Towards an Empirically Grounded Theory of Action for Improving the Quality of Teaching at Scale

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Orienting Questions

- Which aspects of the work we describe are relevant to science education?
- How might those aspects be adapted for science education?
  - Current work in science education on which can build?
  - Adaptations that will be necessary?

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Overview

- Progress in research in mathematics education
  - Last 25 years
- Challenge: What does it take to improve the quality of teaching on a large scale?
  - Ongoing longitudinal study
- Relevance to science education

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Research on Supporting Students' Mathematical Learning

- Delineated trajectories/progressions of students' learning in a range of mathematical domains
  - Problematized content
- Informed the development of instructional materials and formative assessment systems
  - Commercially-published curricula

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Research on Supporting Students' Mathematical Learning

- Rigorous mathematical tasks
- Individual or small group work
- Whole class discussion
  - Teacher presses students to explain and justify their reasoning and to make connections between different solutions

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Research on Mathematics Teaching

- Specified key aspects of teachers' knowledge
  - Mathematical knowledge for teaching
- Identified specific high-leverage instructional practices that support *all* students' development of central mathematical ideas
  - Setting up rigorous mathematical tasks
  - Planning and conducting productive whole class discussions

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Setting up Rigorous Mathematical Tasks

Three students at a school are raising dollars for the school's Valentine's Dance. All three decide to raise their money by having a dance marathon in the cafeteria the week before the real dance. They will collect pledges for the number of hours that they dance, and then they will give the money to the student council to get a good DJ for the Valentine's Dance.

- Rosalba's plan is to ask teachers to pledge $3 per hour that she dances.
- Nathan's plan is to ask teachers to give $5 plus $1 for every hour he dances.
- James's plan is to ask teachers to give $8 plus $0.50 for every hour he dances.

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Setting up Rigorous Mathematical Tasks

- Key contextual features of the task
- Key mathematical ideas of the task
- Linguistic demands of the task statement

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Research on Supporting Mathematics Teachers' Learning

- Professional development to support teachers' development of specific high-leverage practices
  - Pedagogies of investigation
  - Pedagogies of enactment

The Challenge

- What does it take to improve the quality of mathematics teaching and student learning on a large scale?
  - Across a large urban district

The Challenge

- The closer that an instructional innovation gets to what takes place between teachers and students in classrooms, the less likely it is that it will implemented and sustained on a large scale.

(Richard Elmore)

Refining the Problem

- Supporting the learning of groups of teachers
  - Necessary, essential, critical
  - But not sufficient
- Influence of teacher professional development on classroom practice is mediated by school and district settings in which teachers work

Refining the Problem

- Challenge: Organizing school and district settings to support teachers' ongoing improvement of their classroom practice
  - Implicates mathematics coaches, school leaders, and district leaders
- A problem of organizational as well as teacher learning

Research Project: 2007 - 2011

- Investigated (and supported) four districts' instructional improvement efforts in *middle-grades* mathematics – 360,000 students
  - High proportion of students from traditionally underserved groups
  - Limited financial resources
  - High teacher turn over
  - High proportion of novice teachers

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Background: Research Project

- Most schools and districts clueless about how to respond productively to high-stakes accountability
  - A minority have reasonably well worked out strategies
- Recruited districts that:
  - Were responding by attempting to improve the *quality* of instruction
  - Were implementing reasonably coherent sets of improvement strategies

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Vision of High-Quality Math Instruction

- Articulated relatively ambitious goals for students' mathematical learning
- Specified what should happen in classrooms to enable students to reach those goals
  - Build on students' current reasoning to achieve a mathematical agenda that focuses on central mathematical ideas
    - Consistent with research in mathematics education and related fields + NCTM (2000) *Standards*

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Initial Conjectures

- Mathematics education, teacher education, educational policy and leadership
  - Teacher professional development
  - Curriculum materials and resources
  - Teacher collaborative groups
  - School instructional leadership
  - District leadership
- Test, revise, and elaborate initial conjectures

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Long-Term Goal

- *Theory of action* for large scale instructional improvement in mathematics
  - A set of strategies or policies for supporting and holding teachers (and others) accountable for developing ambitious practices
  - A rationale that explains how the strategies are expected to support teachers' (and others')development of the intended forms of practice

(Argyris & Schön, 1974, 1978)

Participants

- 6-10 schools - 30 middle-grades teachers in each district
- Mathematics coaches
- School leaders
  - Principals, assistant principals
- District leaders
  - Across central office units that have a stake in mathematics teaching and learning

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Annual Cycles of Data Collection, Analysis, and Feedback

October

- Interviewed district leaders to document current strategies for improving middle-school mathematics

January-March

- Collected data to document how the districts' strategies were actually playing out in schools and classrooms

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January-March

- Collected data to document how the districts' strategies were actually playing out in schools in classrooms

- Audio recorded interviews with the 200 participants
- On-line surveys for teachers, coaches, and school leaders
  - The school and district settings in which the teachers and instructional leaders work
    - Sources of support
    - To whom and for what they are held accountable

(Downloadable at http://bit.ly/MISTtools)

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January-March

- Collected data to document how the districts' strategies were actually playing out in schools in classrooms

- Video-recordings of two consecutive lessons in the 120 participating teachers' classrooms
  - Coded using the *Instructional Quality Assessment* (IQA)
- Assessments of teachers' and coaches' *Mathematical Knowledge for Teaching* (MKT)
- Video-recordings of select district professional development
- Audio-recordings of teacher collaborative time
- On-line assessment of teacher networks completed by all 300 mathematics teachers in the participating schools
- Student achievement data

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Annual Cycles of Data Collection, Analysis, and Feedback

February-May

- Analyzed transcripts of the 200 interviews
  - Identified and explained gaps between each district's intended and implemented improvement strategies
- Developed a detailed report for leaders in each district
  - Shared findings and made actionable recommendations

May

- Met with district leaders to discuss our findings and recommendations

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Annual Feedback Analyses

- Addressing these concrete problems was a primary context in which we refined and elaborated our conjectures about potential supports
  - Pragmatic focus
  - A *case of* supporting large-scale instructional improvement
- Evolving conjectures informed the formulation of specific feedback recommendations

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Retrospective Analyses

- Draw on multiple types of data
- Five components of theory of action
  - A coherent instructional system for high-quality mathematics instruction
    - Instructional materials and teacher professional development
  - Teacher collaborative time

Retrospective Analyses

- Mathematics coaches' practices in providing job-embedded support for teachers' learning
- School leaders' practices as instructional leaders in mathematics
- District leaders' practices in supporting the development of school-level capacity for instructional improvement

Research Team

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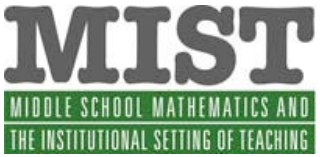

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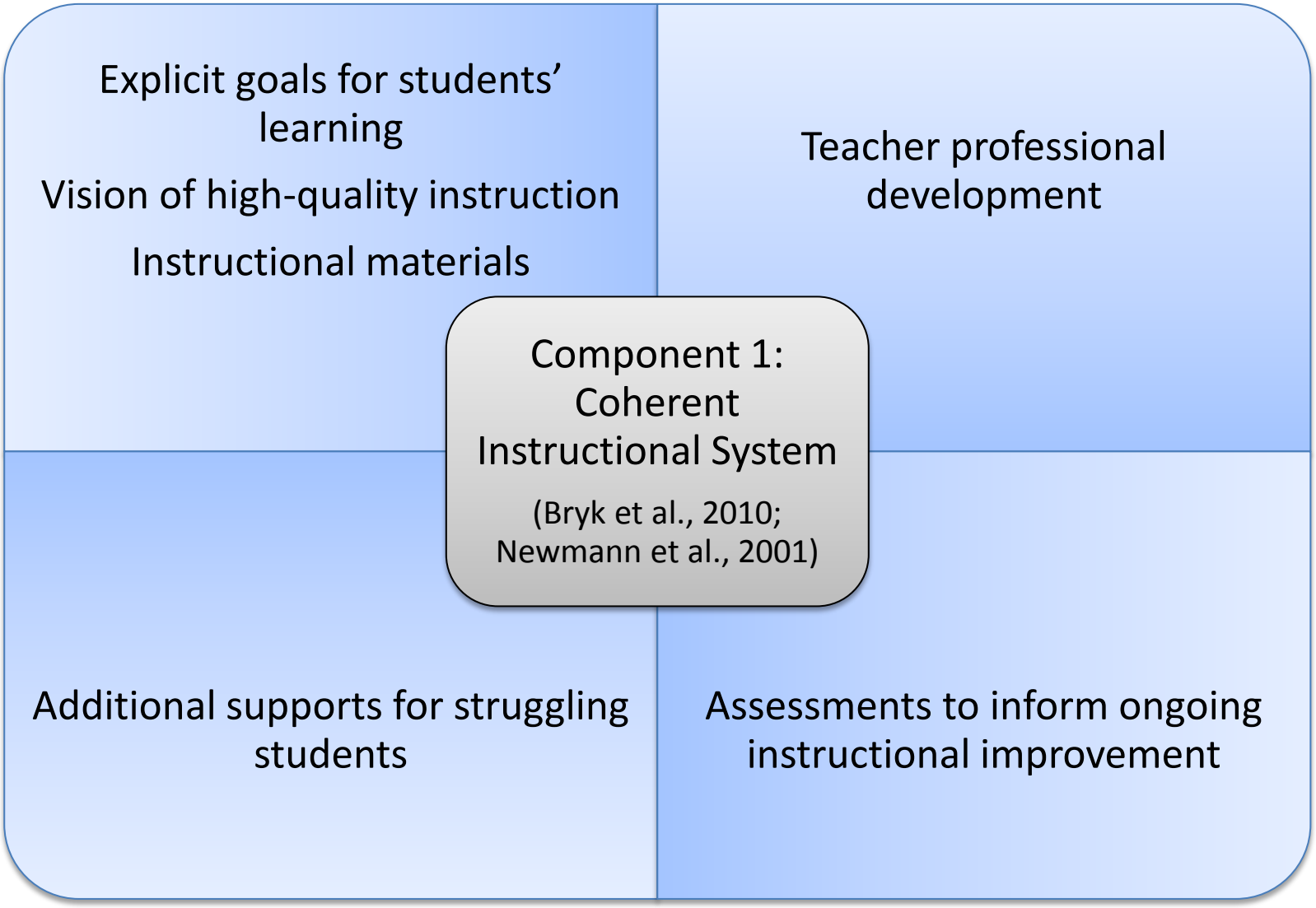

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Explicit goals for students' learning

Vision of high-quality instruction

Instructional materials

Component 1: Coherent Instructional System

Vision of instruction

- Small set of high-leverage practices (Ball et al., 2009) that are learnable in the context of high-quality professional development

Instructional materials

- Necessary but not sufficient
- Requires significant teacher learning (Remillard, 2005)

- Sustained over time
- Involves the same group of teachers working together
- Organized around small set of high-leverage practices and instructional materials
- Pedagogies of investigation & enactment (Grossman et al., 2009)
- Coordinated across contexts
  - Pull-out district-based
  - Teacher collaborative time

Teacher professional development

Component 1: Coherent Instructional System

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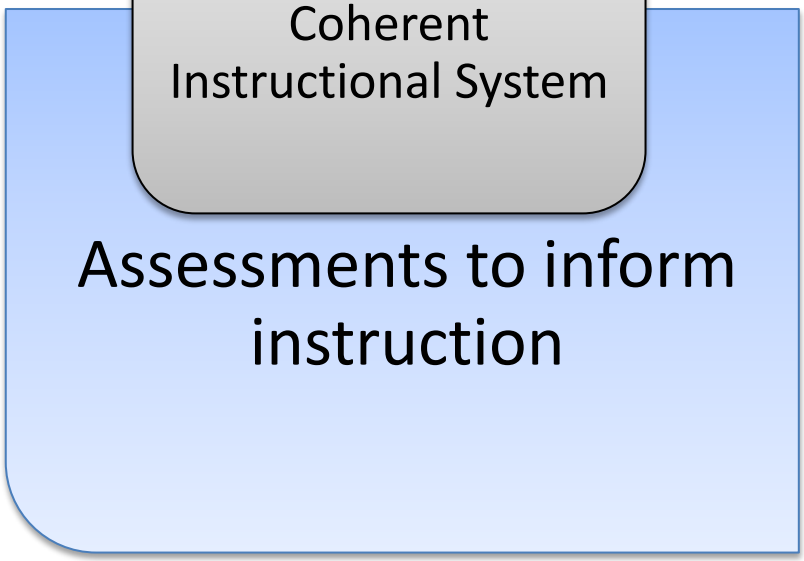
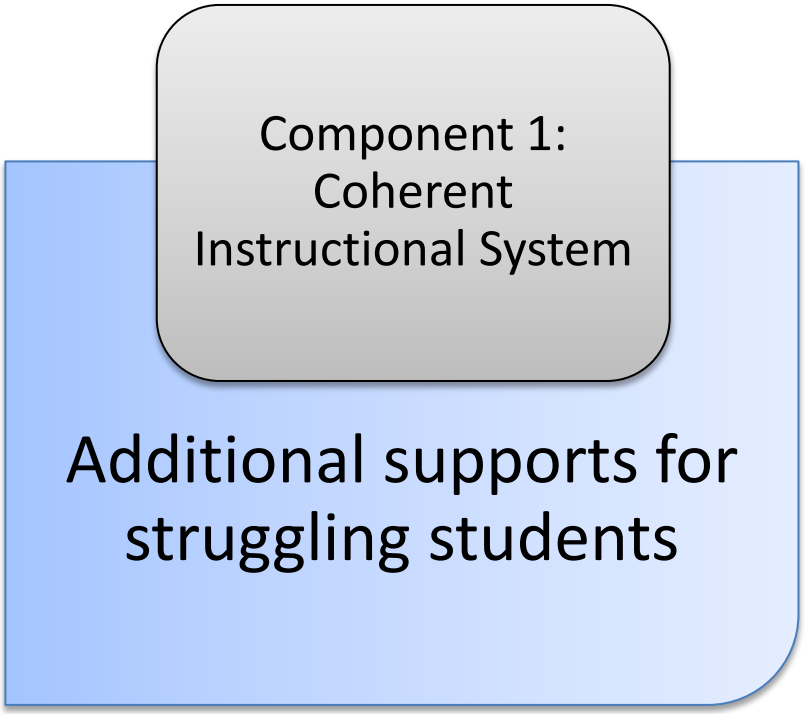
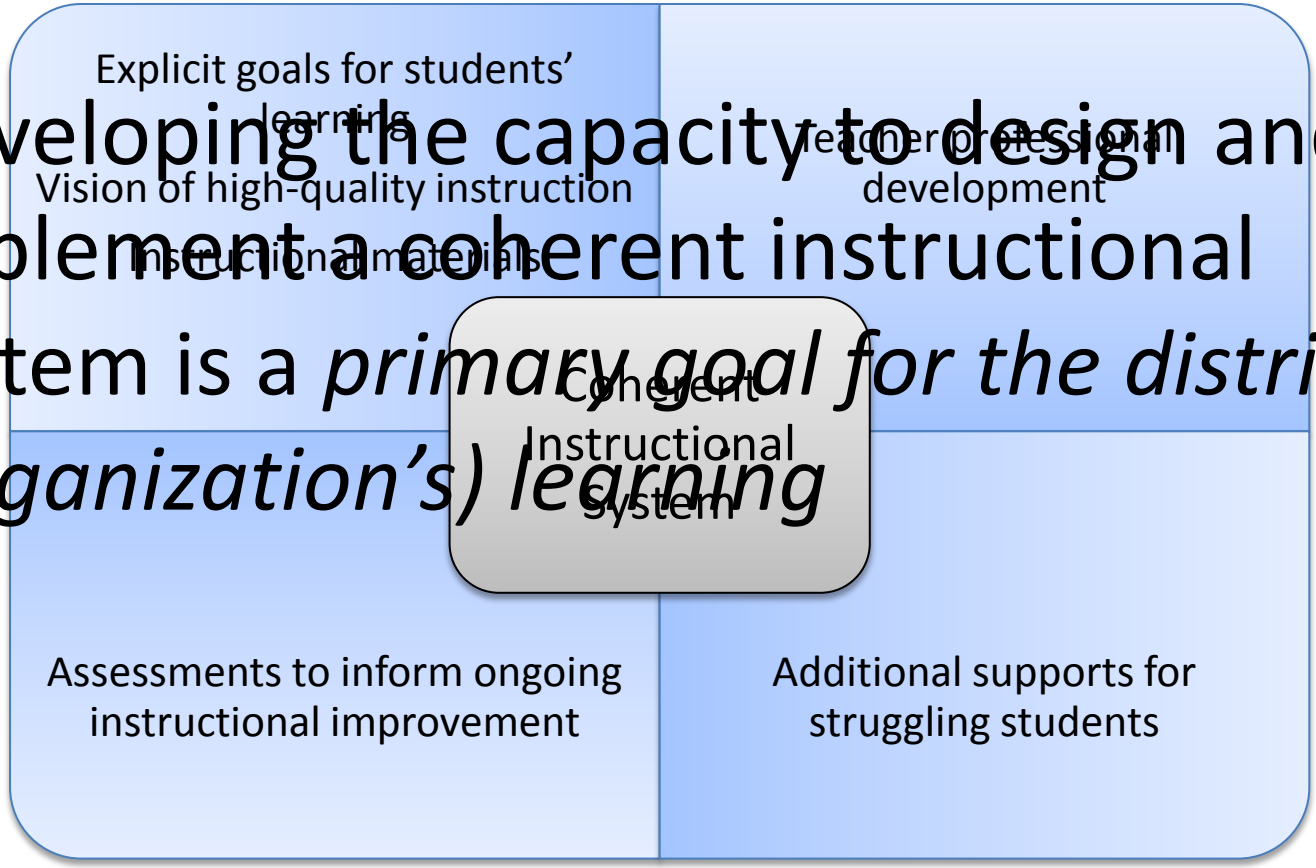


- Aligned with goals for students' learning
- Informs ongoing improvement of instruction

- Aimed at supporting struggling students to participate successfully in *mainstream* instruction



Component 1: Coherent Instructional System



Developing the capacity to design and implement a coherent instructional system is a *primary goal for the district's (organization's) learning*

Component 2: Teacher Collaborative Time

- Regularly scheduled time for collaboration
  - Trust, mutual accountability for student learning, and access to others' expertise
  - At least as important as teacher "buy-in" in driving instructional improvement
    - A key support for school-wide instructional improvement

Teacher Collaborative Time

- Other elements of a coherent instructional system can support the development of productive teacher collaborative groups in schools
  - Instructional materials
  - District professional development

Depth of Interactions

- Low-depth interactions
  - Pacing, sharing materials
- High-depth interactions
  - Doing mathematics problems together and identifying central mathematical ideas
  - Analyzing student work to understand the different ways that students solve particular problems

(Coburn & Russell, 2008)

Productive Teacher Collaborative Time

- The types of activities in which teachers engage during professional development
- At least one participant has developed relatively accomplished practices
- Accomplished participants constituted as leaders
- Leaders press other teachers on specific high-leverage issues

(Coburn & Russell, 2008)

Initial Findings

- Interactions with peers with more sophisticated instructional practices support the development of teachers' own practices
- The level of sophistication of the instructional practices of the most accomplished teacher in a school is related to overall improvement in quality of instruction in the school

Component 3: Coaching

- Coaches can potentially be more accomplished others who have developed relatively sophisticated knowledge and instructional practices

Initial Finding

- Supporting the development of a cadre of coaches is challenging
  - In one of our districts, school-based coaches are only slightly ahead of the teachers they work with
    - Visions of high-quality instruction
    - Instructional practices

Initial Finding

- Development of relatively accomplished instructional practices is necessary but not sufficient for developing effective coaching practices
- What else is needed?
  - Professional vision:
    - Vision of high-quality mathematics instruction
    - Envisioned trajectory for teachers' learning
    - Repertoire of activities in which coach can engage teachers

Current Position on Coaches' Practices

Groups of Teachers	Individual Teachers
• Lead teacher collaborative time	• Co-teaching • Modeling • Enacting coaching cycle (jointly plan a lesson, coach observes enactment, jointly analyze the lesson)

- Coaches press on similar high-leverage issues with groups of teachers and with individual teachers

(Coburn & Russell, 2008)

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Supporting Coaches' Development of Target Practices

- High-leverage coach PD activities
  - District mathematics specialists support coaches in:
    - Co-teaching, modeling, enacting coaching cycle
    - Pressing groups of teachers and individual teachers on high-leverage issues

Component 4: School Instructional Leadership

- No consensus on what school leaders need to know and be able to do in order to be effective instructional leaders in mathematics
  - General characteristics of high-quality instruction
    - Observe and provide feedback
  - MKT, student mathematical learning, high-quality mathematics instruction, teacher learning
    - Coach mathematics teachers

Initial Finding

- Interviews – vision of high-quality mathematics instruction
  - Form rather than function views
  - Consistent with teachers' reports of the feedback they receive from school leaders
- Extensive professional development
  - Focused on general, content-independent characteristics of high-quality instruction

Implications

- General principles of high-quality inquiry-oriented instruction
  - Too abstract -- not able to connect general principles to concrete instructional practices
- MKT, student mathematical learning, high-quality mathematics instruction, teacher learning
  - Beyond the capacity of most districts

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Current Position

- Distribution of instructional leadership:
  - Coaches (and district mathematics specialists) are primarily responsible for supporting teachers' learning
  - School leaders press and hold teachers accountable for developing ambitious instructional practices

School Leadership Practices

- Observing mathematics instruction and providing feedback
- Participating in teacher collaborative time
- Supporting coaches in supporting teachers' learning

Observing Instruction and Providing Feedback

- School leader professional development:
  - Instructional practices on which teacher professional development focuses (e.g., setting up complex tasks)
  - Distinguishing between low- and high-quality enactments of these instructional practices
  - Providing feedback that communicates appropriate expectations for improvement

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Participating in Teacher Collaborative Time

- Signals the importance of teacher collaboration
- Hold teachers accountable for using collaborative time productively
- A context for school leaders' learning
  - Orients what to focus on when observing instruction

Supporting Coaches

- Coach effectiveness depends on school leaders assuming shared responsibility for instructional improvement with the coach

  (Gibbons & Cobb, 2011; Mangin, 2007; Matsumura et al., 2009)
- One-on-one meetings with coach
  - Focus on quality of classroom instruction + plan how to support instructional improvement

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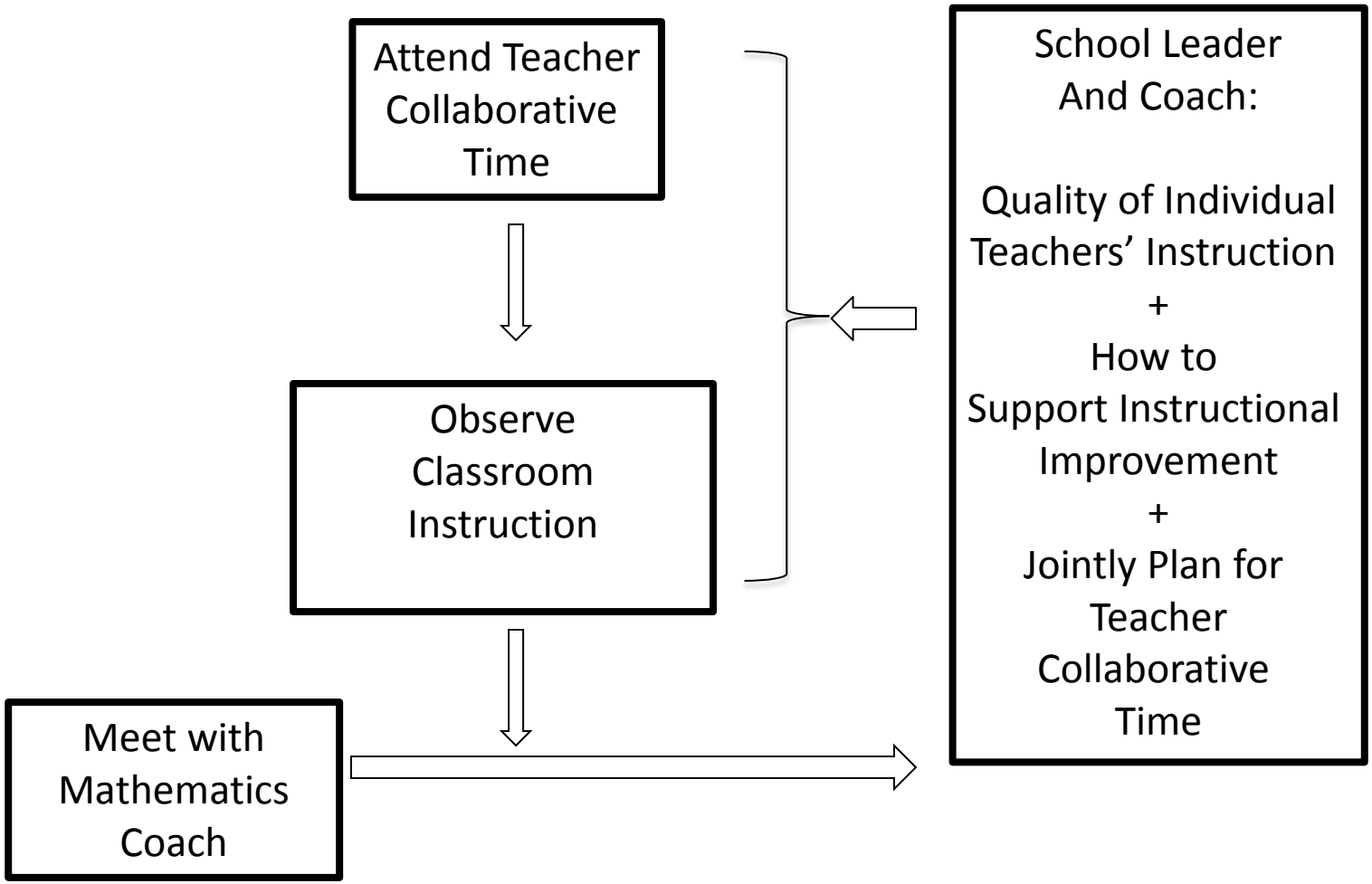
School Leadership Practices



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Component 5: District Instructional Leadership

- What is necessary on the part of district instructional leadership to support the development of school-level capacity for instructional improvement?

District Instructional Leadership

- Crucial that leaders in different central office units frame the problem of improving students' mathematics learning in compatible ways:
  - Instructional improvement orientation
  - Instructional management orientation
    - Both orientations are necessary but must be tightly coordinated

District Instructional Leadership

- Also crucial that district leaders in different units have compatible:
  - goals for students' mathematical learning
  - visions of high-quality mathematics instruction (i.e., goals for teachers' learning)
- Otherwise, likely to pursue conflicting agendas for mathematics instruction

District Instructional Leadership

- Important that district leaders approach instructional improvement:
  - From a *learning perspective* (Hubbard, Mehan, & Stein, 2008)
    - Much more likely to recognize people in the district with expertise in mathematics teaching and teacher learning
  - Design and implement coherent supports that are aligned with vision of high-quality instruction

District Instructional Leadership

- How do district leaders, especially across C&I and Leadership, get on the same page?
  - Role of superintendent in setting direction for the improvement effort
  - Important that district leaders in various units collaborate regularly on the design and implementation of instructional improvement policies

Theory of Action for Instructional Improvement at Scale

- Improving instruction at scale is a problem of organizational as well as teacher learning
- A design for *supporting* and *coordinating* the learning of the members of multiple role groups
  - Comprehensive
  - Necessarily provisional

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Theory of Action for Instructional Improvement at Scale

- All five components necessary
  - Coherent instructional system
  - Teacher collaborative planning time
  - Content-focused coaching
  - School instructional leadership
  - District leadership

Research Project: 2011 - 2015

- Two districts – 120 teachers – 25 schools
  - Annual data collection, analysis, and feedback cycles
  - Collaborate more closely with district leaders
    - Co-design professional development for teachers, coaches, and school leaders
    - Organized around specific high-leverage practices
      - Launching challenging instructional tasks

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Research Project: 2011 - 2015

- Summer district leadership institutes
  - Build on feedback report
    - Data on quality of particular high-leverage instructional practices in district classrooms
  - Develop a design for addressing the problem indicated by the data
- Co-lead professional development for school leaders

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Papers downloadable at:

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Interview protocols and surveys:

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