Journal of Mathematical Behavior xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

The Journal of Mathematical Behavior

journal homepage: www.elsevier.com/locate/jmathb

# Developing collective capacity to improve mathematics instruction: Coaching as a lever for school-wide improvement☆

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ARTICLE INFO

*Article history:*
Received 1 August 2016
Received in revised form 2 November 2016
Accepted 9 December 2016
Available online xxx

*Keywords:*
Mathematics coaching
Professional learning community
School-wide reform
Teacher learning

ABSTRACT

Mathematics coaching, as typically practiced in US schools tends to be responsive and individually focused work in which coaches respond to invitations from individual teachers to help them improve their teaching. But what does the work of coaching look like if it is organized instead to engage teachers collectively in service of school-wide improvement? This is the question we take up in this paper through examining the case of one school-based elementary mathematics coach whose work more closely aligned with emerging findings in the field of instructional improvement about the power of coaching for school-wide reform. The coach helped to dramatically transform a recent history of poor performance and deficit-oriented narratives pertaining to the school and its children. Through a fine-grain analysis, we illustrate the coach's work implicated in supporting groups of teachers to come to mutual understanding around and further development of shared high-quality instructional practices. The components of coaching that help support collective capacity are discussed.



## 1. Introduction

Mathematics coaching, as typically practiced in US schools tends to be responsive and individually focused work: coaches respond to requests from administrators or invitations from individual teachers to help them improve their teaching (Mangin & Dunsmore, 2014). But what might coaching entail if it were organized instead to engage teachers collectively in the service of school-wide improvement? This is the question we take up in this paper through the case of one elementary mathematics coach whose work more closely aligned with emerging ideas about the potential power of coaching in school-wide reform (Cohen, 1995; Kruse & Zimmerman, 2012; Mangin & Dunsmore, 2014). The coach played a key leadership role in dramatically transforming a recent history of poor performance and deficit-oriented narratives pertaining to school and its children. Over a period of three years, student performance (as measured by standardized tests) improved the school's standing from the bottom 5% of all schools in the state to the 78th percentile. The quality of classroom instruction improved considerably, and teachers' professional community strengthened as well. We examine the role the coach played in fostering such improvement

☆ The research reported on in this article was supported by the Spencer Foundation under grant No. 201500018.
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http://dx.doi.org/10.1016/j.jmathb.2016.12.002
0732-3123/

possible as she built collective capacity in the school to improve instructional practice towards what we describe below as ambitious and equitable mathematics instruction.

Our analysis takes us inside a recurring professional learning activity called "Math Labs," embedded within the school day and facilitated by the coach. We purposefully selected one Math Lab that occurred during the *fourth year* of improvement efforts at the school and involved a group of 4th grade teachers, an English Language teacher, and the school principal. The coach aimed to support the teachers' development of ambitious practices with regard to fractions instruction. This account intends to offer a detailed view of the work involved as the coach facilitates and supports the learning of a group of teachers learning simultaneously about mathematical content, pedagogical principles, and student reasoning. Our analysis carries implications for how to organize coaching to support the *collective* learning of teachers, including how to organize coaches' time, how coaches identify goals for teachers' learning, and how to facilitate the practices of coaches use when supporting groups of teachers' learning.

## 2. Theorizing how teachers' collective learning is supported

Communities of practice offer a complex view of long-term collaborative learning in which participants engaging with one another over time, develop tools, including language, and artifacts particular to their community as they also shape new identities in the process (Crafton & Kaiser, 2011; Wenger, 1998). The creation of such communities that make a difference in teachers' instructional practices requires "the participation of people who are fully engaged in the process of creating, refining, communication, and using knowledge" (Wenger, 1998, p. 111). Consistent with a communities of practice approach, learning cannot be understood separately from activity setting in which people participate. We argue that we cannot understand the coach's role without an understanding of the activity setting that gives meaning to her actions. The Math Lab, therefore, plays a prominent role in our explication of the coach's work. Further, we examine how the coach facilitates the collaboration of teachers within a community of practice by closely examining the *language* used during a Math Lab. It is language that scaffolds a group's activities toward its achievement and supports (or undermines) the development of particular identities and relationships within a social activity (Crafton & Kaiser, 2011).

We use records of interaction to capture "the evidence that participants provide each other through their collaborative discourse, [which] informs them about their understanding, goals, intentions, and expectations" (Greeno, 2006, p. 86). We take these interactions as learning opportunities for teachers. Specifically, we examine how activities within the Math Lab stand to support new forms of discourse, practice, and understanding (Greeno & Gresalfi, 2008). This emphasis on "opportunities" foregrounds the group process over any particular impact on individuals (Horn, Kane, & Wilson, 2015).

Our analysis of participants' joint engagement enables us to argue whether and how teachers are moving toward *mutual understanding*. At Hilltop elementary, the school leaders are working toward developing instructional practices among teachers that provide similar, high-quality learning opportunities to students. Across their professional learning settings, Hilltop elementary teachers gain opportunities to develop mutual understandings of mathematics, student reasoning in mathematics, and instructional practices. We draw on van de Sande, and Greeno's (2012) work to analyze records of interaction for evidence of the coach supporting the teachers' toward mutual understanding, which aims for participants to develop cognitive framings that are sufficiently aligned. Cognitive framing includes participants' understanding of the kinds of knowledge that are relevant to their participation in an activity, the kinds of knowledge they need to construct in order to succeed in an activity, and the ways in which participants organize information within a situation or problem they are working on. In this analysis, we are concerned with examining how the coach supports teachers' cognitive framings toward achieving mutual understanding. In other words, we look for how the coach guides groups of teachers to participate in activities that support taken-as-shared ways of reasoning about teaching mathematics (Cobb, 2001) toward developing similar ambitious instructional practices.

## 3. Setting of the case study

To examine how coaching can be designed to support systemic change and the collective learning of teachers, we selected an elementary school where the coach played a key role in successfully supporting the reorganization of mathematics teaching across the entire school. Located in the Pacific Northwest, Hilltop elementary (all names are pseudonyms) is a racially, linguistically, and ethnically diverse urban elementary school serving over 400 kindergarten through fifth grade students. The demographic makeup includes 60% black, 12% Hispanic, 12% Asian/Pacific Islander, 8% white, and 8% that indicated as two or more races.[1] The school leaders identified that about 20% of students classified as black spoke Somali or Amharic at home. Over 80% of students qualified for free or reduced-priced lunches and 30% were qualified as transitional bilingual. Prior to the start of this study, Hilltop Elementary was identified as a "failing school," performing in the bottom 5% of Title I schools in the state.

Under federal guidelines, because of persistently low performance on standardized tests, the school leaders were awarded a School Improvement Grant. The newly selected principal hired a mathematics coach to work on the improvement efforts in mathematics. School leaders reached out to university teacher educators for support in designing and implementing the

[1] Data from https://nces.ed.gov/

Please cite this article in press as: Gibbons, L. K., et al. Developing collective capacity to improve mathematics instruction: Coaching as a lever for school-wide improvement. *Journal of Mathematical Behavior* (2017), http://dx.doi.org/10.1016/j.jmathb.2016.12.002