

FACTORS THAT AFFECT MATHEMATICAL DISCUSSION AMONG SECONDARY STUDENT TEACHERS AND THEIR COOPERATING TEACHERS

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In an extensive review of research on teacher preparation, Wilson, Floden, and Ferrini-Mundy (2001) pointed out that "study after study show that experienced and newly certified teachers alike see clinical experiences (including student teaching) as a powerful – sometimes the single most powerful – component of teacher preparation" (p. 17). They go on to suggest that cooperating teachers exert a powerful influence on the development of student teachers. However, the research evidence on the nature of this influence is both conflicting (Metcalf, 1991) and scant (Wilson, Floden, and Ferrini-Mundy, 2001; Giebelhaus, 2002; Hawkey, 1998). In part, this is due to the complexity of the student teaching experience in which cooperating teachers see their roles differently and interact with student teachers in a variety of ways (Wilson, Floden, and Ferrini-Mundy, 2001; Hawkey, 1997). It is also in part because "we are only beginning to gain an understanding of the specific factors that affect the course of teacher learning" in student teaching (Zeichner & Gore 1990) (p. 338).

The research reported here is part of a larger study aimed at understanding some of the factors that affect what prospective secondary teachers learn during the student teaching experience. We focused on the nature of the mathematical conversations between student teacher and their cooperating teachers.

Methodology

We began by distributing a questionnaire to all 25 cooperating teachers who had agreed to accept a student teacher during a recent semester. From this group, 8 were chosen based on the following considerations: (1) the sample from different levels of school, such as, high school, middle school, or junior high), (2) expected number of

formal meetings per week between them and their student teachers, like more than 1 versus less than 1, and (3) anticipated percent of time devoted to math content in their meeting, for example, more than 15% versus less than 15%. Pseudonyms were created for these corresponding cooperating and student teachers and the same letter was used as the first letter when assigning pseudonym for each pair of cooperating and student teachers, e.g. Dawn and Mr. D.

The data collected for the part of study reported here consist of midterm and end-of-term interviews with each participant and selected recorded conversations between these cooperating teachers and their student teachers. Interviews covered a variety of topics that are available elsewhere (Peterson and Williams, in review). Each pair of participants was also given a hand-held cassette recorder and a supply of tapes to record any conversations between them expected to be over 5 minutes in duration. A total of 42 conversations, ranging from 1 per pair to 9 per pair, were recorded. The interviews and recorded conversations were transcribed for analysis.

The project staff first read the interview data if they were conducting eight case studies in order to build a preliminary description of the relationship in each pair. As we discussed preliminary descriptions of each pair, common themes began to emerge. Then we examined the recorded conversations with the goal of finding confirming and disconfirming evidence for our initial descriptions of each pair and refining the themes emerged in our analysis of interviews from each pair. In the end, we coded both interviews and recorded conversations for common themes and revised in a final time coding. The four codes were used relevant to this report and they were: (1) mathematical knowledge, (2) pedagogical content knowledge which presents and represents content knowledge and translates it into forms students can understand, (c) the attitude of participants about the relative importance of mathematical knowledge and mathematical knowledge *for teaching*, and (d) the relative importance of classroom control for teachers (more information on coding and code development is available in Peterson and Williams, in review).

Results

The question of how often the student teacher / cooperating teacher pairs in our study engaged in mathematical conversation is a complex one. This complexity is due in part to differences in the perceptions of the participants and the researchers about what counted as mathematical discussion. Although our study validates prior research that shows mathematical conversations are infrequent, we focus mainly on the factors that seem to support or discourage mathematical discussions.

Factors inhibiting mathematical discussion

From our analysis, four inhibitors of mathematical discussion emerged. The first two were beliefs shared to varying degrees by both cooperating teachers and student teachers, while the last two were specific to each perspective. These inhibitors were: (a) issues other than mathematics, particularly management issues, were more important for both teachers; (b) the mathematics being taught in public schools is straightforward, easy to understand, and therefore easy to teach for both of them; (c) cooperating teachers believes that student teachers have adequate mathematical training; and (d) it is difficult for a student teacher to confide in a cooperating teacher.

Management is more Important. At least two of the cooperating teachers shared the view that the mathematics taught took a back seat to the challenge of management in the classroom. Mrs. C explained: "It's kind of like when you get the learning strategies and lesson planning and classroom management under your belt, you can really start thinking about and reflecting about what it is you're doing as you do it." For her, the student teaching experience and teaching in general seemed to be a two-phase process. The first phase is learning how to manage the classroom, and the second allows for a focus on the mathematics being taught.

Mr. B also saw mastery of management skills as essential. He explained, "In the junior high level, the whole name of the game is classroom management and control. If you never get beyond that, you never teach." The teaching of mathematics seemed easy to him but he felt it could not take place until the more difficult task of management was mastered.

Several student teachers mentioned how little they had talked about mathematics when compared to classroom management. Connie said, "We've talked a lot about [classroom management], more so than the mathematics . . . because the math you can usually find in the books, it's there somewhere." This emphasis on management discourages mathematical discussion to a large degree, since many student teachers struggle with management throughout their student teaching experience.

Mathematics being taught is straightforward. Ball (1991) noted there is a common belief that the mathematical understanding needed for teaching is not difficult, and that it does not extend very far beyond what was learned in college courses. This belief was evident in the comments of our cooperating teachers. When asked what she had learned about mathematics during her experience as a teacher, Mrs. A replied, "I don't know if I've learned a whole lot, but I've had to refresh it." Three of the eight cooperating teachers answered in similar ways, suggesting they felt that the mathematical knowledge they needed for teaching was essentially what they learned as undergraduates. The challenges of teaching did not motivate them to revisit their mathematical understandings or to push beyond the mathematical material they needed to present.

Student teachers also expressed similar sentiments. When asked "What have you learned about mathematics since you first started teaching?" three out of the eight student teachers responded that they had not learned much. For example, Jennifer said, "You know the subject material, obviously, because you've struggled through four years of [college] math." She said, "[As for] the mathematics itself, I've been through the ropes so I understand." For the student teachers, the mathematics seemed to be easy even if teaching it presented some challenges.

Student teachers have adequate mathematical understanding. Possibly the most consistent belief held by the cooperating teachers is that student teachers come to the student teaching experience with a good knowledge of mathematics. Every one of the eight cooperating teachers had high praise for the academic preparation of the student teachers. When asked about the strengths of their student teachers, all remarked on this theme. Comments such as: "she knows her material," "he is very knowledgeable with

the math," and "she has a good, strong math background" were prevalent in the interviews.

It is interesting to note that this attitude, in many cases, inhibited mathematical discussion and even discouraged correction by the cooperating teacher when mathematical concepts were taught incorrectly. For example, Mrs. J explained, "I have a hard time not jumping up; once in awhile she'll say something not correct, but usually the kids recognize it. For instance, yesterday she was doing parabolas and [said that] they're all functions. There are just little things like that." Even mistakes made by the student teacher were often excused as a case of "nervous," because of the strongly held belief that the student teachers, as mathematics majors, would not likely have a mathematical misconception. Mrs. J recalled another experience in the following way: "Sometimes she'll tell the kids something incorrect and I don't say anything and it just so happened the following day she was gone so I cleaned it up." Jennifer, her student teacher, was never approached about the concepts she taught incorrectly.

Even with this attitude of student teacher competency, several cooperating teachers recall having to explain certain mathematical concepts to their student teachers and expressed some surprise at the math the student teachers don't seem to know. Mr. T recounts such an experience: "I can't remember the time, but she's come up several times and said she learned things she hadn't realized before and it kind of surprised me because this is a sixth grade classroom and she's a math major. I haven't had that much advanced math so it surprised me." Mrs. J had a similar experience with Jennifer: "I'm surprised...because I think she knows more math than I do, at least she's gone through more classes. She doesn't really see the big picture." On the whole, the cooperating teachers in our study were very surprised at the holes that they found in the mathematical knowledge of their academically well-prepared student teachers.

It is difficult to confide in a cooperating teacher. Another barrier to mathematical discussion was the intimidation caused by the cooperating teacher's role in the evaluation of the student teacher. Two student teachers mentioned this idea specifically and at least three cooperating teachers mentioned its effect.

Another example comes from Mrs. C who noticed the role that this intimidation may play when she said, "It's important the cooperating teacher doesn't have anything to do with the student teacher's grade in any way because I don't know if she'd be as comfortable with me. I want that comfort zone there so she won't be afraid to ask questions." This lack of comfort acted as a barrier to mathematical discussion in several of the pairs studied.

Factors supporting mathematical discussion

As suggested above, mathematical discussions were comparatively rare and arose only when there was substantial motivation on the part of a cooperating teacher or student teacher. The two major motivations for both cooperating teachers and student teachers are: (a) recognition that even by a well-prepared cooperating teacher or student teacher, the mathematics being taught is not straightforward but is rich and worthy of further exploration, and (b) recognition that the mathematical knowledge needed for teaching is unique and needs to be learned. This knowledge is not assumed to have already developed before the student teacher came to their student teaching experience.

Richness of mathematics. Four of the cooperating teachers felt that they had learned a lot about mathematics since they started teaching. Mrs. C remarked that undergraduate mathematics just "scraped the surface" and that more in-depth understanding was required for teaching. Mr. T and Mr. D both admitted to not having all the answers, even after many years of teaching. Mr. D used a metaphor to explain how his views and knowledge have changed by saying: "I don't see math like that anymore as something someone is plugged into and they have all the automatic answers because they're a math professor or math teacher. And as a teacher, I've realized just because I'm a math teacher doesn't mean I have all the answers."

Similar sentiments were also expressed by the student teachers. Anne said that one thing she had learned about mathematics was that she doesn't know it all. Dawn, teaching algebra, said, "I have learned so much. I feel like I didn't even know math when I first started teaching." These student teachers found quite a bit of difficulty even with the

"simple" subject matter they were teaching. This difficulty sometimes motivated mathematical discussion.

Need for different understanding. All eight cooperating teachers mentioned the need for knowledge beyond simple content knowledge for teaching. Most felt that this knowledge was not gained in pre-service preparation. Many comments were made alluding to the idea that a different knowledge was required to convey material to students. Common comments included student teachers need to learn: "a different way of saying it that makes it easier for the kids to comprehend," and "looking at it from a different perspective, a different angle, because you're going to have to teach it from different perspectives and different angles to some students." This pedagogical content knowledge was assumed to be lacking in incoming student teachers, which helped motivate some mathematical discussions to greater degrees in some pairs than in others.

All eight student teachers also mentioned needing to know how to teach mathematics effectively, beyond just knowledge of the mathematics being taught. Sunny said she had learned "a lot more of how to teach it and how to explain it."

Many of the student teacher noted they had not learned about mathematics itself during student teaching but rather "why" the mathematics works and the superficial understanding of mathematics they developed during their experience as a student. Anne noted, "It's not just a list of formulas, which I sometimes thought of math as. I thought you could list all the formulas on a piece of paper and that was math but it's not." Anne claimed, "I mean there are things they learn at their age I never thought too deeply about, but when I had to teach it I had to."

Conclusions

The research cited at the beginning of the article indicates that mathematics in and for teaching is different than personal mathematical knowledge. All eight cooperating teachers in this study acknowledged this difference. However, neither this recognition, nor the recognition of the richness of school mathematics, translated into regular conversations about mathematics for teaching with student teachers.

The daily struggles of classroom management that student teachers encountered became a regular topic of conversation between student teachers and cooperating teachers. There is also a belief among cooperating teachers that because student teachers have just completed many college level mathematics classes, they have an excellent mathematical understanding well above the simple mathematics of pre-algebra and algebra. Such belief helped create a community of mathematics cooperating teachers who can even be somewhat intimidated by that assumed knowledge so that they are hesitated to bring mathematics topics in their conversation with student teachers.

At the same time, student teachers believe that they should have a complete understanding of the mathematics and if not they are somehow deficient. As a result, new teachers will not bring up the mathematical topic to avoid revealing a weakness.

This is problematic in light of Ball's research (1991) and the comments of some of the student teachers in this study. We hope that the result of this research will help all members of the mathematics teaching community begin to acknowledge that mathematics in and for teaching is an important and worthwhile topic of conversation not only with new teachers but among colleagues with all levels of experience.

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