NCTM NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Professional Development
Research Brief

Posted on March 17, 2009

Mathematics Specialists and Mathematics Coaches: What Does the Research Say?

The National Mathematics Advisory Panel (2008) reported that across the country, many schools and districts are using mathematics specialists or coaches in an effort to improve instruction and learning in mathematics, even though little research exploring their effectiveness exists. Depending on the state or district, there are varying roles and responsibilities for these leadership positions, as well as a variety of implementation models. For the purposes of this Research Brief, I will use the term *mathematics coaches* to refer to those who work directly with teachers, since this terminology is more widely used in the literature and in school districts across the United States. I will use the term *mathematics specialists* to refer to those who work directly with students. The research discussed here includes published studies or studies from paper presentations since 1990.

Research on Mathematics Specialists

Research on the effects of mathematics specialists (those who work directly with students) is virtually nonexistent. McGrath and Rust (2002) studied the effectiveness of departmentalized mathematics at the elementary level. The study compared gain scores in achievement test data from students in self-contained classrooms and departmentalized classrooms in grades 5 and 6. For the mathematics subtest of the achievement data, there were no significant differences in student achievement gain scores between departmentalized and self-contained classes. However, Gerretson, Bosnick, and Schofield (2008) found that using mathematics specialists at the elementary school level allowed teachers more time to effectively plan lessons and focus their professional development. In addition, teachers in this study reported gains in student achievement as a result of using mathematics specialists. Research is needed to determine the effectiveness of mathematics specialists.

Research on Mathematics Coaching

The research on mathematics coaching is more abundant but includes just seven studies that provide preliminary insights. The studies focus on improving instructional practices, designing coaching programs, and improving student achievement.

Improving Instructional Practices. Campbell (1996) and Race, Ho, and Bower (2002) studied the role of mathematics coaches as one component of large-scale professional development programs. Campbell reported that 40 percent of the teachers significantly changed their instructional practice by actively engaging students so as to build conceptual understandings of mathematics. Similarly, Race et al. found that participating teachers increased the frequency of best practices (e.g., hands-on learning, higher-order thinking, and addressing a variety of learning styles) and used a greater variety of instructional formats (e.g., activity-based lessons, investigations, and discussions). The researchers acknowledged that all aspects of the professional development programs affected the teachers but claimed that without the support of the coaches, teachers likely would not have persisted in making significant changes to their instructional practice.

Becker (2001) and McGatha (2008) studied mathematics coaches who worked with teachers but were not part of large-scale professional development programs. Teachers in these studies also experienced positive changes in their instructional practices, such as (a) focusing more on the "big ideas" of mathematics rather than treating topics as being isolated and unconnected; (b) emphasizing problem-solving over skill-based instruction (Becker 2001); (c) using students' work to inform instruction; and (d) allowing students' to think for themselves, which resulted in significant increases in students' mathematical thinking and communication (McGatha 2008). With varying results and to differing degrees, all four studies indicated the potential for coaches to have positive impacts on teachers' instructional practice.

Designing Coaching Programs. Mangin (2005) compared mathematics coaching programs in five school districts to determine the most effective design components. All districts were focused on improving teachers' mathematics instruction through mathematics coaching, but each district designed the coaching position differently. Mangin found that programs that had mathematics coaches working in one subject area and in one school were more effective than the programs that had coaches working in two or more subjects or schools. Another effective component of the more successful programs was broad communication about the role and responsibilities of the mathematics coach so everyone (supervisors, princi-

pals, coaches, and teachers) worked from a common understanding. Mangin pointed out that communication was a less obvious aspect of program design but proved to be essential for successful implementation.

Improving Student Achievement. As mentioned previously, Campbell (1996) gathered data from a large-scale professional development program that had coaches as one component. Campbell (1996) found that gains in student achievement were not immediate when compared with the students in the control schools. However, significant results emerged midway through the second grade. Once achievement gains were established, they were maintained through the second and third grade, the scope of the reported study. Since this professional development program was not designed to specifically examine the impact of the mathematics coaches on student achievement, that connection cannot be explicitly made with this study.

Erchick et al. (2007) reported findings from the first year of a three-year mathematics coaching project. Unlike the Campbell study (1996), the primary purpose of this study was to understand the effectiveness of the mathematics coaching project as a professional development intervention in schools and its impact on student achievement in those schools. For the first year of the study, student achievement was tracked in grades 3 and 4 only. Students took a pretest in January when the mathematics coaches began their work in schools and a posttest in May. Even within this short time, modest gains in student mathematics content knowledge at both grade levels were achieved. Schools involved in the mathematics coaching project had an average increase of 9.2 percent on the mathematics section of the state achievement test compared with the state average of 6.4 percent. This study is ongoing and has the potential to provide us with valuable insights in the future.

Another ongoing study that attempts to isolate explicitly the impact of a mathematics coach on student achievement is reported by Campbell (2007). This study focused on the first year of placement of mathematics coaches in five urban and suburban school districts. One unique characteristic of this study is the randomization of the assignment of mathematics coaches and the statistical models used to isolate the coaches' impact. At the time of her report, only one of the school districts had released student achievement data. Given these restrictions, Campbell reported that the impact of coaches seemed to emerge first in lower grades. Although there was no preliminary indication of significant impact of coaches on student achievement in grades 4 and 5, a significant impact on the third-grade subscale of probability and statistics emerged from the analysis. As more data are collected in this ongoing study, researchers hope to potentially begin to isolate and understand the impact of mathematics coaches on student achievement.

Conclusion

It is important to note that mathematics specialists and coaches do not work in isolation. They are part of an educational system that includes students, parents, administrators, and others. In fact, most of the studies discussed in this article were part of larger reform efforts including new mathematics curriculum and professional development sessions for both teachers and coaches. Isolating the impacts of coaches in these contexts is challenging. However, the preliminary results, although not strong, are encouraging. Even though little empirical evidence is currently available, substantial anecdotal evidence from programs throughout the United States indicates that coaching can be effective in improving teaching and learning (e.g., Neufeld and Roper 2003; Poglinco et al. 2003; Richard 2003).

As schools and districts across the country increasingly turn to mathematics coaches or specialists to help improve teaching and learning, it is important that program evaluation and research into effective practices be a crucial part of program design. The available empirical and anecdotal evidence suggest that coaching is a promising professional development practice that can lead to improved teaching and learning. However, we need to continue to pursue research that can support these initial findings.

By Maggie McGatha
Judith Reed Quander, Series Editor

REFERENCES

Becker, J. "Classroom Coaching: An Emergent Method of Professional Development." Retrieved September 29, 2005, from teachersnetwork.org/TNPI/research/growth/becker.htm. 2001.

Campbell, P. F. "Empowering Children and Teachers in the Elementary Mathematics Classrooms of Urban Schools." *Urban Education* 30, no. 4 (1996): 449–75.

———. "A Quantitative Investigation of the Activity and Impact of Elementary Mathematics Coaches." Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL, 2007.

Erchick, D., P. Brosnan, D. Forrest, L. Douglass, M. Grant, and K. Hughes. "Findings from the First Year of a K−6 Mathematics Coaching Project." Paper presented at the Research Presession of the National Council for Teachers of Mathematics, Atlanta, GA, 2007.

Gerretson, H., J. Bosnick, and K. Schofield. "Promising Practice: A Case for Content Specialists as the Elementary Classroom Teacher." *The Teacher Educator Journal* 43, no. 4 (2008): 302–14.

Mangin, M. M. "Designing Instructional Teacher Leadership Positions: Lessons Learned from Five School Districts." Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada, 2005.

McGatha, M. "Levels of Engagement in Establishing Coaching Relationships." *Teacher Development* 12, no. 2 (2008): 139−50.

McGrath, C., and J. Rust. "Academic Achievement and Between-Class Transition Time for Self-Contained and Developmental Upper-Elementary Classes." *Journal of Instructional Psychology* 29, no. 1 (2002): 40−43.

National Mathematics Advisory Panel. *Foundations for Success: The Final Report of the National Mathematics Advisory Panel*. Washington, DC: US Department of Education, 2008.

Neufeld, B., and D. Roper. "Coaching: A Strategy for Developing Instructional Capacity." The Annenberg Institute and the Aspen Institute Program on Education. Retrieved September 29, 2005 from www.annenberginstitute.org/images/Coaching.pdf. 2003.

Poglinco, S. M., A. J. Bach, K. Hovde, S. Rosenblum, M. Saunders, and J.A. Supovitiz. *The Heart of the Matter: The Coaching Model in America's Choice Schools*. Pittsburgh, PA: Consortium for Policy Research in Education, 2003.

Race, K. E., E. Ho, and L. Bower. "Documenting In-Classroom Support and Coaching Activities of a Professional Development Program Directed Toward School-Wide Change: An Integral Part of an Organization's Evaluation Efforts." Paper presented at the annual meeting of the American Educational Research Association. New Orleans, LA, 2002.

Richard, A. "Making Our Own Road: The Emergence of School-Based Staff Developers in America's Public Schools." The Edna McConnell Clark Foundation. Retrieved October 4, 2005 from www.emcf.org/pdf/student_ourownroad.pdf. 2003.