EXAMINING MATHEMATICS COACHING

A Mathematics Coaching Research Design

Elizabeth A. Burroughs, Jennifer L. Luebeck, and David A. Yopp

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Research Partners

MONTANA STATE UNIVERSITY

RMC RESEARCH

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Research Team

Montana State University

- David Yopp, PI
- Beth Burroughs, CoPI
- Jennifer Luebeck
- Mark Greenwood

RMC Research

- John Sutton, CoPI
- Clare Heidema
- Arlene Mitchell
- Lyn Swackhamer

Session outline

- Research design to examine mathematics coaching
- Defining coaching knowledge
- Instruments to measure coaching effectiveness

The Examining Mathematics Coaching project (EMC)

- Investigating knowledge that contributes to successful coaching in two domains
  - Coaching Knowledge
  - Mathematics Content Knowledge.
- The influence of these knowledge domains is examined in two ways:
  - investigating correlations between assessments of coach and teacher knowledge and practice in each domain
  - by investigating causal effects of targeted professional development for coaches.

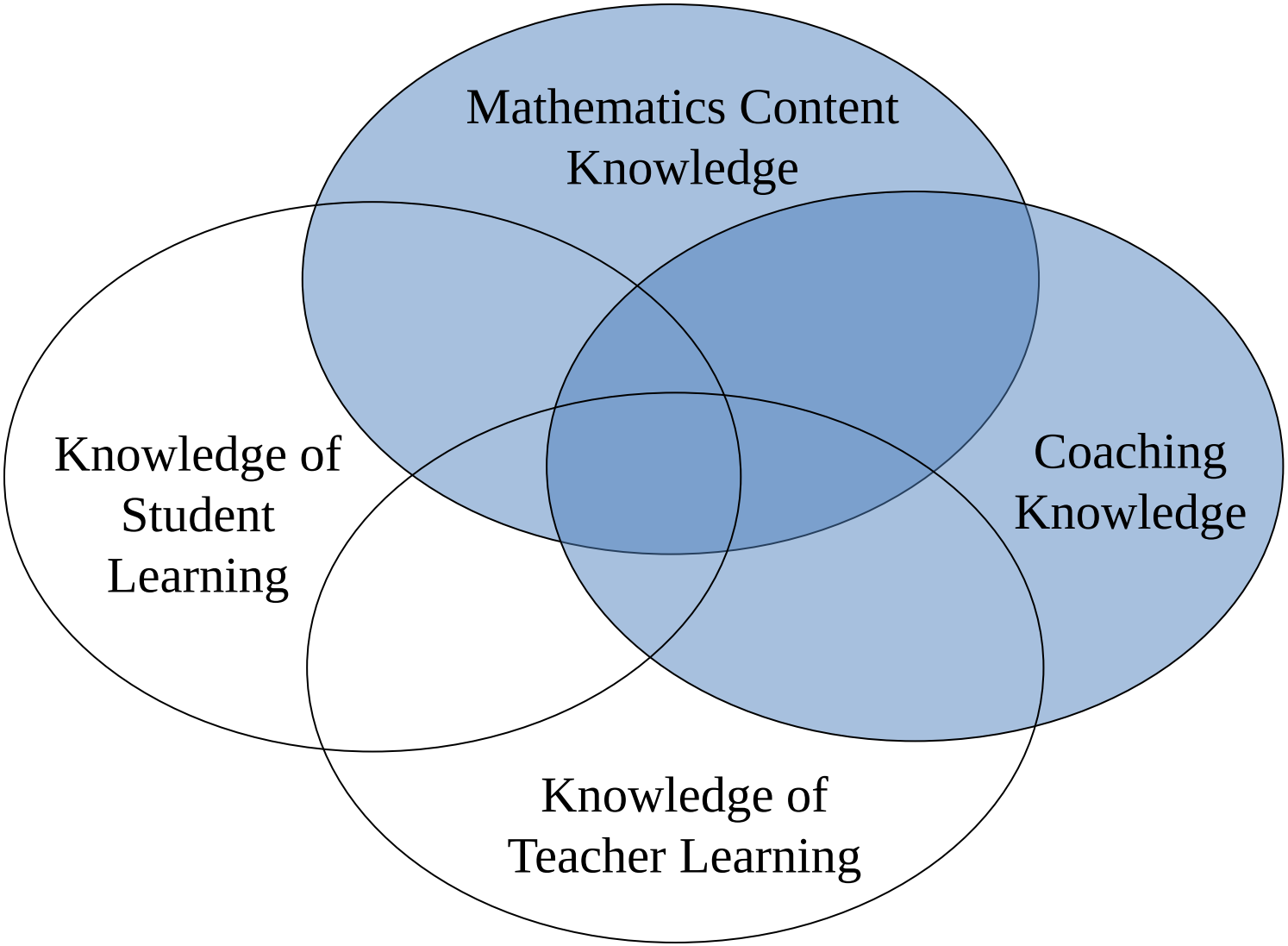
Research design

- A **non-experimental** design will answer: To what extent does a coach's depth of content knowledge in coaching knowledge and mathematics content knowledge influence coaching effectiveness?
- An **experimental** design randomly assigns coaches to one of two groups to answer: To what extent does professional development targeting these two knowledge domains improve coaching effectiveness? and To what extent are the effects of the targeted professional development explained by increases in knowledge?

Why study this?

- A comprehensive understanding of the effectiveness of coaching does not exist.
- Moreover, no studies have demonstrated what types and depths of knowledge effective coaches hold.
- At the same time, implementing coaching involves considerable cost and logistical effort for schools.

Knowledge Domains



EMC research hypothesis

- The effectiveness of a mathematics classroom coach is linked to several domains of knowledge. Coaching knowledge and mathematics content knowledge contribute significantly to a coach's effectiveness measured by the positive impact on teacher practice, attitudes, and beliefs.

EMC Goals

1. Determine the degree to which coaching knowledge contributes to coaching effectiveness.
2. Determine the degree to which mathematics content knowledge contributes to coaching effectiveness.
3. Contribute to research on knowledge for coaching through an experimental design studying the impacts of coaching knowledge and mathematics content knowledge on teachers' knowledge, attitudes, and classroom practices.

Potential Impacts of EMC

- Understanding of knowledge needed for effective mathematics coaching
- Understanding of what contributes to effective mathematics coaching
- Understanding of coaching best practices
- Understanding of factors influencing coaching effectiveness
- Instruments to evaluate and monitor mathematics coaching

Mathematics Coach: EMC Definition

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.

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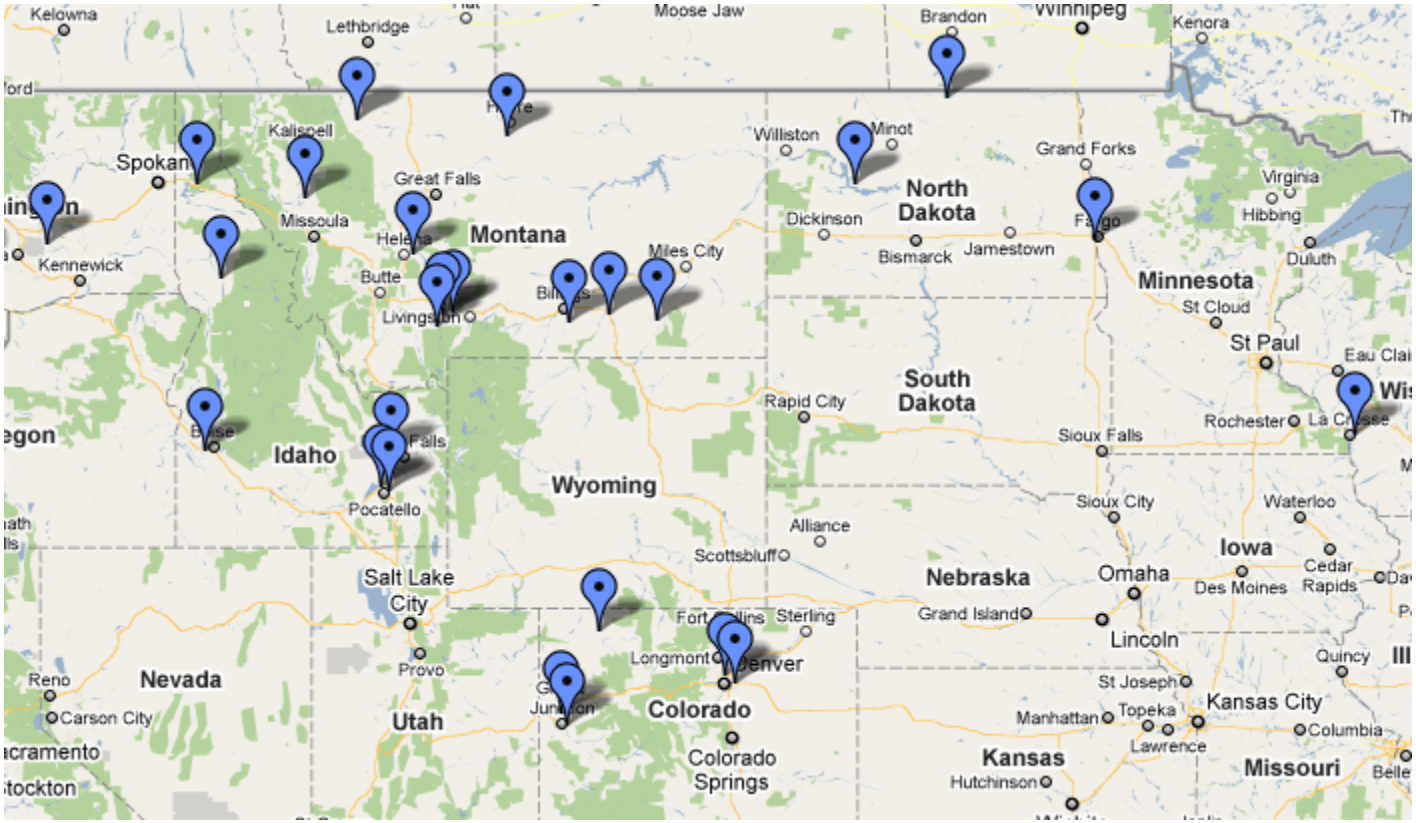
Participants

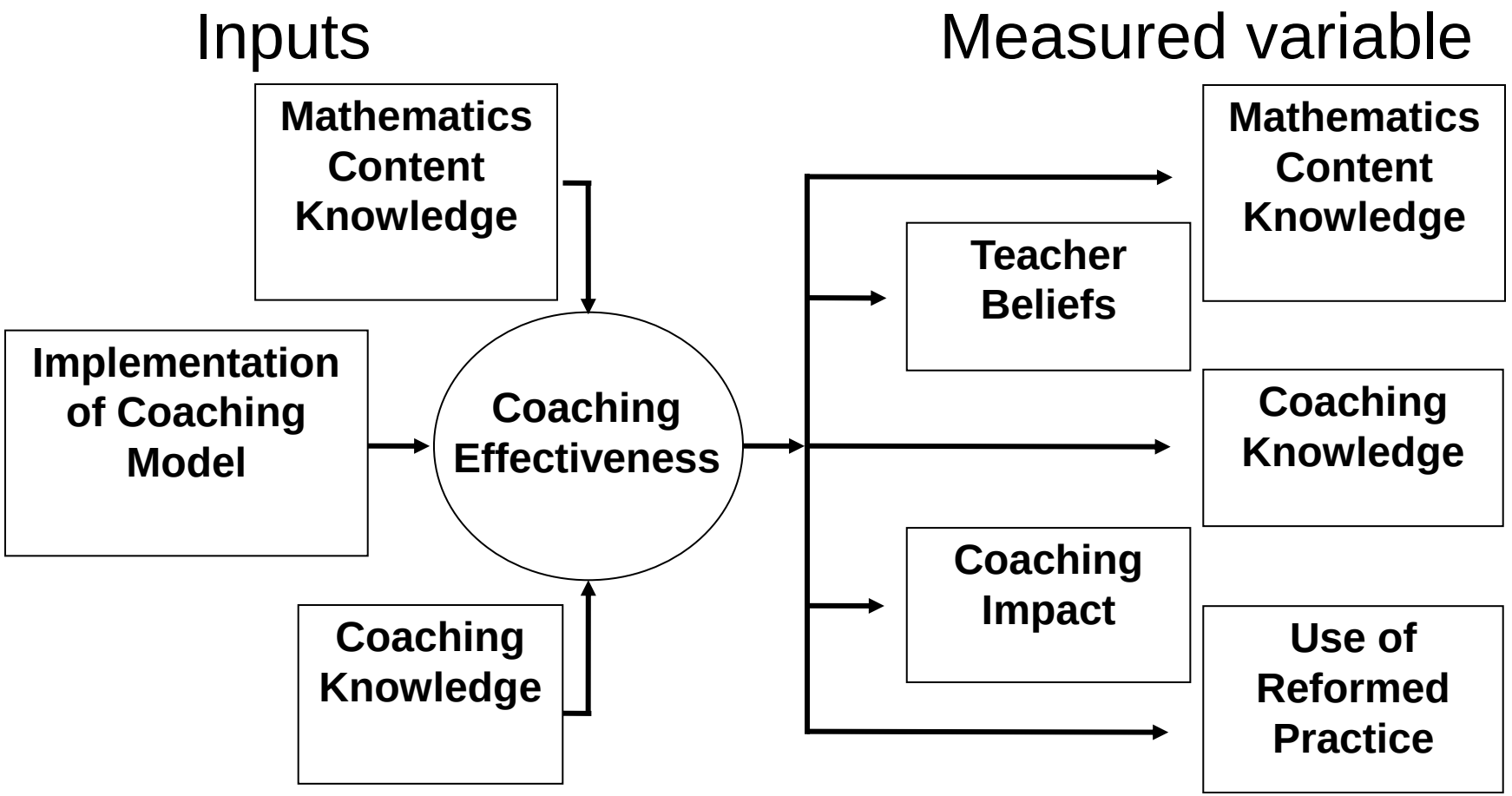
59 coach participants and 177 teacher participants located in Montana, Idaho, Colorado, North Dakota, Washington, and Wisconsin



Crossover Design

	Group 1	Group 2
Year 1 2009-10	Provide orientation to EMC coaching model.	
Year 2 2010-11	Provide PD on Mathematics Content Knowledge. Summer 2010 Web-based PD School Year	Web-based PD School Year 2010-11
Year 3 2011-12	Web-based PD School Year 2011-12	Provide PD on Coaching Knowledge. Summer 2011 Web-based PD School Year
Year 4 2012-13	Provide PD on Coaching Knowledge Summer 2012 Web-based PD School Year	Web-based PD School year 2012-13
Year 5 2013-14	Web-based PD School Year 2013-14	Provide PD on Mathematics Content Knowledge. Summer 2013 Web-based PD School Year

Logic Model


Inputs
Measured variable
Mathematics Content Knowledge
Implementation of Coaching Model
Coaching Effectiveness
Coaching Knowledge
Teacher Beliefs
Coaching Impact
Mathematics Content Knowledge
Coaching Knowledge
Use of Reformed Practice

Coaching Model

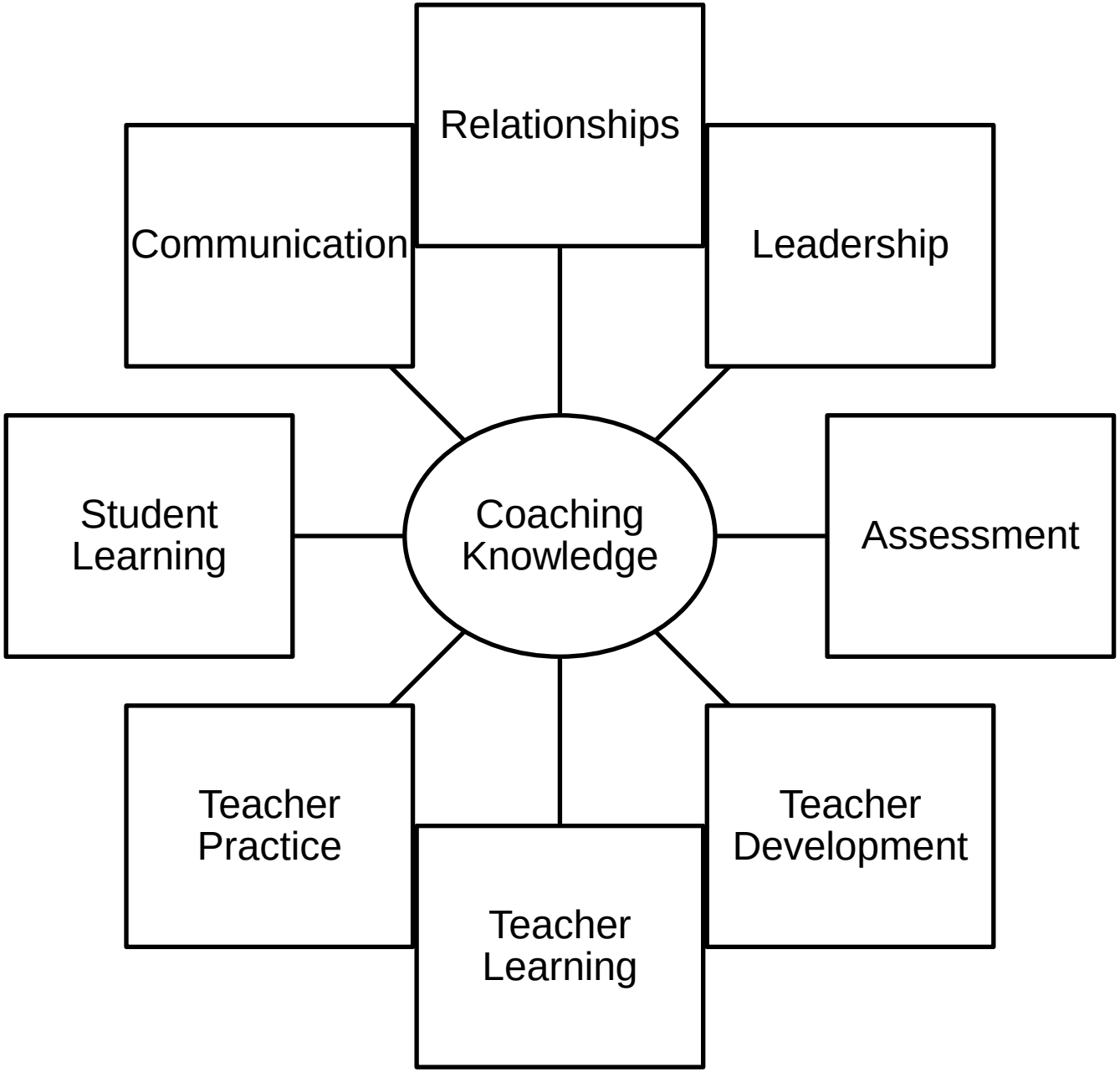
Coaching Model	•**Pre-conference** of at least 15 minutes focused on planning for upcoming lesson with emphasis on teacher's stated goals, objectives, and needs •**Observation** or model of a lesson •**Post-conference** of at least 30 minutes reflecting on planned teacher actions Coaching will focus on aspects of standards-based teaching as defined by NCTM process and content standards, not on generic pedagogy such as classroom management
Content Focus	Number and operation: ratio and proportion
Frequency	Three teachers per coach provide data points for research. Teachers are coached at least eight times per academic year and at least four times within the content focus
Quality Assurances	Coach and teacher reflection instruments, coach skill inventory, and teacher needs inventory ensure consistent implementation of coaching across schools Self-identified teacher needs are used in planning and goal setting, and progress toward these goals is monitored and reflected on by coaches

Delphi Study

- An iterative process where experts identify and refine the constructs being studied

Defining coaching knowledge

- Three phase process engaged 10 national experts and practitioners in the area of mathematics coaching.
- The Delphi panel identified 8 components of coaching knowledge.
- Experts collectively defined each knowledge area and expressed their level of agreement with the collective definitions.


Relationships
Communication
Leadership
Student Learning
Coaching Knowledge
Assessment
Teacher Practice
Teacher Development
Teacher Learning

Activity

- Use the handout to examine the working definitions of coaching knowledge. In a small group, choose one definition and indicate the degree to which
- This is an accurate definition for coaching knowledge of …
- This definition captures my thinking related to coaching knowledge of …
- This definition enhances my thinking related to coaching knowledge of …
- This definition can help inform my work.

Knowledge of 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 assess lesson effectiveness. A coach also knows how to help the teacher learn to use student work to inform instruction in ways numerical assessment results cannot. The coach knows how to help teachers interpret and use assessment data to make informed decisions about instruction and student learning.

Knowledge of 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.

Knowledge of Leadership

- A coach knows how to identify, define, communicate, and advocate for specific goals and objectives that align with the institution's vision for mathematics and relate to student success and to teachers' professional growth. 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 advocate for, negotiate with, and influence others.

Knowledge of Relationships

- The coach knows how to use relationships to support self-directedness in teachers and that the coaching relationship is grounded in content. 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.

Knowledge of 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) teachers often experience in developing 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.

Knowledge of 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, potential learning trajectories, 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 there may be a gap between a teacher knowing a strategy and effectively using a strategy and how to help the teacher address that discrepancy.

Knowledge of 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, with a particularly strong knowledge of student-centered and student-focused instruction. A coach knows how these beliefs, practices, and resources translate into teacher actions in mathematics classrooms.

Knowledge of 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, metacognition, 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 about a variety student mathematical learning environments (e.g. co-operative, inquiry, and discovery learning environments) and knows how to create them and how to support them. A coach knows the entire K-8 mathematics curriculum, including how ideas taught in a particular grade support learning subsequent grades. A coach knows how to support teachers in acquiring facility for engaging students in challenging and meaningful mathematical experiences, processes, problems, and tasks within the continuum of ideas in the K-8 mathematics classroom. A coach knows the research about student learning in mathematics**.**

Issues with definitions

- What does a coach need to know about Student Learning that is distinct from what an effective teacher would know?
- Other issues from the breakout groups

Creating a Measure of **Knowledge of Coaching**

Coaching Knowledge Survey

Leadership

A coach knows various ways to address challenges and how to communicate in ways that advocate for, negotiate with and influence others.

Leadership

A coach knows how to communicate in ways that negotiate with and influence others.

Beliefs

Disagree Perhaps Agree

1 2 3 4 5 6 7 8

When a principal and a group of teachers disagree on how mathematics should be taught, the mathematics coach should try to help them find common ground.

In the end, it really doesn’t matter whether the principal and the mathematics coach agree on what needs to change in a school. (Reversal)

Actual Practice

Not at all reflective of my coaching practice							Very reflective of my coaching practice
1	2	3	4	5	6	7	8

As mathematics coach, I sometimes help the teachers and their principals understand each other's points of views about effective mathematics instruction.

I meet regularly with the principal to discuss our visions for mathematics instruction.

Teacher Development

A coach knows various models of teacher stages of development, adult change, the continuum of learning (e.g. from beginning to experienced to expert teacher; or from an unsophisticated view of teaching to a sophisticated one) teachers often experience in developing content knowledge, pedagogy, beliefs, and management.

Teacher Development

A coach knows stages of development, adult change, the continuum of learning

teachers often experience in developing pedagogy and management.

Beliefs

	Disagree			Perhaps			Agree
	1	2	3	4	5	6	7	8
After hearing about a new teaching strategy and developing a plan for implementation, teachers will usually incorporate the strategy into their practice. (Reversal)								

Actual Practice

Not at all reflective of my coaching practice — **Somewhat** — **Very reflective of my coaching practice**

1 2 3 4 5 6 7 8

Once I have helped a teacher incorporate a new mathematics teaching strategy, I do not follow up with the teacher about it because I want the teacher to take ownership of the strategy. (Reversal)

Teacher Learning

- ***A coach knows about internal and external teacher motivations and about effectively engaging teachers in the coaching process.***

Beliefs

Disagree			Perhaps				Agree
1	2	3	4	5	6	7	8

A mandate from the principal is more likely to motivate a teacher to change his or her teaching practice than a coach's bid to improve student learning. (Reversal)

Actual Practice

I frequently tell teachers that yes, they can make a difference in student mathematics learning.

Not at all reflective of my coaching practice — Somewhat — Very reflective of my coaching practice

1 2 3 4 5 6 7 8

Other Instruments

Coaching Skills Inventory

How confident do you feel coaching teachers on encouraging student participation?

Not at all confident				Very confident
1	2	3	4	5

Teacher Needs Inventory

How confident do you feel using cooperative learning?

Not at all confident — Very confident

1 2 3 4 5

I would not like to partner with coach on this topic.	Not sure if I would like to partner with coach on this topic.	I would like to partner with coach on this topic.
[ ]	[ ]	[ ]

Coach and Teacher Reflections

My coach and I discussed significant and worthwhile mathematical content.

Not at all				To a great extent
1	2	3	4	5

Contact Us:

David Yopp

406-994-3123

yopp@math.montana.edu

Web: www.math.montana.edu/~emc/