SCHOOL-BASED COMMUNITY OF TEACHERS AND OUTCOMES FOR STUDENTS

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This paper describes a school-based professional development project for elementary teachers where all teachers from the school and university mathematics educators regularly met to share and plan mathematics teaching strategies for the school's diverse student body. Analysis of data from focus group interviews with participating teachers revealed that the establishment of a mathematics education community in the school impacted students' motivation for learning mathematics. From the teachers' point of view, their own participation in a mathematics education learning community made their students more interested in learning mathematics. The project underscored the importance of considering school communities as unit of change in mathematics education professional development.

PROJECT SIPS

When listing the ten most important principles from research for professional development, Clarke (1994) stated that professional development opportunities should "involve groups of teachers rather than individuals from a number of schools, and enlist the support of the school and district administration, students, parents, and the broader community" (p. 39). Since the early 1990s, educational researchers have highlighted the importance of working with schools as organizations (Fullan, 1990) and considering schools as the unit of change in educational reform (Wideen, 1992). Researchers have also emphasized that successful professional development initiatives involve communities of teachers, privileging teachers' interactions with one another (Wilson & Berne, 1999) and operating within the school organizational structures (Hawley & Valli, 1999).

Teachers working together and sharing their mathematics teaching experiences are the tenets of Project SIPS (Support and Ideas for Planning and Sharing in Mathematics Education), a school-based professional development project to help elementary grades teachers improve the quality of their mathematics instruction by building a mathematics education community within the school. The project emerges from and develops the importance of considering schools as a unit of change in mathematics education.

In fall 2000, classroom teachers, administrators, and mathematics educators met at Adams Elementary Schools (pseudonym) to discuss issues related to mathematics teaching at the school. During the meeting, teachers voiced their frustration with not being able to mathematically reach all their students—especially their low-achieving children. The group discussed professional development ideas to work within the

fabric of the school to improve teachers' mathematical knowledge and to help teachers meet children's needs.

Supported by an Eisenhower Higher Education grant, SIPS began in May 2001 with a needs assessment in which teachers raised mathematics topics and instructional approaches they would like to know more about. In the 2001-2002 school year, schoolteachers and university mathematics educators (two faculty and a graduate research assistant) began to meet regularly to talk about mathematics, children's mathematics learning, and mathematics teaching. All homeroom teachers at the school, some of the school's special education teachers, and a few staff members have been involved in the project since it started, continuing to meet and build the school mathematics education community over three years.

This paper focuses on the first year of SIPS activities and on data from an evaluation interview conducted at the end of that year (2001-2002). In particular, the paper highlights some student outcomes that resulted from the establishment of a mathematics education community at the school.

Adams Elementary School

At Adams Elementary School, 90% of the children qualify for free or reduced lunch. In its school district, Adams has the highest percentage of Hispanic children (29% in 2000 and 39% in 2003), although the school population is mostly African American (57% in 2000 and 51% in 2003). The school enrolled about 400 children in 2001-2002 (the number varied during the year), organized into 2 pre-K, 3 kindergarten, 4 first-grade, 3 second-grade, 2 third-grade, 2 fourth-grade and 2 fifth-grade classrooms. During this year, SIPS worked with 27 teachers at the school: all 18 homeroom teachers and 9 Title I, Special Education, or English Speakers of Other Languages (ESOL) teachers. Two thirds of the teachers were White, six were African American and three were Hispanic. These 27 teachers attended at least 30 hours of SIPS meetings over the year. Other members of the school community such as the school's arts, music, and physical education teachers; staff personnel; administrators; paraprofessionals; and student teachers also attended a few SIPS meetings during the year.

Because Adams serves a low socioeconomic school population, it receives supplementary government money (through Title I) to better serve its students. The school has been pressured to increase its achievement test scores and it has used part of its extra resources to reduce class size (particularly in first grade) and work with ESOL and reading programs.

Mathematics had not been a focus of attention for teachers' professional development at Adams until SIPS started. An initial background questionnaire distributed to participants at the beginning of the project revealed that 20 of the 22 teachers who returned the form (91%) had not completed any in-service activity in the previous five years that discussed research on children's learning of mathematics.

First Year Activities of SIPS

In its first year, SIPS consisted of a variety of mathematics-related activities. These activities included the formation of a Mathematics Leadership Team, monthly worksessions and mathematics faculty meetings. To begin the project, a Mathematics Leadership Team (MLT) was formed with a teacher from each grade level and two special education teachers. The MLT conducted a mathematics needs assessment with all teachers. It then met with school administrators, mathematics educators and the project consultant (a mathematician) to identify topics to be covered in staff development activities throughout the year. For example, second grade teachers wanted help with subtraction and place value, whereas fourth and fifth grade teachers selected fractions and decimals as an important topic to be addressed by SIPS. All grade levels mentioned they needed help with problem solving and mathematics vocabulary.

The project started with a 4-hour mathematics workshop about the Principles and Standards for School Mathematics (NCTM, 2000). All teachers at the school, as well as paraprofessionals and school administrators, participated in this initial activity where mathematics educators talked about new goals for school mathematics, children's mathematical learning, and problem solving. After this workshop, two SIPS activities constituted the heart of the project during its first year: grade-specific professional development worksessions and mathematics faculty meetings.

SIPS worksessions took place at the school, during school hours. Within grade-level groups, teachers worked with the mathematics educators at the school media center. Each group met for a half-day activity every other month. Substitute teachers were hired to allow for teacher participation. Each half-day worksession addressed research on children's learning of mathematics topics selected by the grade-level teachers as important to them and as an area in which they believed they needed help. During the worksessions teachers were introduced to activities and ideas for teaching mathematics, explored their knowledge of and teaching strategies for the highlighted mathematical topics, and planned lessons to implement in their classrooms.

The after-school mathematics faculty meetings were attended by the whole school staff and, whenever possible, by school administrators. These meetings were devoted to building and maintaining a mathematics education community within the school. During these meetings, teachers had the opportunity to share with their colleagues what they were doing in their mathematics teaching. These meetings were also a forum for mathematics problem solving. Teachers worked on solving problems, sharing their solutions and discussing how the problems and concepts discussed could be adapted for use with their students. Teachers had the opportunity to experience mathematics in a way that was based on currently accepted views for mathematics teaching—such as those espoused by NCTM (2000).

Four other activities that were not part of the project's initial plan happened during the first year of SIPS and turned out to be important components of the project. In

November 2001, in-service and pre-service teachers met to learn about bi-lingual mathematics-related resources to use in the classroom. In January 2002, the whole school planned a day of mathematics activities for the 100th day of school. In April 2002 the school hosted its math night, a traditional school event that became part of SIPS as teachers used SIPS meeting time to plan. University graduate and undergraduate students joined the schoolteachers in conducting the math night activities. Finally, as SIPS developed, teachers began to voice their interest in and need for further help in the classroom. So, during the second semester of the 2001-2002 school year, the SIPS graduate research assistant devoted part of her project time (6 to 7 hours per week) to visit the school, listening to teachers' needs and helping teachers in classrooms whenever they asked for support.

All activities of SIPS during the project first year were aimed at developing trust among university mathematics educators and school staff. Although impacting mathematics instruction at Adams Elementary School was an important long-term goal of the project, creating and sustaining a mathematics education at the school was the most important objective of the project in its first year. It was expected that, on the long run, this community would impact mathematics instruction and students' achievement at the school. Thus, mathematics educators were not initially looking for students' outcomes from SIPS first year. These outcomes, nonetheless, emerged from the teachers' discourse as they discussed the project.

SIPS RESEARCH

By the end of the first year of SIPS, mathematics educators raised the question of the impact of the project on teachers and the school community. In its research approach, SIPS is an interpretive study that aims at revealing "the complex world of lived experience from the point of view of those who lived it" (Schwandt, 1994, p, 118). Searching for an understanding of how the project was unfolding, how the community was developing, and what teachers' believed they were taking from the project, the mathematics educators developed an interview protocol to begin gaining access to teachers' perception of SIPS and its first year activities. The project external evaluator used this protocol in a series of focus group interviews with all participating teachers. This paper focuses on data from these interviews.

The interviews were designed to be an opportunity for teachers to voice their opinions freely and make suggestions for changes in the project. They also had the role of gathering information for the formative assessment of SIPS. The focus group approach allowed for group discussion, encouraging "participants to talk to one another, asking questions, exchanging anecdotes, and commenting on each others' experiences and points of view" (Kitzinger & Barbour, 1999, p.4). The interviews were conducted with groups of three or four teachers, organized by grade level (seven groups), with the addition of some Title I, special education, and ESOL teachers. These semi-structured interviews lasted approximately 45 minutes and were all

audiotaped and transcribed. Mathematics educators received a transcript of the interviews and a report from the project evaluator.

This paper has participants' language as its main data source since the data analyzed came from teachers' discussions during the focus groups interviews. Through content analysis of the interview transcripts, mathematics educators searched for patterns in the teachers' discussion of SIPS and for recurring words and themes that expressed teachers' perception of the ways in which the SIPS community was developing. We also searched for teachers' comments on how SIPS was (or was not) influencing their work in their classrooms. We looked within interviews and across the seven interviews to bring up issues that were important to teachers, trying to represent an overall view of the teachers instead of particular aspects commented on by only one or two teachers. In particular, we looked for teachers' discussion of their own teaching during the first year of SIPS, changes they perceived in themselves and their students, and ideas from the project that they tried to use in their classrooms.

When considering their own classroom and their learning in SIPS, teachers talked about the way in which their new involvement with mathematics impacted their students' motivation for learning mathematics. This increased motivation was mentioned by most teachers in all grade levels. Teachers also talked about their increased interest in problem solving and mathematics communication in the classrooms, which had implication for students' willingness to work on these areas. These last two ideas were not mentioned as often as motivation, but were very strongly supported by a few teachers. Teachers' comments on students' motivation, problem solving and communication in the classroom are further discussed in the following session.

Outcomes for Students

When asked about the influence of SIPS on their own teaching and their classrooms, teachers mostly mentioned students' improved motivation for learning mathematics. Teachers talked about the importance of having new ideas for teaching mathematics and how beneficial it was for them to be able to carry SIPS activities directly to their own classrooms—components of the project that the mathematics educators considered important for the overall goal of building trust in the newly established mathematics education community. However, what teachers highlighted most often when talking about the impact of SIPS was the students' participation in these activities and the students' increased appreciation and motivation for working in mathematics.

> Well, my kids are so in love with math now. They begged me on days that we were doing the [standardized tests] and we were going to take it easy in the afternoon because they worked so hard. They didn't want to take it easy, they wanted to do math. You know, I am good at math but it's not necessarily my favorite subject, but they loved it. So I said, "Well, OK, something we are doing here is coming across . . . the joy of math somehow is coming across

> to these kids. And I think it's because, you know, of a lot of the activities and things that I've gotten from the meetings.

First, second, third and fourth grade teachers noted that their own growing enthusiasm for mathematics was reflected in students' more positive attitudes. Teachers shared with students what they learned in the worksessions and faculty meetings, and students seemed to become more engaged with mathematics learning activities.

> I think they see their teacher getting more excited about it so they get more excited about it.

> I think the children were aware, too, a lot of them, that the teachers were actually going to a math workshop or they were going to a math meeting. I think they knew that we were all working on something.

One teacher remembered a graphing survey done by third-grade students about their favorite subject. Math was highlighted by the majority of students as a favorite subject. Special education teachers also spoke of their students' increased motivation for mathematics and their willingness to stay on task, especially when the teachers used the mathematics children's literature they learned of through SIPS.

Teachers also spoke of their students becoming more effective problem solvers and learning to communicate their ideas about mathematics more clearly. Second grade teachers, for example, reported that students were beginning to get the idea that there are multiple ways to solve the same problem—an idea stressed in many SIPS worksessions. Students, however, were still working on this idea.

> It was really hard to get them in the beginning, like you said, they come up with that one way or two ways, and they are finished and they want to hand it to you and there was a lot of moaning and groaning. . . Like when we got the money, like how many ways can you make a dollar? "Well, I already made it two ways." And it's like, "Well, there's more than [two ways]."

A fifth grade teacher saw that students were more successful with multiplication after he had introduced them to strategies such as using pictures, graph paper and arrays. He also reported that his students were thinking more as they participated in different kinds of problem-solving activities, and that he wanted them to continue to be challenged:

> They will meet your expectations. Just the problem solving is good for letting the students' minds work. . . . We spent a whole class on magic numbers. "Let's pair up and find out if magic squares can work with other numbers." It was incredible to watch their minds.

One first grade teacher noticed her students' growing abilities in communicating about mathematics:

> I noticed that my kids were more responsive to sharing, speaking about manipulatives, and that helped me a lot to do the activities.

One fifth grade teacher also highlighted communication about mathematical ideas as something that was improving in his classroom:

> My kids can talk in terms of math. I whitewashed some of the vocabulary earlier-- I didn't communicate the expectation that they need to be able to talk about the numerator and denominator and understand the process by which you make a fraction and what the numerator means. Now we're doing least common denominator, and it's a breeze--they understand.

To summarize, the most consistent student outcome reported by teachers was increased student motivation for mathematics. The reports of increased student abilities in problem solving and mathematics communicating were anecdotal but were reported across kindergarten, first, second, and fifth grade levels. Some teachers, however, appeared more concerned with basic mathematics skill development than with problem solving and mathematics communication skills.

DISCUSSION

In analyzing research on teaching, Floden (2001) calls for continue study of links between teaching and student achievement—which he calls the effects of teaching. In a similar position, it is important to continue to search for links between professional development activities for teachers and students' achievement in mathematics. These links, however, depend on and are mediated by teachers' learning through professional development activities and teachers' adaptation of what they learned to their own classrooms.

In its first year, the main goal of SIPS was to establish trusting relations within a mathematics education community that was developing at Adams Elementary School. Although impacting mathematics instruction at the school was a long-term goal of the project, it was not the main concern of the mathematics educators as the project began because of the crucial need to build trust. However, the focus groups interviews with participating teachers revealed that the SIPS mathematics education community impacted students as it developed. As teachers tried newly learned ideas in their classrooms there was an overall increase in students' motivation for learning mathematics—across all grade- and ability-levels at the school.

Research in professional development has shown the importance of teachers working in communities for teachers' professional growth (Wilson & Berne, 1999). SIPS adds to this body of literature, showing that teachers' engagement in communities of learners also impacts teachers' perceptions of student engagement with mathematics. Given that learning to value mathematics is an important mathematics education goal for all students (NCTM, 1989), increasing student motivation through teacher participation in professional communities is an important outcome for professional development. Further investigation is needed to continue to examine how teachers' professional development and student learning in mathematics are related. Moreover, research needs to examine the extent to which and what aspects of professional development are directly related to student learning.

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