TITLE: Cultivating Classroom Leadership: Research in Professional Development for Grades K-8 Mathematics Coaches

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ABSTRACT: (250 WORDS)

This paper provides a description of the design, content, and assessment of a professional development course for grades K-8 mathematics classroom coaches in seven states across the western United States. The course is one component of a larger research project studying the knowledge held by effective mathematics coaches. The professional development is centered upon standards-based mathematics practice and eight themes about knowledge that contributes to mathematics classroom coaching. The course is a 45-hour summer residential course attended by approximately 60 coaches across two summers. The coaches are randomly assigned to attend one of two summers to allow for an experimental design with a treatment and a control group. The results document a significant change in coaching knowledge held by participants. The results from this project provide a research base for a professional development course for mathematics classroom coaches.

CONTENT:

A coach can be broadly defined as an educator who works collaboratively with a teacher to improve that teacher's practice and content knowledge, with the ultimate goal of affecting student achievement. Coaching is a promising model for enhancing K-8 mathematics teachers' professional practice. While coaching can include the role of mentoring, the coaching model can be implemented at any point in a teacher's career, making coaching a more broad technique for ongoing, embedded teacher professional development. Coaching has many elements identified as necessary in effective teacher professional development: Coaching can be collaborative, grounded in participant inquiry and reflection, sustained and intensive, connected to a school's development plans, and directed at engaging teachers in concrete tasks connected to their own students' work (Darling-Hammond & McLaughlin, 1996).

The evidence supporting the effectiveness of mathematics coaches is growing. There are a handful of studies showing indications of a connection between coaching and student mathematics achievement (Campbell & Malkus, 2011; Meyers & Harris, 2008; Wilkins, 1997). Other studies have shown that coached teachers are more likely to engage in collaborative activities and that coached teachers believe their students learn more due to coaching (Sparks & Bruder, 1987; Smylie, 1989).

A robust study of coaching must define what model the coaching follows and examine what knowledge the coach holds. This paper will describe a coaching model and the content of a professional development course designed to prepare mathematics instructional coaches to follow that model. Examining Mathematics Coaching (EMC) is a 5-year research and development project examining the effects of a coach's *knowledge for coaching* on a diverse population of K-8 teachers. At the outset the project hypothesized that the effectiveness of a mathematics classroom coach is linked to several domains of knowledge, and that coaching knowledge and mathematics content knowledge contribute significantly to a coach's effectiveness. Coaching effectiveness is measured at the teacher level, by positive impact on teacher classroom practice, teacher mathematics knowledge for teaching, and teacher beliefs and attitudes about mathematics and teaching.

While the literature is rich in providing details about what constitutes mathematical content knowledge (Hill, Rowan, & Ball, 2005; Ball, Bass, & Hill, 2003; Shulman, 1986), coaching knowledge has largely been without formal definition. To fill this void, EMC conducted a study to define domains for coaching knowledge (Sutton, Burroughs & Yopp, 2011). The hypothesis of this phase of the research was that there exists coaching knowledge that is distinct from teaching knowledge. That is, to be an effective mathematics instructional coach, one must hold knowledge that is distinct from knowledge held by an effective mathematics classroom teacher. To identify that distinct knowledge, researchers consulted a Delphi panel.

To assemble the Delphi panel, researchers identified 10 experts in the field of mathematics coaching. These experts were invited to name two others who possessed the expertise to participate on the panel. Seven of the original 10 invitees agreed to participate in the Delphi panel, and five of these gave two referrals each. Of the 10 referrals, five agreed to participate. The final Delphi panel consisted of 12 participants. Of these 12, six are authors or co-authors of coaching or mathematics coaching books; four are directors of grant-funded professional development projects on mathematics coaching; one is a mathematics coaching practitioner; and one studies coaching as a researcher in mathematics education. Through a cyclic process of responding to prompts about knowledge held by coaches, the panel arrived at agreement on coaching definitions. There were eight domains of coaching knowledge identified in the study: assessment, communication, leadership, relationships, student learning, teacher development, teacher learning, and teacher practice (Sutton, Burroughs & Yopp, 2011). These domains and their corresponding definitions were used as the themes for the professional development course in coaching knowledge.

Design of the Professional Development Course

The professional development content is centered upon standards-based mathematics classroom practice in grades K-8 and the eight themes about knowledge held by coaches. The course is a 45-hour summer residential course attended by approximately 60 coaches across two

summers. Because the course is just one component of the more comprehensive research project, coaches are randomly assigned to attend one of two summers to allow for an experimental study. The study follows a cross-over design. The first group received professional development in mathematics content in year one of the project, while the second group acted as a control. The following year, the second group received professional development in coaching knowledge, while the first group acted as a control for the coaching knowledge component of the study. In the final two years of the study, the groups will alternate, so that by the end of the study all of the participating coaches will receive professional development in both components of knowledge.

Coaching Model

EMC defines a mathematics coach to be an on-site professional developer who enhances teacher quality through collaboration, focusing on research-based, reform-based, and standards-based instructional strategies and mathematics content that include the why, what, and how of teaching mathematics. In this model, a coach works with each individual teacher eight times in a school year. These coaching interactions include a pre-conference, a classroom observation, and a post-conference. The EMC model focuses only on the classroom supporter role of the coach (Killion, 2008), while acknowledging that within their schools, coaches may take on additional roles. For the study, coaches identify three teachers with whom they will follow this model; EMC does not hire or assign coaches so the coaches' work with teachers beyond the three they have identified may vary.

Content of the Professional Development Course

The over-arching goal of the professional development course is to prepare coaches to recognize standards-based mathematics instruction in K-8 mathematics classroom settings. Standards-based mathematics instruction is defined as that which develops mathematical processes (National Council of Teachers of Mathematics, 2000), mathematical practices (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), and mathematical strands of proficiency (National Research Council, 2001).

The professional development begins with a focus on Teacher Learning and Teacher Development. The elements of the theme of Teacher Learning are identified as

- Engaging teachers in the coaching process.
- How teachers in general acquire knowledge of content, pedagogy, and pedagogical content.
- How individual teachers best acquire knowledge.
- Recognizing the discrepancy between "vision and practice."

The elements of the theme of Teacher Development are identified as

- Teacher development in content, pedagogy, beliefs, and management.
- How to support individual teachers' development.
- Teachers' motivations and barriers for learning.
- Supporting teachers in applying mathematical processes (discourse, exploration, engagement) to classrooms.
- Helping teachers manage the learning environment and improve student learning.

The first day's activities begin with a focus on setting norms for group interactions and using protocols to facilitate a deep level of interaction. This is approached both from the perspective of facilitating the joint work of the group involved in the week's professional development, and also as a tool that coaches can use in their work with teachers. Participants examine a video clip of a first grade mathematics classroom and discuss how to use observations to engage teachers in the coaching process. The professional development examines the change process and adult learning. The course also examines characteristics of effective professional development. The course uses a video case and a written scenario to delve into teacher development across a continuum, looking at both a teacher leader and at a novice teacher.

The professional development course then turns to a study of Teacher Practice and Student Learning. The elements of the theme of Teacher Practice are identified as

- A coach knows how to discern teacher beliefs.
- A coach has a depth and breadth of knowledge of teaching research and teaching actions.

The elements of the theme of Student Learning are identified as

- A coach knows how to discern teacher beliefs.
- A coach has a depth and breadth of knowledge of teaching research and teaching actions.

The second day's activities begin with an observation of classroom instruction to illuminate for coaches how to help teachers identify student thinking in classroom settings. Participants reflect on the beliefs their teachers hold about classroom instruction. The course examines research about how individuals learn and about effective mathematics instruction. Participants examine classroom videos and identify elements of effective instruction in those videos.

The professional development course then turns to the themes of Assessment and Communication. The elements of the theme of Assessment are identified as

- Assess teacher needs and using that assessment to set goals for coaching.
- Assess student thinking and using that to set goals for coaching.
- Help teachers know how to use assessment in their classrooms.

The elements of the theme of Communication are identified as

- Communicate professionally about students, curriculum, and classroom practice.
- Mediate a conversation, by pausing, paraphrasing, probing, inquiring, and asking reflective questions.
- Use nonverbal communication and listen actively.
- Communicate in problem-resolving conversations.

Prior to the third day, the participants have been given the assignment to read a synopsis of three coaching models, which compares coaching recommendations given in Instructional Coaching (Knight, 2007), Cognitive Coaching (Garmston, Costa, Ellison, and Hayes, 1999) and Content-Focused Coaching (West and Staub, 2005), as they relate to communication and assessment. The third day's activities focus on the careful examination of assessment and communication for coaching through the lens of those three coaching models. The third day's activities involve the examination of videos of coaching practice, both the practice of a novice coach and an experienced coach. Through the videos, the professional development identifies coaching moves and analyzes them with respect to the three coaching models. The day concludes with an analysis of teachers' stated needs through the use of an instrument designed to facilitate discussion between the teacher and coach (Yopp, Burroughs, Luebeck, Heidema, Mitchell & Sutton, 2011).

The fourth day of professional development returns to the themes of Teacher Practice and Student Learning, now specifically through the eyes of a coach who can choose one of the three, or a combination of the three, examined models for coaching practice. Participants consider worthwhile mathematical tasks, teacher questioning, mathematical discourse, cooperative learning, and formative assessment. Participants practice coaching through role play scenarios.

The professional development concludes with a focus on the themes of Relationships and Leadership. The elements of the theme of Relationships are identified as

- The purpose of the relationship is to support teaching and content.
- Communicate in a way that establishes trust, rapport, and credibility.
- Establish positive inter-personal environments.
- Foster relationships that respect various cultural influences (socio-cultural, school/district, and authority-autonomy).

The elements of the theme of Leadership are identified as

- Be strategic about setting goals and objectives for teachers and students.
- Use, evaluate and influence the school's vision.
- Evaluate the utility of educational policies.
- How to address challenges.

- The coaching process.

The final day's activities examine various roles for coaches beyond classroom supporter. Participants find examples of using research to inform coaching conversations. They also discuss strategies for scheduling coaching sessions and building support from administrators. The week concludes with an examination of how to use school-wide assessment data to make coaching decisions.

Results

To assess the effectiveness of the coaching professional development, researchers use the Coaching Knowledge Survey (Yopp, Burroughs, Sutton & Greenwood, 2011). The Coaching Knowledge Survey consists of items that measure the beliefs and practices about coaching, and scores are returned as a measure of the percentage of responses that conform to recommendations for coaching practice found in the coaching literature.

Figure 1 shows the means and confidence intervals for both groups of coaches at three time points, each one year apart. The first time point is a pre-test. This reflects coaches' responses at the beginning of the study, before any coaches received professional development. The second time point reflects coaches' responses after Group 1 received professional development in mathematics content knowledge and Group 2 received no professional development. Both groups had implemented the EMC coaching model for a school year. The third time point reflects coaches' responses after Group 1 had received only the mathematics content knowledge professional development and Group 2 had received the coaching knowledge professional development. Both groups had implemented the EMC coaching model for two school years.

The results document a significant change in coaching knowledge held by participants in the professional development course (Group 2, n=26) over the control group (Group 1, n=24). Little difference is observed between the groups in times 1 and 2, when neither group received professional development in coaching knowledge. The primary hypothesis test of interest in this data set involves whether the professional development group that received coaching knowledge professional development improved more from time 2 to time 3 than the group that did not receive a treatment. The estimated difference between the groups in the changes from time 2 to time 3 is 0.062 (SE = 0.0268, t_{102}=2.3). The one-sided test provides a p-value of 0.011, suggesting strong evidence of more of an increase in the scores for the Group 2 than the control group. A similar test is based on averaging the first two time points to assess whether the increase in time 3 relative to the average in times 1 and 2 is the same between the two groups. This provides an estimated difference in the change of 0.049 (SE=0.025, t_{102}=1.95, p-value=0.027 for the 1-sided test). So whether time 3 is compared to the second time or the average of the first two observations, the professional development course in coaching knowledge seems to have improved the scores more than the untreated group.

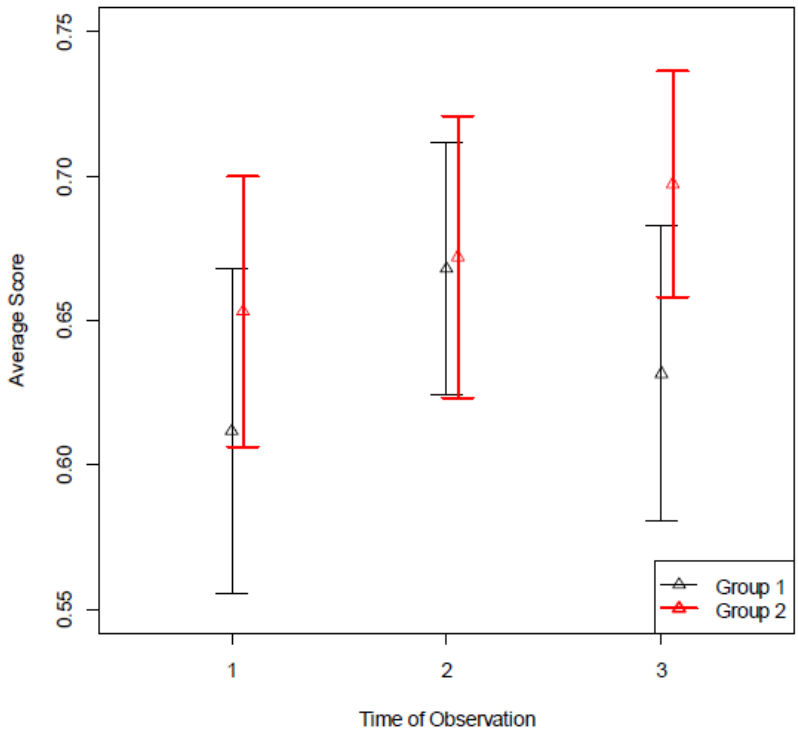

Figure 1. Estimated means, with 95% confidence intervals, based on non-constant variance, repeated measures model, for Coaching Knowledge Survey, administered as a pre-test, before coaching knowledge professional development was offered to either group, and after coaching knowledge professional development was offered to Group 2.

Conclusion

The results from this evaluation provide a research base for a professional development course for mathematics classroom coaches. Though we find promise in the positive results of our professional development in educating coaches about the practices advocated in coaching literature, as studies like the EMC Project continue to yield results, researchers may find that mathematics coaches who seem to have this coaching knowledge may still not have the impact one would expect because of some of the other constraints of coaching. Similarly, while a knowledgeable coach may have a positive impact on teaching practice, it may still be necessary to provide additional professional development for both the coach and teacher, based on other needs and school contexts.

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