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Reflections on Creating Strong Mathematics Coaching Programs

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American schools are striving to invent programs to increase student achievement in mathematics that will help American students compete in the 21st century economy. Many states are aligning their mathematics standards and benchmarks with countries that achieved high scores on international testing such as Japan, Korea, Germany, and Finland. The new Common Core Standards for Mathematics (CCSS, 2010), which 44 states adopted, reflect a goal to deepen students' understanding of mathematics. Teaching these new mathematics standards to students from pre-kindergarten through grade 8 requires an even stronger understanding of mathematics and the associated pedagogical content knowledge. Recently, to meet these needs, many large urban districts have turned to mathematics coaching programs as a component of their K-8 staff development plans (Russo, 2004).

Mathematics coaching programs that focus on strengthening the mathematical and pedagogical knowledge of teachers and include a focus on explicit instructional strategies that can be carried back into the classroom, we see gains in the mathematics achievement of students (Brosnan & Erchick, 2009; Herrelko, Jeffries, & Robertson, 2009; Ingvarson, Meiers, and Beavis, 2005; Russo, 2004; West & Staub, 2003). Resnick and Glennan (2005) suggest that on-site coaching for teachers in a range of content areas can improve the academic achievement of urban districts in those content areas.

For eight years, I have been a university facilitator for statewide mathematics coaching programs serving elementary schools in urban and rural settings in the State of

Ohio. In this role, I provide professional development for mathematics coaches focused on mathematical content and pedagogical practices, keeping in mind that we want to prepare mathematics coaches who can help teachers use research-based instructional strategies and assessment methods as they teach mathematics. We also want to prepare mathematics coaches who can help teachers become reflective practitioners. Over the past 8 years, our data show that schools and districts participating in mathematics coaching programs show increases in the mathematics achievement of their students (Brosnan & Erchick, 2009; Herrelko, Jeffries & Robertson, 2009). In this article, I discuss some of the lessons we have learned about what helps make a mathematics coaching program successful.

Roles of School and District Administrators

School and district administrators play key roles in making a mathematics coaching program a success. This includes identifying the needs of the school or district to be addressed by the mathematics coaching program, establishing clear goals related to those needs and determining how progress toward those goals will be measured, committing the time and resources needed, selecting and hiring the mathematics coaches, and clearly articulating expectations regarding the roles mathematics coaches are to play as they provide support to schools. This can often include negotiating the roles of mathematics coaches with the teachers union to ensure that these mathematics coaches have the full support of their teacher colleagues. When mathematics coaching programs do not have the support needed from school and district administrators, problems can arise.

Some of these problems occur when mathematics coaches are used to address a variety of short-term needs that might arise in a school that are not connected to the established goals of the mathematics coaching program. For instance, when mathematics coaches are used to cover classrooms when teachers are absent, work directly with students who need more support, or copy and distribute material needed by teachers, it can mean that mathematics coaches have less time to provide the kind of support to teachers that strengthens mathematics teaching and learning over the long run.

Problems can also arise when administrators fail to establish scheduled time for coaches and teachers to work together separate from the time allocated to mathematics instruction, whether it is before or after school or during teachers' planning time, or fail to establish how teachers will be compensated for the time they spend with mathematics coaches outside of their contract day. It is also important to consider how time has been scheduled for other similar efforts, for instance, a literacy coaching program, and what precedents might have been set for teacher compensation.

Finally, it is important that mathematics coaching positions are negotiated in terms of where these new positions fit into the collective bargaining unit, contractual implications of these new positions, who is responsible for supervising mathematics coaches, and how salaries are determined. If these issues are not negotiated and resolved, tensions can arise between teachers and mathematics coaches that get in the way of productive working relationships.

Administrators play an important role in determining when a mathematics coaching program is to begin, timetables for posting mathematics coach positions and recruiting applicants, conducting mathematics coach interviews and selecting candidates, and then finally making decisions about where to place these mathematics coaches. Some districts make the decision to begin a coaching program just before the start of the school year. This places the district into a situation of hiring the first applicants who arrive at the district office as their mathematics coach rather than finding a teacher leader with the necessary skill set needed to be a successful mathematics coach. Using a timeline that starts sufficiently in advance of the launching of the mathematics coaching program increases the likelihood of hiring well qualified mathematics coaches who can be supported as they transition from their present positions to their coaching roles.

Defining the Role of a Mathematics Coach

A mathematics coach is a teacher leader and a change agent working to strengthen the mathematical and pedagogical knowledge of teachers in order to strengthen student achievement in mathematics. This requires that the mathematics coach take the responsibility for being knowledgeable about research in mathematics education. It also requires that mathematics coaches have a compelling history of strong mathematics instruction in their own classrooms. Finally, mathematics coaches must understand what it means to support the mathematics teaching practice of their colleagues.

West and Staub (2003) defined the work of a mathematics coach as taking place in three stages: 1) a collaborator who helps a teacher in the planning process; 2) a facilitator who helps enact the plan; and 3) a facilitator who helps the teacher reflect upon what student learning happened during the lesson. The mathematics coach brings to the three-stage process an expertise in mathematics content and pedagogy including research-based practices, strategies, and methods that teachers can learn and implement in their own classrooms. The coach keeps the focus of the planning of the lesson, the enactment of the lesson, and reflection on what students seem to be learning during the lesson with implications for next steps. In addition, the mathematics coach supports the examination of teachers' assumptions about mathematics instruction in order to be able to challenge and support some of those assumptions and build a stronger mathematics teaching practice (McGonagill, 2002). These features of the role of a mathematics coach are consistent with how others describe this work as well (e.g., Becker, 2003; Mink, Owen, and Mink, 1993; Olson and Barrett, 2004). When these approaches are solidly put into place, mathematics coaching programs and any associated professional development are likely to continue even with high rates of administrator and teacher turnover (Balfanz, MacIver, and Byrnes, 2006).

Creating Schedules that Support Mathematics Coaching

Time needs to be identified during the school day for mathematics coach and teacher collaboration before and after mathematics instruction. Before the lesson, in a pre-conference meeting, the mathematics coach and the teacher identify the mathematical concept to be taught, review the teacher's mathematics lesson plan, and make any adaptations that might strengthen the lesson. During the enactment of the lesson, the mathematics coach might

model particular instructional strategies, coteach the lesson with the classroom teacher as the lead instructor, or might play a role of assistant to the classroom teacher. After the lesson, in a postconference meeting, the mathematics coach and teacher debrief together by reviewing what happened during the lesson including a discussion of what students learned, the strengths and weaknesses of the lessons with regard to student learning, and next steps.

In my role as a university facilitator, I often observe mathematics coaches as they work with teachers, and I see big differences in what mathematics coaches are able to accomplish as a result of whether there is adequate time scheduled for mathematics coaches and teachers to collaborate together using the stages identified by West and Staub (2003). When time is allowed for the preconference, the teacher and mathematics coach work together smoothly in the classroom. When there was no time to confer prior to the teaching of the lesson, there is no coordination of efforts, no sharing of classroom responsibilities, no shared vision of where the lesson is going and how it will get there. Where there is no time for a postconference, reflection on what happened during the lesson and implications are not discussed, the opportunity for change and growth are lost. The strength of these collaborations between a mathematics coach and teachers rests on the available time that the teacher and coach have time during preconference and postconference collaboration and reflection. During my observations of mathematics coaching practice, these two meetings were typically missing because of union contracts that did not define or allow for these meeting times during the school day or because administrators usurped these times with other school duties or responsibilities. With little time to collaborate and reflect together, teacher growth and change is impeded.

The Importance of Building a Trusting Relationship

In order to earn the trust of the teachers, mathematics coaches must be allowed to keep the confidences of teachers. Developing trust takes time and effort. The mathematics coach must prove that he or she is trustworthy in the eyes of the teachers. The coach needs to be helpful, open to working in a manner that helps teachers feel comfortable, and not threatening. The mathematics coach needs time to build this kind of trust with teachers in order to learn about their strengths and limitations and be better able to support their learning. The mathematics coach should also be careful not to comment on the perform-

ance of specific teachers in an evaluative way, so teachers feel confident that discussions they have with mathematics coaches about areas of needed support do not end up being communicated to other teachers or administrators and do not appear on evaluation documents. When trust is established, teachers are open and willing to admit to the challenges they face in their mathematics instruction and request the help they need.

Holding Mathematics Coaches Accountable

Accountability for how mathematics coaches use their time in a school is important. Reports dealing with where, what, with whom the mathematics coach is working is a valuable source of information about how mathematics coaches are spending their time and who is receiving their support. The districts in which I worked each had a different means of coach accountability. One required a minute by minute accounting of the coach's time on a spreadsheet that was signed by the principal each week and submitted to the administration. Another provided a weekly template on one page where the coach noted the teacher and content that was worked on that week. These accountability tools can provide useful information for those who supervise mathematics coaches and can also provide important documentation for use in determining the effectiveness of a mathematics coaching program.

Who Could Be a Mathematics Coach?

Finding the right person to be a mathematics coach is fundamental to having a successful mathematics coaching program. Whether districts search outside their current teaching staff or move a classroom teacher into a coaching position, several professional qualifications are important to consider in both creating the position description and during the interview process. These include: (a) solid knowledge of mathematics and an enthusiasm for teaching mathematics; (b) well developed mathematics content knowledge for teaching; (b) well cultivated interpersonal skills and collaboration skills; (c) experience providing professional support to teachers; and (d) current teaching license or certification with a minimum of 5 years of teaching experience. Each of these is discussed further below.

(a) Solid mathematics content knowledge for teaching.

Mathematics content knowledge for teaching is defined by the University of Michigan Learning Mathematics for Teaching Institute as having to do with the mathematical reasoning, insight, understanding, and skill needed to successfully teach mathematics to students (Ball, Hill, & Bass,

2005). The Ohio State University (OSU) Math Coaching Program (MCP) collected data that revealed that the level of mathematics content knowledge for teaching of those selected to be mathematics coaches was only marginally stronger than that of the teachers they would be coaching. As a result, weekly full-day professional development sessions were developed specifically for mathematics coaches that addressed important mathematical concepts, research about how students learn mathematics, and implications for instruction. By the end of one academic year, data showed there was significant growth in the mathematics content knowledge for teaching of these mathematics coaches as well as increases in the mathematics content knowledge for teaching of the teachers they were coaching, and these were both associated with gains in the mathematics performance of students (Brosnan & Erchick, 2009). These data suggest the importance of building a strong understanding of mathematics content knowledge for teaching among mathematics coaches through a substantial commitment to their ongoing professional development.

(b) Well-cultivated interpersonal skills and collaboration skills. Interpersonal skills are an essential ingredient for mathematics coaches. It is important for mathematics coaches to be able to actively listen to the teachers with whom they work, understand the dilemmas teachers face when they plan and enact mathematics lessons, and offer support without being judgmental. This supports the creation of a relationship that is collaborative and trusting (Feger, Woleck, & Hickman, 2004). The MCP model reflects the work of cognitive coaching as defined by Costa, Garmston, and Glickman (1994) where coaches intently listen to the teachers and ask reflective questions that elicit the thoughts and feelings about teaching and learning that can become the basis of their work together.

(c) Experience providing professional development support to teachers. There are important differences between working with adults and working with students. It is important for mathematics coaches to have had some prior experience successfully collaborating with colleagues and other adults, including experience supporting their

thinking and practice related to mathematics teaching and learning, as these kinds of experiences are central to the development of a strong mathematics coaching practice. It is also important for mathematics coaches to show evidence of professional development practice that models the kind of practices that we want teachers to take on with their students.

(d) An active teaching license or certificate with minimum of 5 years of successful experience teaching mathematics.

Earning a teaching license or certification means that mathematics coaches have successfully completed teacher preparation programs and passed state-required tests that are required of all certified teachers. At least five years of successful experience teaching mathematics, including the ability to be articulate about what it means to support the mathematics learning of students, means that mathematics coaches have something to offer teachers who are working to strengthen their mathematics teaching practice with their own students. This includes an appreciation for the complexities and challenges of teaching mathematics as well as what it means to strengthen one's mathematics teaching practice over time. This background knowledge and experience creates mutual respect and empathy between coach and teacher.

Conclusion

Having worked with three mathematics coaching programs as the university professional development provider, and having spent a number of years supporting mathematics coaches as they work in their districts and schools, I have had the opportunity to make some observations about what elements make a successful mathematics coaching program. It is my hope that this article has something to offer to others as they consider starting a mathematics coaching program that will have strengthened mathematics teaching and learning and help students be more successful in mathematics. Deciding to start a mathematics coaching program requires the creation and articulation of a shared understanding of program goals, a commitment of time and resources, and the selection of and support for mathematics coaches themselves. All of these are key to program success.

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