided her with opportunities to ask questions about her teaching, observe their teaching and decide how other teacher's action might apply to her classroom, and collect teaching ideas. Mr. Red and Ms. Green both indicated they talked about teaching ideas with other teachers. Ms. Green described other teachers as mentors; she also indicated the importance of personal mentors. For Ms. Clair, talking with other teachers meant

talking with professors and her student teacher supervisor. Ms. Yellow (15%) identified talking with other teachers as having the most influence on her development as a teacher.

Two teachers identified attending conferences as important factors in their development as a teacher (Ms. Clair, Ms. Amanda). Ms. Clair attended Minnesota Education Association and SciMath<sup>MN</sup> conferences. Ms. Amanda attended various conferences, which probably explains why she indicated that attending conferences was the most important component of her teacher development (25%). Specifically, she attended conferences supported by the Minnesota Education Association, the National Council of Teachers of Mathematics, and the Bureau of Education and Research. She has also gone to two conferences on ALC instruction.

Other items that influenced teachers' development included: (a) volunteer work (Ms. Blue), (b) district curriculum (Ms. Yellow), (c) principal evaluations (Ms. Yellow), (d) research work of others (Ms. Yellow, Ms. Amanda), (e) own research work (Ms. Yellow), (f) participation on a list serve (Ms. Yellow), (g) student comments (Ms. Yellow), and (g) graduation rule meetings (Ms. Yellow).

The teachers' self-reflection on teaching was minimally addressed in the profiles. Items that were included were general statements such as awareness of student progress and had ideas for changing instruction.

The teachers' descriptions of their professional development experiences indicated that all of the teachers except Mr. Evans had participated in various professional experiences. Many of the opportunities for professional growth were categorized as interacting with other teachers. These opportunities included: (a) meeting with teachers in your building (Ms. Brown, Mr. Red, Ms. Yellow), (b) district grade level meetings (Ms. Rink, Ms. Yellow), (c) inservice meetings (Ms. Clair), (d) parent-teacher conferences (Mr. Red, a student teacher), (e) authority figures that explain what has worked for them (Ms. Clair), and (f) campus education groups (Mr. Darin, Ms. Green).

Three teachers identified attendance at conferences as an important component of their development as a teacher. Mr. Red, a student teacher, attended his first Minnesota Council of Teachers of Mathematics conference while he was student teaching. As previously described, Ms. Clair and Ms. Amanda (inservice teachers) have attended a variety of conferences.

Two teachers indicated they had grown professionally as a result of taking post-baccalaureate classes. Ms. Yellow stated that she had taken a web design course and a mathematics content course. Ms. Clair participated in a month-long technology academy.

The teachers' descriptions of their development as a teacher also included plans for future professional opportunities. These plans showed an awareness of the need for professional development. Mr. Red's and Mr. Evans' statements illustrated this awareness. Mr. Red, a student teacher, stated: "I want to get better at everything." Mr. Evans, a third year teacher explained, his recent realization about the need for

improvement: “My first and second year of teaching I was kind of under the impression that I was a pretty good teacher and I was doing a lot of things right....Now this year, having basically revamped my curriculum, I’m starting to wonder if I don’t have a lot of room for improvement....I realize that there’s a lot of things going on out there that...I could incorporate into my classroom.”

Three student teachers’ professional development plans focused on wanting to meet a goal rather than knowing what the professional development opportunity would look like. Ms. Blue talked about learning to work within her cooperating teacher’s system and learning more classroom management ideas. Mr. Red wanted to know more about developing lessons that appealed to different learning styles. Ms. Green needed easier access to resources and a mentor that would give mathematics specific feedback.

Comments by the remaining teachers contained references to a specific type of professional development opportunity. The various opportunities included: (a) attend conferences (Mr. Darin, Ms. Clair, Ms. Amanda), (b) attend curriculum materials training (Mr. Cord), (c) talk with other teachers (Mr. Evans), and (d) take time to explore newly-acquired resources (Ms. Yellow).

The analysis guidelines say to (a) write a section that discusses any other information that stands out and (b) write a final section that includes any questions that I discovered going through this process. With respect to results, if there was any other information that stood out, it has already been included. In general, I don’t remember that situation happening very often, if at all. The final section is going to be a description of the process followed, challenges met, and process questions raised as I wrote the analysis. At some time, we will want a discussion on what does the cross-case results mean. I don’t feel that is it appropriate to do that yet since there are questions about the process.

There are three items that made the writing of this cross-case analysis challenging: (1) the profiles are not in the same format, (2) the profiles do not contain the same amount of detail, and (3) the authors are not interpreting the sections in the same way. However, we decide to address each these issues will affect the results that are presented.

I used the teacher profile template as my organizer for the analysis. The following information shows how I grouped some of the content, what decisions I made for a given section, and which teacher apparently did not have any information for that section.

### **Knowing Math Content**

1.1 important, accurate, and appropriate content

*tried to connect ideas to the state standard content areas; it did not appear that there was a clear agreement among the authors about how to approach this section*

- 1.2 mathematics for all  
*based this discussion on whether or not the authors used the phrase “mathematics for all”; it is possible that some of the teachers included the ideas of mathematics for all, but if an author did not use that phrase, I did not interpret what was written.*

Missing teachers: Mr. Darin, Ms. Rink, Mr. Evans, Mr. Cord, Ms. Clair, Ms. Amanda

- 1.3 understanding the nature of mathematics  
*focused this discussion around the five process standards; used ideas from the 7 teachers that defined problem solving and from observations of nine teachers for the problem solving discussion; the real-world connection was easy to find from the described lessons; the discussion of communication, representation, reasoning and proof was limited to those authors that used those phrases during the knowing mathematics content section; I’m guessing that more theme ideas are present but I went by what was labeled by the authors*

Missing teachers: definition—Mr. Darin, Ms. Rink, Mr. Evans

Key ideas—Mr. Darin (all)

Ms. Rink, Mr. Evans, Mr. Cord, Ms. Clair, Ms.

Amanda (missing from the communication, representation, and reasoning and proof discussion)

- 1.4 curriculum constraints and decisions (how do you decide what to teach)  
*focused this discussion of factors that influenced teachers decisions about what content to teach; easy to find ideas for all teachers*

## **Knowing Pedagogy**

- 2.1 description of mathematics activities (kinds of activities-what is an activity and appropriate activities)  
*based this discussion on six teachers’ definition of activity and on ideas from observations of all teachers*

Missing teachers: definition—Mr. Darin, Ms. Rink, Mr. Evans, Mr. Cord

- 2.2 kinds of thinking used/classroom discourse  
*it’s not clear how we are defining discourse or if all of the authors agree on an interpretation; based this discussion on ways in which instructional activities provided students with opportunities to demonstrate their thinking*

- Missing teacher: Mr. Evans—example of instruction were present but not in enough detail to address opportunity for student thinking
- 2.3 teacher's roles in class and discourse  
*based this discussion on six teachers' statements and all teachers' observed lessons*
- Missing teachers: definition--Mr. Darin, Ms. Rink, Mr. Evans, Mr. Cord (a missing definition includes the situation where the author did not specifically use the phrase "the teacher's role")
- 2.4 assessments (variety and expectations) and has student learning been achieved  
*focused this discussion on the ways that the teachers assessed student learning; much of this discussion is on the how and some of it includes the purpose of the assessments; none of the authors really addressed the idea of has student learning been achieved*
- Missing teacher—Mr. Darin (no direct references to assessment were made in the profile)
- 2.5 external resources  
*didn't write this up as a separate section; authors talked about resources in various places in the profile; the information seemed to fit better with the discussion of how teachers make decisions about their content*

## **Knowing Students**

- 3.1 appropriate to students  
*based this discussion on two ideas: (a) ways in which activities accommodated the range of ways in which students learn and (b) building on students interests; the phrase 'accommodating the range of ways in which students learn' is from MTOI; only four of the profiles specifically used this phrase and discussion; this is another example of differences in author interpretation; part b was based on observations of nine teachers*
- Missing teachers for part a: Mr. Darin, Ms. Rink, Mr. Evans, Mr. Cord, Ms. Clair, Ms. Amanda
- Missing teacher for overall appropriate to student discussion: Mr. Darin
- 3.2 students' roles in class and discourse  
*based this discussion on the author's use of this phrase in six profiles, quoted definitions of five teachers, and observations of all teachers*

Missing teachers: the author's use of the phrase is missing—Mr. Darin, Ms. Rink, Ms. Evans, Mr. Cord

- 3.3 management of social aspects and behavior  
*based this discussion on two interpretations listed in MTOI: (a) instructional grouping strategies used by the teachers to promote mathematics learning and (b) encouraged student participation of and risk taking by all students; authors did not always use these two phrases, but their ideas seemed to fit into these two categories*

**Establishing an Environment (overall there seems to be some confusion about what fits in this category; also minimum descriptions were included in the profiles)**

- 4.1 management of physical facilities and resources  
*based this discussion on the management of desks and use of large group and small group settings (use of space)*

Missing teachers: Ms. Clair and Ms. Amanda

- 4.2 insures physical safety in the classroom  
*based this discussion on references to appropriate use of tools and emotional safety*

Missing teachers: Mr. Darin, Ms. Rink, Mr. Evans, Mr. Cord

### **Developing as a Teacher**

- 5.1 inserted 'ideas that have contributed to the individual's development as a teacher'—a discussion on the pie chart information  
*based this discussion information generated from the pie charts during the interview*

Missing teachers: Mr. Darin, Ms. Rink, Mr. Evans

- 5.2 self-reflection on teaching  
*minimally addressed in the profiles; made a couple of general comments for discussion*

- 5.3 professional development opportunities

*based this discussion of past professional development experiences and future plans for professional development*

- 5.4 resources, support communities, and learning communities  
*incorporated whatever ideas were mentioned in to section 5.3; authors didn't really use the phrase communities*

Additional comments:

- 1) With respect to the overall process, it was challenging to write a cross-case analysis when I didn't write all of the cases. Part of the analysis process in a qualitative study is one of getting to know your cases better and better as you work with the data. In other words, it would have been nice to look back at the original data to clarify a few issues. Even though I had my own original data, I did not look back at it in order to be sure that I was treating each case fairly.
- 2) I also found myself torn between two processes: (1) Are we collecting data and seeing what patterns and categories emerge? Or (2) Are we collecting data and then looking at it based on a structure? If we are using a structure (MTOI), does that mean we need to talk about every item listed?
- 3) It's not clear whether we as a group are looking at the MTOI items in the same way. It's possible that a discussion by the authors on how they were going to categorize items would have been helpful.
- 4) I know that people have disagreed with me before, but if our focus is on part 1 in number 2, then we need to spend more time with them in the classroom. Probably, related to this issue is the notion that we need to decide which part of the data is the primary data. Are we starting with CLES and STEBI ideas and looking to see if they are present in the classroom? Or are we starting with the observations—describing what is happening in the classroom and then seeing how CLES and STEBI ideas connect to occurrences in the classroom. This same argument could be stated about the written instruments and the observations—what are we using as the primary data—what they say they do in the classroom or what they actually do.

Dr. Kay Wohlhuter, University of Minnesota Duluth, spring 2000