

**PROFESSIONAL DEVELOPMENT:
MOVING FROM TELLING TO LISTENING**

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This paper reports on a professional development initiative designed to enhance teachers' mathematical knowledge and pedagogical expertise and to support them as they connect their professional development with classroom practice. We describe teachers' experiences as they move from a model of teacher explanation and repeated student practice to attending to students' mathematical thinking within problem solving settings. Such a shift in pedagogy is challenging and difficult to put into action. Our study of 147 teachers helps to shed light on these challenges. Specifically, we examined 1) how teachers can be supported as they move from telling to listening in their classrooms and 2) what are their experiences as they make this move. We are able to provide some evidence of the strategies, practices, and processes that promote meaningful professional development. Our study demonstrates that professional development over time, resources to support student and teacher learning of new math concepts, and working within a collaborative school community enhance teachers' confidence and expertise in the complex task of supporting students' thinking in a problem-solving setting. We find that the model of teachers moving from telling to listening in their classrooms also serves as a sound professional development model.

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Our study reports on a professional development (PD) initiative designed to provide teachers with experiences to support them as they move from a model of teacher explanation and repeated student practice to attending to students' mathematical thinking within problem solving settings. Such a shift in teacher practice is challenging and difficult to put into action. This study, that included 147 teachers, helps to shed light on the professional development experiences that support teacher learning.

Current perspectives on mathematics teaching and professional development

Current perspectives in mathematics education focus on the understanding of mathematical concepts, procedures, connections, and applications through problem solving (National Council of Teachers of Mathematics [NCTM], 1989, 2000; National Research Council, 1989). As such, meaningful mathematics takes place in classrooms that help students investigate, represent and connect mathematical ideas through mathematical discussion in the context of problem solving (Hiebert et al, 1996; Lampert, 1990; NCTM, 1989, 2000). However, facilitating such problem solving and mathematical inquiry poses substantial challenges for teachers. The posing of problems, the facilitation of discussion, and the consolidation of mathematical concepts are teacher practices that require a great deal of expertise and attention. Teachers struggle with such issues as when to explain and when to listen, how much time to leave for ideas to emerge, and what question to ask next (Suurtamm & Graves, 2006).

Several reasons have been suggested as to why this shift in practice is challenging. For example, in many cases, teachers, themselves, have not learned mathematics in this way, nor have they had opportunities to learn or teach in inquiry-oriented settings. New ways of thinking about mathematics teaching requires new understandings on the part of teachers and involves “observing students, listening carefully to their ideas and explanations, having mathematical goals, and using the information to make instructional decisions” (NCTM, 2000, p.19). Additionally, focusing on students' thinking is challenging as students present a variety of ways

of thinking about a mathematical problem (Ball, 2001; Schifter, 2001). For elementary teachers, their limited understanding of mathematics may make them hesitant to engage students in open-ended problem solving or may prevent them from recognizing and furthering the important concepts that are inherent in mathematical activity (Ball, 1990, 1999; Ball, Lubienski & Mewborn, 2001). Working with teachers to learn to pose problems, to provide opportunities for students to explore the problems and to listen to their solutions takes time and poses several challenges. Teachers often perceive their roles as explaining mathematical facts and procedures. Professional development, therefore, has the challenge of shifting these perceptions as well as addressing new mathematics content and pedagogies.

While there is no perfect model for professional development, several characteristics of effective PD for mathematics teachers have been highlighted in the literature (Loucks-Horsley, Stiles, & Hewson, 1996; Mundry, 2005; NCTM, 1991). Professional development should present a vision of a mathematics classroom that rests on research about how children learn and provide a window into the nature of mathematical teaching and learning. Participants should be engaged in mathematical content as well as pedagogy (Ball, 2003; Cohen & Hill, 2000; Crespo, 2000). Strategies, such as investigation and collaborative work, that serve as models for effective teaching and learning should also be used in professional development. Research has also shown that professional development that is sustained over time (Carroll, Fuson, & Diamond, 2000) and connected with the teachers' own classroom experiences supports new teacher learning (Bednarz, 2000). Research also indicates the importance of attending to individual teacher needs, providing learning opportunities tailored to those needs, and creating a climate of collegiality and support (Mewborn, 2003).

Context of our study

Our research focuses on a particular PD initiative that is set within the community of French-language educators in the province of Ontario, Canada. The francophone community represents 4.8% of the population of Ontario and has its own set of publicly-funded school boards. While curriculum documents, set by the provincial government, are provided in both French and English, French-language resources that align with the curriculum are lacking. Thus this project began with funding for a group of French-language mathematics educators from various school boards to develop pedagogical resources for teaching mathematics in the French-

language schools. This initiative evolved to include field-testing the resources with francophone teachers from different grade levels and to support them as they used the resources. The team of resource developers thus also became a professional development team who we will refer to as Resource/Professional Development (RPD) team.

The professional development initiative

The PD initiative extended over a three-year period. The first year focused on the development of primary mathematics and included Kindergarten to Grade 3 teachers; the second year was aimed at teachers of Grades 4 and 5; and the third year focused on Grades 6, 7 and 8. Each year followed a similar pattern and engaged the group of teachers for one full school year, with PD meetings spread throughout the year so that teachers had the opportunity to try new ideas in their classroom and discuss them with their colleagues. The PD sessions focused primarily on the teachers' understanding of mathematics and on ways to help students develop mathematical understanding. In the first meeting, the RPD team shared examples of current research in math education to provide a rationale for changing some of the traditional approaches to mathematics so that students develop a better understanding of mathematical concepts (Cobb et al., 1991; Carpenter et al., 1993). Teachers discussed topics such as teaching through problem solving and connecting school mathematics with the mathematics in students' lives. All sessions engaged the participants in mathematical problem solving and solution sharing, working with manipulatives, viewing videos of classroom activities, and discussion. These activities focused on strategies to help students develop mathematical understanding. Time was also devoted to sharing experiences of using the new resources in classrooms. As well as formal PD meetings at different times of the year, the teachers were also provided with assistance from their math consultant through visits to their classrooms. These visits took a variety of forms such as observation, co-teaching, or assistance with preparation of materials. The teachers were also able to contact the RPD team directly if they had questions or need assistance.

Participants

In this paper we are including the work with all three years of the project. This would include 23 Kindergarten through Grade 3 teachers from the first year; 39 Grade 4 and 5 teachers from the second year; and 85 Grade 6, 7, and 8 teachers from the third year. It should also be noted that the teachers participated in school groups, for example, a school would send all the K

– Grade 3 teachers from that school to participate in the initiative. The mathematics consultants from the school boards involved in the project also received the training so that they knew what the teachers were learning, and they also supported the teachers through their visitations, observations, or assistance in classrooms in the schools. The teachers had a variety of experiences ranging from a few beginning teachers to over 50% with more than 9 years of teaching experience. The participants in this PD initiative, that included classroom teachers, mathematics consultants, and the RPD team were also participants in our research study. It should be noted that our involvement in this initiative was solely as researchers. In other words, the PD was designed and carried out by the RPD team that did not include the authors of this paper.

The study

This project is a specific example of a group of teachers being involved in a unique initiative to learn more about teaching mathematics within a supportive environment. As Merriam and Simpson (1995) suggest, a case study approach helps to provide an intense description of a group or community to illustrate the interplay of various factors and complexity of human situations. In examining teachers' experiences in this situation we are drawing on a social-constructivist framework (Confrey, 1990; Davis, Mayer & Noddings, 1990; Forman, 2003). From this perspective, new understanding is constructed in relational networks that emerge from the interactions of people and activity environments. This shifts the traditional view of learning from the acquisition of something to a formulation of learning as participatory (Sfard, 1998) which is important for conceptualizing professional development as situations for building communities for inquiry into practice.

To answer our research questions and to gather data from the multiple components of the professional development initiative, we used a case study design that included multiple sources of data. For each year of the project, two questionnaires were administered. The first was at the beginning of the school year and the second was half way through the year. The first questionnaire gathered information from the teacher about their current and past teaching experience, level of confidence about mathematics teaching, and reasons for involvement in the project. The second questionnaire gathered data on teachers' classroom experiences, and ways that they were supported and challenged. Data were also collected through focus group

interviews with participating teachers, consultants, and the RPD team. All interviews were audio-taped and transcribed. We also had access to training materials, and the full pedagogical resource package that was created for each grade. A qualitative analysis of the data was completed through content analysis of the open-ended questions from the teachers' questionnaire and the transcribed discussions of the focus groups, as well as an analysis of the professional development sessions and videotaped classroom experiences. Our analysis was inductive to uncover emergent categories, themes and concepts (Guba & Lincoln, 1981).

Results

Teachers reported a number of changes in their classroom practice that included increased questioning, promoting more communication, an increased use of manipulatives and basically being more attentive to student solutions. In terms of questioning, most teachers said that they were using questioning more effectively, and encouraging multiple ways of looking at a task or solving a problem. The teachers promoted a different learning environment, encouraging risk-taking, and more communication, specifically, more mathematical talk between students. They noted that the increased student communication made them more aware and responsive to students' thinking and encouraged all students to engage in the activities. Teachers also reported that they increased their use of manipulatives in a more meaningful way, moving from manipulatives as fun, to manipulatives as representations of mathematical ideas. They also saw that manipulatives were beneficial to all, not just struggling students. Most importantly, teachers developed ways of listening and responding to student solutions and recognized that students are able to correct their own errors, and develop new ways of solving problems through the sharing of solutions.

Teachers also reported an increase in their own understanding of mathematics, and suggested that working with different methods and strategies allowed them to understand some of the standard algorithms that they had been using for years. Teachers also overwhelmingly reported a change in their students' learning and attitude towards mathematics. Students seemed more positive, mathematics seemed more interesting to them and the students were involved in more mathematical activity. They particularly noticed that students who had previously struggled with mathematics were having more success.

Discussion

The data provides evidence of teacher learning and changes in classroom practice and an examination of the professional development initiative sheds light on the components that helped to facilitate this learning. Teachers provided accounts of the aspects of the PD that were most helpful. These include support from colleagues, an opportunity to discuss classroom experiences and challenges, and the dynamic of the RPD team and the teachers as they moved back and forth from organized meetings to classroom practice. Many of these components and others inherent in the project, such as sustained professional development, a supportive community, focus on content and pedagogical knowledge, and connections to classroom practice parallel the effective components cited in the research literature. However, we would like to emphasize the important role that collaboration, community, and communication played in this professional development initiative.

The collaboration achieved by including all teachers of the same grades within a school supported teacher implementation of new ideas, and established a momentum to continue learning and sharing over the next few years¹. Teachers were encouraged to share ideas with one another and to communicate about student learning. As one teacher commented, when she could not understand a student's written solution she would consult with the teacher next door and together they would figure it out. The visits from the consultants provided feedback, but also served as an opportunity for the teachers to voice their concerns or to discuss issues that they had in their classroom. Teachers also discussed the sense of community at the professional development meetings as they connected with the RPD team and shared their experiences. In turn, the RPD team confirmed the value of the teachers' feedback. This collaboration provided teachers with new ideas to take back to the classrooms, and provided the RPD team with new ideas to incorporate into their resource development and future professional development meetings. Thus, the professional development initiative was not one of telling the teachers what they should be doing in a classroom but allowed the teachers to experience new ways of teaching and learning and to talk about those experiences in a supportive and safe environment. As one teacher summarizes:

¹ We have evidence of continued collaboration as we have had follow-up interviews with the teachers in subsequent years as part of another research project.

I think I can compare how kids feel to what we have done because we felt the same way. Because we had the experience of doing this ourselves in the training, our confidence to proceed was based on experience rather than theory. (Focus group H, June 2006)

This quote reflects the supportive environment that the teachers experienced as they learned and tried out new pedagogical and mathematical understandings. Our findings support the notion that the model of teachers moving from telling to listening in their classrooms also serves as a sound professional development model.

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