

Research in Mathematics Instructional Coaching

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Outline

- Part 1. Introduction to the research project
- Part 2. Defining coaching knowledge
- Part 3. Instrument development, use, and results



Part 1: Introduction to EMC

EMC Project Description

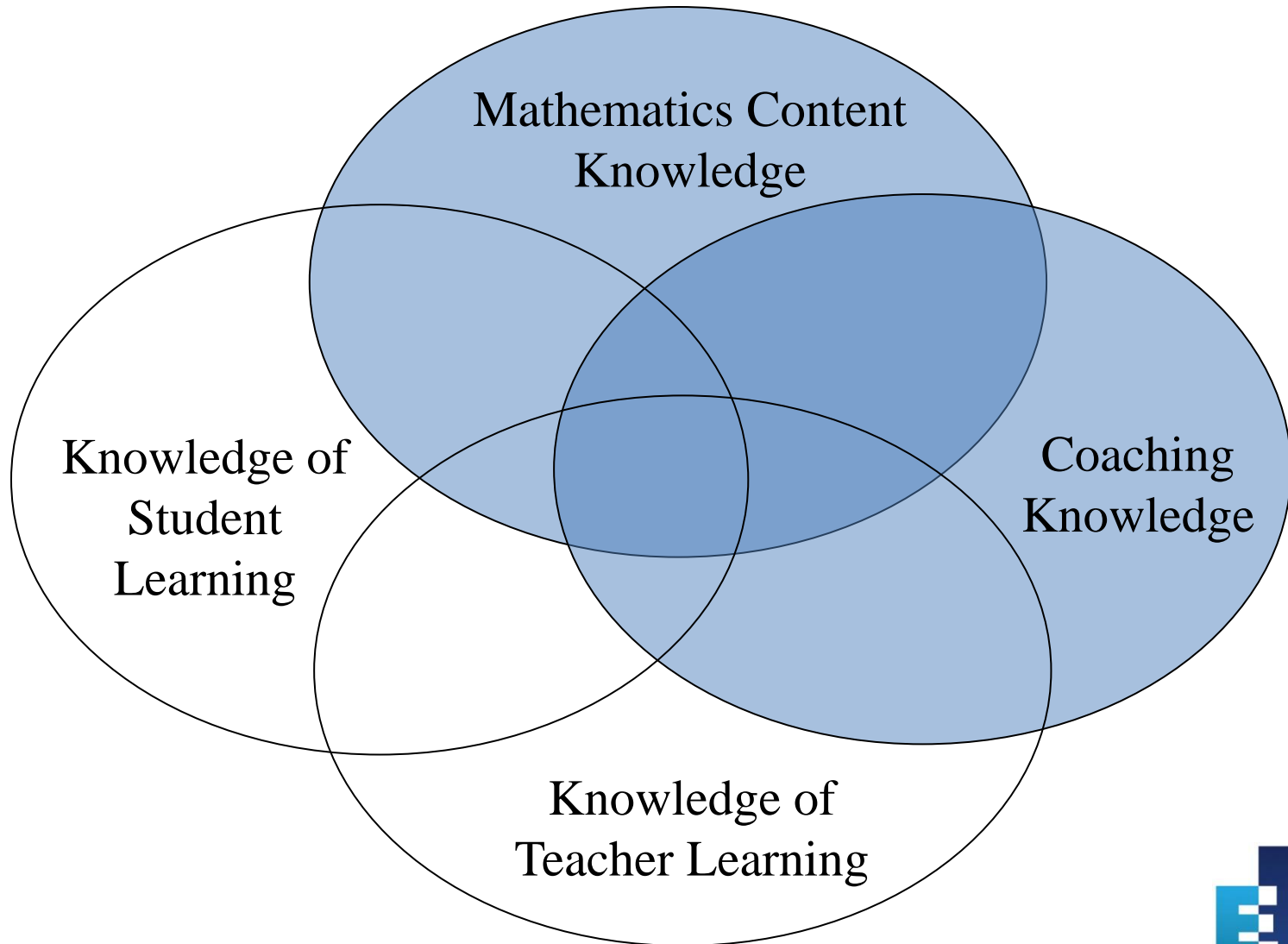
- EMC is a 5-year research and development project examining the effects of a coach's *knowledge for coaching* on a diverse population of K-8 teachers.

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.



Knowledge Domains

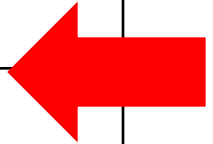


EMC research hypothesis

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

Crossover Design

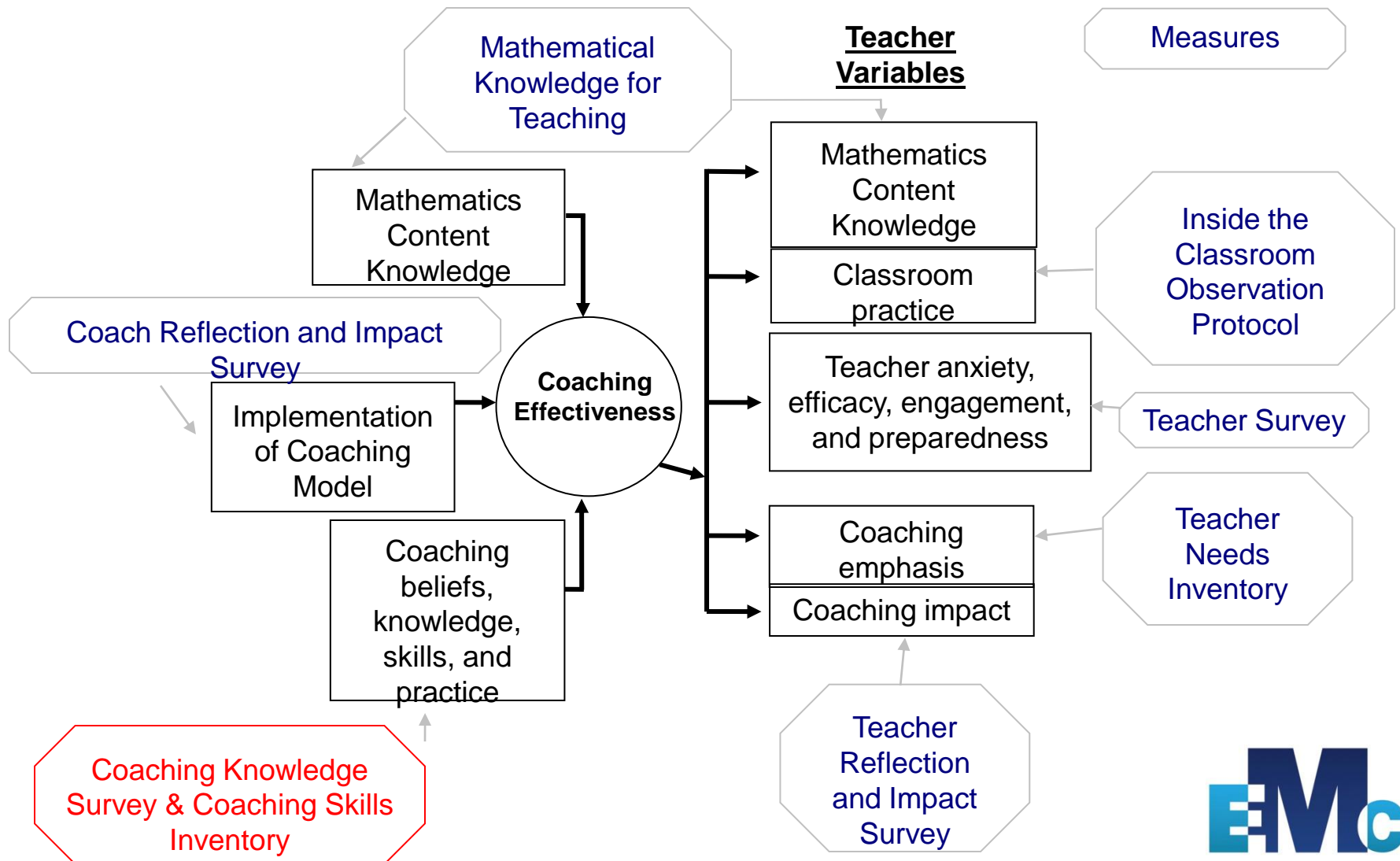
	Group 1	Group 2
Year 1 2009-10	Provide orientation to EMC coaching model	
Year 2 2010-11	Mathematics Content Knowledge	
Year 3 2011-12		Coaching Knowledge
Year 4 2012-13	Coaching Knowledge	
Year 5 2013-14		Mathematics Content Knowledge



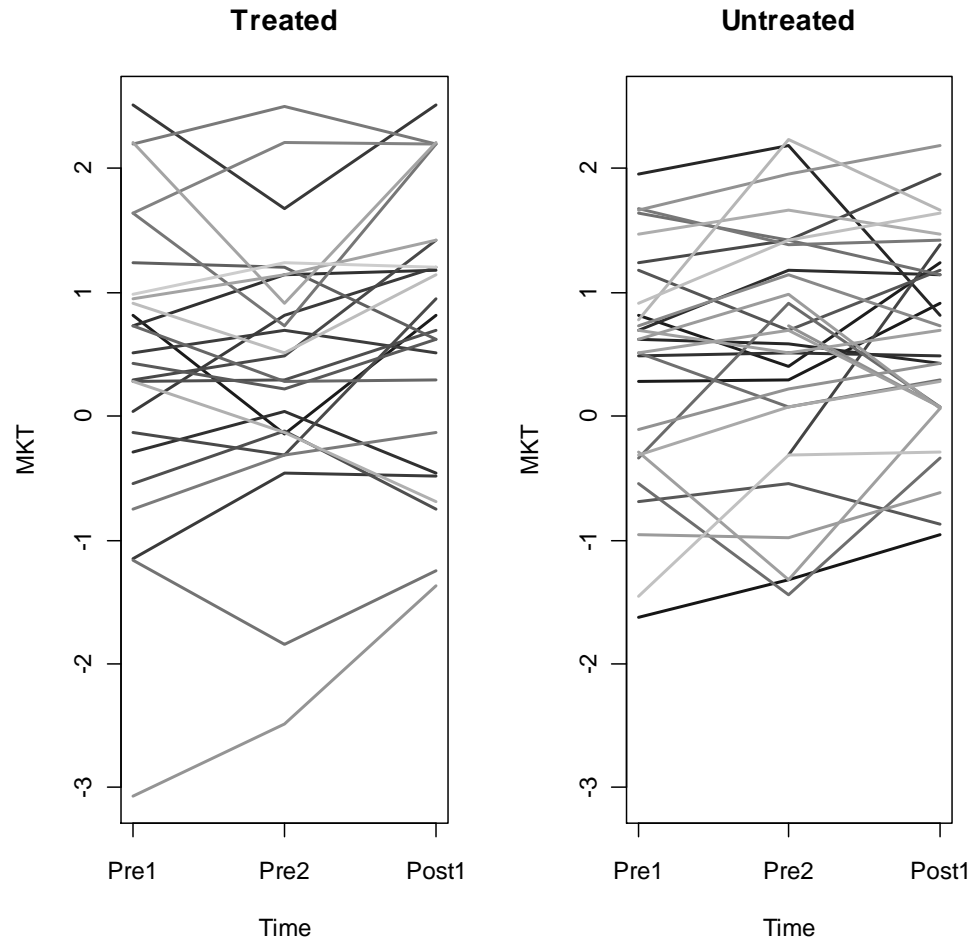
Research design

- 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**?

Project Variables and Measures



Example: MKT Among Coaches



Pre-pre-post

- No evidence of a treatment by time interaction (p-value=0.34)
- Estimated gains were higher in treatment than control group, but not large enough (yet) to detect a treatment effect
- Evidence of a time effect (p-value=0.012)
- No evidence of a difference in Pre1 vs Pre2 (p-value=0.56).
- Evidence of a difference between Post1 vs Pre1 (diff=0.23, p-value=0.005) and Post1 vs Pre2 (diff=0.18, p-value=0.0243)

Part 2: Defining coaching knowledge

Delphi Study

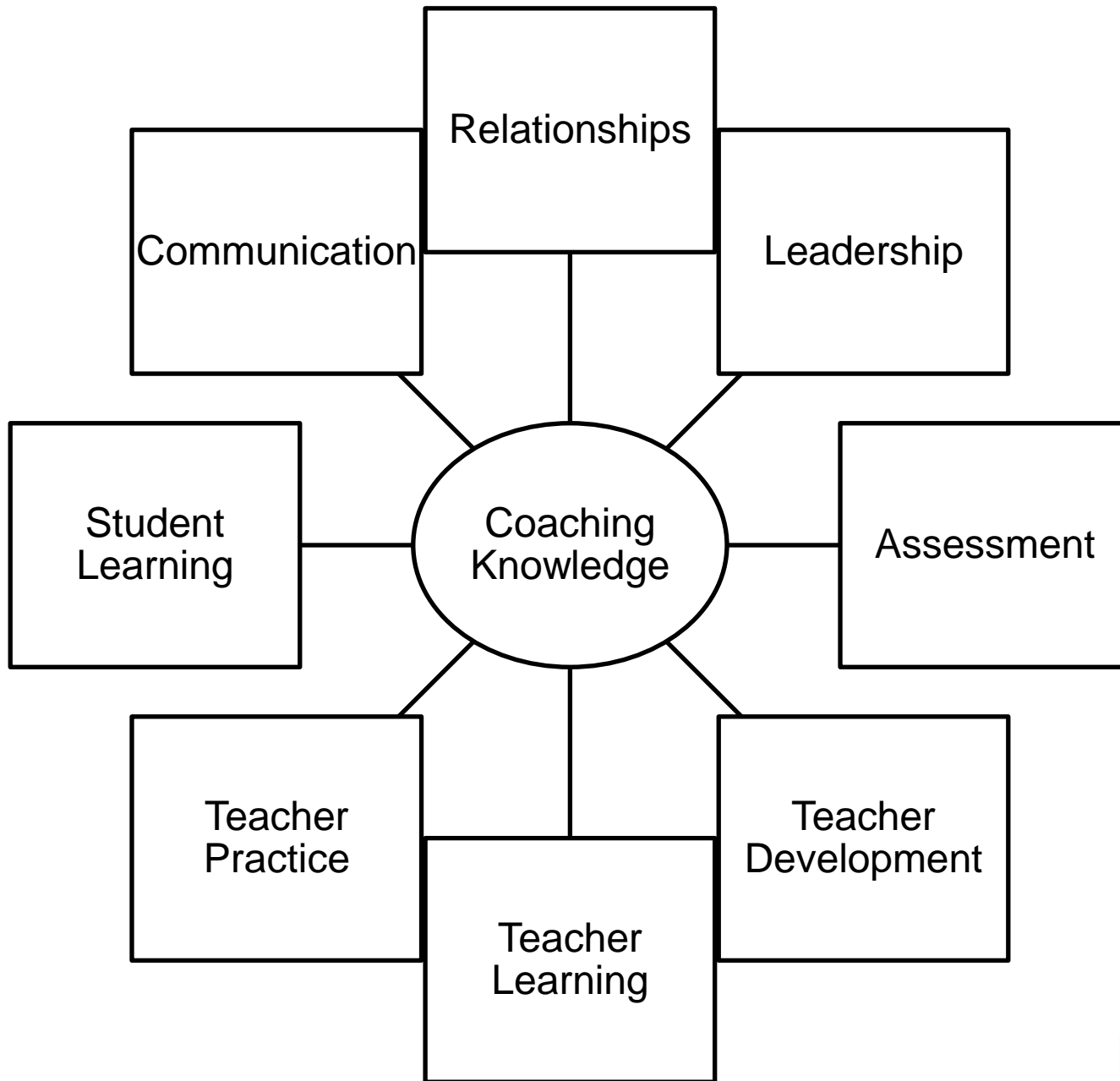
- An iterative process where experts identify and refine the constructs being studied

Motivation

- Coaching authors address the same areas: trust, relationship, feedback, reflective questioning, co-teaching, lesson modeling
- But, in the details, there is not wide agreement in the literature about what coaches know and do

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.





Definitions provide a structure

- Definitions help to identify what many authors tend to have agreement on

Table Activity

- At your table, examine the working definitions of coaching knowledge
- Choose at least one definition and answer two questions
- One participant should be prepared to share responses with the whole group for each definition discussed.

Table Activity

- What aspects or features of the definition are surprising or unexpected for you?
- How do the definitions reflect your understanding of the role of coaches?
- How might these definitions influence and/or inform your work?
- Is it important to distinguish practice-based knowledge from belief-based knowledge?
- What is an appropriate way to measure coaching knowledge?

Examining Definitions

- In a small group, choose one definition and discuss
 - How do the definitions reflect your understanding of the role of coaches?

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

- A 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.



Part 3. Instrument design, implementation and results

Coaching Knowledge Survey

- Generated items based on coaching knowledge definitions with attention on alignment to the literature
- Likert scale items of two types: *Beliefs* and *Practices*
- Selected response items

Monothetic Clustering of our Participants' Responses to Coaching Questions

Graphical Monothetic Clustering (Greenwood, 2011)

- A divisive algorithm that “splits” the observations from one large group into smaller groups, using:
 - Sequential selection of variables that maximally associate with the remaining variables. The variable most highly related to the others is used for a binary split.
 - Next level data is explored in the same manner of the next level of split in the sequence.

The Mathematics

- For pair-wise variables f and g ,

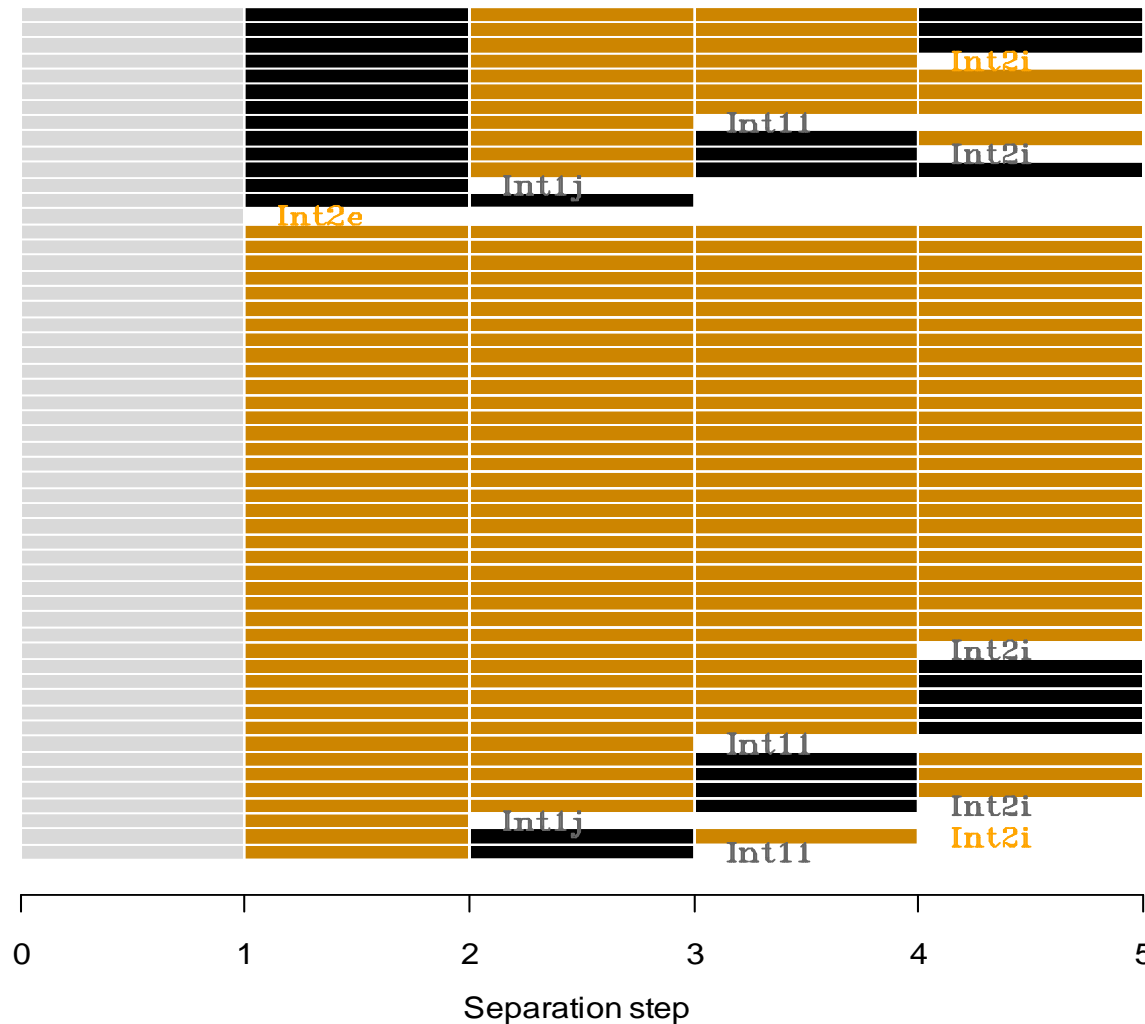
$$A_{fg} = |a_{fg} b_{fg} - b_{fg} c_{fg}|$$

where a_{fg} , for example, is an entry from the contingency (frequency of agreement or disagreement) matrix.

- $A_{fg} = \sum_{f \neq g} A_{fg}$

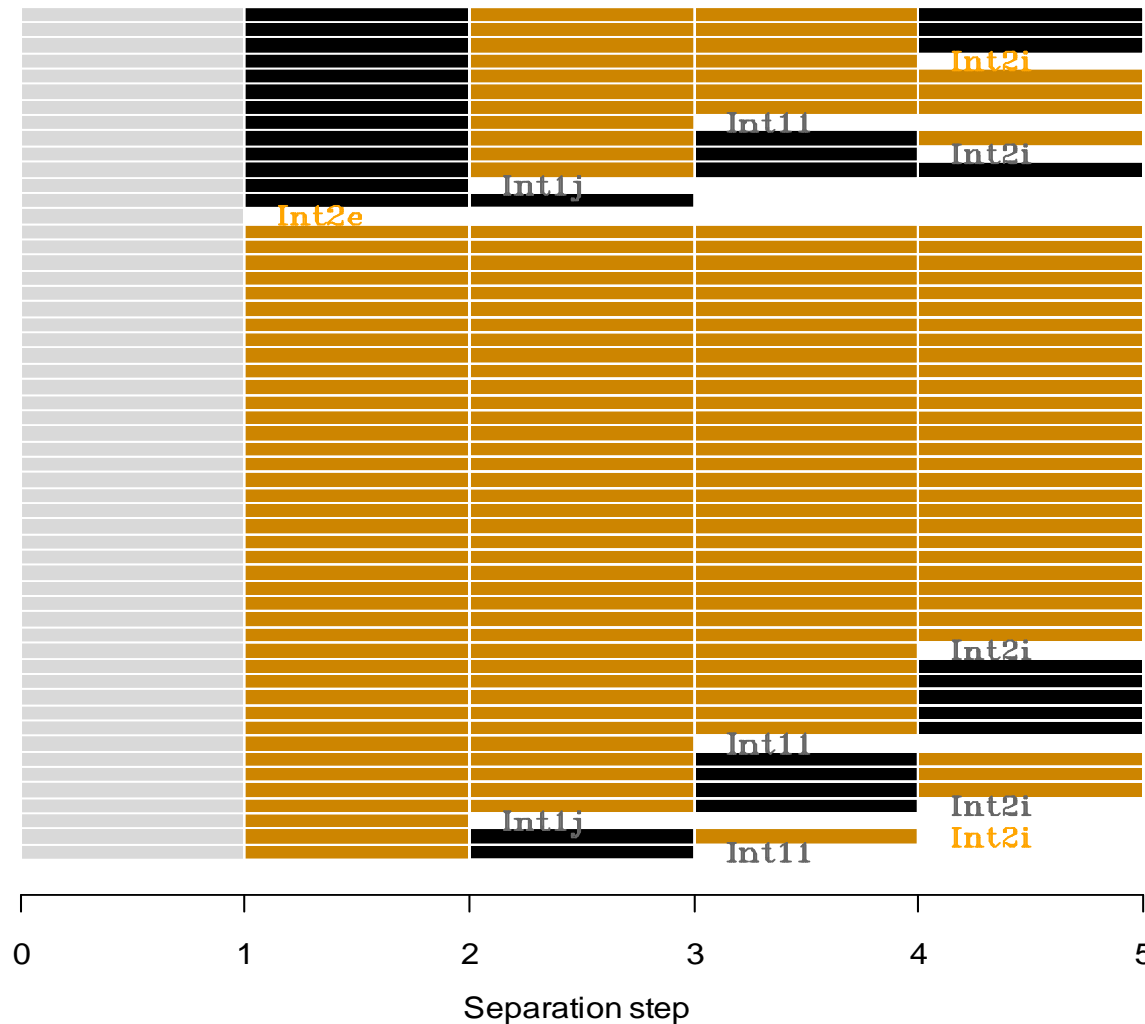
Example Graph

Enhanced Bannerplot



Theme Intelligence: Our coaches' patterns:

Enhanced Bannerplot



What does this tells us?

Roughly a 20% of our coaches don't agree with these statements:

2e. A student's intelligence can be changed through excellent teaching.

2i. Teachers can influence students' learning styles.

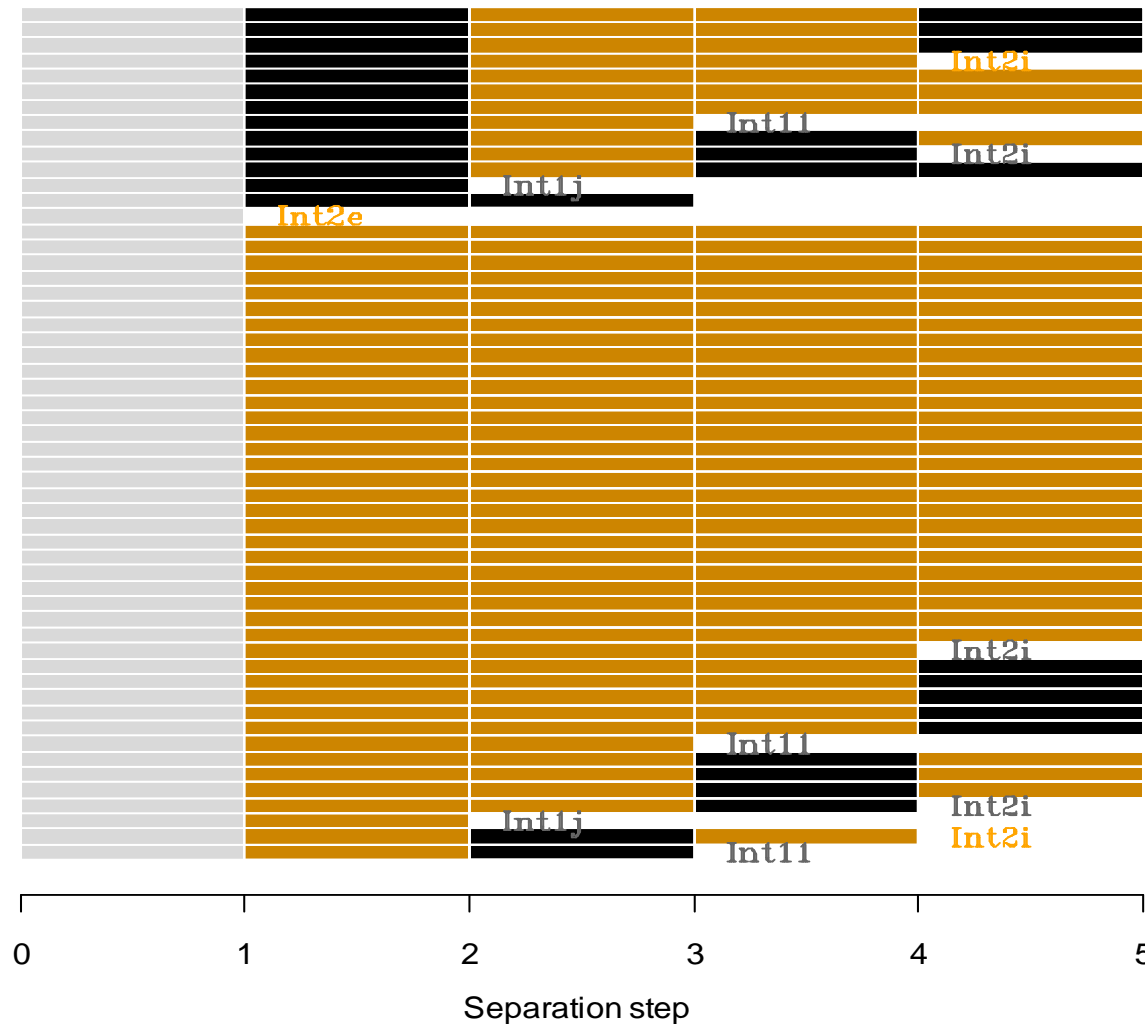


What does this tell us?

That under this theme, we have some variation on how coaches respond to these items.

Theme Intelligence: Our coaches' patterns:

Enhanced Bannerplot



What can we do with this information?

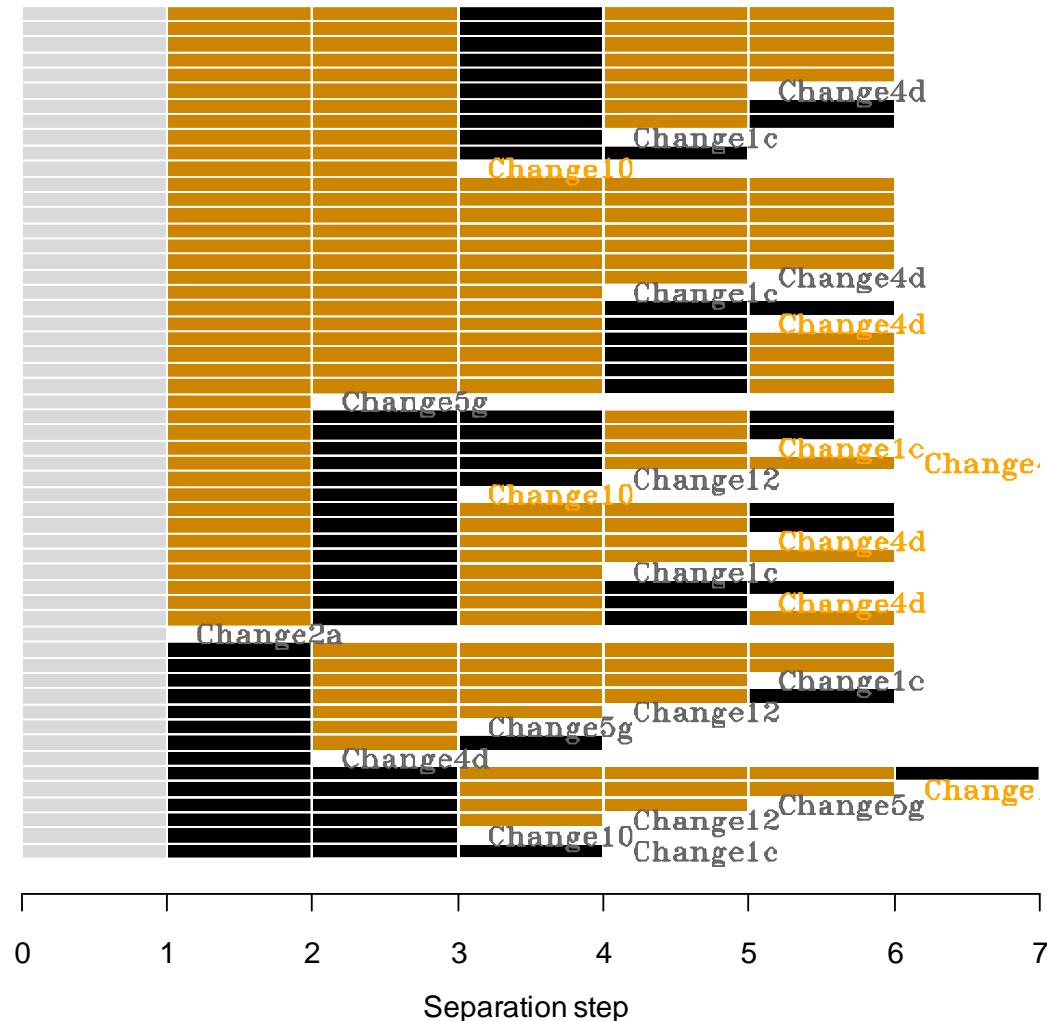
- Understand what to focus on in PD scenarios.
- This summer, after we treat roughly half of this group, 30 coaches, we can make observations about whether the treated group answers these items more consistently.

What can we do with this information?

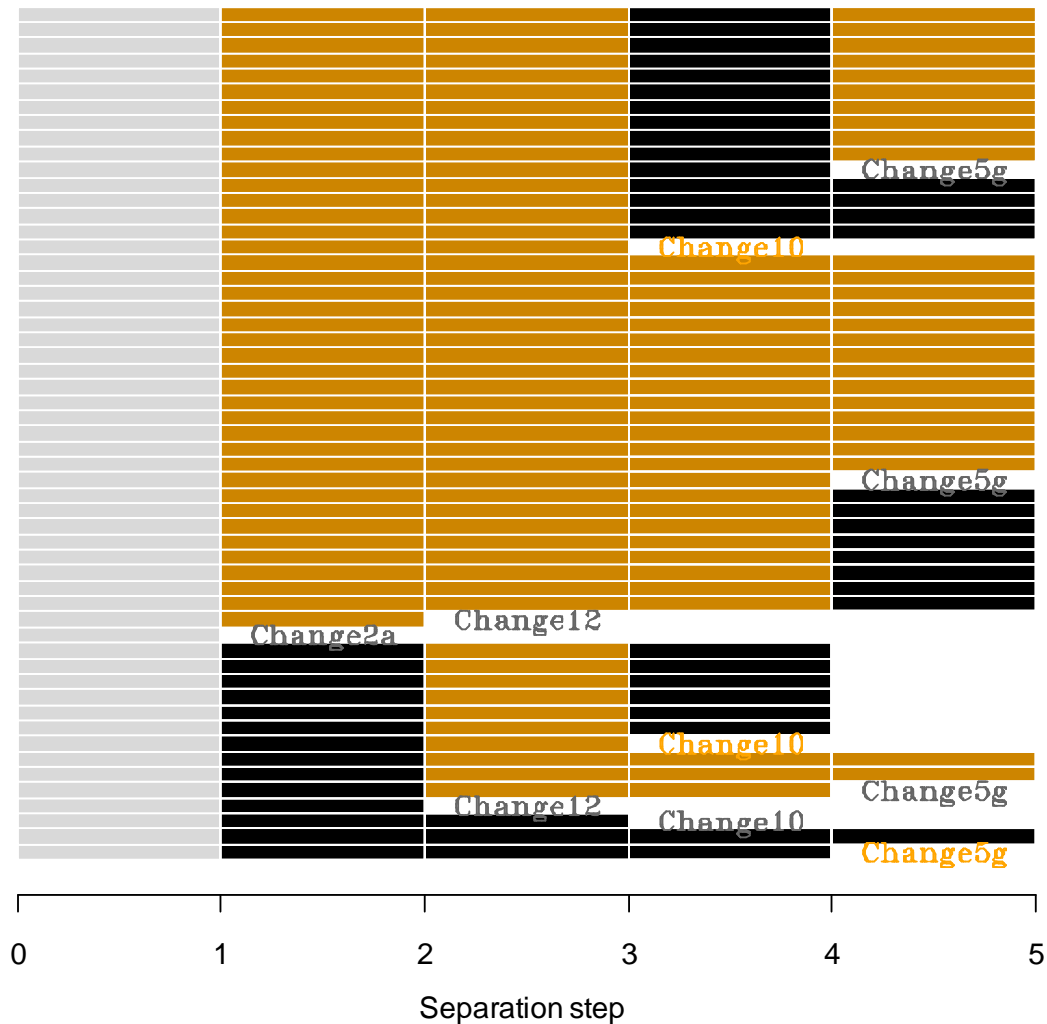
- Assign coaches a “measure” of how far their scores are from our “coach” response at various stages (e.g. pre-PD/post-PD) and use that as an explanatory variable.

Teacher Change Theme-All Items

Enhanced Bannerplot



Teacher Change Theme—Strongly Related Items



What does this tell us?

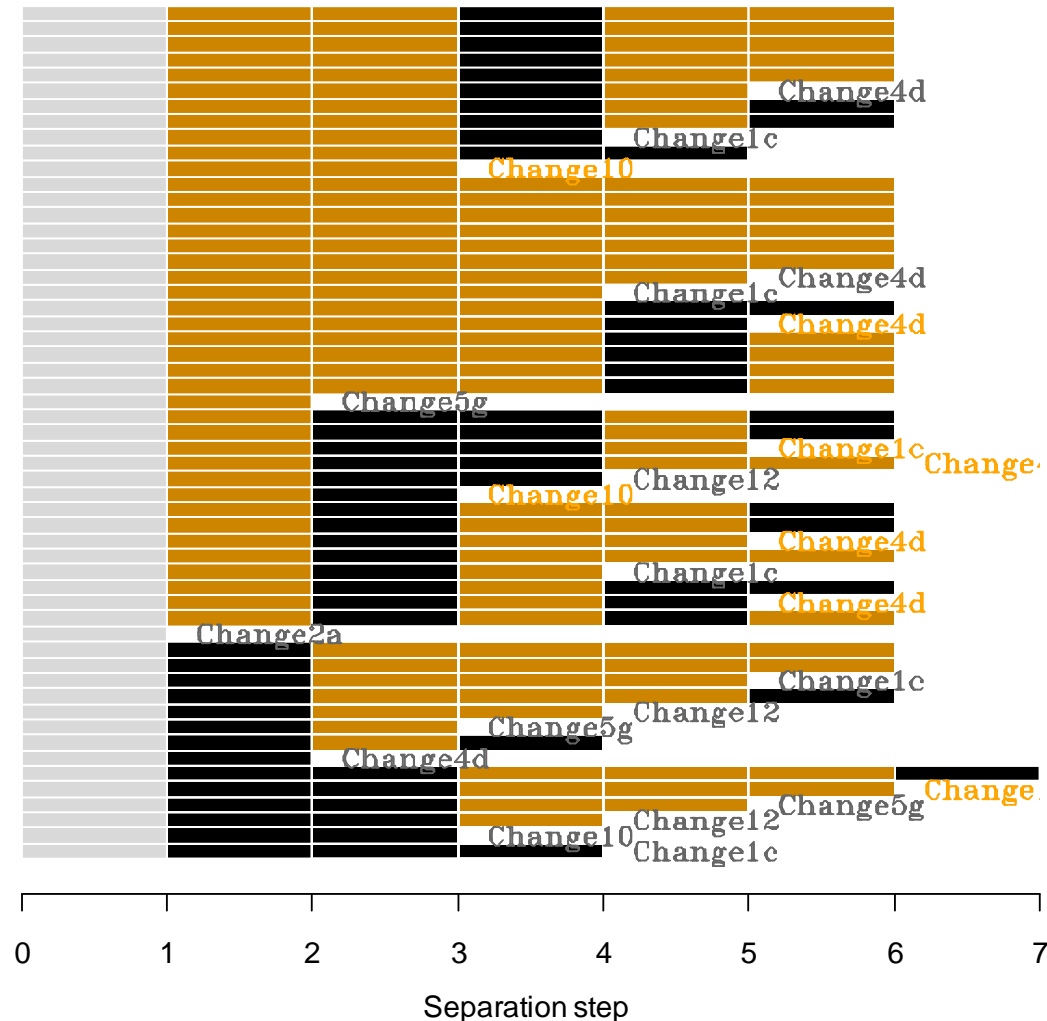
- Our coaches response to 2a, *once a teacher knows about a research-based strategy for improving student learning, the teacher will begin using the strategy*, is most associated with how the coach responds to other items.
- Most of our coaches are aware that less than 50 percent of teachers implement what they learn in PD (Item 12).
- About a third of our coaches don't seem to set improvement goals with teachers.

What can we do with this information?

- Understand what to focus on in PD scenarios.
- This summer, after we treat roughly half of this group, 30 coaches, we can make observations about whether the treated group answers these items more consistently.

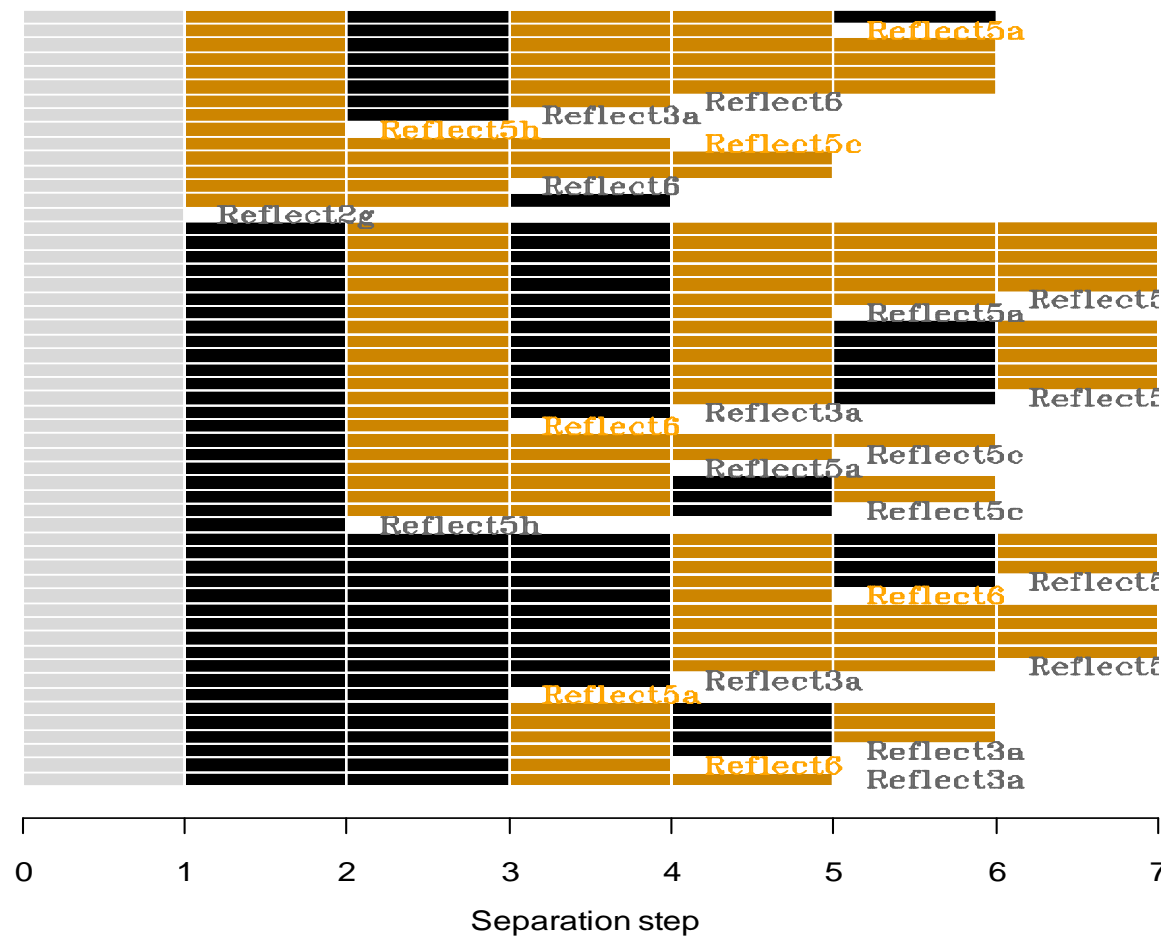
Teacher Change Theme-All Items

Enhanced Bannerplot



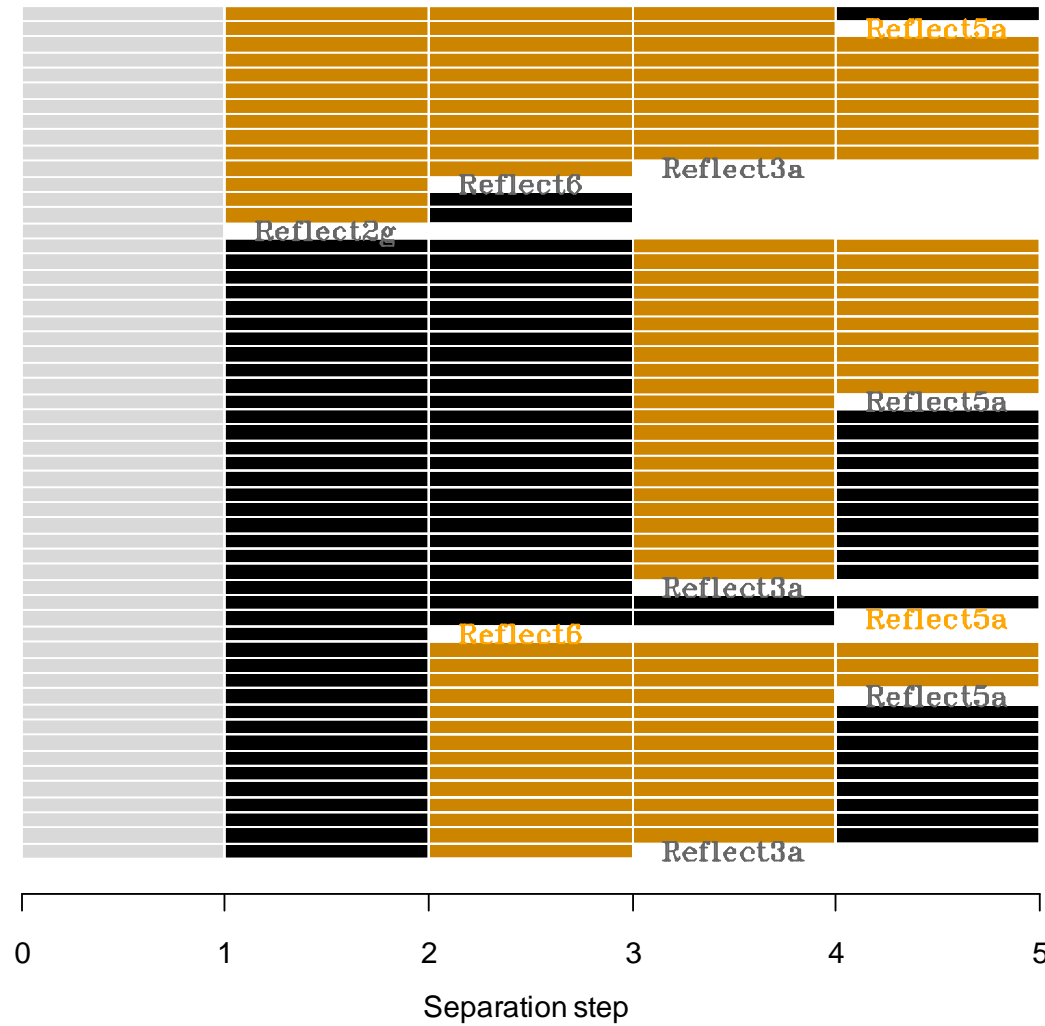
Reflective Questioning and Coach Conversations: All Items

Enhanced Bannerplot



Reflective Questioning and Coach Conversations: Highly connected items

Enhanced Bannerplot





What does this tell us?

3a. When a teacher says something I find confusing, I paraphrase what I heard and say it back to her or him.

Most of our coaches say this reflects their practice.



What does this tell us?

2g. When a teacher says something that isn't quite mathematically correct, an effective mathematics coach says, "You are almost right," and then gives the teacher a clear explanation of the correct mathematics.

Most of our coaches say this reflects their practice.

What does this tell us?

People who say the following reflects their practice:

2g. When a teacher says something that isn't quite mathematically correct, an effective mathematics coach says, "You are almost right," and then gives the teacher a clear explanation of the correct mathematics.

tend to not choose:

6b. "Let me paraphrase your explanation, followed by a restatement of teacher approach."

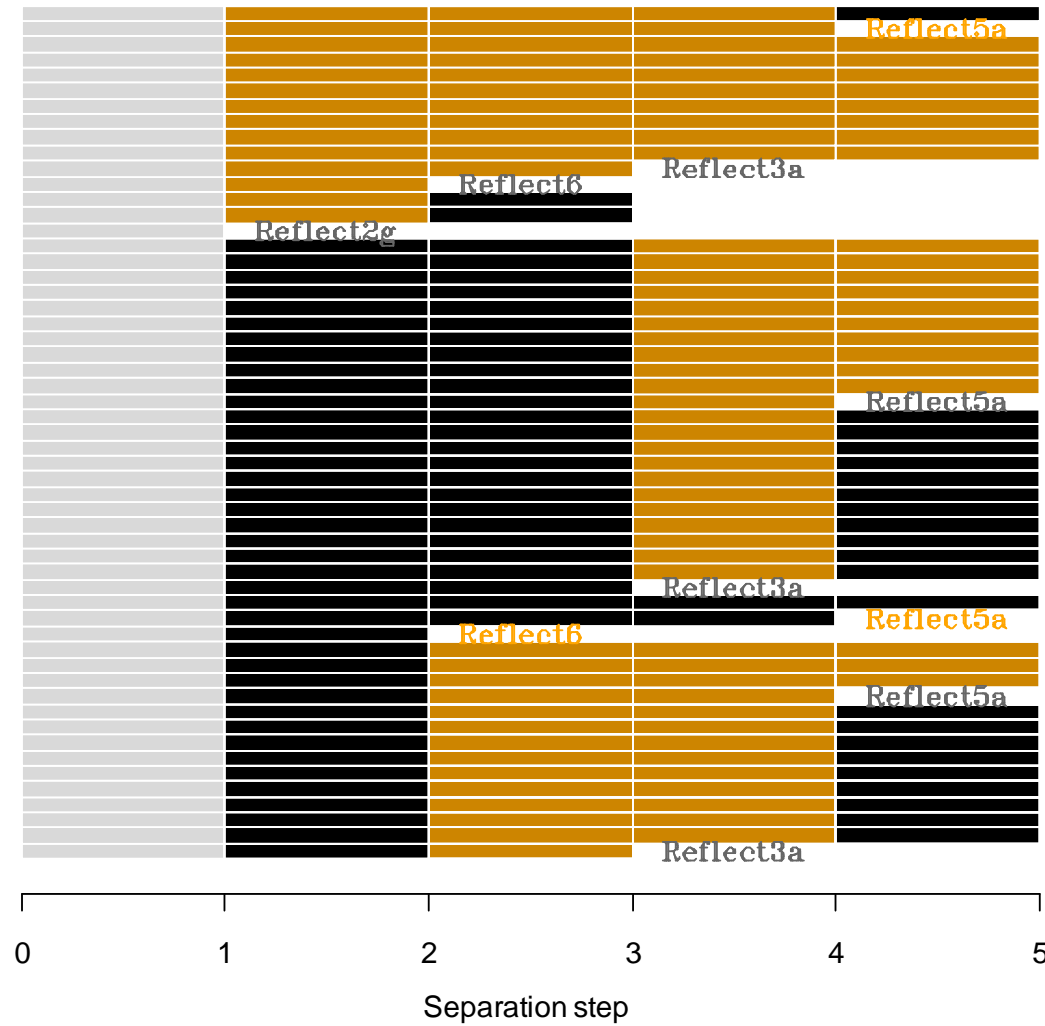
and tend to say:

5a. When a teacher says something I find confusing, I say, "That confused me," and ask the teacher to rethink it.

reflects their practice.

Reflective Questioning and Coach Conversations: Highly connected items

Enhanced Bannerplot

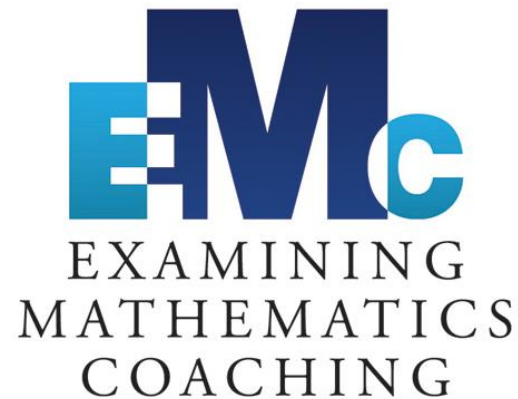




Concluding Discussion

- What needs are most pressing in the field of mathematics instructional coaching?

Thank You



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