Defining Coaching Knowledge for K–8 Mathematics Instructional Coaching

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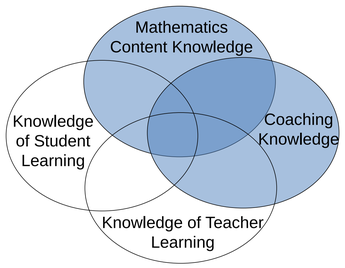
Introduction

The Examining Mathematics Coaching (EMC) Project researches knowledge that contributes to successful coaching in two domains: Coaching Knowledge and Mathematics Content Knowledge.

A mathematics coach is 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 includes the why, what, and how of teaching mathematics.

EMC Research Hypothesis

The effectiveness of a mathematics classroom coach is linked to several domains of knowledge. Coaching Knowledge and Mathematics Content Knowledge are two of these domains that contribute significantly to a coach's effectiveness as measured by positive impact on teacher practice, attitudes, and beliefs.



Research Methods

Fifty-six coaches work with three teachers each. Each coach is randomly assigned to one of two treatment groups.

EMC uses (1) a non-experimental correlative study of knowledge for coaching and change in teacher practice, and (2) an experimental causal crossover design measuring the effects of increased knowledge for coaching on teacher practice. The study also will yield data about the environmental characteristics of effective coaching.

Crossover Experimental Design

	Group 1	Group 2
Year 1	Provide Orientation to EMC Coaching Model	
Year 2	Provide PD on Mathematics Content Knowledge	
Year 3		Provide PD on Coaching Knowledge
Year 4	Provide PD on Coaching Knowledge	
Year 5		Provide PD on Mathematics Content Knowledge

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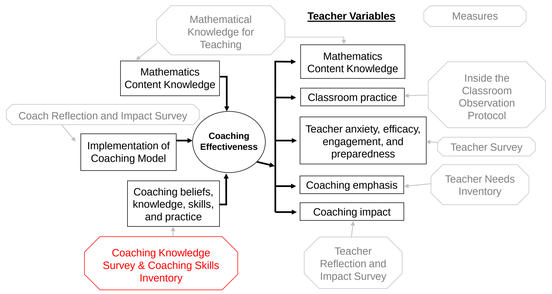
Project Variables and Measures



Delphi Study to Define Coaching Knowledge

- A three-phase process engaged 10 national experts and practitioners in the area of mathematics coaching.
- Throughout the process, panelists were asked to reflect on models of coaching and report areas of coaching knowledge, unique from teaching knowledge, that contribute to effective mathematics coaching.
- The EMC researchers then identified domains of knowledge using qualitative analysis techniques.
- The Delphi panel identified eight components of coaching knowledge.
- The panel collectively defined each knowledge area and expressed a level of agreement with the collective definitions.

Instrument Design and Use

Data collection uses a variety of instruments. Analysis uses mixed-methods for qualitative data, quantitative data, and ordered categorical data.

The project is measuring coaching knowledge through a combination of factor scores on Likert items about familiarity with coaching literature; factor scores on coaches' self-reported confidence and perceived effectiveness; and character scores based on responses to scenarios.

Coaching Knowledge Survey

Using the definitions and existing literature on coaching, project researchers wrote items to measure knowledge of, beliefs about, and practices in mathematics coaching. After two pilots, the Coaching Knowledge Survey is in use.

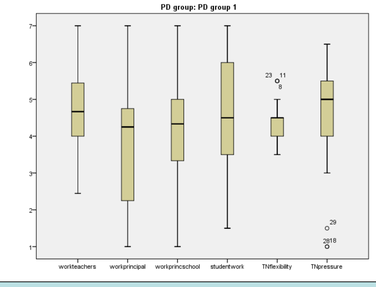
Factor 1: **Working with teachers**
Sample item: "I have difficult conversations with teachers, when necessary, about mathematics misconceptions they hold."

Factor 2: **Working with principals (Teacher level)**
Sample item: "An effective mathematics coach asks the principal what she or he believes the teachers' needs are."

Factor 3: **Working with principals (School level)**
Sample item: "I provide feedback to the principal about whether or not the school is meeting its vision for mathematics instruction."

Factor 4: **Using student work**
Sample item: "I collect students' mathematics work from a teacher's classroom to guide our coaching conversations."

Factor 5: **Teacher need (Pressure)**
Sample item: (Reversal) "An effective mathematics coach coaches only on teacher-stated needs."



Project Definitions of Coaching Knowledge Resulting from Delphi Study

Assessment

A coach knows how to assess teachers' needs—personal, instructional, content, and management—and how to assess and use teacher content knowledge and pedagogical content knowledge to inform and support teachers. A coach knows how to determine what teachers know about assessment, including different types, their uses, and limits. A coach knows how to use data and assessment of student thinking to inform her or his work with teachers. A coach knows how to help the teacher learn how to set goals and assess lesson effectiveness. A coach also knows how to help the teacher learn when looking at student work is better than looking at numerical assessment results. The coach knows how to help teachers interpret and use assessment data to make informed decisions about instruction and student learning.

Communication

A coach knows how to communicate professionally with others about students, curriculum, and classroom practice. A coach knows how to mediate a conversation, by pausing, paraphrasing, probing, and inquiring. A coach knows how to ask reflective questions. A coach knows how to use nonverbal communication and knows how to listen actively in conversation. A coach knows how to communicate in problem-resolving conversations.

Leadership

A coach knows how to strategically identify, define, and communicate specific goals and objectives that relate to student success and teachers' professional growth, and align with the institution's vision for mathematics. The coach uses this vision and knowledge to inform her or his work with other school leaders, to bridge the gap that may exist between teachers' beliefs and their ability to implement instruction that reflects those beliefs, to earn trust with teachers and administrators, and to enhance teachers' content knowledge. The coach knows whether educational structures and policies impede or promote students' equitable access to quality instruction. The coach knows how to hold teachers, administrators, and schools accountable. The coach knows the coaching process and how to implement it. The coach knows how to address challenges and how to extend teacher cognitive processes regarding instruction—planning, doing, reflecting—and how to advocate for, negotiate with, and influence others.

Relationships

The coach knows that the coaching relationship is grounded in content and how to use the relationship to support self-directedness in teachers. A coach knows how to communicate professionally with a variety of audiences, and knows how to establish and maintain rapport and credibility with teachers and other stakeholders based on trust, empathy, mutual understanding, and confidentiality. A coach knows about environments where positive relationships take place, including challenging and safe learning environments for teachers and students, collaborative working environments, and environments where people share common beliefs and goals with honest reflection. The coach knows how to work within the specific culture of the district and school. The coach knows how autonomy, issues of authority, and socio-cultural aspects of class, race, and gender for students and teachers influence relationships and influence perceptions and models of help and authority.

Student Learning

A coach knows how to support teachers in analyzing student thinking and conducting mathematical error analysis, and knows how to support teachers in acquiring facility with mathematical processes (mathematical discourse, mathematical exploration, meta-cognition, etc.) that help students engage in challenging and meaningful mathematics problems and tasks. A coach knows how to develop and how to provide teachers with learning opportunities aimed at improving student learning by analyzing student work and student ideas as they are presented in the classroom. A coach knows how to help teachers recognize evidence of learning potential and deficits in student work. A coach knows how to help teachers become proficient at creating and managing mathematical learning environments in the K-8 spectrum. A coach knows how to support teachers in acquiring the ideas and the continuum of ideas in the K-8 mathematics classroom. A coach knows the research about student learning in mathematics.

Teacher Development

A coach knows various models of teacher stages of development, adult change, and the continuum of learning (e.g., from beginning to experienced to expert teacher; or from an unsophisticated view of teaching to a sophisticated one) that teachers often experience in exploring content knowledge, pedagogy, beliefs, and management. A coach knows how to ascertain a teacher's understanding of mathematics, teaching, and learning and is able to differentiate experiences to support an individual teacher's learning. A coach knows teachers' motivations for learning and barriers to learning and supports the development and use of reflection and feedback to enhance teaching and learning.

Teacher Learning

A coach knows about internal and external teacher motivations and about effectively engaging teachers in the coaching process. A coach knows the myriad ways teachers know and understand mathematics content and the teacher's pedagogical and pedagogical content needs, which may or may not be recognized by the teacher. A coach knows about how an individual teacher best learns, incorporating knowledge about developmental continuums and teacher beliefs about learning. A coach knows how to support teacher learning through reflective practice and self-directed goal-setting. A coach knows how to help teachers recognize that there may be a discrepancy between vision and practice and how to help the teacher address that discrepancy.

Teacher Practice

A coach knows how to discern teacher beliefs about mathematics teaching practice and holds a depth and breadth of knowledge of all types of practice and instructional resources for effective management and mathematics learning. A coach knows how these practices and resources translate into teacher actions in mathematics classrooms for effective teaching and learning.

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For further information …

Or to request copies of our instruments, please contact *emc@math.montana.edu*. More information on this project can be obtained at the EMC Web site: *http://www.math.montana.edu/~emc.*