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# Mathematics coaching and instructional reform: Individual and collective change

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ABSTRACT

Mathematics coaching initiatives are being implemented in schools and districts across the country, guided by the notion that these initiatives will foster individual teacher's learning and thereby support system-wide instructional improvement in mathematics. This paper explores the evolving roles that mathematics coaches played in a system-wide instructional improvement effort focused on elementary mathematics education in a medium-sized suburban school district. Using social network analysis and qualitative analysis of interviews, we argue that coaches facilitated teachers' implementation of a new mathematics curriculum by acting as brokers, first as intermediaries between the district office and schools, then as catalysts for collective inquiry. Further, we show how coaches' work was both enabled and constrained over time by various organizational dimensions at the school and district levels. Overall, our findings suggest that district and school leaders should think beyond the roles and responsibilities of individual coaches, and consider how to support coaches as participants in system-wide networks focused on continuous learning and instructional improvement.



## 1. Introduction

Over the last two decades, many mathematics education reform efforts have focused on transforming classroom pedagogy to support the use of ambitious teaching practices (Cobb & Jackson, 2011; Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010). Supported by standards developed by the National Council of Teachers of Mathematics (NCTM, 2000), as well as the Common Core State Standards (CCSS) in mathematics, such practices seek to promote students' conceptual knowledge—or "learning that involves understanding and interpreting concepts" (Arslan, 2010)—rather than reliance on memorization or step-by-step procedures. By engaging in mathematical discourse and argumentation, the goal of ambitious mathematics teaching is for students to develop the ability to explain the reasoning behind their mathematical ideas and to solve real-world problems.

Efforts have been made in a variety of contexts to support teachers' use of these reform-oriented practices in mathematics, with many such efforts including formal professional development (Bell, Wilson, Higgins, & McCoach, 2010; Borko, 2004; Carpenter, Fennema, & Franke, 1996). Mathematics instructional coaches are often part of these professional development initiatives, and are charged with providing ongoing support to individual teachers to facilitate improvement in

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teachers' instructional practices (Cobb & Jackson, 2011; Sun, Wilhelm, Larson, & Frank, 2014). In many cases, the theory of change behind instructional coaching is that coaches' work with individual teachers will result in system-wide instructional improvement over time (Mangin & Dunsmore, 2015).

In line with this theory of change, much of the literature on mathematics coaching has focused on the individual coach-teacher relationship (Marsh, McCombs, & Martorell, 2010), the roles and responsibilities coaches take on within schools and classrooms (Mudzimiri, Burroughs, Luebeck, Sutton, & Yopp, 2014), and the school- and district-level factors that enable or constrain coaches' work (Huguet, Marsh, & Farrell, 2014; Mangin, 2009). Though essential for understanding how to develop and sustain reform efforts, fewer studies examine how mathematics coaching initiatives are implemented as part of system-wide efforts to support teacher learning and curricular reform (Cobb & Jackson, 2011; Coburn & Russell, 2008).

Focusing on one local school system in which teachers' beliefs and practices changed significantly over time in support of a reform-oriented curriculum for teaching elementary mathematics (Hopkins & Spillane, 2015; Hopkins, Spillane, Jakopovic, & Heaton, 2013; Spillane, Hopkins, & Sweet, under review), we explore whether and how a mathematics coaching initiative—as just one component of the district's reform efforts—contributed to these system-wide shifts. We ask: (1) What roles did coaches play in supporting curriculum implementation during a system-wide instructional improvement effort? and (2) How did dimensions of the school system's organizational infrastructure enable and/or constrain coaches' capacity to support change? To address these questions, we used longitudinal analysis of social network and interview data to examine the work of four mathematics instructional coaches over time. Our findings revealed that coaches served as brokers of the district's reform efforts by directly and indirectly facilitating the exchange of information (Burt, 1992) related to a new mathematics curriculum. As such, we argue that coaches, through their work as brokers, enabled robust shifts in teachers' opportunities to learn about mathematics instruction over time, and these shifts were facilitated by various dimensions of the organizational infrastructure.

We begin by outlining the literature on instructional coaching, describing the theoretical frameworks that guided our analysis. Then, we present our mixed methodological approach. Turning to findings, we first describe how coaches' work as brokers evolved over time, from intermediaries who transferred reform-related information between the district office and schools to catalysts who facilitated collective inquiry between teachers (Stovel & Shaw, 2012). Then, we show how various dimensions of the districts' organizational infrastructure enabled and constrained coaches' work. We conclude with a discussion of the implications of our work for theory, research, and practice.

## 2. Literature review

The instructional coaching literature can be situated more broadly in scholarship on teacher leadership. Teacher leadership, a concept that developed in many ways out of research on distributed leadership (Spillane, 2006), has received attention in the last few decades as a crucial element of teacher professional development and instructional improvement (Smylie, Conley, & Marks, 2002). It has been defined as both a role and a practice (Scribner & Bradley-Levine, 2010), meaning that teacher leaders include individuals who hold formal positions and are specifically tasked with leading instructional change (e.g., coaches, team leaders, department heads), as well as individuals who lead on the job in more informal ways (Neumerski, 2013; York-Barr & Duke, 2004). In this paper, we focus on the formal role of the elementary mathematics instructional coach, and on the practices these coaches engage in to support teacher professional learning and instructional improvement.

Instructional coaches, through their work with individual teachers, are thought to facilitate teacher learning and knowledge development that will, over time, result in system-wide changes in instructional practice and student achievement (Mangin & Dunsmore, 2015). Research evidence generally supports this theory of change, showing positive associations between instructional coaching, teacher knowledge development (Sun et al., 2014), changes in teaching practice (Carlisle & Berebitsky, 2011; Cohen & Hill, 2001; Cronen et al., 2008; Neufeld & Roper, 2003; Rodgers & Rodgers, 2007; Teemant, 2014), and increased student achievement (Biancarosa, Bryk, & Dexter, 2010; Campbell & Malkus, 2011; Elish-Piper & L'Allier, 2011; Marsh et al., 2010; Obara & Sloan, 2009; Spelman & Bell, 2012).

Though an important feature of system-wide improvement, much of the extant literature explores instructional coaching as an individually focused task, delineating coaches' responsibilities (Mudzimiri et al., 2014), identities (Chval et al., 2010), and learning trajectories (Gallucci, Van Lare, Yoon, & Boatright, 2010). In a recent study of the work of seven elementary mathematics coaches, for example, Mudzimiri et al. (2014) demarcate three categories of coach activities: 1) work related to the coaching cycle (e.g., observing instruction, meeting with teachers one-on-one, working with students), 2) administrative duties (e.g., meeting with administrators), and 3) other responsibilities (e.g., visiting informally with teachers, managing data, facilitating team meetings, locating resources). Focusing on the first category, the authors outline the topics coaches focused on in their interactions with teachers, from mathematics content and pedagogy to curriculum issues and classroom management, and describe the approaches that coaches used to address them, from directive to collaborative.

While Mudzimiri et al. (2014) point out the importance of knowing how to effectively negotiate interactions with teachers, other scholars suggest that coaches must also attend to the politics of coaching during times of policy or curricular change (Coburn & Woulfin, 2012), for example by working to understand school leaders' desires (Huguet et al., 2014). In doing so, coaches must learn to negotiate a variety of tensions (Mangin & Stoelinga, 2011) so they can promote the ongoing and iterative interactions with teachers that have been shown to facilitate instructional change (Coburn & Russell, 2008).

In general, at least two mechanisms have been identified as important for supporting productive interactions between coaches and teachers: professional development and strong district or school leadership. Given the range of activities in

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