Supporting Mathematics Coaches in the Era of Common Core State Standards

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EMC
EXAMINING MATHEMATICS COACHING

Agenda for Session

- Overview of Examining Mathematics Coaching (EMC) Project
- Professional Development for Coaches
  - Mathematics Content
  - Coaching Knowledge
- Video Assessment of Coaching (VAC)
- Research and Findings

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.

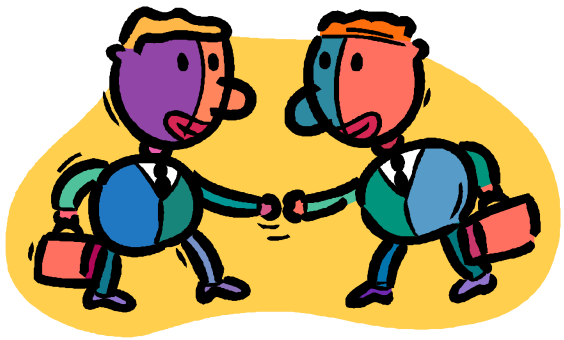
EMC Definition for Mathematics Coach:

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.

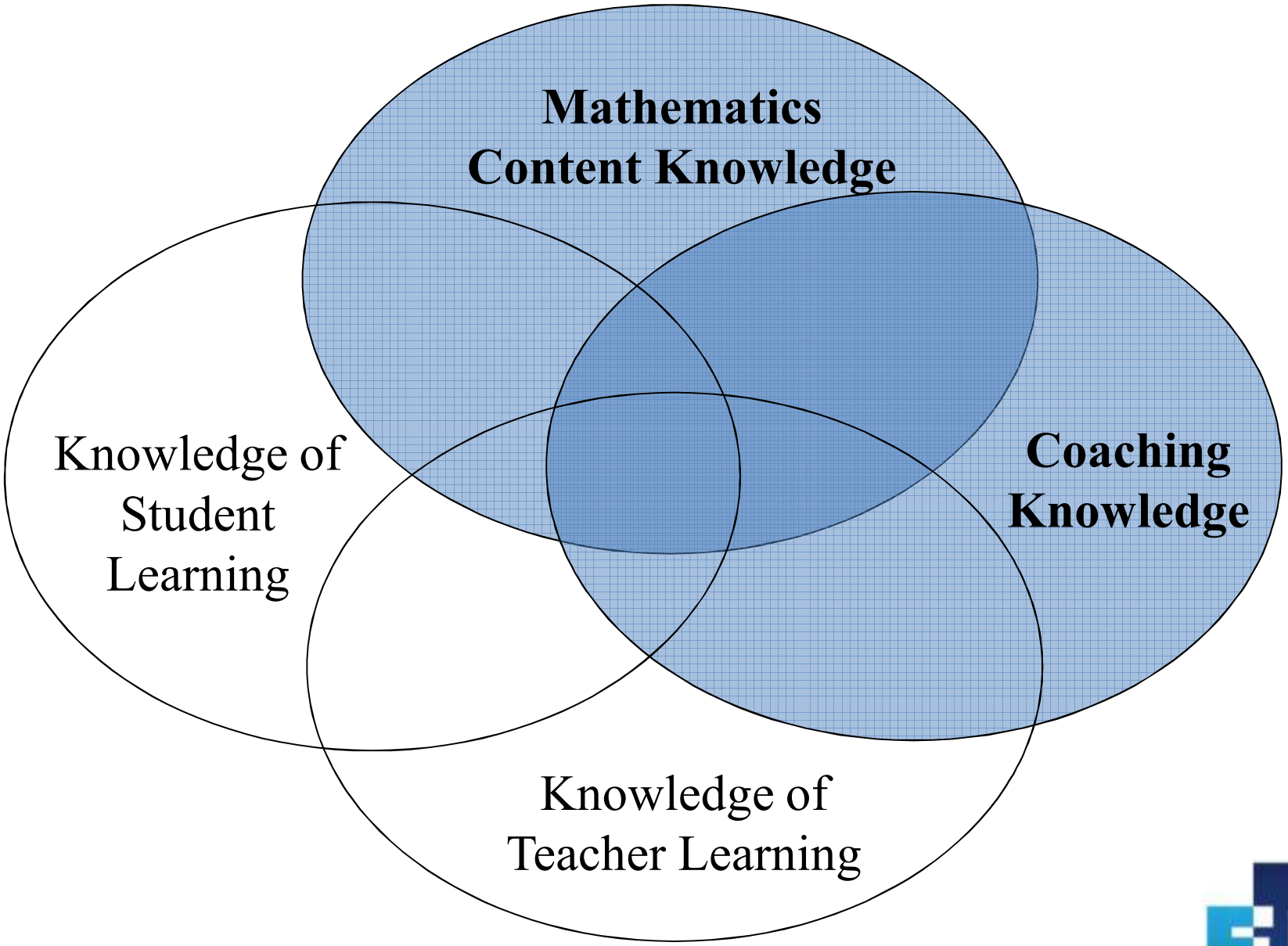
EMC Research Hypothesis

The effectiveness of a mathematics classroom coach is linked to several domains of knowledge.

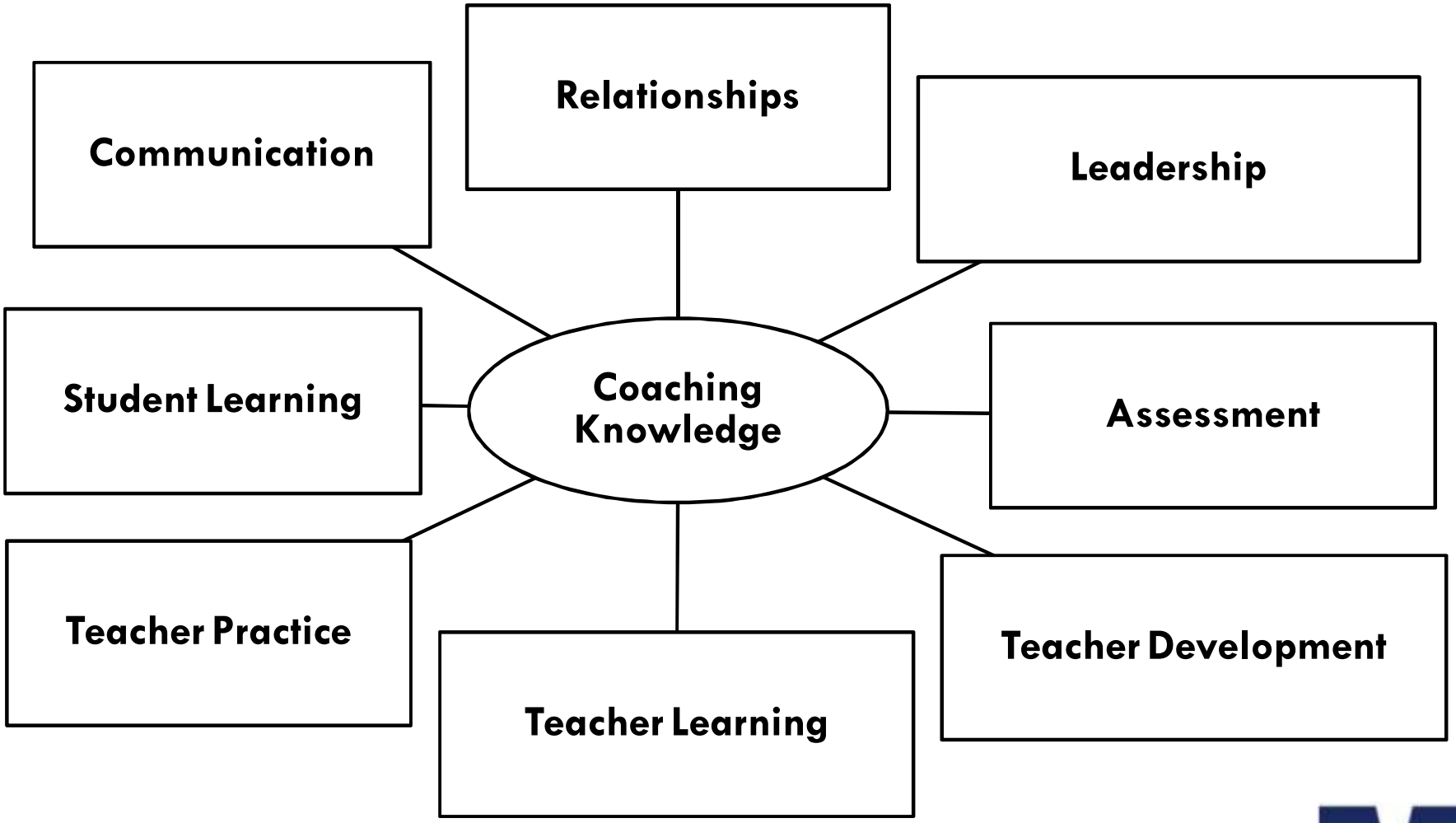
Coaching knowledge and **mathematics content knowledge** contribute significantly to a coach's effectiveness, as measured by positive impact on teacher practice, attitudes, and beliefs.



Knowledge Domains



Coaching Knowledge



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 two questions:

  (1)To what extent does professional development targeting these two knowledge domains **improve coaching effectiveness**?

  (2)To what extent are the effects of the targeted professional development **explained by increases in knowledge**?

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

We are here.

Professional Development

Two one-week professional development courses:

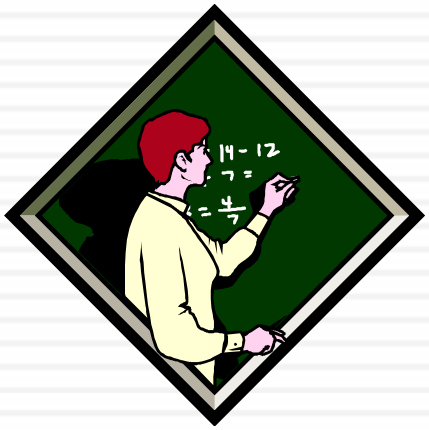
- **Knowledge of mathematics content,** specifically in the area of number and operation, with a focus on ratio and proportion.
- **Coaching knowledge,** addressing eight themes identified by coaching experts.

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 Common Core State Standards and Standards of Mathematical Practices, 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.

Professional Development for Coaches

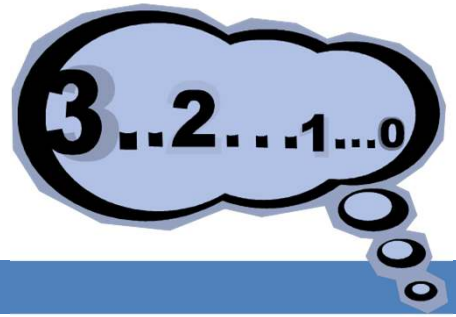
Mathematics Content



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 Practices and Number Sense



- Standards of 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:

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

1. How many cups of sugar do you need to make ¾ batch of cookies if a full batch takes 2½ **cups of sugar?**
2. How many posters can you paint with 2½ **cans of paint if one** poster takes ¾ can of paint?
3. How many pounds of birdseed do you need to fill a bird feeder if 2½ **pounds of birdseed fills the bird feeder ¾ full?**
4. What is the area, in square yards, of a rectangular garden that is 2½ **yards long by ¾ yard wide?**
5. How many servings of lemonade can you make if you have 2½ cups of lemonade and a serving is ¾ 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.

Professional Development for Coaches

Coaching Knowledge

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 & Teacher Development	*Themes: Teacher Practice & Student Learning*	*Themes: Communication & Assessment*	*Themes: Teacher Practice & Student Learning*	*Themes: Relationships & Leadership*

Teacher Learning & Teacher Development

Teacher Learning

- Engage 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"

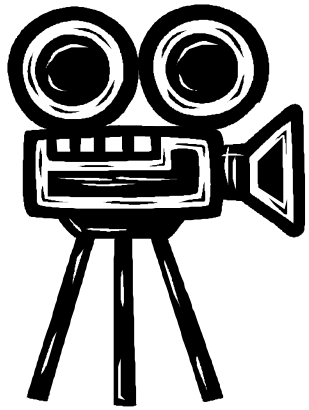
Teacher Development

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

Example Activity: Teacher Development

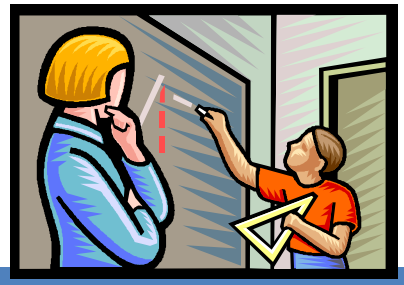
Based on what you notice the most in the video, decide what you could discuss with the teacher in a conference.

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



Be prepared to give a rationale for your decision.

Student Learning & Teacher Practice



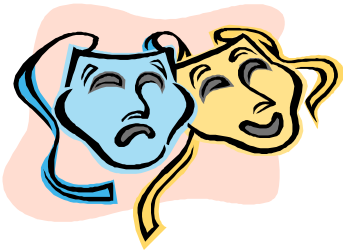
Student Learning

- 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

Communication & Assessment

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

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

Example Activity: Communication

- Take a moment to review the pre-conference viewing guide.
- As the video plays, take notes on your observation guide and transcripts.
- Use the transcripts to make notes of specific examples of coaching moves.

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
- Employ the coaching process

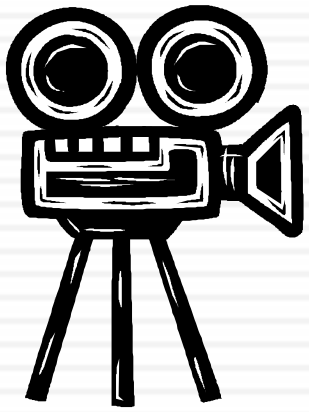
Activity:
Coaching Heavy or Coaching Light?

- Read pages 21-26: *Coaching Heavy or Coaching Light* (JoEllen Killion)
- Identify one or two ideas that can help you as you think about your own role in the coming year(s).
- Walk and talk with a partner, returning by the specified time.

Coaching Heavy or Coaching Light

- "The difference is in the coach's perspective, beliefs, role decisions, and goals, rather than in what coaches do."
- Coaching light: driven by coaches' desire to be valued and appreciated (they aren't necessarily needed)
- Coaching heavy: "high-stakes interactions between teachers and coaches." Coaching heavy maximizes the potential for reform.

Video Assessment of Coaching (VAC) Instrument



Yopp, D. A., Barlow, A. T., Burroughs, E. A., Harmon, S. E., & Sutton, J. T. (**2013**) Assessing Coaching Knowledge via a Video-Based Tool. *ZDM International Journal of Mathematics Education.*

DOI: 10.1007/s11858-013-0558-7.

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, to appear).

Video Assessment of Coaching (VAC) Instrument

Video features:

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

Sample:

- 28 school-based coaches
- Median coaching experience: 4.5 years
- Hours training (range): 6 had no training; 4 had 200+ hrs.
- Types of training (range): Instructional, Cognitive, Content-focused

Math Content

Main Task:

There are 20 data points ranging from 52 to 59.5 and the median is 53.5. Develop a data set with these characteristics and display that data in a stem-and-leaf plot.

The task is atypical of stem-and-leaf-plot activities commonly seen in K-8 mathematics classrooms because the data must contain numbers with a nonzero tenths digit.

Video Assessment of Coaching (VAC) Instrument

We hypothesized that

asking all participants to address

each of the themes

would reveal variation in participants' views about effective coaching practice

as well as

provide evidence of new dimensions

regarding coaches' views of effective practice.

Prompt (Praise)

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, 1 neutral, unfavorable — 8

Practice

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

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.”

These are terms found in some of the coach literature.

Prompt (Redirecting)

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.

Response: Favorable view of implementation

I am working on becoming more and more of a "constructivist" when I am teaching teachers. I think this is what the coach in the video was doing. Essentially, she was helping the teachers construct their own understanding of effective math instruction.

Response: Favorable view with conditions

Most of the time I do like the idea of redirecting teachers' questions back to them, BUT only so that you together can dig into the question.

Response: Favorable view of practice; unfavorable view of implementation

I think those are a good start to the questioning. She did start to draw them out to think about their questions, but instead ***it came out as being evasive****, as if she didn't have the answer so let's move on… She might have said, "That's a good question.* ***What do you think?"…***

(continued on next slide)

Response: Favorable view of practice; unfavorable view of implementation

Getting the two into a discussion would build the professional relationship *between the two and model a way for them to* ***answer their own questions and develop brainstorming*** *skills. More direct and guiding questions would help …or even asking,* ***"who could we ask?"****… if the coach is not always available as a resource.*

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.

Prompt (Facilitating)

Coaches are responsible for facilitating the coaching session.

Discuss whether or not this coach's facilitation of the sessions (both the pre-lesson and post-lesson conferences) aligns with your perception of effective coaching.

Response: Favorable view of implementation

I thought [sic] overall the coach did a good job of ***engaging with the teachers.*** *They were* ***reflective about their lesson and looked at challenges****, successes and ways to improve.*

Response: Unfavorable view of implementation

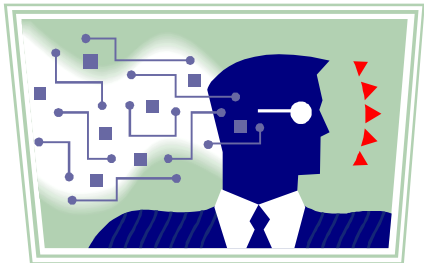
I do not feel like this coach facilitated a coaching session. *Like I said before, she had a* ***nice uplifting conversation****, and* ***no one (not even the kids) learned anything new.***

(continued on next slide….)

Response: Unfavorable view of implementation

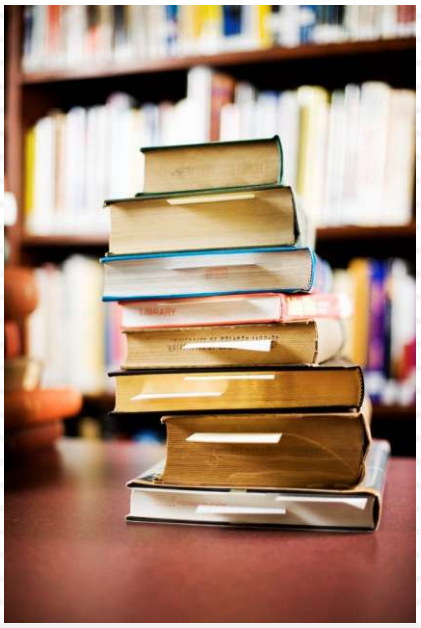
***Teachers were unable to indicate what they learned**, they were unable to indicate how their new learning impacted students, they were unable to determine what they wanted to learn.*

Summary



- Lots of variation in views expressed in response to the VAC.
- Coach training did not 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.**

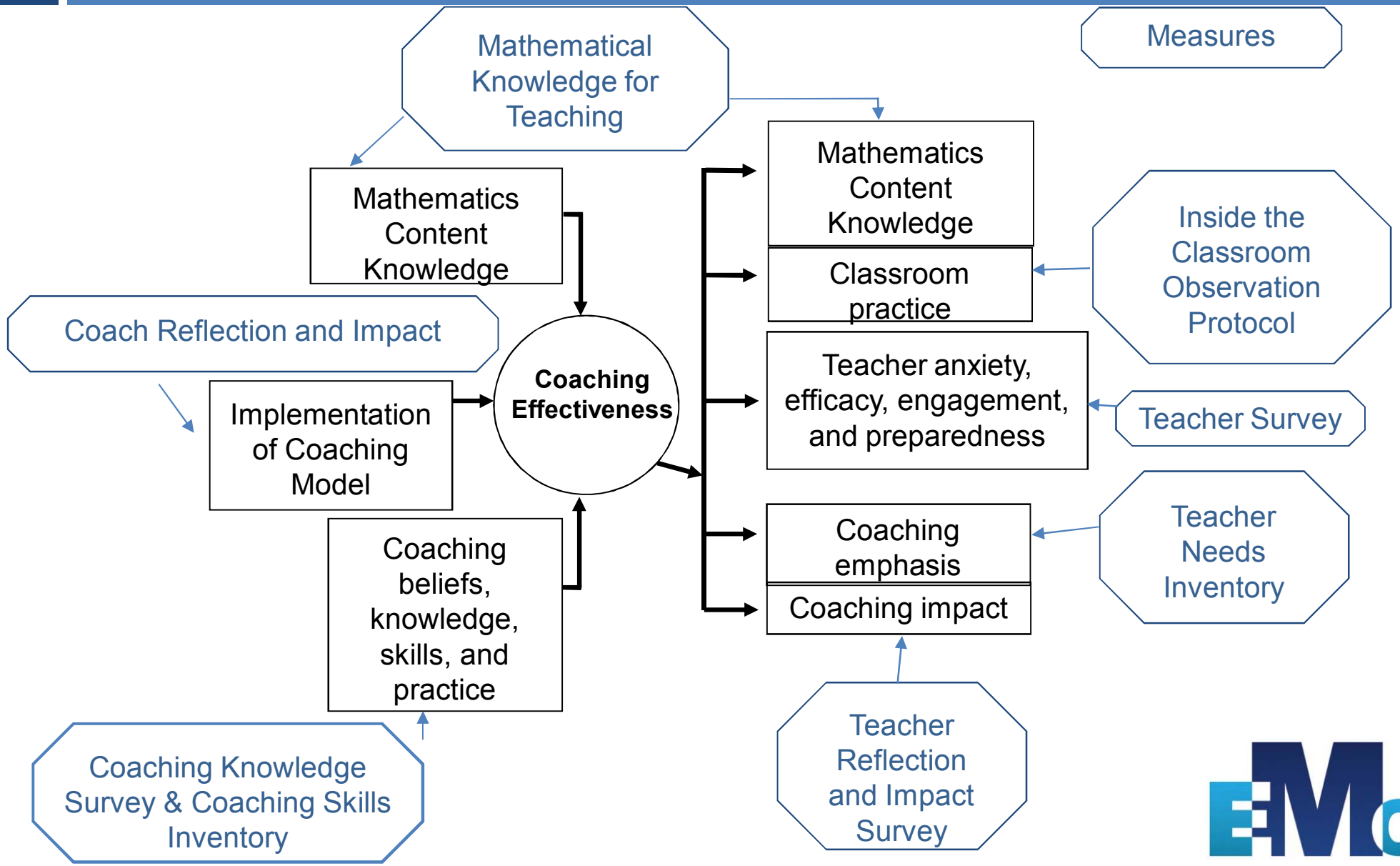
Research and Findings



Research Questions

1. *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?*
2. *To what extent does **professional development** for coaches in these two areas improve their coaching effectiveness?*
3. *To what extent are the effects of targeted professional development on coaching effectiveness explained by increases in coaching knowledge and mathematics content knowledge?*

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 Question 1

To what extent does a coach's depth of knowledge in coaching knowledge and mathematics content knowledge influence coaching effectiveness?

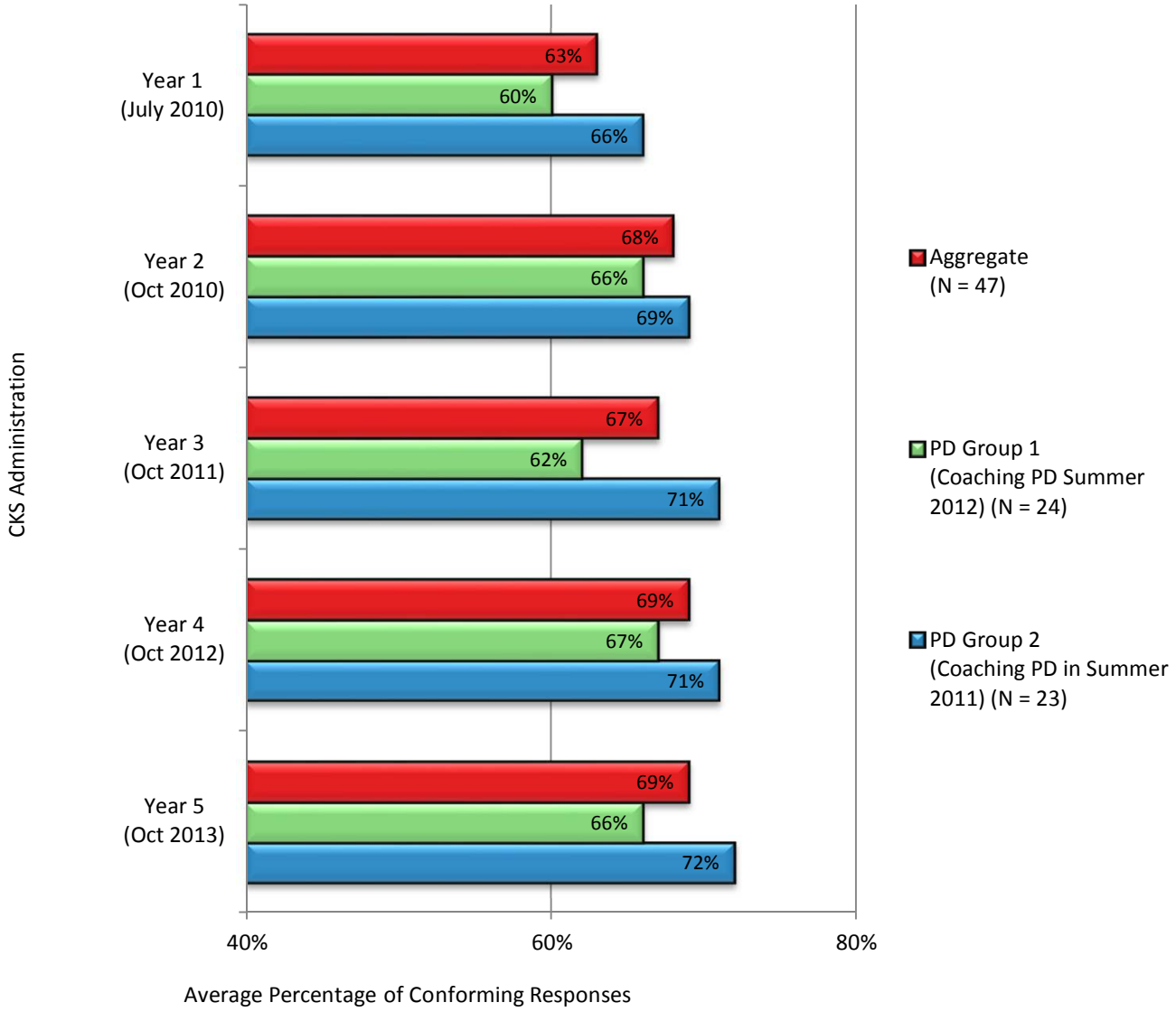
- Models examine how variation in these aspects of the coaches propagates into teachers' measures.

- Four years of data

Summary of Findings for Research Question 1

- Improvements in coaches' CKS scores and CSI (self-efficacy measure of coaching skills) are related to increases in teachers' mathematics knowledge
- Variation in coaching intensity and CSI scores are related to higher classroom practice scores.
- Coaches with higher MKT scores are associated with teachers with higher MKT scores.

Coaching Knowledge Survey



Research Question 2

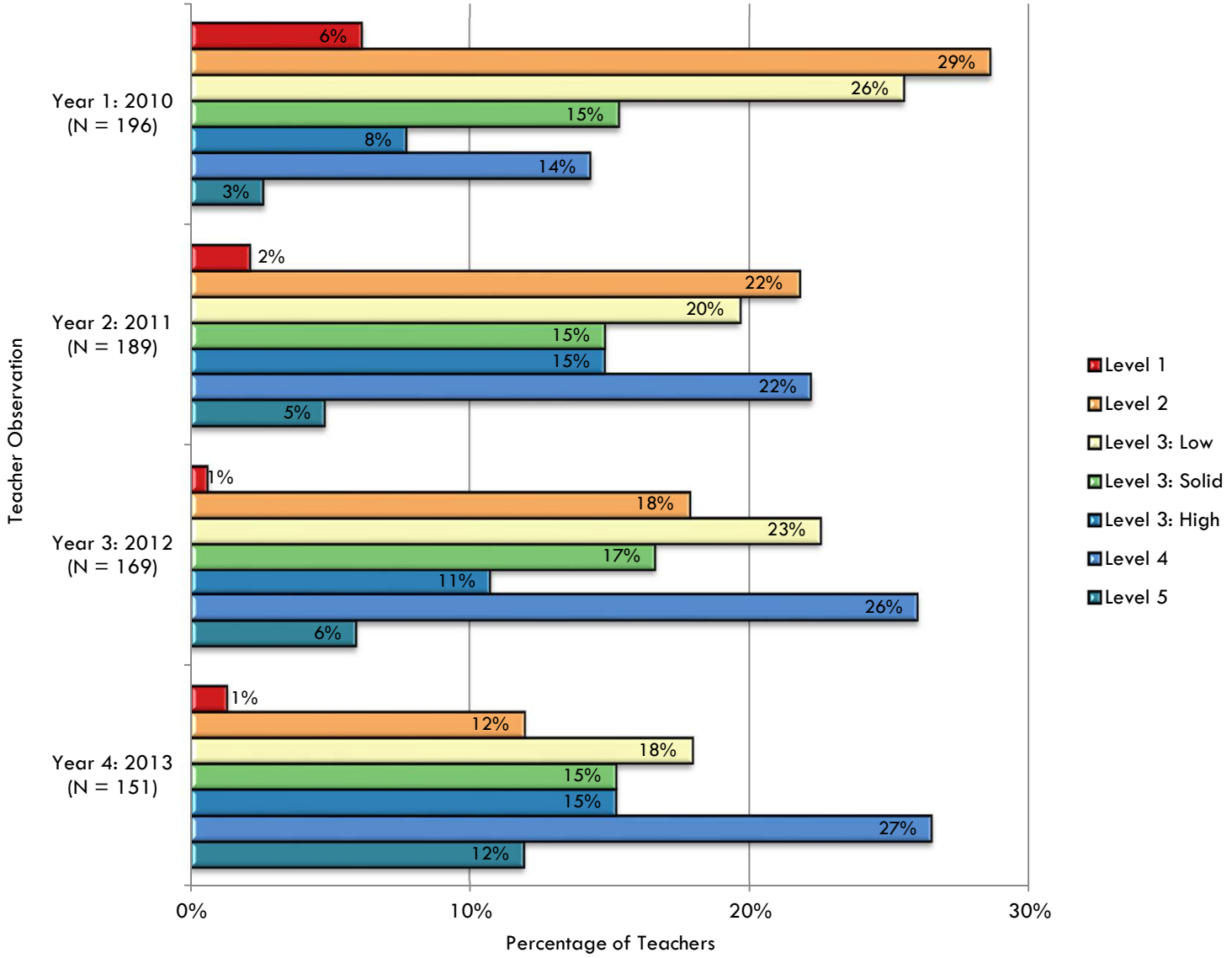
To what extent does professional development targeting these two knowledge domains improve coaching effectiveness?

- Control for coaching intensity and outside PD
- Effects are examined on changes in teachers' MKT, teachers' attitudes, and teachers' practice
- Hierarchical linear models
- Four years of data (more being collected)

Summary of Findings for Research Question 2

- No detected coach-level PD effects on teacher content knowledge or teacher attitude
- Some evidence of PD effects on teacher practice
- Coaching intensity relates to increases in ITCOP scores
- For all models, there are changes over time
- Suggestive evidence that changes happened in the different groups at different times; follow-up analyses will be conducted

Classroom observations



Research Question 3

To what extent are the effects of targeted professional development on coaching effectiveness explained by increases in coaching knowledge and mathematics content knowledge?

- Analysis uses 51coaches randomly assigned to PD groups; 5 years of data
- Analysis uses linear modeling, and control for outside mathematics or coaching training

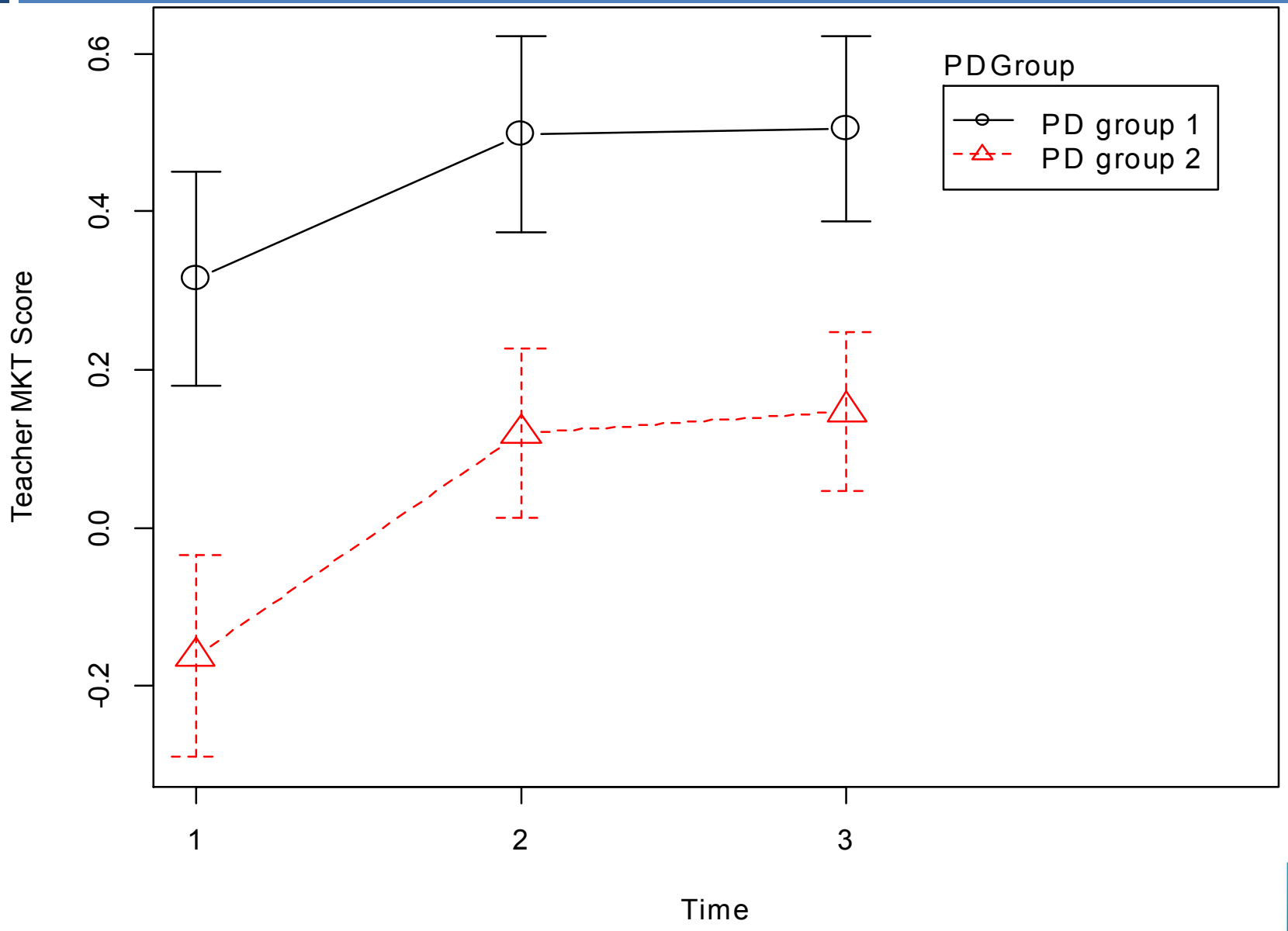
Summary of findings for Research Question 3

- No evidence for direct effects of professional development on coaches' MKT scores either in terms of differences in groups or differences in changes over time.
- There is evidence of a change over time in MKT scores of the coaches in the study, with the highest average score in the last year of the study.
- There is evidence of a time effect and a PD effect on the mean scores of the CKS.

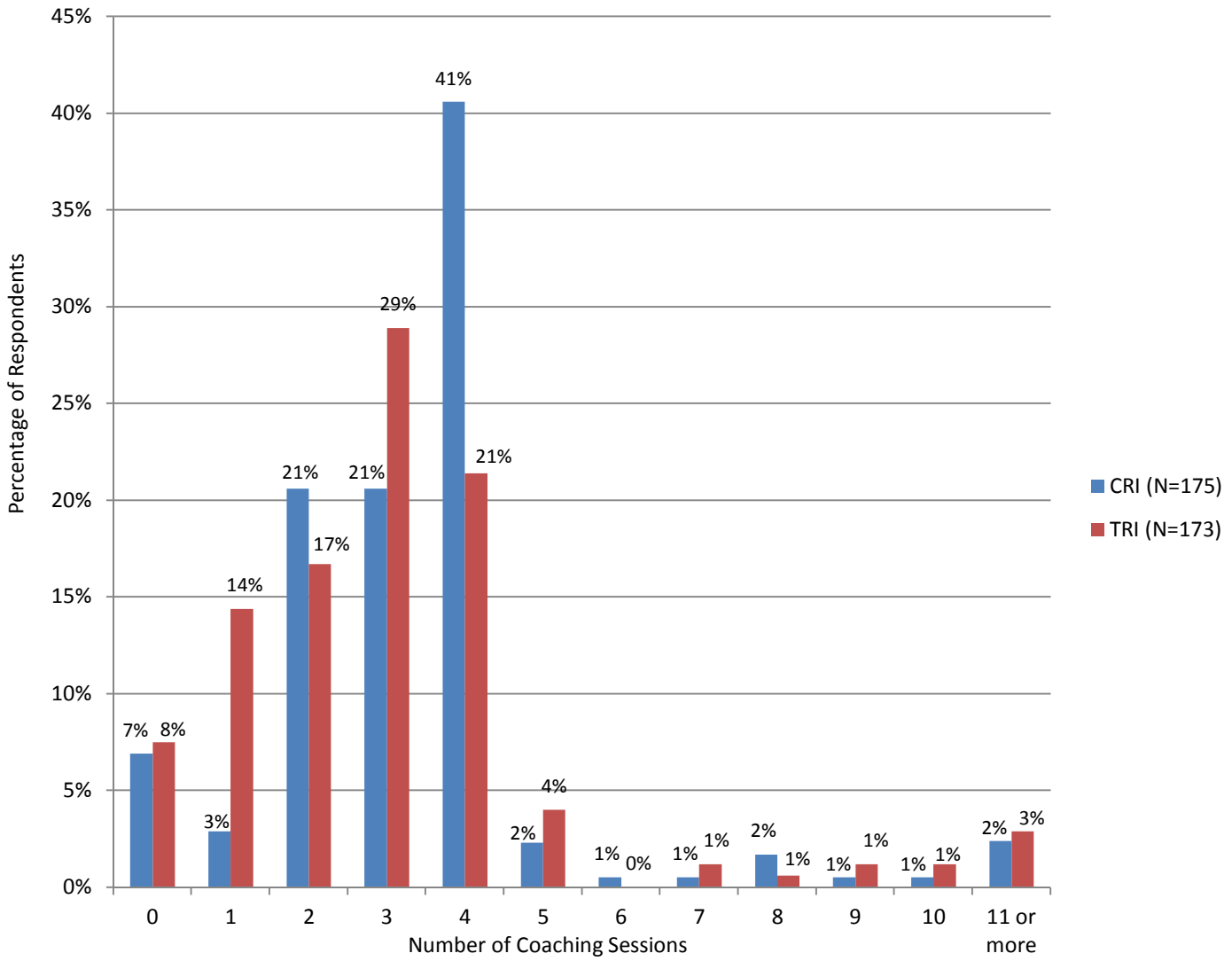
Research Analysis Methods

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

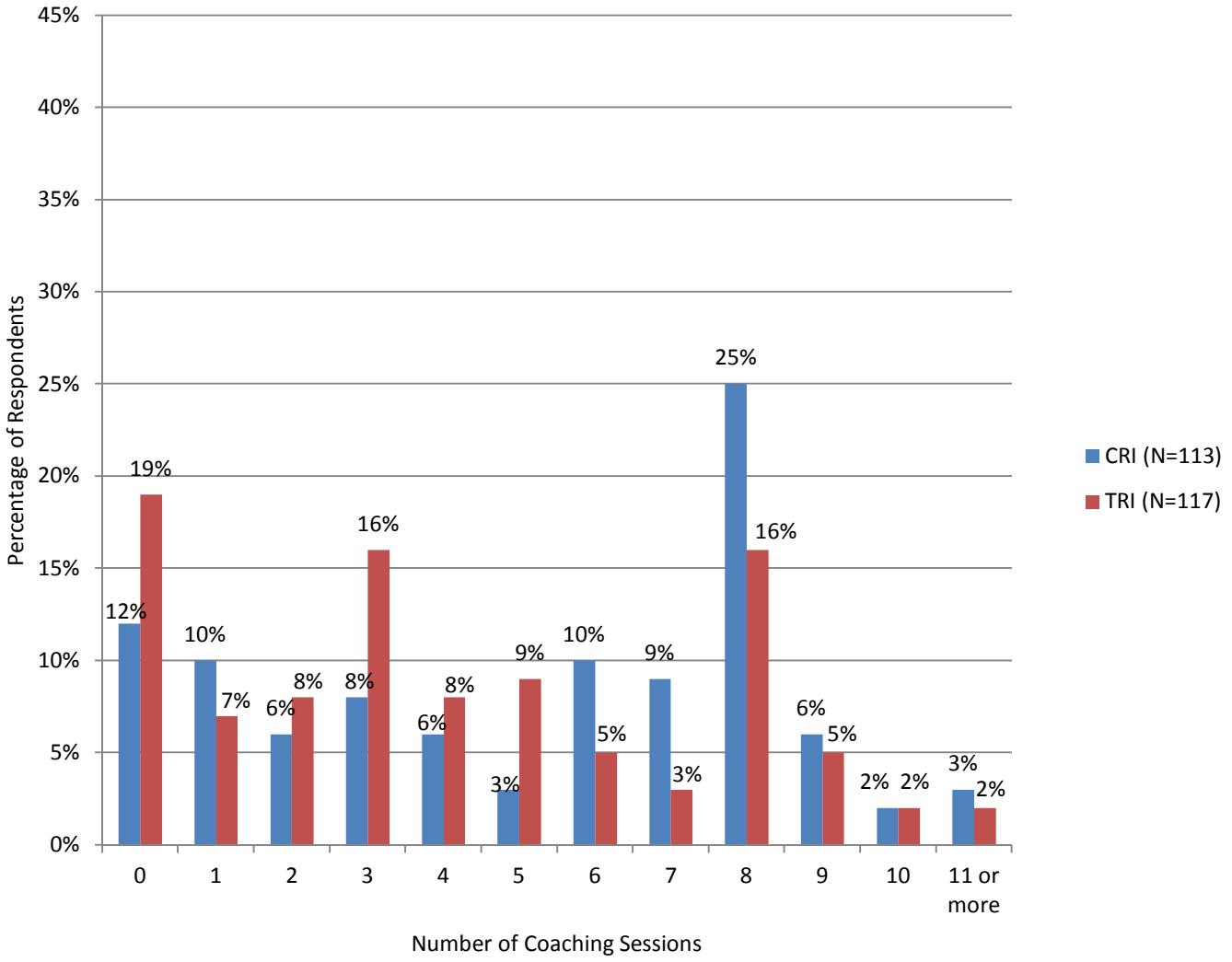
Plot of Teacher MKT Mean Scores



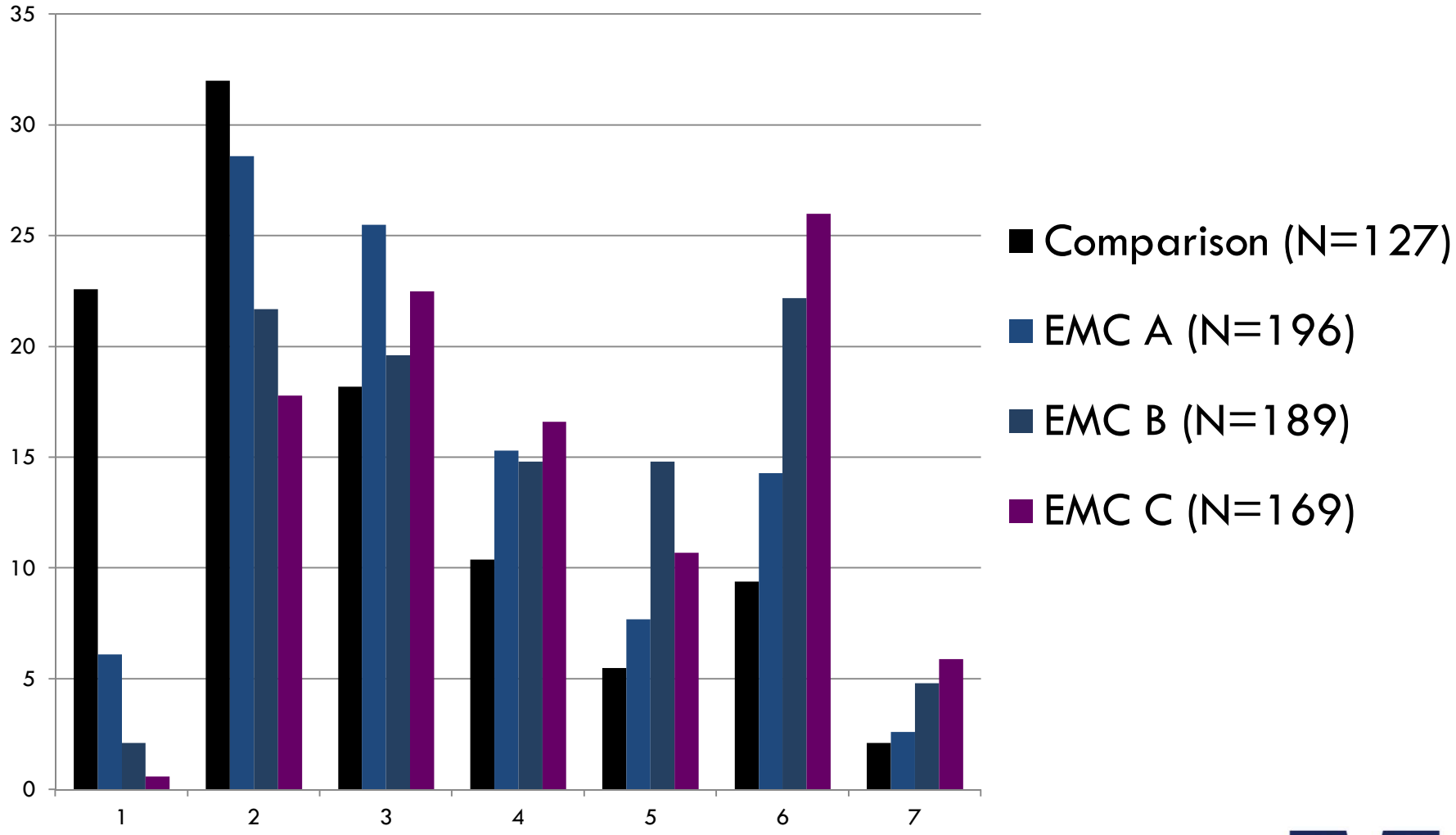
Year 1 Number of Sessions



Year 3 Number of Sessions



ITC COP Comparison to Norms



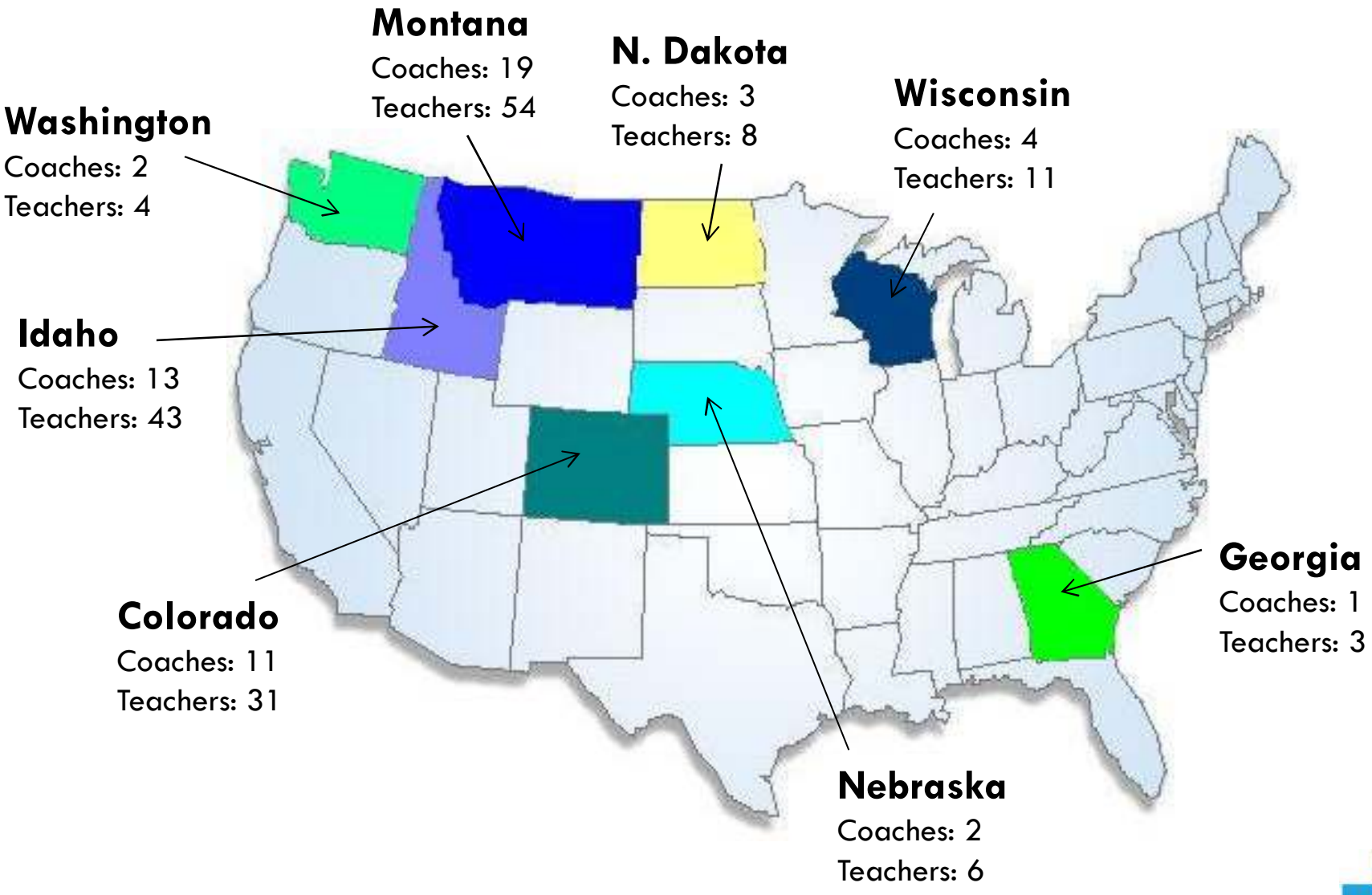
Summary of Evidence

- 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!

EMC Participants: Where They Are



What We Learn From Participants:

- Coaches want to learn how to have hard conversations with teachers about:
  - mathematics content
  - student learning
- Coaches expend a lot of energy on resistant teachers.
- Professional development in coaching knowledge is important.

Thank you!

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