Support for Coaches: Theoretically-Informed and Research-Based Practices for Content and Pedagogy

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EMC
EXAMINING MATHEMATICS COACHING

Research Contributors

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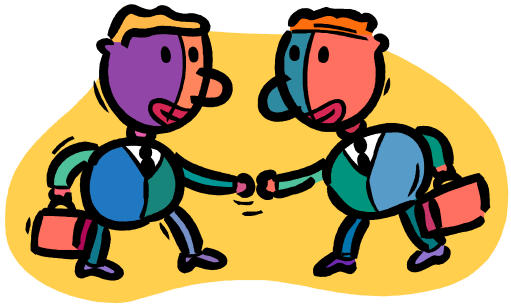
EMC Project Description

EMC is a 5-year research and development project examining the effects of a coach's *knowledge for coaching* on a diverse population of K-8 teachers.

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, as measured by positive impact on teacher practice, attitudes, and beliefs.



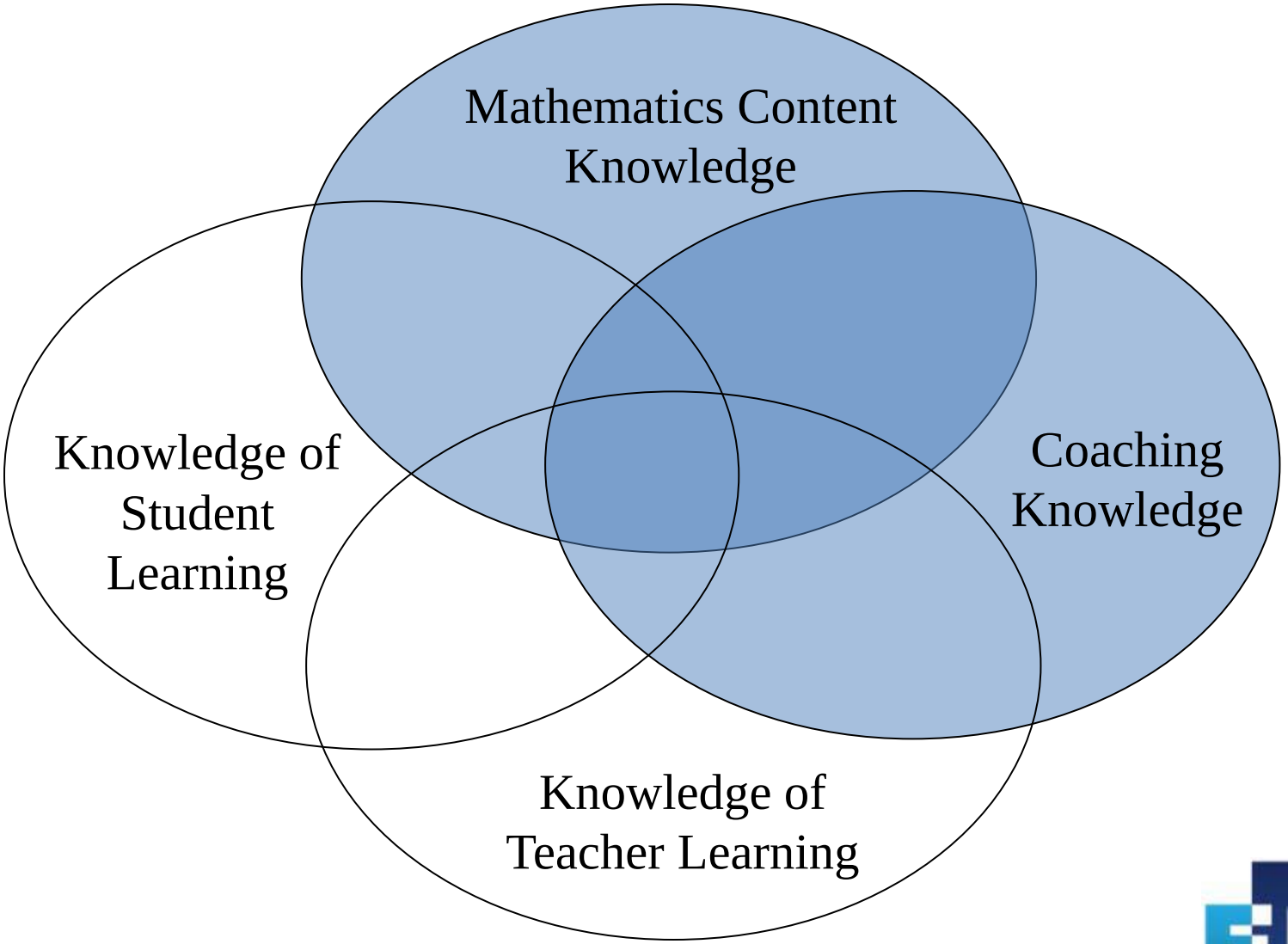
Research Questions

- *To what extent does the depth of a coach's knowledge in two primary domains (**coaching knowledge** and **mathematics content knowledge**) influence their coaching effectiveness?*
- *To what extent does **professional development** for coaches in these two areas improve their coaching effectiveness?*
- *To what extent are the effects of targeted professional development on coaching effectiveness explained by increases in coaching knowledge and mathematics content knowledge?*

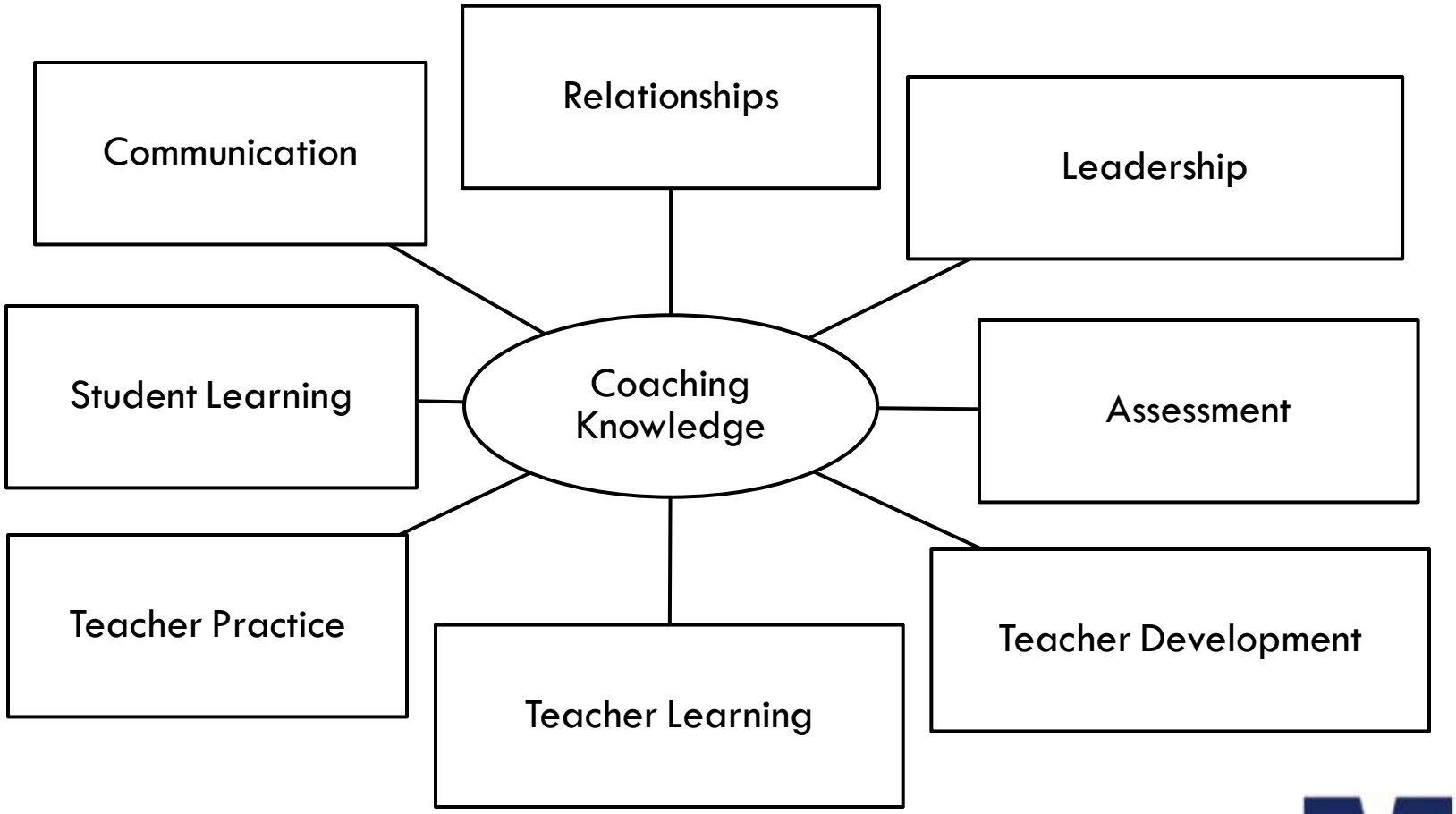
Coaching Model

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.

Knowledge Domains



Coaching Knowledge



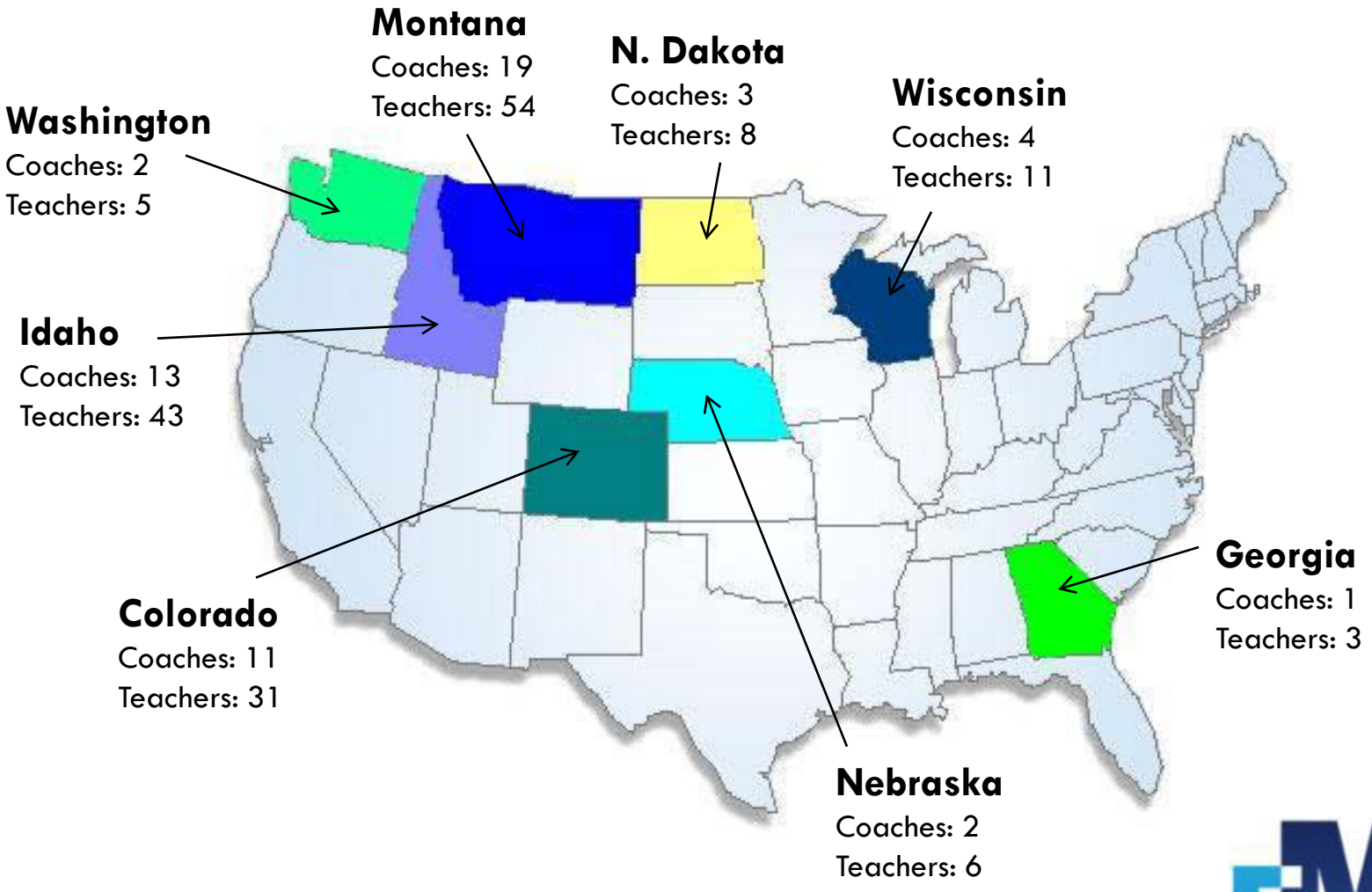
Mathematics Coach: EMC Definition

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 include the **why, what, and how** of teaching mathematics.

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 correlate to **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**?

EMC Participants: Where They Are



Research Design

- Each coach (n = 56) is randomly assigned to Group 1 or Group 2.
- Group 1 coaches have mathematics content PD (summer 2010), followed two summers later by coaching knowledge PD (summer 2012).
- Group 2 coaches have coaching knowledge PD (summer 2011), followed two summers later by mathematics content PD (summer 2013).

Crossover Design

	Group 1	Group 2
Year 1 2009–10	Provide orientation to EMC coaching model	
Year 2 2010–11	Mathematics Content Knowledge	
Year 3 2011–12		Coaching Knowledge
Year 4 2012–13	Coaching Knowledge	
Year 5 2013–14		Mathematics Content Knowledge

Professional Development Challenge

- Create two distinct one-week professional development courses
- One course should shift participants' knowledge of **mathematics content,** specifically in the area of number and operation, with a focus on ratio and proportion.
- One course should shift participants' **coaching knowledge,** as described by the Delphi study, addressing eight themes identified by coaching experts.

Professional Development Design

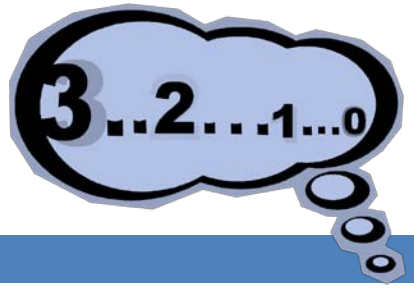
- 45 hours, 1 week, residential
- Participants are all coaches enrolled in the research project.
- Experience in mathematics coaching varies considerably.
- Mathematical knowledge varies considerably.

Mathematics Content

Mathematics Content Topics

Monday	Tuesday	Wednesday	Thursday	Friday
Focus on Mathematical Practice and Number Sense	Computation	Fraction Concepts	Fraction Operations and Ratios	Proportional Reasoning and Percent

Mathematical Practice and Number Sense



- Standards for Mathematical Practice describe ways teachers and learners engage with mathematics content.
- It is important to select appropriate representations of numbers or numerical problems based on context
- Factorization, divisibility, and divisibility rules are based on mathematical structure.

Number Sense Activity (Example)

Here are several pairs of multiplication calculations.

What pattern do you notice when you find the products?

24	27	35	42	56	32	156	144
×9	×8	×18	×15	×12	×21	×12	×13

Explain why, in each case, the products are the same.

Write another pair of multiplication problems with the same product.

Computation

- The properties of numbers and operations on numbers create structure that underlies computational methods, including algorithms.
- Multiplicative thinking is a skill to develop with all students.
- Models can be used to solve contextual problems, decide what operation is involved, and give meaning to number sentences.

Fraction Concepts

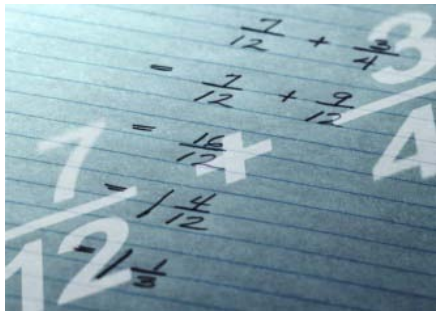
- Unitizing is the basis for fraction understanding.

- There are various models for representing fractions and these complement each other and enrich the meaning of fractions.

Fraction Operations and Ratios

- Models for fractions and their operations reveal structure that underlies computational methods.

- Various mathematical connections link ratios and fractions.



Multiplication or Division

Which of the following problems are solved by:

$1\frac{3}{4} \times \frac{1}{2}$ OR $1\frac{3}{4} \div \frac{1}{2}$?

1. How many cups of sugar do you need to make a half batch of cookies if a full batch takes $1\frac{3}{4}$ cups of sugar?
2. How many posters can you paint with $1\frac{3}{4}$ cans of paint if one poster takes $\frac{1}{2}$ can of paint?
3. How many pounds of birdseed do you need to fill a bird feeder if $1\frac{3}{4}$ pounds of birdseed fills the bird feeder $\frac{1}{2}$ full?
4. What is the area, in square yards, of a rectangular garden that is $1\frac{3}{4}$ yards long by $\frac{1}{2}$ yard wide?
5. How many servings of lemonade can you make if you have $1\frac{3}{4}$ cups of lemonade and a serving is $\frac{1}{2}$ cup?

Proportional Reasoning and Percent

- Multiplicative reasoning is a fundamental component of proportional reasoning.
- Proportional situations can be represented by a variety of models, and certain models promote sense-making in solving proportions.

Coaching Knowledge PD

Week-long Theme

- Teaching coaches to recognize standards-based mathematics

- Standards-based mathematics develops mathematical processes, mathematical practices, and mathematical strands of proficiency.

Coaching Knowledge Topics

Monday	Tuesday	Wednesday	Thursday	Friday
Teacher Learning	**Student Learning & Teacher Practices I**	**Communication for Coaching**	**Teacher Practices & Student Learning II**	**Logistics of Coaching**
Themes: Teacher Learning and Teacher Development	*Themes: Teacher Practice and Student Learning*	*Themes: Communication and Assessment*	*Themes: Teacher Practice and Student Learning*	*Themes: Relationships and Leadership*

Teacher Learning & Teacher Development

Teacher Learning

- Engaging teachers in the coaching process
- How teachers in general acquire knowledge of content, pedagogy, and pedagogical content
- How individual teachers best acquire knowledge
- The discrepancy between "vision and practice"

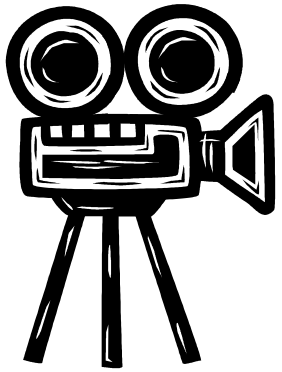
Teacher Development

- Teacher development in content, pedagogy, beliefs, and management
- How to support individual teachers' development
- Teachers' motivations and barriers for learning

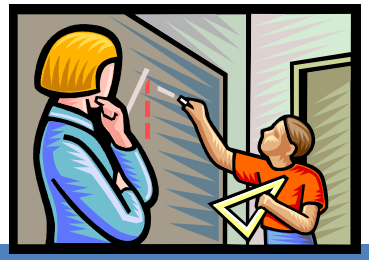
Example Activity: Teacher Development

Use this video clip to decide what you could discuss with the teacher in a conference, based on what you notice the most. Be prepared to give a rationale.

- Mathematics content?
- Communication?
- General pedagogy?
- Something else?



Student Learning & Teacher Practice



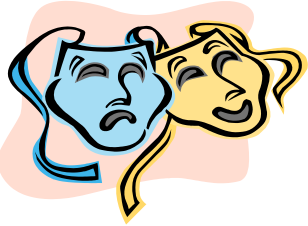
Student Learning

- A coach knows how to support teachers in applying mathematical processes (discourse, exploration, engagement) to classroom.
- A coach has knowledge to help teachers manage the learning environment and improve student learning.

Teacher Practice

- A coach knows how to discern teacher beliefs.
- A coach has a depth and breadth of knowledge of teaching research and teaching actions.

Scenario: Worthwhile Tasks



Roles

- Participant **A** is **Coach.**
- Participant **B** is **Teacher.**
- Participant **C** is **Observer.**

Process

- Individual prep (quiet time): 5 minutes
- Role play: 5 minutes
- Debrief: 15 minutes
  - 1st: Observer
  - 2nd: Teacher
  - 3rd: Coach
- Large group discussion: 5–10 minutes

Relationships & Leadership

Relationships

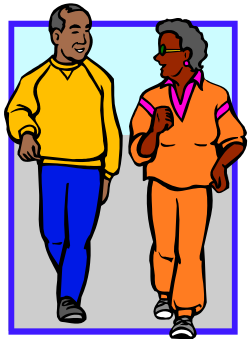
- The purpose of the relationship is to support teaching and content
- Communicate in a way that establishes trust, rapport, and credibility
- Establish positive inter-personal environments
- Foster relationships that respect various cultural influences (socio-cultural, school/district, and authority-autonomy)

Leadership

- Be strategic about setting goals and objectives for teachers and students
- Use, evaluate, and influence the school's vision
- Evaluate the utility of educational policies
- How to address challenges
- The coaching process

Activity:
Coaching Heavy or Coaching Light?

- Read pages 21-26: Coaching Heavy or Coaching Light.
- Identify the one or two ideas that can help you as you think about your own role in the coming years.
- Walk and talk with a partner. Return at the specified time.



Assessment & Communication

Assessment

- Assess teacher needs and use that assessment to set goals for coaching
- Assess student thinking and use that to set goals for coaching
- Help the teachers know how to use assessment in their classrooms

Communication

- Communicate professionally about students, curriculum, and classroom practice
- Mediate a conversation, by pausing, paraphrasing, probing, inquiring, and asking reflective questions
- Use nonverbal communication and listen actively
- Communicate in problem-resolving conversations

Video Assessment of Coaching (VAC) Instrument

Barlow, Burroughs, Harmon, Sutton, Yopp (Under Review, 2013)

Video Assessment of Coaching (VAC) Instrument

- Purpose: gather data about participants' views of effective coaching practices
- Akin to how Kersting, Givvin, Thompson, Santagata, and Stigler (2012) used classroom video as "prompts to elicit teachers' analyses" (p. 571), we used video of coaching sessions to prompt coaches' reactions.

Video Assessment of Coaching (VAC) Instrument

We prompted coaches on six specific aspects of coaching, derived from our understanding of the widely used mathematics coaching texts:

- focusing the coaching discussion on mathematics
- attending to student learning
- providing positive feedback
- using questioning to engage teachers in reflection
- redirecting teachers' questions
- facilitating the coaching session

Video Assessment of Coaching (VAC) Instrument

Prompts because they emerged from an earlier exploratory study of 21 practicing coaches and 6 coaching experts (Yopp, Burroughs, Barlow & Sutton, under review).

Video Assessment of Coaching (VAC) Instrument

Video features:

- 5 minute introduction on stem and leaf plots
- 15 minutes of a novice coach working with 2 teachers in a coaching cycle—pre and post conference.

Sample

- 28 school-based coaches
- Median coaching experience: 4.5 years
- Range of hours training: 6 with no training; 4 with 200 or more
- Range of types of training: Instructional, Cognitive, Content-focused

Video Assessment of Coaching (VAC) Instrument

We hypothesized that asking all participants to address each of the themes would reveal variation in participants' beliefs about effective coaching practice, as well as provide evidence of new dimensions regarding coaches' beliefs of effective practice.

Prompt 1
Practice: Redirecting Teacher Questions

In the pre-lesson conference, the coach responds to teachers' concerns or questions with phrases such as "That's a good question" and "You'll need to think about that." Discuss whether or not this redirecting of teachers' questions aligns with your perception of effective coaching practices.

Results

Implementation comments—when the participant made comments regarding the implementation of the practice in the video

Practice comments—when the participant made comments regarding a specific coaching practice without reference to the video

Results

Implementation

- 4 favorable, 12 unfavorable, 1 both, 0 neutral

Practice

- 14 favorable (6 of which gave conditions), 6 gave unfavorable

Both

- 10 participants

Results

Conditions:

Redirecting teachers' questions is appropriate as long as the coach guides and centers on the teacher's questions and doesn't avoid the questions completely.

Practice/prompt

During the post-lesson conference, the coach referenced her notes about positive aspects of the teachers' actions during the lesson. For example, the coach said, "I like the way you shared the roles." Discuss whether or not this coach's comments about the teacher's actions during the lesson align with your perception of effective coaching.

Results

Implementation

- 3 favorable, 1 favorable with conditions, 8 unfavorable, 1 neutral

Practice

- 10 favorable, 3 favorable with conditions, 6 gave unfavorable

Both

- 4 participants

Results

Conditionals regarding positive feedback:

- Being specific makes more favorable
- Is there focus on difficult conversation as well?

Results

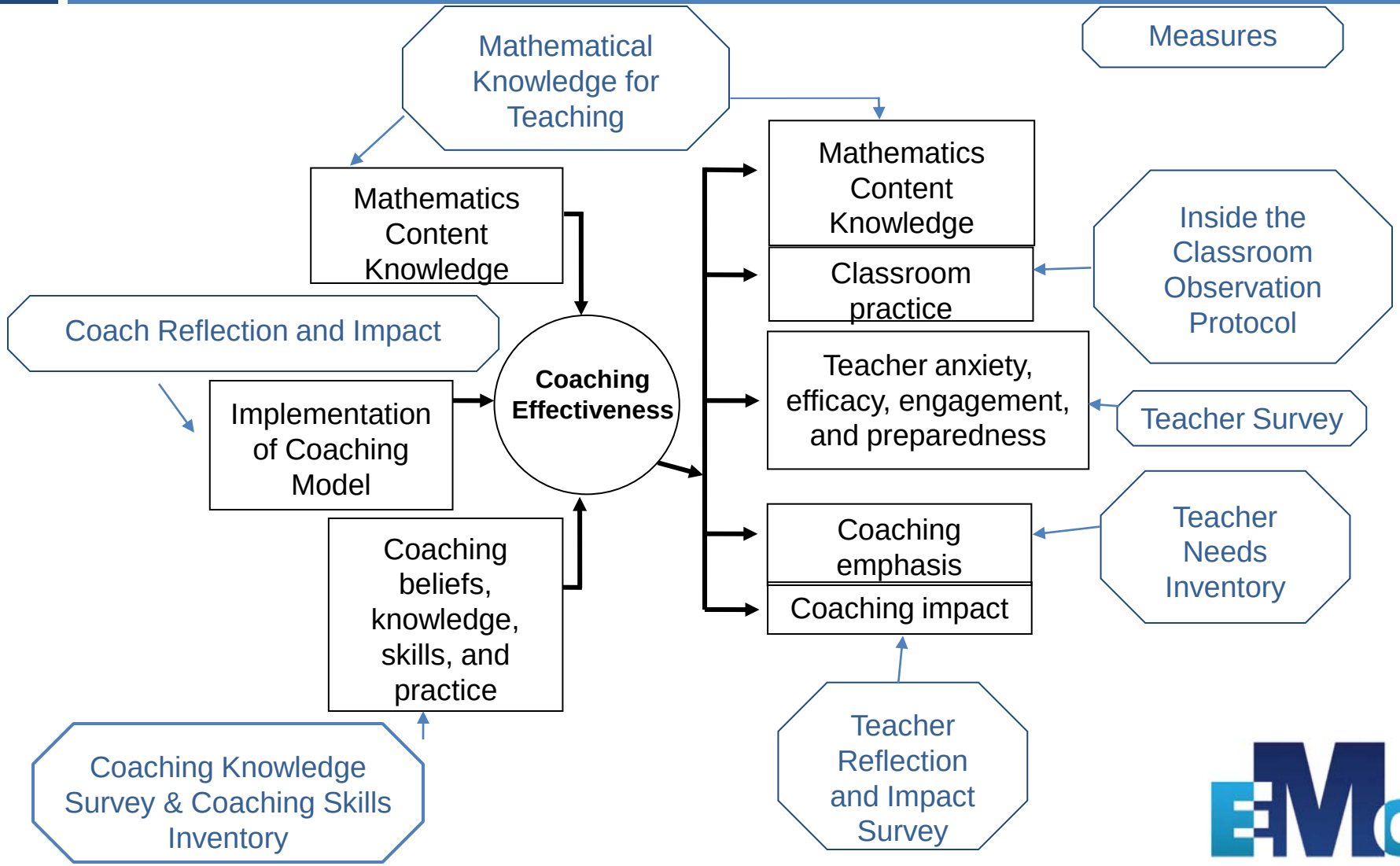
Participants who made unfavorable comments used terms like “evaluator” and “supervisor;” terms found in some of the coach literature.

Summary

- Lots of variation in beliefs expressed in response to the VAC.
- Coach training didn't guarantee participant's views aligned with the prominent coaching model in which he or she was trained. (views expressed in reaction to video and prompt).
- Data was valuable for guiding our PD efforts.

Research and Findings

Project Variables and Measures



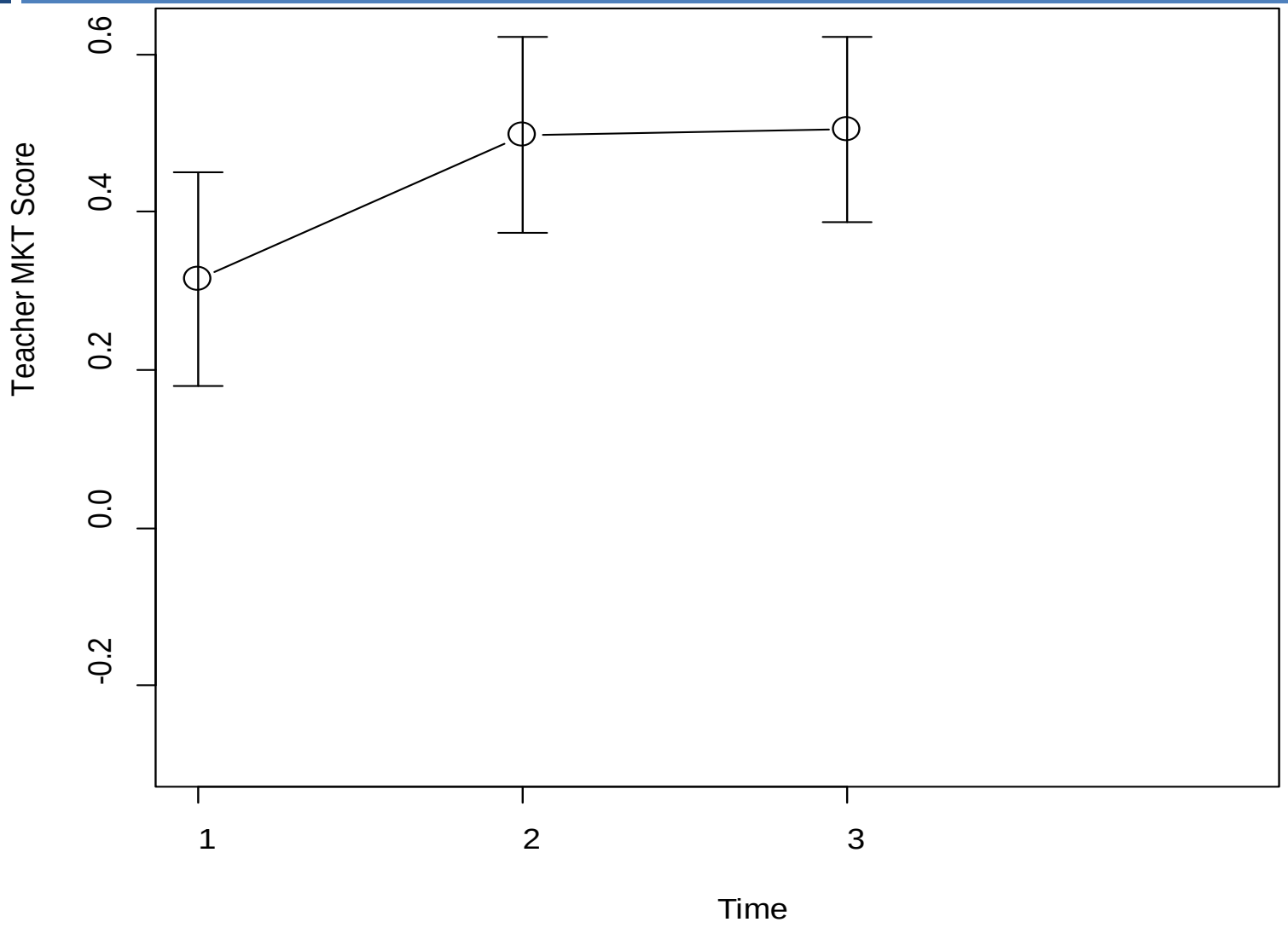
Instruments and 2010 Status √=Data in√=V and R

Instrument	Target	Purpose	Status
Mathematics Knowledge for Teaching (MKT)	Coach Teacher	assessing mathematics content knowledge for teaching	√ √
Coaching Impact Instrument (CII)	Coach Teacher	assessing coaches' and teachers' perceptions of coaching's impact on instruction	√ √
Coach and Teacher Reflection Instrument (CRI and TRI)	Coach Teacher	monitoring and logging coaching interactions including quantity, quality, and duration of coaching sessions	√ √
Coaching Knowledge Survey (CKS)	Coach	assessing coaching knowledge	√
Coaching Skills Inventory (CSI)	Coach	self-assessment of coach skills	√ √
Inside the Classroom—Classroom Observation Protocol (ITC-COP)	Teacher	assessing classroom impacts	√ √
Teacher Needs Inventory (TNI)	Teacher	planning tool to provide focus for coaching sessions	√ √
Teacher Survey (TS)	Teacher	assessing teacher attitudes, beliefs and perceptions of mathematics teaching	√ √

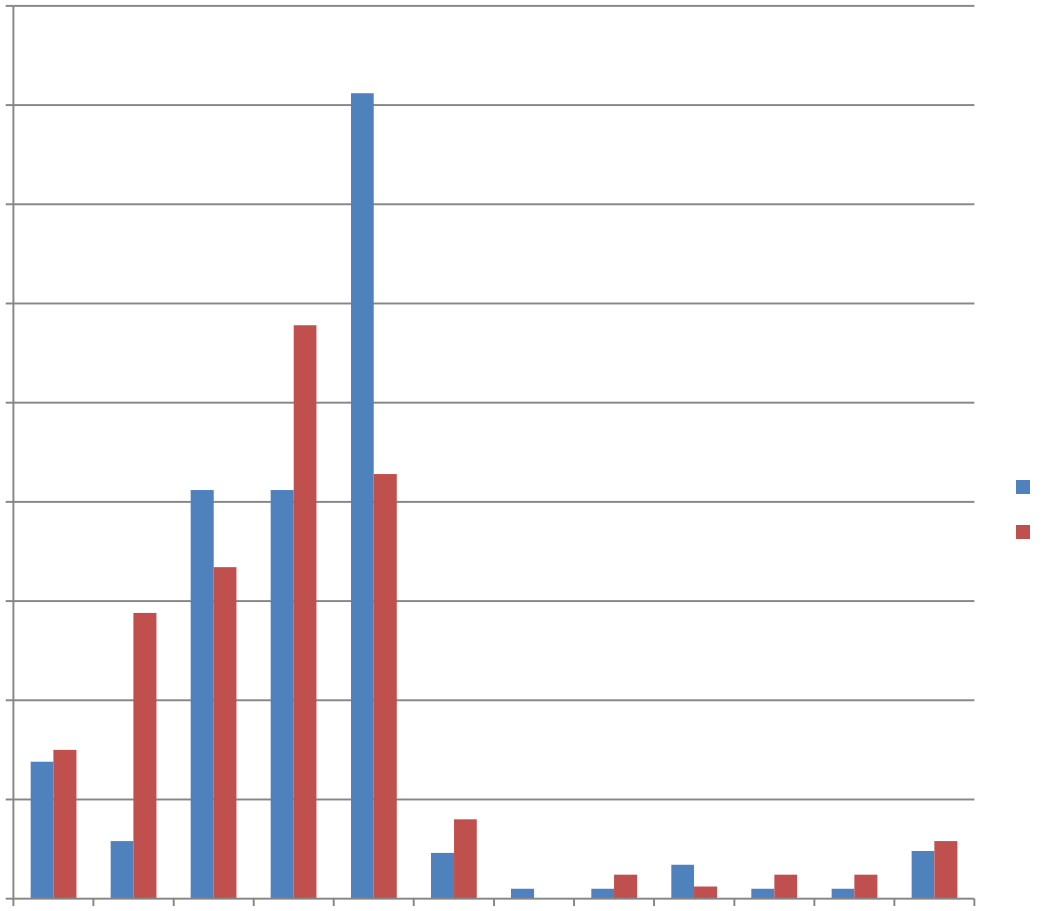
Research Analysis Methods

- Mixed Methods (MKT, CSI)
- Structural Equation Modeling (MKT, ITC COP)
- Descriptive Statistics (TRI and CRI)
- Multi-level Hierarchical Linear Modeling

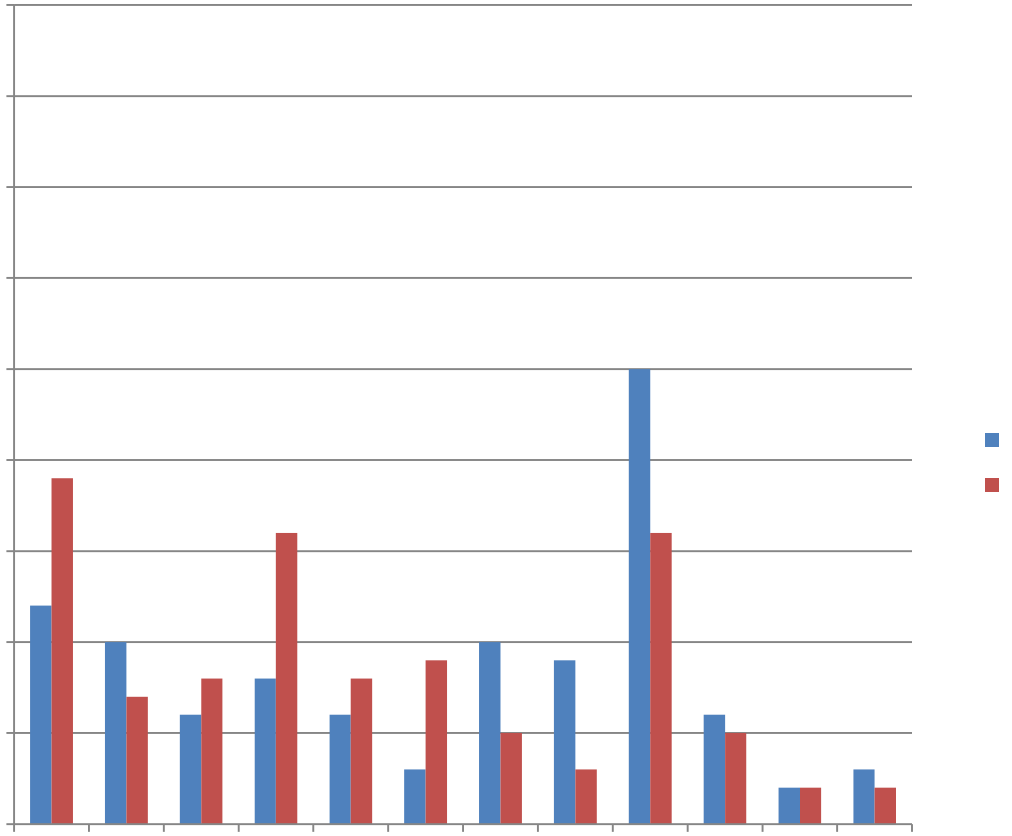
Plot of Teacher MKT Mean Scores



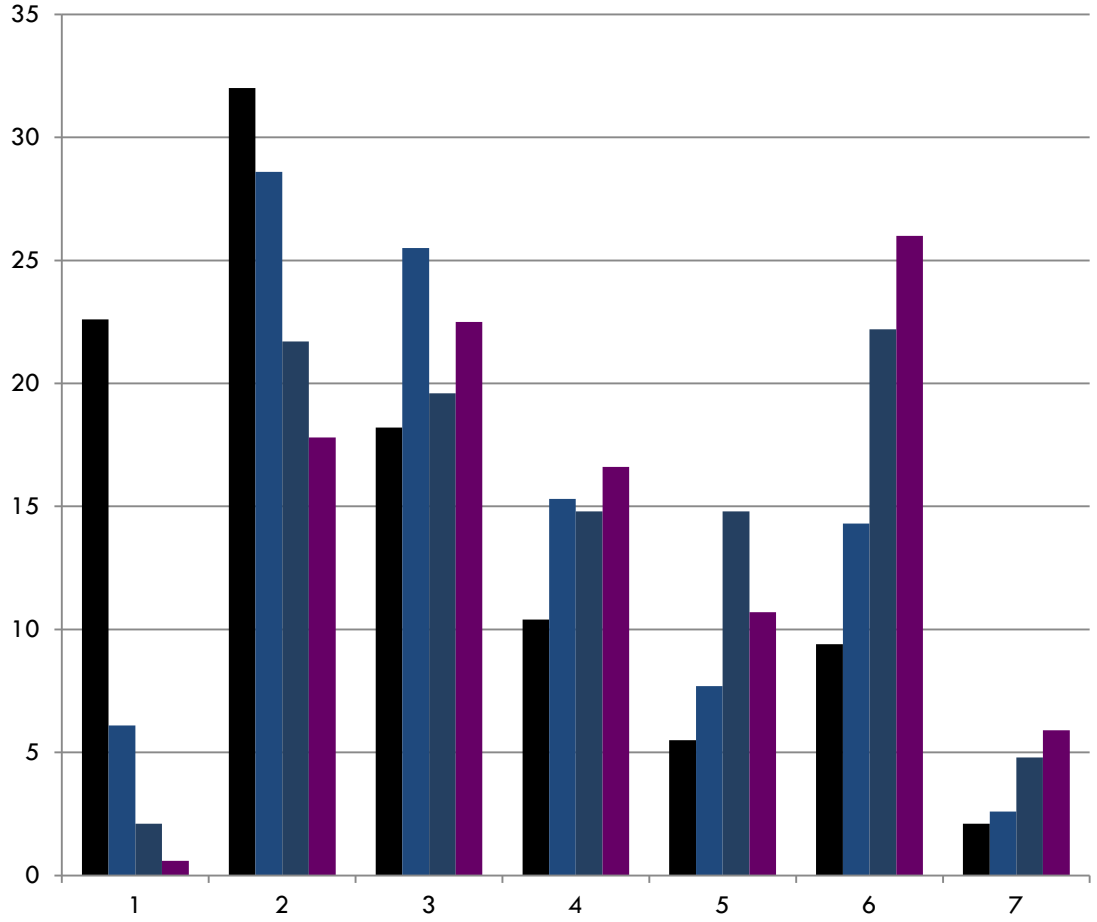
Year 1 Number of Sessions



Year 3 Number of Sessions



ITC COP Comparison to Norms



Summary of Evidence

- There is some evidence that Coach mathematics knowledge as measured by the MKT is influencing coaching effectiveness.
- There is some evidence that Coach reflection on coaching skills as measured by the CSI is influencing coaching effectiveness.

We Are Grateful for our Participants!

Thank you!

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