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Secondary mathematics coaching: The components of effective mathematics coaching and implications

Priscilla Bengo*

Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education, University of Toronto (OISE/UT), 252 Bloor Street West, Toronto, Ontario, M5S 1V6, Canada

HIGHLIGHTS

- I explored the elements of mathematics coaching that improve teaching practice.
- These are viewed as the elements of effective mathematics coaching.
- I found the following elements: time, trust, the coach's background and courage.
- I also found that effective coaching required resources and was differentiated.
- Coaching improved instruction.

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ABSTRACT

Mathematics coaching, which can be defined broadly as job-embedded learning for mathematics teachers with someone who can help, is being used in Canada to improve teaching practice and increase student achievement. Mathematics coaching research is quite new with little written on the components of effective coaching. The paper attempts to contribute to this research. Employing observations, interviews, archival data, and surveys, the study finds that time, trust, the coaches' backgrounds, and their courage in trying new initiatives may be elements of effective coaching. Effective coaching also required resources and was differentiated. Mathematics coaching improved teacher practices.

1. Introduction

Mathematics coaching research is quite new (e.g., Obara, 2010) and coaching means different things to different people (e.g., Grossek, 2008; Horwitz, Bradley, & Hoy, 2011). Cornett and Knight (2008) state that there are several forms of coaching. Therefore, coaching work and hence how mathematics coaching is defined is influenced by the coaching model. The three common mathematics coaching models are cognitive coaching, content-focused coaching, and instructional coaching (Barlow, Burroughs, Harmon, Sutton, & Yopp, 2014). Cognitive coaching (Costa & Garmston, 2002) can be described as a mediation approach to coaching that assumes that an individual's behavior is a result of his or her thought and perception. The coach considers very carefully what a teacher is saying and may employ paraphrasing to help a teacher determine a goal during self-assessment. The coach may also probe to help the teacher attain clarity. A three-phase cycle is used with a pre-lesson conference, a lesson observation, and a post-lesson conference.

Content-focused coaching (West & Staub, 2003) examines students' learning in a particular subject area and a teacher's plan, strategies, and methods to positively influence it. The coach must be able to determine the teacher's needs. The coach looks at a teacher's content knowledge and disposition toward mathematics, pedagogical knowledge, pedagogical content knowledge, and beliefs about learning, as well as the teacher's ability to understand student thinking and the ways teachers use curriculum materials, including planning lessons. Pedagogical content knowledge combines content knowledge of a specific subject and an understanding of how to teach that subject (Shulman, 1987). This form of coaching focuses on designing lessons. Evidence used during coaching consists of student comments, examples of student thinking, student assessment data, and samples of student work, for instance.

* Tel.: +1 416 333 2158.
E-mail address: priscilla.bengo@mail.utoronto.ca.

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Content-focused coaching also employs the three-phase cycle.

Instructional coaching stresses a partnership approach. Knight (2007) suggests seven principles (equality, choice, voice, dialogue, reflection, praxis, and reciprocity) as the theoretical basis for instructional coaching. Specifically, the coachee is treated as an equal by the coach (equality), can select what they learn and how they learn (choice), the teachers know they can reveal their opinions concerning content they are learning (voice), and the coach involves teachers in conversations concerning the content being learned while thinking and learning with them (dialogue). Praxis describes the act of applying new ideas to one's own life, while reciprocity is defined as mutual gain. Like cognitive coaching, instructional coaching depends on the coach's ability to know the teacher's perspective and listen carefully in coaching conversations. A three-phase cycle is used as in the other models. Instructional coaching is concerned with behavior, content, instruction, and formative assessment. In terms of behavior, "teachers need to create a safe, productive learning community for all students. Coaches can help by guiding teachers to articulate and teach expectations, effectively correct behavior, increase the effectiveness of praise statements, and increase students' opportunities to respond" (Knight, 2007, p. 23). Content refers to the content knowledge of the teacher, instruction refers to effective instructional strategies that teachers can use to help students learn and formative assessment should be used by the teacher to determine whether students are learning. The data collected relates to the strategies the coach and teacher are trying. It is important for the coach to emphasize the positive. The models have similarities; an obvious one is the three-phase cycle. Barlow et al. (2014) note that they all have the coach "interacting with teachers about mathematics content, promoting teacher reflection, and negotiating professional relationships between coach and teacher" (p. 228). Based on the models, mathematics coaching can be viewed broadly as a form of professional development for teachers with someone who can help.

Mathematics coaching is used to improve teacher instruction with the intention of improving student achievement in many parts of the world, for example, Australia, the Netherlands, the United Kingdom, Canada, and the U.S. (e.g., Campbell & Malkus, 2014). Many school districts and schools employ it so that teachers can learn in schools or instructional contexts. Campbell and Malkus (2014) state that different forms of coaching are employed in the previously mentioned areas. Mathematics coaching is supported by research that shows a positive impact of coaching on student achievement (e.g., Blank, 2013; Campbell & Malkus, 2010, 2011; Hindman & Wasik, 2012; Neufeld & Roper, 2003; Teemant, 2014). It is also supported by research that demonstrates that a teacher is an important factor in the improvement of student achievement (e.g., Kuijpers, Houtveen, & Wubbels, 2010). Based on these findings, many have concluded that helping teachers enhance their instructional practices will improve student achievement. However, helping teachers to improve instruction is difficult. For example, some teachers are resistant to change because it is not easy to learn the new instructional strategies (Obara, 2010), or because they believe that the new instructional strategies are ineffective (e.g., Bengo, 2013). Some argue that the method of professional development for teachers and its quality can address this issue (e.g., Knight et al., 2015). Specifically, to employ knowledge acquired from workshops or professional development activities in the classroom requires that a qualified person views a teacher's actual instructional practices and gives them feedback (Knight, 2007). This is a rationale for mathematics coaching. Coaching can show teachers how and why certain teaching strategies work (Obara, 2010).

There is an emerging body of research on mathematics coaching that outlines the components of effective coaching. It categorizes them as those concerning the skills of the coach and factors existing in the school and school district. The research shows consistency in terms of the requirements for effective mathematics coaching. For example, the potential components of effective mathematics coaching discussed by Knight et al. (2015), Obara (2010), and Hull, Balka, and Miles (2009) overlap. Specifically, effective communication skills, leadership skills, pedagogical content knowledge, content knowledge, curriculum knowledge and how well a coach is able to work with adults. This research has been developed using various coaching models. It is limited but promising, and therefore warrants investigation (Cornett & Knight, 2008). Obara (2010) and Mudzimiri, Burroughs, Luebeck, Sutton, and Yopp (2014) call for additional research on the components of effective coaching. This study addresses this need as it expands the knowledge base on the components of effective mathematics coaching.

1.1. Components of effective mathematics coaching

Fig. 1 depicts the proposed components of effective coaching from the current literature. The underlying hypothesis is that coaching will improve teacher practice and therefore affect student academic performance.

1.1.1. Qualities of the coach

The qualities of the coach and professional development for coaches are included in the framework for the following reasons. Leinhardt and Greeno (1986) and Smith (1995) noted that a teacher's inability to teach certain topics could be linked to his or her insufficient understanding of the topics. Given this, Obara (2010) argues that effective mathematics coaches need to have a deep knowledge of mathematics content to be able to support teachers with an inadequate understanding of the subject. Even when the coaches have this knowledge, they must ensure that they do not create an expert-novice situation when working with

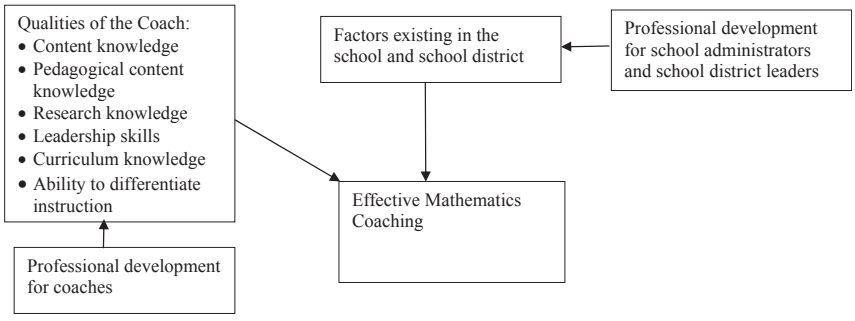

Fig. 1. The conceptual framework.