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Using Research to Guide Decisions about Mathematics Teachers' Professional Development

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THE PARADIGM for high-quality professional development of mathematics teachers has shifted significantly during the past decade. In *The Knowing-Doing Gap*, Pfeffer and Sutton explore what they regard as one of the great mysteries of organizational management—the disconnect between what we *know* and what we *do* [6, p. 4]. In the old paradigm of professional development, school administrators dedicated time, money, and resources for professional development in which they fell victim to another damaging gap—the disconnect between what the professional development is *expected* to achieve and what they ultimately are willing to *accept* on the actual implementation level.

This article does not provide a comprehensive review of various professional development models. Rather, it identifies essential issues gleaned from research that should be considered in designing the process and content for effective professional development that closes the administrative expectations–acceptance gap of mathematics teachers and specialists.

The professional development of teachers and specialists should connect practice to research in mathematics education. Collaborative “group-think” that is not steeped in a strong foundation of research should not be expected or accepted. How will teachers come to know about relevant research? It should be the responsibility of the researchers, teachers, and administrators mutually to identify and undertake meaningful research into practice [9, p. 215]. Students’ learning, teachers’ knowledge development, and research-affirmed practices are the pillars of a new paradigm for professional development in mathematics.

The Goal of Professional Development

In the new and emerging paradigm of professional development, the term professional development means “a comprehensive, substantiated, and intensive approach to improving teachers’ and principals’ effectiveness in raising student achievement” [5, p. 6]. This new paradigm for professional development envisions mathematics teachers and specialists collaborating interdependently to deepen their knowledge of mathematics pedagogical content and competencies, and expects action on that knowledge with application to practice. Teachers then reflect collaboratively on the impact of their new knowledge on students’ learning on the basis of the practical application of their classroom actions.

1. What are the most crucial *process* issues to consider when designing professional development?

The first design issue is to create a culture of teacher collaboration and professional development. Extensive evidence from the research community indicates unequivocally that the “right kind of continuous, structured teacher collaboration improves the quality of teaching and pays big, often immediate, dividends in student learning” [8, p. xii]. Teacher communities of practice—that is, teacher teams working together to professionally develop one another—“create, expand, and exchange knowledge about their practice,” which in turn leads to a more authentic and subsequent change in actual classroom practice [9, p. 186]. Research has repeatedly concluded that teacher isolation has adverse consequences for students, for teachers, and for any effort to improve schools [2, p. 172].

A second design issue is the provision of adequate time for professional development. Professional development of teachers that relies on one-shot workshop models, that is strictly provided outside of the context of the teachers’ work environment, and that nurtures an expectation of teacher isolation without support or pressure for implementation is not supported by research [1, p. 49]. Professional development is not an event or “training” as in the old paradigm. Professional development and learning are ongoing, continuous, sustainable activities inside and outside the school walls. Professional development lasting fourteen or fewer hours showed *no effect* on teachers’ learning. The largest effects were for programs offering 30–100 hours spread out over six to twelve months [1, p. 79]. Advocating and ensuring quality time for teacher learning in a collaborative mathematics course, grade level of mathematics instruction, or interdisciplinary team is the responsibility of all school leaders. Finding ways to make more effective use of the time currently available within the school culture and to enhance time available is an essential professional development design issue.

A third professional development design issue is to ensure teacher equity and access to professional development and learning experiences. The goal is to pur-

sue high “within school” teacher-knowledge quality and low “between teacher” implementation variance in the context of mathematics content and pedagogical knowledge. The world’s highest performing school systems are able to “decrease the pedagogical variability between teachers and increase the quality of instruction ... they do this by establishing clear instructional priorities and investing in teacher preparation and professional development” [3, p. 12].

It is important, then, that all teachers and specialists have access to the district or school site’s ongoing professional development, are required to fully engage and participate in the professional learning community for professional development established by the school or district, and are expected to act on the professional development content that ensures that the teacher learning experience includes issues of equitable opportunities for all students to learn relevant and meaningful mathematics.

2. What are the most crucial *content* issues to consider in designing professional development for mathematics teachers and specialists?

To build teachers’ knowledge capacity and sustain *implementation* of that knowledge into the classroom, the professional development content should be framed around three crucial questions.

First, what do we want students to learn at this grade level or in this course? What mathematical knowledge, skills, understandings, and dispositions do we expect them to acquire as a result of this unit of instruction? A school committed to helping all students learn must ensure that the professional development teachers receive provides great clarity and low teacher-to-teacher variance on the question “Learn what?”

Second, how will we know if each student is learning the essential mathematics skills, concepts, understandings, and dispositions that the teacher team, school, and district deemed most essential? This question reveals the greatest variability in quality teacher practice and acts as the linchpin in the professional development of mathematics teachers. For teachers and teacher teams to answer these questions, they must back up to clarify what students must learn, and they must participate in the alignment of local unit assessments with district standards and develop common assessments and scoring rubrics that optimize students’ learning opportunities and accurately reflect what students know. To adequately answer the “How do we know?” question with fidelity, teacher teams should pursue agreement on test items and work interdependently to decrease the wide variability in the quality, depth, and rigor of assessment instruments used across grade levels and courses. Professional development in mathematics should provide the necessary time, mentoring, and leadership necessary for mathematics teachers to analyze and reflect on student learning and data. Teacher collaboration is