Investigating What It Takes to Improve the Quality of Mathematics Teaching and Learning on a Large Scale

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Overview

Background to project

- Long-term *partnerships* with large US school districts
- Theory of action for instructional improvement at scale

Findings

- Teachers' perspectives, knowledge, and practices
- System of supports for teachers' learning

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Background: US Educational System

Decentralized education system

- Local control of schooling

Each US state divided into a number of independent school *districts*

- Rural districts with less than 1,000 students
- Urban districts with 100,000 students or more

Ambitious and Equitable Mathematics Instruction

Challenging mathematical tasks

Introduce or launch tasks

- All students can begin to work productively on tasks
- Maintain the level of rigor

Small group or individual work

Whole class discussion of students' solutions

- Teachers support students to:
  - Explain and justify their reasoning
  - Make connections between different solutions

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Initial Conjectures

Mathematics education, teacher education, educational policy, and educational leadership

- Instructional materials and associated resources
- Teacher professional development
  - Teacher collaborative time, coaching
- School instructional leadership
- District instructional leadership

District Partnerships

2007-2011: 4 large urban districts – 360,000 students

2011-2015: 2 large urban districts – 180,000 students

- Ambitious instructional practices
- Middle grades – 12 – 14 years old

Test, revise, and elaborate our conjectures

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Participants

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

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Data Collection

- Audio-recorded interviews with the 200 participants
  - 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
    - Tools they used in their work
- On-line surveys for teachers, coaches, and school leaders
- 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 district professional development sessions
- Audio/video-recordings of teacher collaborative meetings
- On-line assessment of teacher networks completed by all 300 mathematics teachers in the participating schools
- Access to district student achievement data

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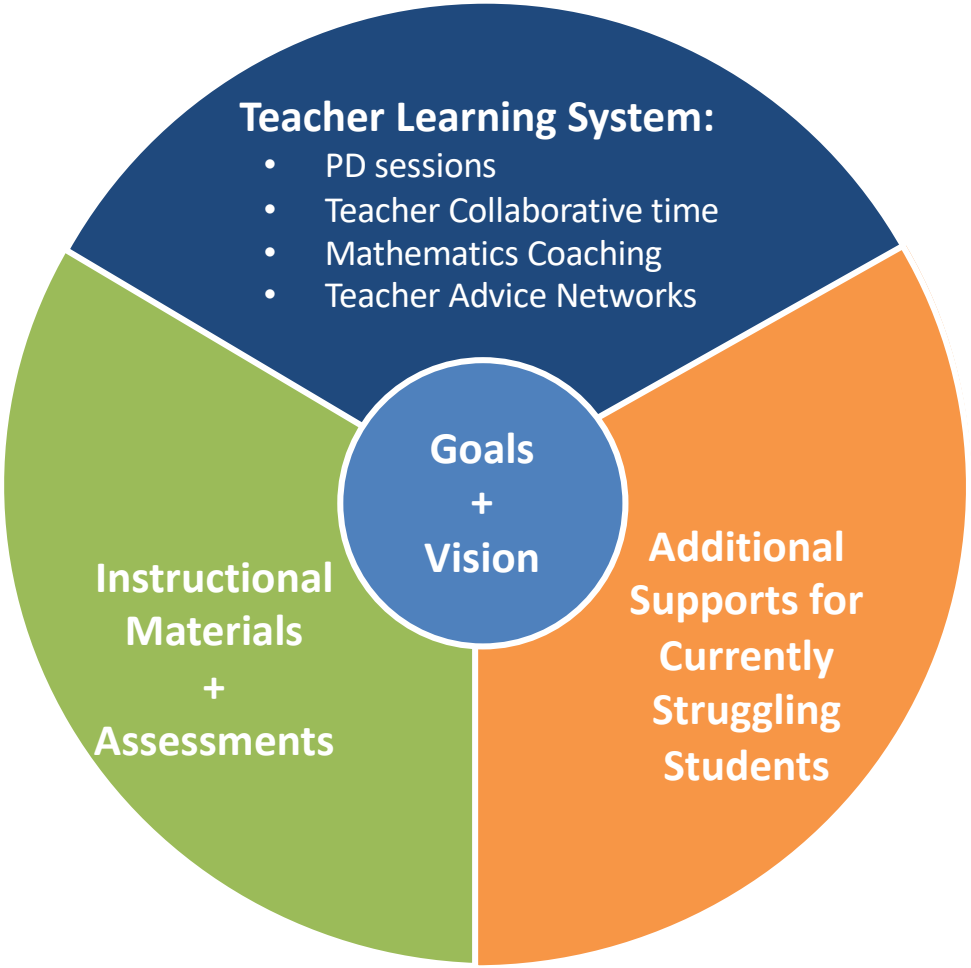
Coherent Instructional System



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Research Team

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Teachers' Knowledge, Perspectives and Instructional Practices

- *Instructional Quality Assessment (IQA)*
  - Video-recordings of lessons
    - Assess the potential of the task(s)
    - Assess the quality of task implementation
- *IQA* coding scheme:

Score	Description
4	Doing genuine mathematics: Exploring, justifying, explaining, generalizing, etc.
3	Using procedures with connections to underlying mathematical concepts
2	Using specified procedures
1	Memorizing or reproducing facts, rules, formulae, or definitions

Measures of Teacher Knowledge

- *Mathematical Knowledge for Teaching (MKT)*
  - Multiple choice instrument
    - Mathematical knowledge that is specific to the practice of teaching

- *Vision of High-Quality Mathematics Instruction (VHQMI)*
  - Interviews
    - Nature of the tasks
    - Nature of whole class discussions
    - Role of the teacher

(Munter, 2014, 2015; Munter & Correnti, 2017)

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Vision of High-Quality Mathematics Instruction (VHQMI)

- Teachers' visions of high-quality mathematics instruction (VHQMI) improved in all 4 districts
  - Instruction (IQA) of teachers who had higher VHQMI scores was more likely to improve

    (Munter & Correnti, 2017)
  - Teachers' VHQMI related to
    - Selecting cognitive demanding tasks
    - Maintaining level of challenge of tasks throughout lessons

    (Wilhelm, 2014)

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Teachers' Perspectives on Their Students' Current Mathematical Capabilities

- *View of Student's Current Mathematical Capabilities (VSMC)*
  - Interviews
    - *Diagnostic dimension*: Explanations of the reasons for student success or failure
    - *Prognostic dimension*: Descriptions of the supports provided to students perceived to be currently struggling

(Jackson, Gibbons, & Sharpe, 2017)

Teachers' Perspectives on Students' Current Mathematical Capabilities

- Teachers' attributions of students' difficulties:
  - Less that 20% attributed to limited instructional or schooling opportunities
  - Almost 30% attributed *solely* to deficits of students, their families, or their communities
- Less than 20% described making productive adjustments to their instruction

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Finding: Teachers' Perspectives on Students' Current Mathematical Capabilities

- Controlling for Mathematical Knowledge for Teaching (MKT) and instructional vision (VHQMI), teachers with productive VSMC are more likely to:
  - Maintain the cognitive demand of tasks (IQA)
  - Conduct higher quality whole class discussions in which students have opportunities to explain their reasoning (IQA)
    - Influenced by the racial, ethnic, and linguistic composition of the classes they taught

(Wilhelm, Munter, & Jackson, 2017)

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Teachers' Perspectives on Students' Current Mathematical Capabilities

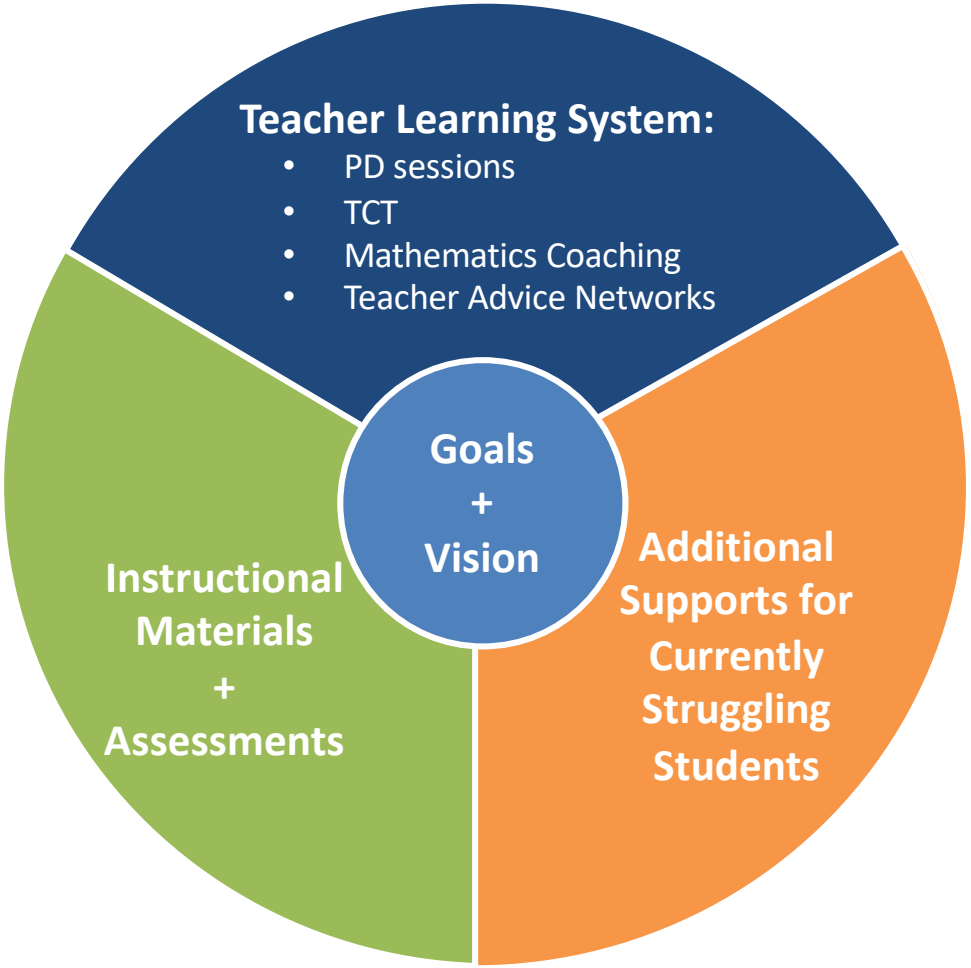
- Teachers' instruction unlikely to improve unless they have developed both relatively sophisticated VHQMI and productive VSMC

(Dunlap, 2016)

Stepping Back

- MKT clearly matters, but supporting improvements in teachers' MKT is not sufficient
- It is also important to support teachers' development of sophisticated VHQMI and productive VSMC
  - Reason and motivation to work to improve the quality of their instruction
    - Level of challenge of tasks teacher select
    - Extent to which they maintain that level of challenge
    - Extent to which they elicit and build on their students' thinking

Coherent Instructional System



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Mathematics Coaching

- *Rationale*: Coaches who have developed ambitious instructional practices can be more accomplished colleagues

- Engage teachers in activities close to instructional practice
  - One-on-one in teachers' classroom
  - Teacher collaborative meetings

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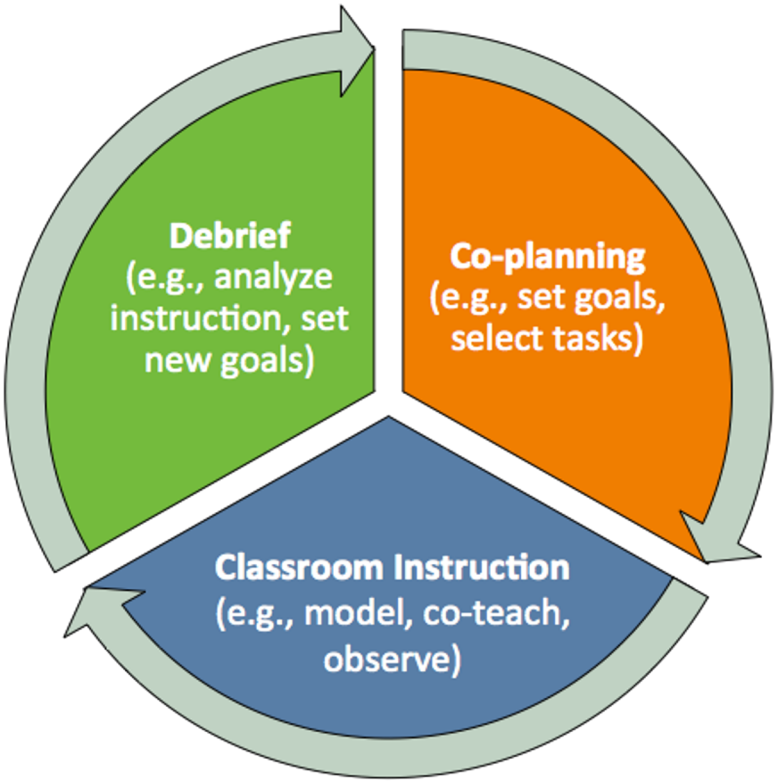
One-on-One Coaching Cycles



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Working One-on-One with Teachers in their Classrooms

Modeling instruction

- Support teachers in developing a vision of specific instructional practices
- Support teachers in developing productive views of their students' current mathematical capabilities

Co-teaching

- Support teachers' *initial* enactment of specific instructional practices

Observing instruction and providing feedback

- Support teachers in *improving* their enactment of specific instructional practices

(Gibbons & Cobb, 2017; Kochmanski, & Cobb, in press)

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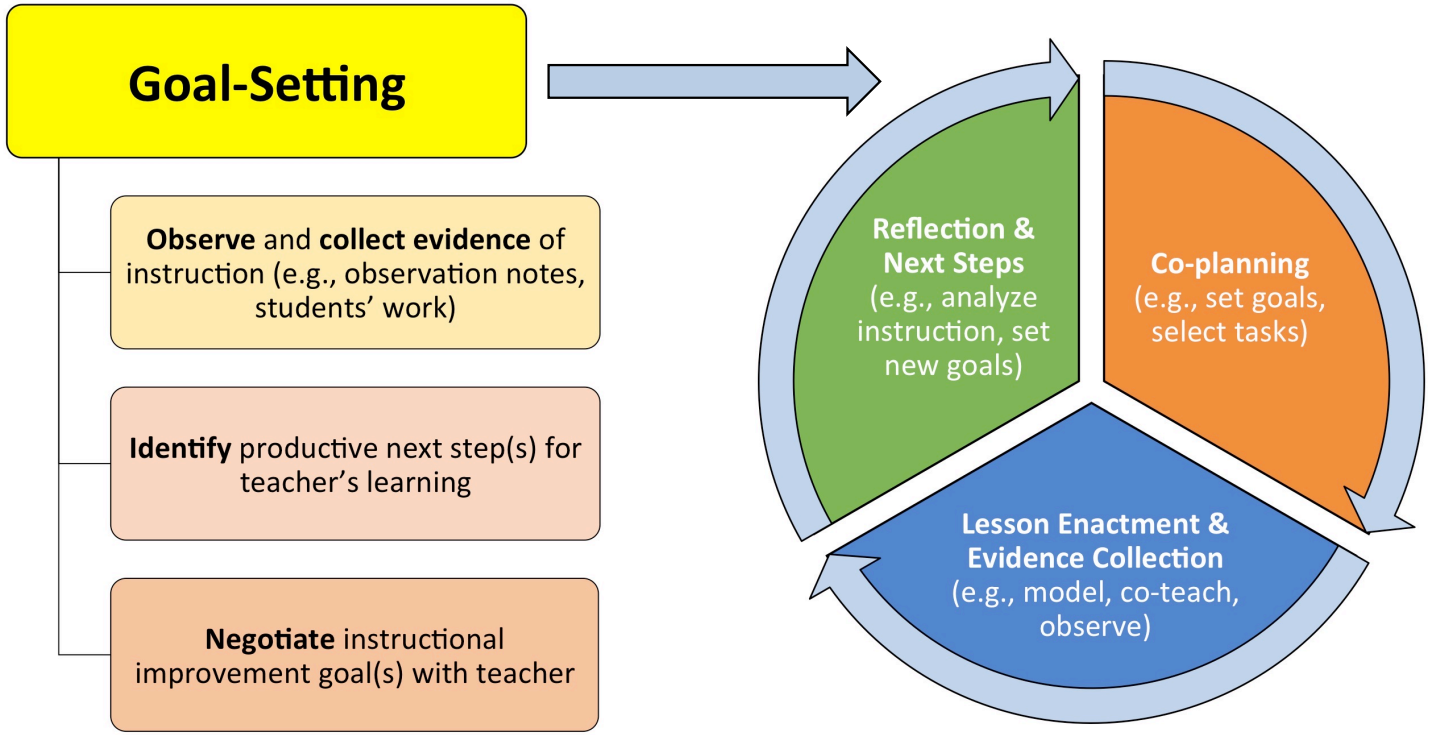
Preparing for First Coaching Cycle



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Productive Instructional Improvement Goals

- A feasible next step given the teacher's current knowledge, perspectives, and practices

- Likely to result in *immediate improvements in students' learning*

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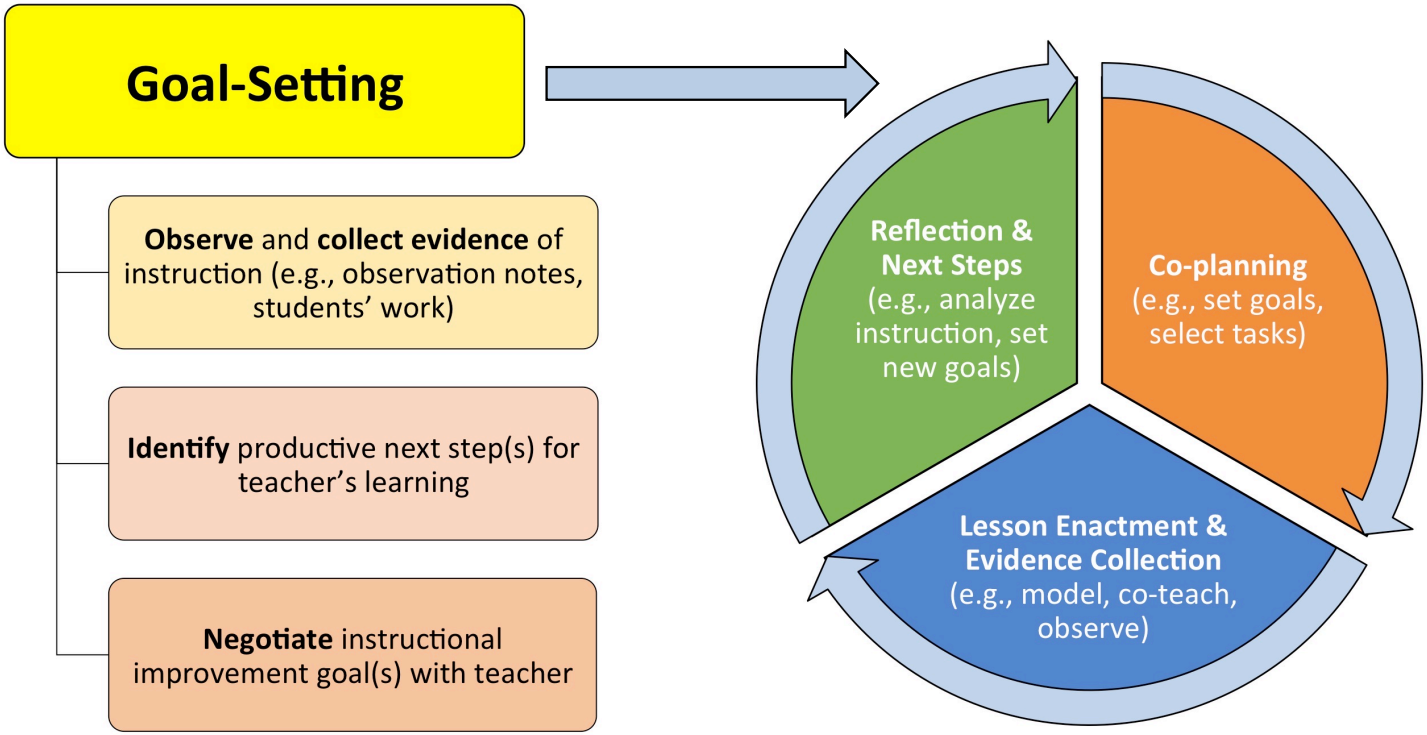
Orienting Coaching Cycles



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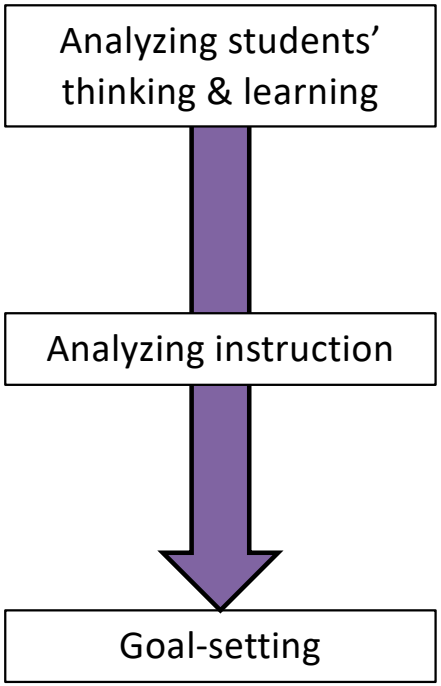
Productive Debrief Conversations



- What were our goals for students' mathematical learning?
- What did students actually learn in this lesson?

- Why did students learn what they did in the lesson?
- Why did instruction result in this learning?

- Did we make progress on our instructional improvement goal(s)?
- What additional improvements can we make to instruction?

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Teacher Collaborative Meetings

- Engaging teachers in mathematics
  - Identify the big mathematical ideas
  - Anticipate student solution strategies and how can build on them
- Analyzing student work
  - Analyze students' thinking and connect to instruction
- Analyzing classroom video
  - Analyze instruction and connect to student thinking
- Engaging in Lesson Study
  - Analogous to one-on-one coaching cycle

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Teacher Collaborative Meetings

- Productive teacher collaborative groups connect:
  - Content – mathematical learning goals
  - Students' reasoning
  - Instruction

(Horn, Kane, & Garner, 2018)

- Expert facilitation

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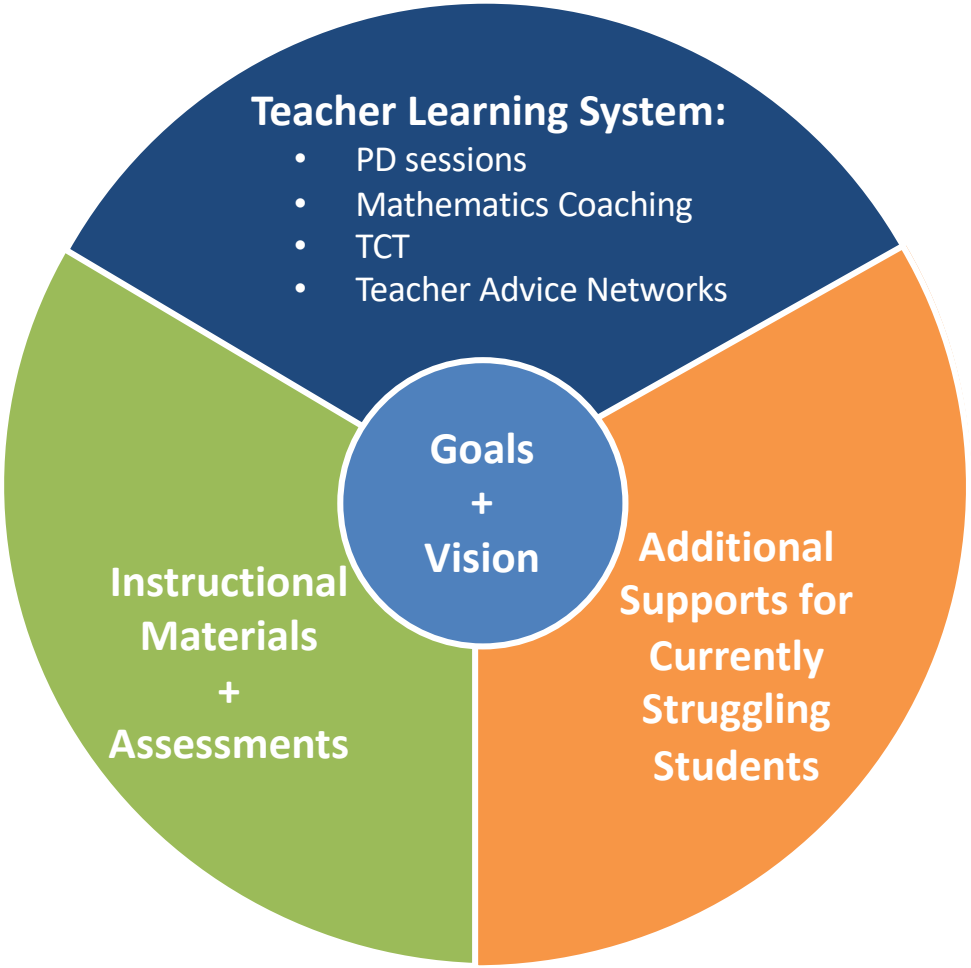

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Teacher Advice Networks

- Constituted as teacher turn to colleagues for advice about instruction
  - Network survey

- Seeking advice from colleagues with more sophisticated instructional practices supports the development of teachers' own instructional practices

(Sun, Wilhelm, Larson, & Frank, 2014)

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Teacher Advice Networks

- Teachers with more sophisticated instructional practices (IQA) are more likely to seek instructional advice

(Garrison, Chen, Smith, & Frank, 2014)

- The *quality* but *not the quantity* of teacher collaborative time influences whether teachers seek advice from each other
  - Those advice-seeking relationships tend to last

(Horn, Garner, Chen, & Frank, 2020)

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Teacher Learning Subsystem

- Coaches can play a key role in coordinating the various elements
  - Lead professional development sessions
  - Facilitate teacher collaborative meetings that focus on the same aspects of instruction
  - Support the teachers in enacting those aspects of instruction in their classrooms

Resources

Papers, interview protocols, surveys, downloadable at:

http://vanderbi.lt/mist

https://www.pmr2.org/

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