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What makes math coaching successful?
Tales from a research study on MQI Coaching

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Individualized coaching appears promising

In U.S. experiments, several programs show positive impacts on student outcomes

- Remote coaching via video (two studies of one program)
- In-district coaching (two studies)

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- NOT typical of some U.S. district-based coaching programs; coaches asked to do other tasks
- Also NOT typical of programs that are mainly professional development with limited visits from coaches

KEY: High-quality interactions between teachers and coaches

- Does NOT always happen, according to research

KEY: Highly trained coaches and monitoring

- In two cases, training of coaches to level of proficiency took one year
- Provided coaches content support and help in providing feedback – e.g., feedback routines

Research Study
Developing Common Core Classrooms Through Rubric-Based Coaching

Question: What is the impact of MQI Coaching on teacher reflection, instructional practice and student achievement outcomes?

142
MATH TEACHERS

23
MATH COACHES

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Watching a Mathematics Lesson

- Allison: Allowance Fractions
- Fifth Grade Mathematics

- Watch the clip
- What stands out to you?

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Allison:
Allowance Fractions

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- Talk to the people around you
  - What stood out to you in this clip?
  - Did people notice the same things? Focus on different things?

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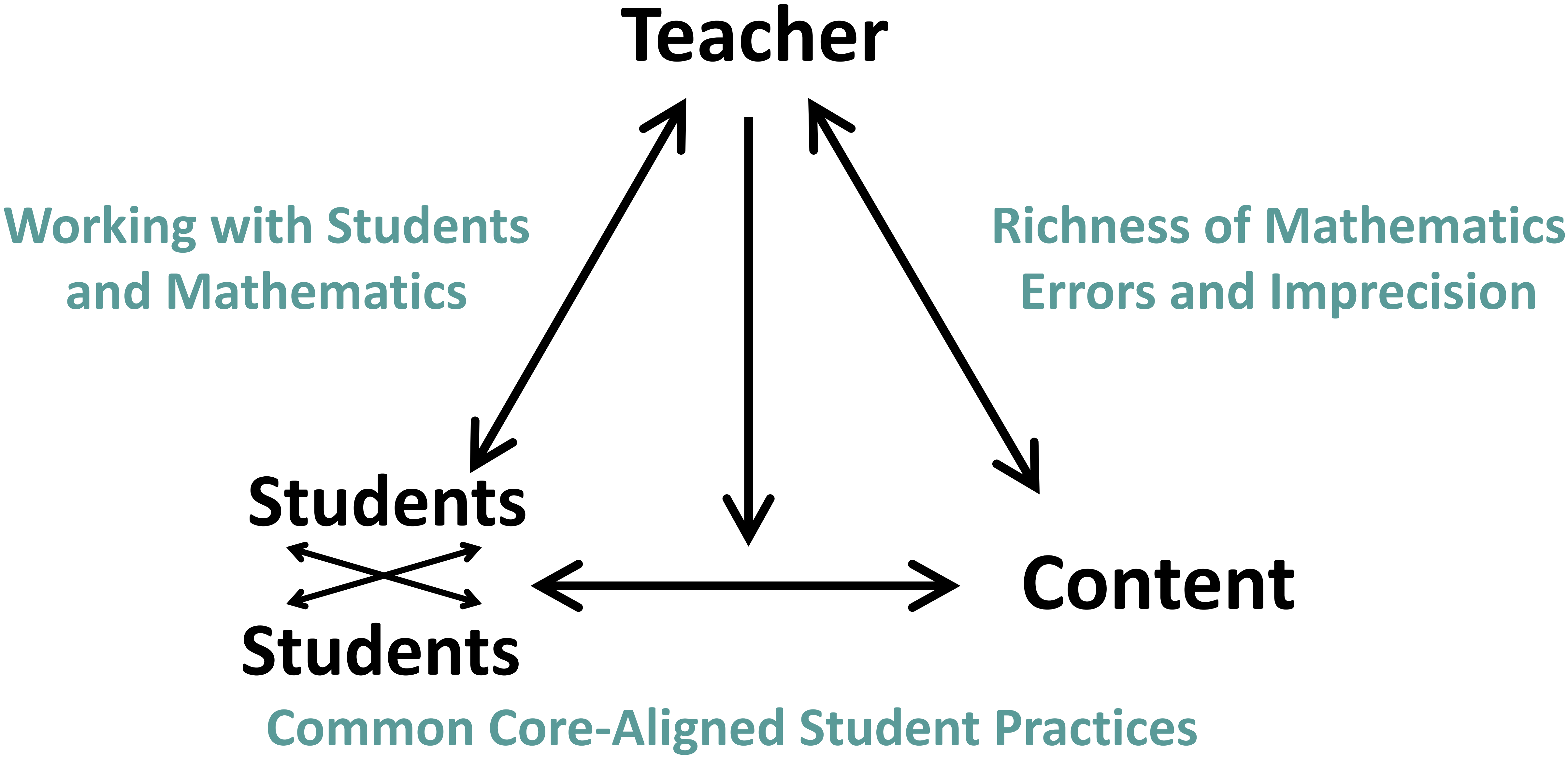
Talking about mathematics instruction can be complicated

For instance, responses to the same short clip of instruction tend to be widely varied in both their focus and their conclusions

Can we develop a common language and common lens for discussing the mathematics in the lesson?

The Mathematical Quality of Instruction (MQI)



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MQI Dimensions and Codes

Richness of the Mathematics

- Captures the depth of the mathematics offered to students
  - Linking Between Representations
  - Explanations
  - Mathematical Sense-Making
  - Multiple Procedures or Solution Methods
  - Patterns and Generalizations
  - Mathematical Language

Common Core-Aligned Student Practices

- Captures the ways in which students engage with mathematical content
  - Students Provide Explanations
  - Student Mathematical Questioning and Reasoning
  - Students Communicate about the Mathematics of the Segment
  - Task Cognitive Demand
  - Students work with Contextualized Problems

Describe this clip using language from two different MQI codes:

1. Mathematical Sense-Making (Richness of the Mathematics)
2. Task Cognitive Demand (Common Core Aligned Student Practices)

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Norms for Discussing Instruction

General Principles for Discussing Instruction using the MQI:

- "Take off your glasses, put on ours"
- Respect for teachers in these videos
- Respect for teachers generally
  - Assume the best –
    - Do not assume a teacher error unless you are certain it has been made
    - Recognize that even the best teachers make occasional missteps or have less than perfect instruction
    - Recognize that each teacher has strengths and weaknesses
- Criterion ≠ perfect instruction
  - Impossible to enact
  - Instead, faithfully capture what happened in the lesson

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Allison:
Allowance Fractions

Describe this clip using language from two different MQI codes:

1. Mathematical Sense-Making (Richness of the Mathematics)
2. Task Cognitive Demand (Common Core Aligned Student Practices)

- What might this clip have looked like if it had been stronger on Task Cognitive Demand? **What would the students be saying or doing?**
- **What would the teacher do to achieve that?** What could the teacher do to elevate the student communication in this clip?

Discussion Note: Don't reinvent the lesson or describe an entirely different way to teach the topic, rather, try to describe incremental improvement on <u>this code for this clip</u>, using the language of the MQI as a guide

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Recap:
Our Process

We just:

- Watched and discussed a clip
- Described it using the MQI and evidence from the video and transcript
- Discussed how it could have been stronger on one particular MQI code
- Discussed what a teacher might do to achieve that stronger instruction

This is the same process that teachers and coaches do together during their coaching cycles.

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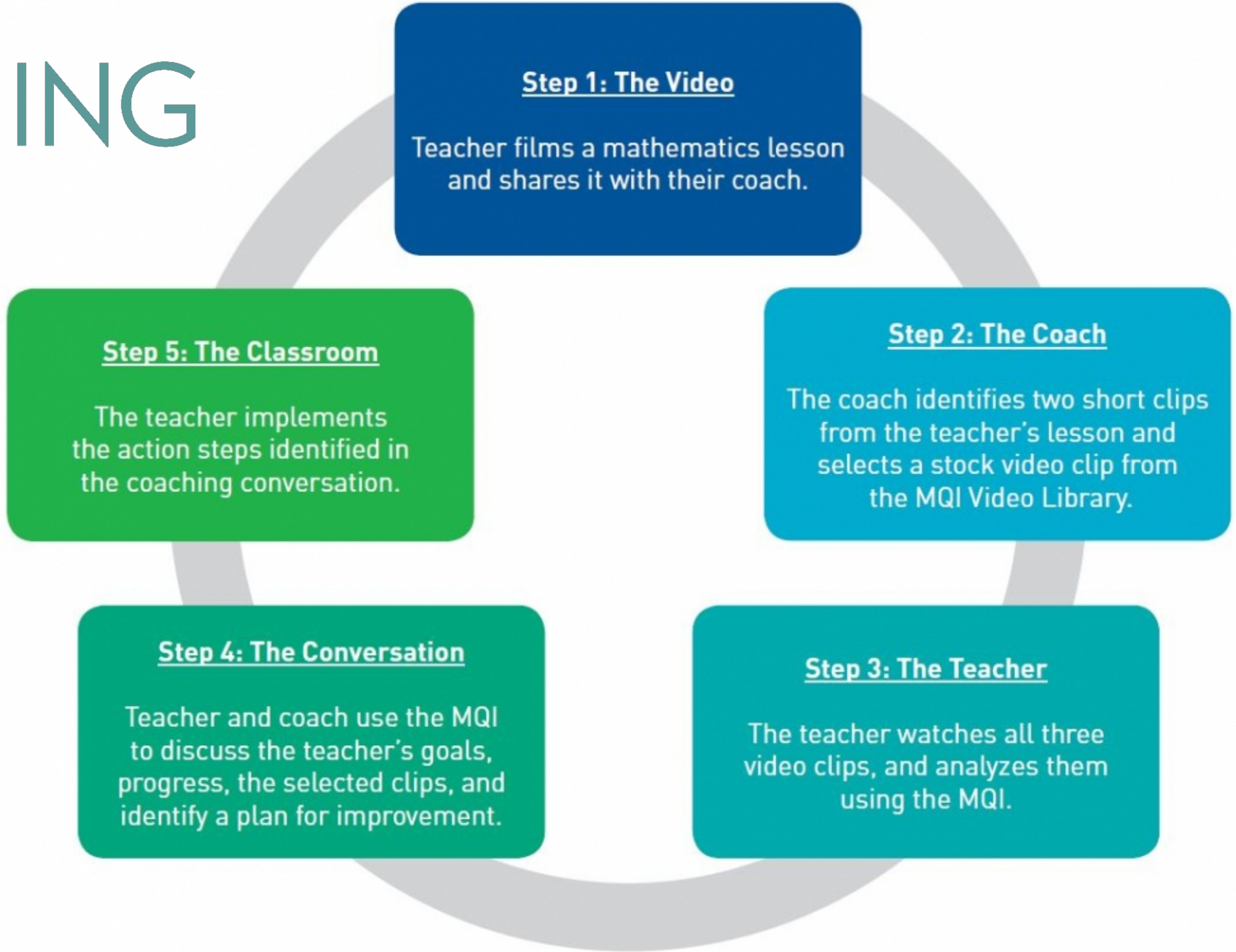
Coaching Cycle

As part of a year-long experience, teachers learn about the MQI rubric, use it to critically analyze video, and then work with an MQI-expert coach to improve their own instruction.



MQI COACHING Theory of Action

- The MQI provides teachers with a framework for planning, enacting, and reflecting on their mathematics instruction.
- Watching and evaluating stock video clips from our library allows teachers to see a wide range of practice.
- Stock video also serves as a norming process for when they look at videotape of their own instruction.
- Teachers will watch video of their instruction, and they will use the lens of the MQI to evaluate and reflect on their own practice.
- Teachers and coaches will collaborate to produce specific and actionable steps for improvement.
- Goals and action steps will be guided by the MQI, but chosen by the teacher.

Research Study

Question: What is the impact of MQI Coaching on teacher reflection, instructional practice and student achievement outcomes?

Method: Randomized controlled trial, teacher-level randomization

Participants: 23 math coaches & 142 math teachers (Grades 3–8) in two midwestern districts

- 72 teachers assigned to treatment
- 70 teachers assigned control

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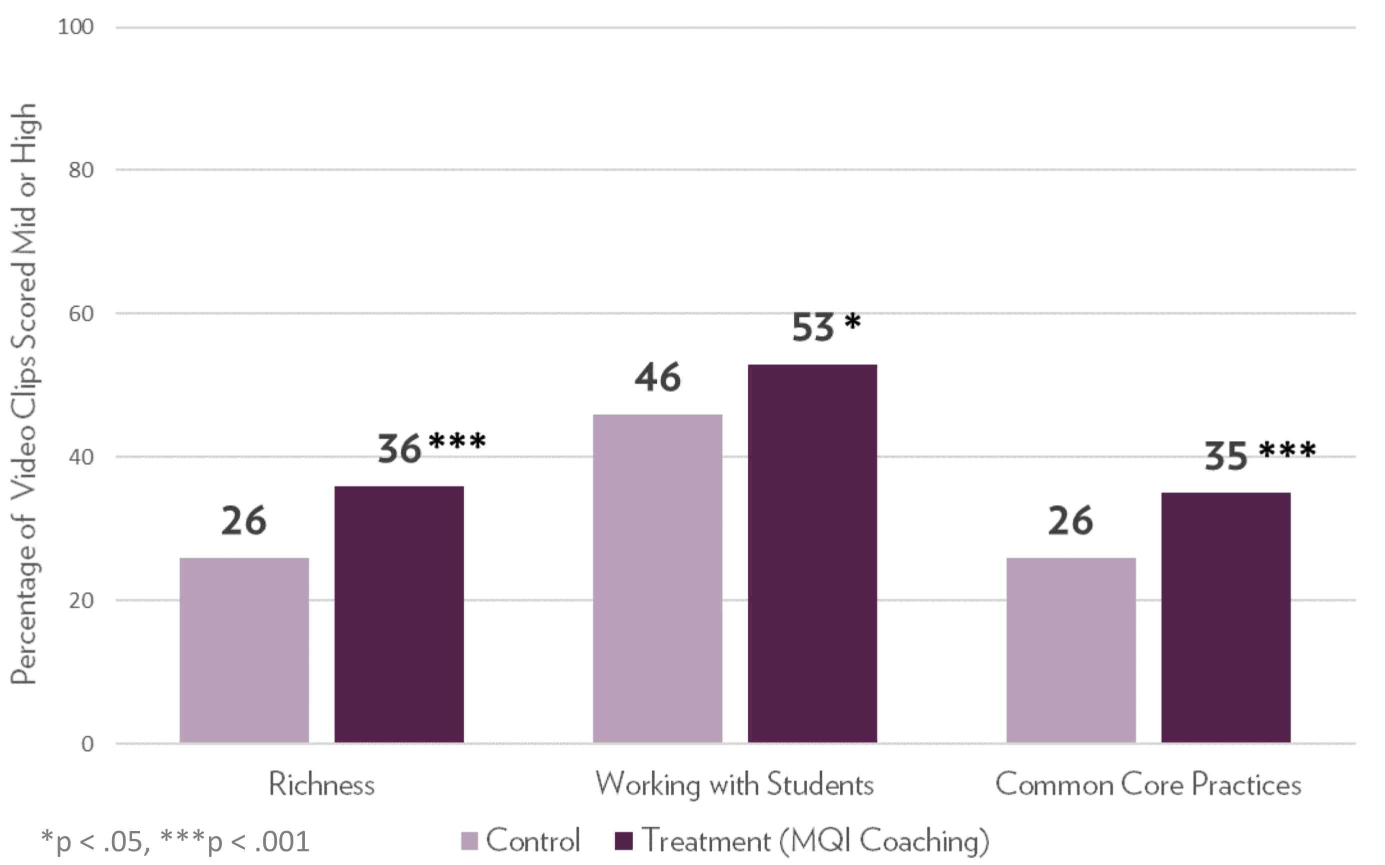
Research Timeline

- 2013-14: District outreach, teacher recruitment, and coach training
- 2014-15: Coaching intervention and data collection
  - Recruited 142 math teachers from 2 districts in the Midwest
    - 1:1 Coaching for treatment teachers
    - Teacher and student surveys for all participating teachers' classes
- 2015-16: Follow-up data collection
    - Teacher and student surveys
    - Classroom video
    - Student assessment
- 2016-19: Data analysis and findings dissemination

KEY FINDING #1

Mathematics Instruction Improved

Figure 3. Instruction Improved in Three MQI Domains



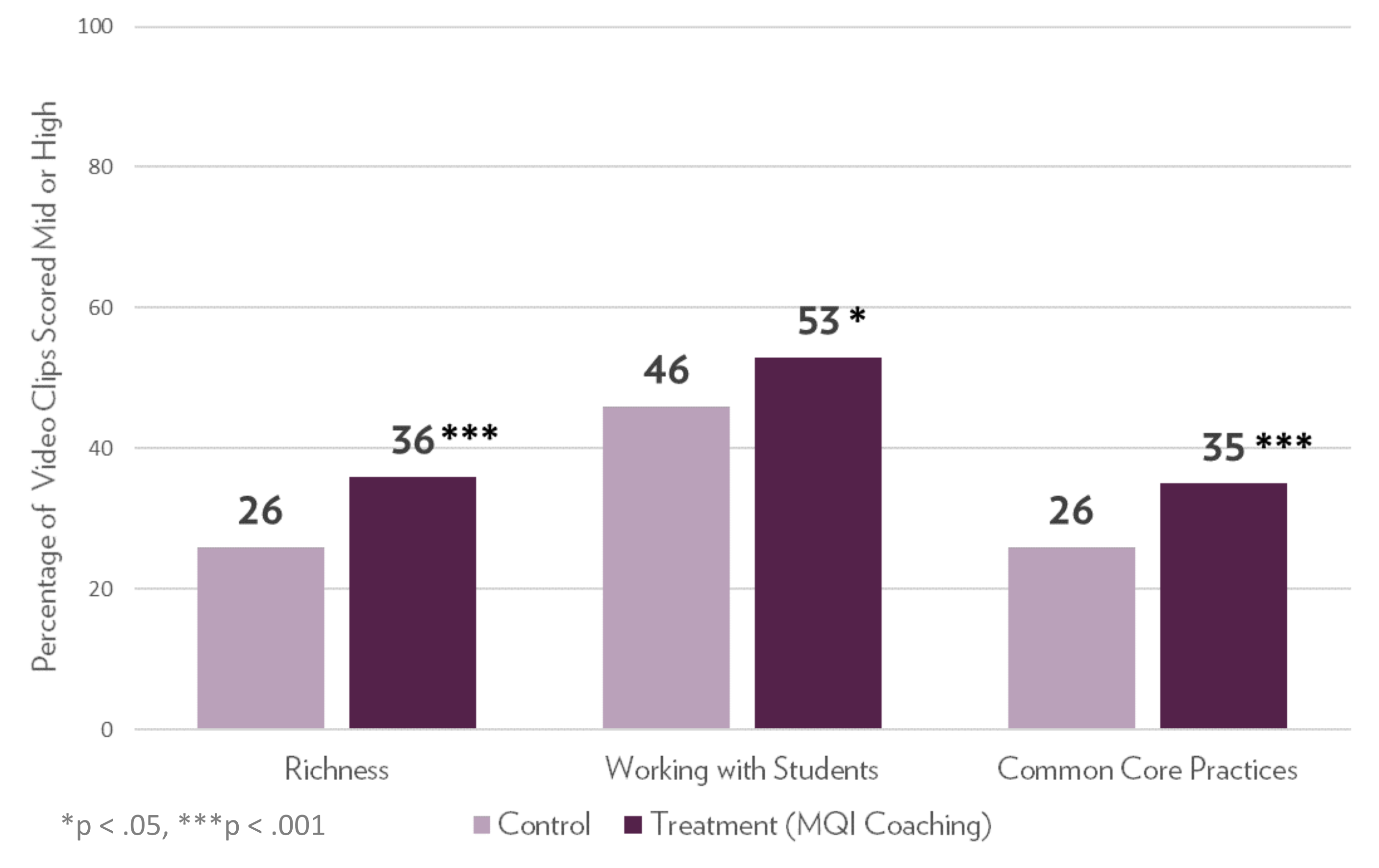
The MQI measures the quality of mathematics instruction in several domains:

- the depth of the mathematics offered to students (**Richness**),
- the teacher's instructional use of student ideas and misconceptions (**Working With Students**), and
- the amount of student participation in cognitively demanding mathematics (**Common Core-Aligned Student Practices**).
- No impact in **Errors**

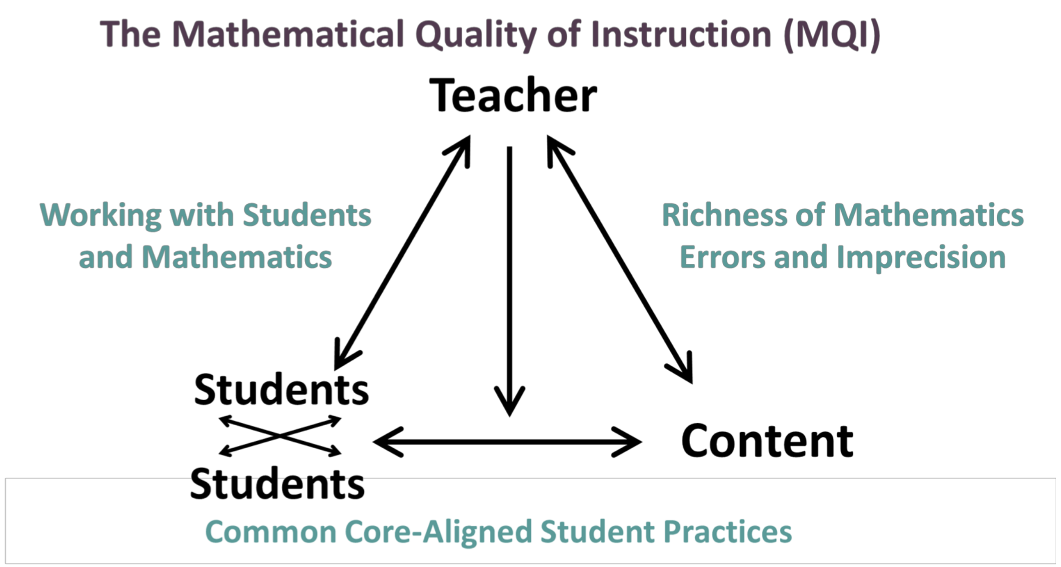
KEY FINDING #1

Mathematics Instruction Improved

Figure 3. Instruction Improved in Three MQI Domains



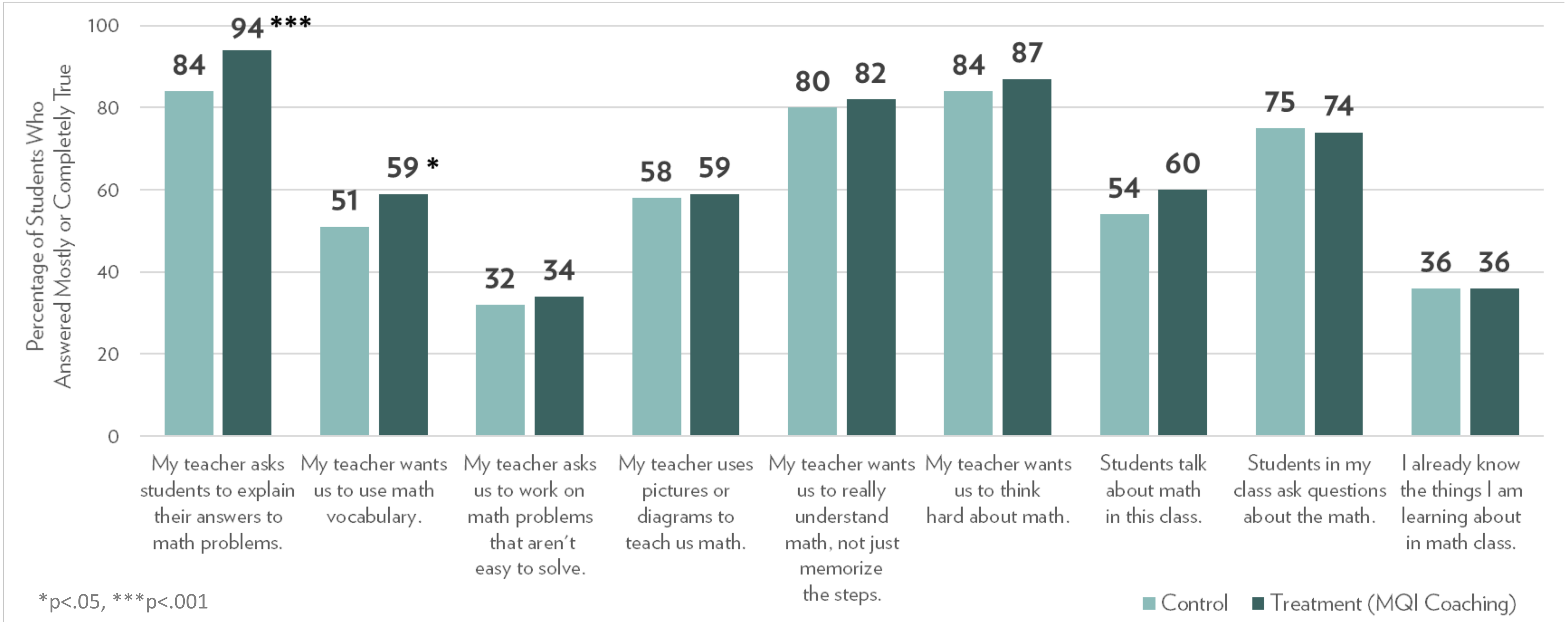
MQI Domains



KEY FINDING #1

Mathematics Instruction Improved

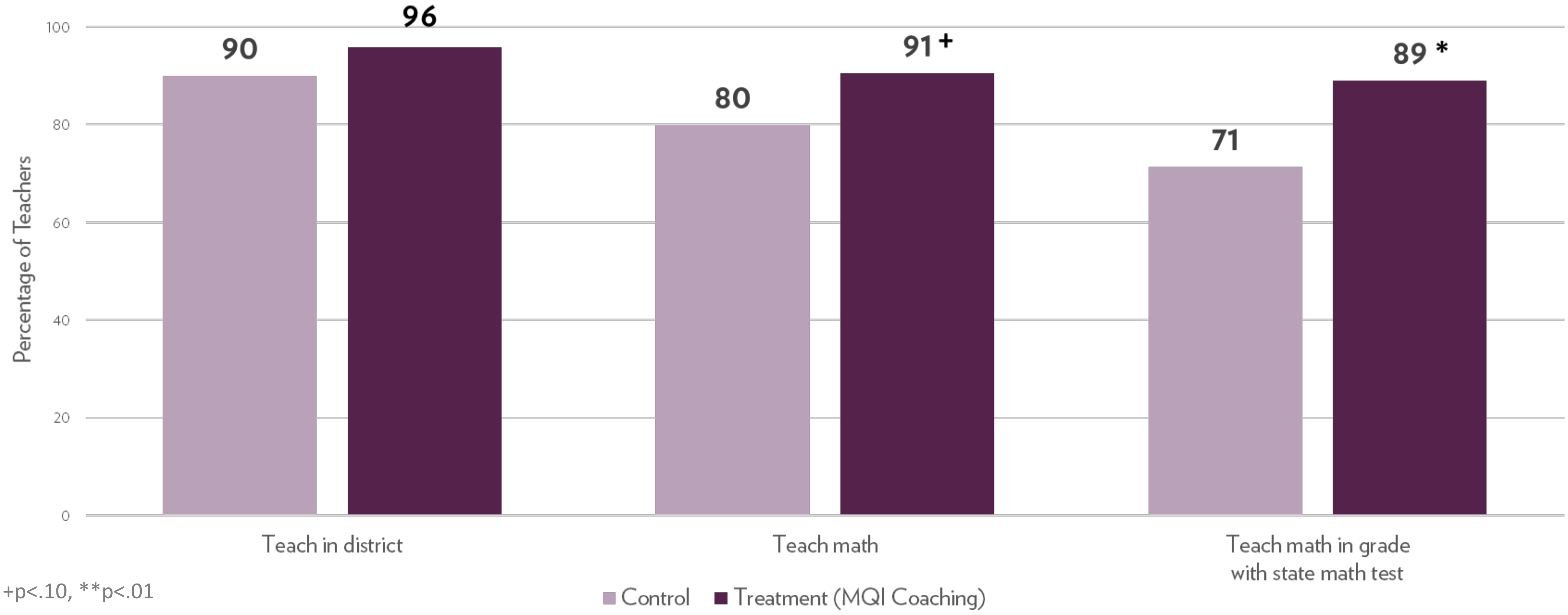
Figure 4. Student Survey Responses Indicate Instruction Improved



KEY FINDING #2

MQI Coaching Increased Math Teacher Retention

Figure 4. Teacher Retention Increased in the Following Year



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KEY FINDING #3

No Significant Impact on Student Test Scores

Changes in teachers' instruction did not produce measurable improvements in student achievement on formative or summative math tests.

Possible explanations include:
- Students' math skills did not improve.
- Better mathematics instruction improved students' abilities in ways not captured by the state standardized test or the district assessment.
- Resulting effects on math achievement were too small to detect, given the power of our research design.

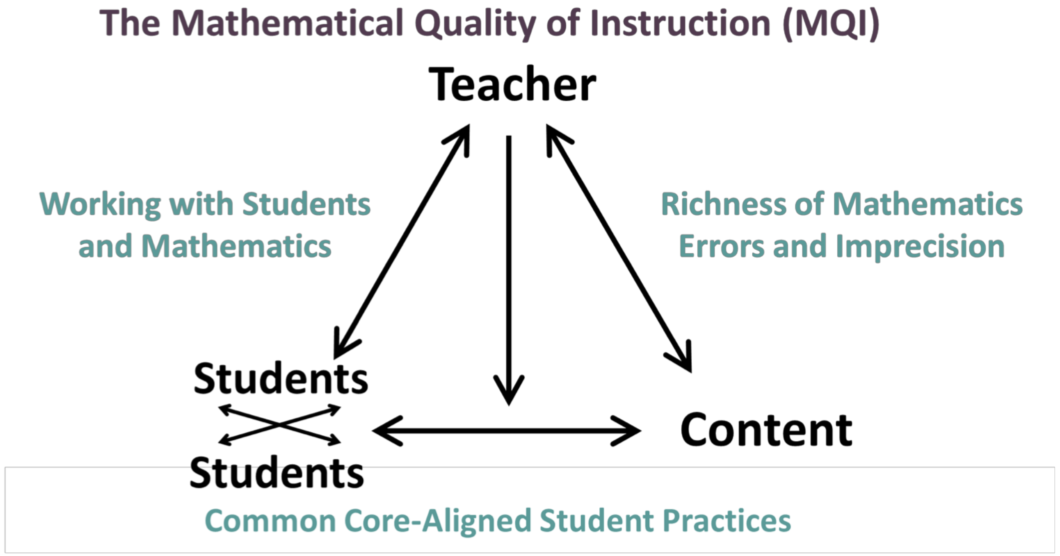
We view the teachers' instructional changes as important outcomes in their own right. Coaching helped teachers provide their students with more opportunities both to reason mathematically and to make sense of mathematics.

MQI COACHING Research Findings

The year after the coaching intervention, we collected video of 5 mathematics lessons each from treatment and control teachers.

Treatment teachers' instruction scored statistically significantly higher (~0.6 SD higher) than control teachers on 3 MQI domains:

- Common Core-Aligned Student Practices
- Working With Students and Mathematics
- Richness of the Mathematics



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Coach Training & Ongoing Coach Support

- Initial in-depth MQI Coach training covers:
  - The MQI rubric
  - Our protocols
  - Our norms
  - Technology and platforms
- Coaches are monitored and supported
  - We listen in to recorded coaching conversations
  - Coaches complete regular check-in surveys
  - We host frequent coach support webinars
  - We are available for on-call coach support and 1:1 coach-the-coach conversations as needed
  - Coaches listen to their own recorded coaching conversations as part of our parallel self-reflective process

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Thank you! If you want to learn more:

Visit us at booth #1505 in the exhibit hall at NCTM 2019!

Request access to the MQI rubric and our video library: http://cepr.harvard.edu/mqi

Learn more about our coaching work: http://mqicoaching.org

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MQI COACHING

MATHEMATICAL QUALITY OF INSTRUCTION (MQI)
-EXCERPT-

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Mathematical Quality of Instruction (MQI) Overview

An observational rubric that provides a framework for analyzing mathematics instruction in several domains, described by the instructional triangle below. Within each domain, individual codes contain score points that categorize instruction into different levels of quality.

The MQI is an observational rubric that provides a framework for analyzing mathematics instruction in several domains. Within each domain, individual codes contain score points that categorize instruction into different levels of quality. The MQI was developed in order to provide a both multidimensional and balanced view of mathematics instruction. The domains are described in text and represented by the instructional triangle below.

Richness of the Mathematics

To what extent are teachers and students making sense of the mathematics of the lesson? Are there elements of "why" and not just how? Do the teacher and students attend to precision in their use of mathematical language? Elements of richness may come from teacher OR students.

Working With Students and Mathematics

To what extent does the teacher *use* student mathematical ideas or misconceptions to move the lesson forward?

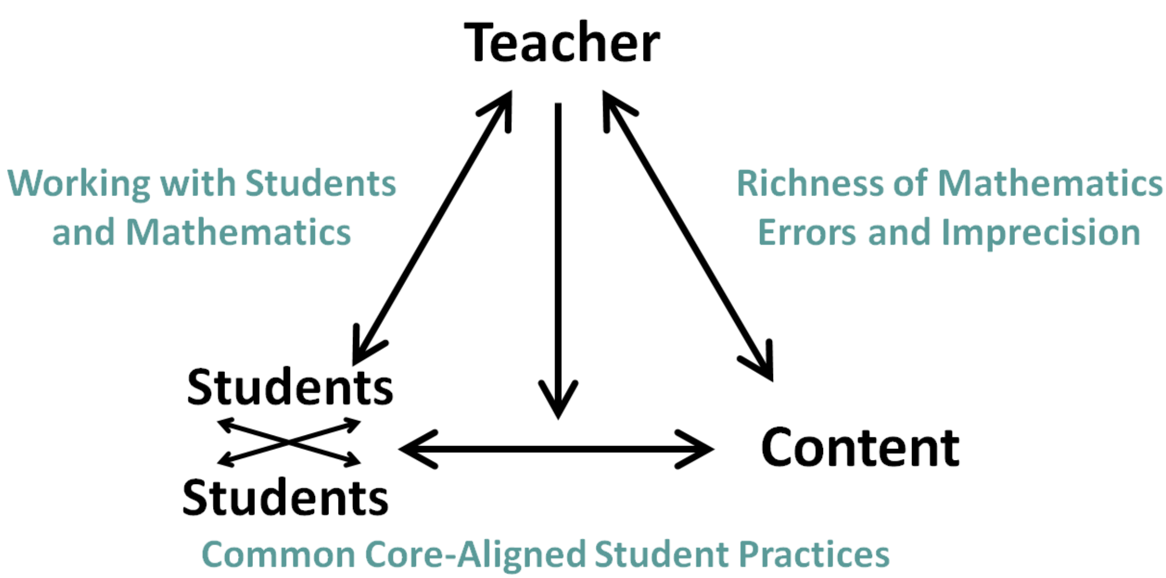
Common Core-Aligned Student Practices

To what extent are the *students*, as opposed to the teacher, *doing* the mathematics of the lesson—engaging in mathematical thinking and reasoning, communicating about mathematics, and solving high-cognitive demand tasks and contextualized problems?

Errors and Imprecision

Is the mathematics of the lesson clear and correct?

MQI Instructional Triangle



Mathematical Sense-Making

This code captures the extent to which the teacher or students attend to one or more of the following:

- The meaning of numbers
- Understanding relationships between numbers
- The relationships between contexts and the numbers or operations that represent them
- Connections between mathematical ideas or between ideas and representations
- Giving meaning to mathematical ideas
- Whether the modeling of and answers to problems make sense

Examples include:

- Focusing on value of quantities (e.g., "7/8 is close to 1")
- The meaning of quantities (e.g., "the six represents the number of groups")
- Discussing reasonableness of an expression, solution method, or answer
- Using estimation or number sense
- Giving meaning to procedures (e.g., "1/4 x 2/3 means taking 1/4 *of* 2/3 *of* a whole")
- Giving meaning to expressions or equations

For word problems, score for activities like explaining why an operation is called for by a problem, why certain numbers are used in the operation, reasonableness of answer, reasonableness of solution method, etc.

In geometry, include making sense of definitions (what counts as a polygon, what does not count as a polygon), formulas, by elaborating them, applying them, finding counter-examples, etc. rather than just stating/executing them. Do not count "Give me examples of a circle" – instead, count cases where the definition or formula has meaning made around it.

If sense-making is partially correct and partially incorrect, only score the portion that is correct (e.g., would be a High, but vague for parts, thus receives a Mid).

Not Present	Low	Mid	High
Not present or incorrect.	Teacher and/or students focus briefly on meaning. For instance, a student may remark that 7/8 is "almost 1" or attends to reasonableness of the solution method.	Teacher and/or students focus on meaning more than briefly (e.g., several instances within the segment or one somewhat long instance), but this work is not sustained or substantial.	Teacher and/or students focus on meaning in sustained way during segment. Need not be the entire segment, but must be substantial.

Task Cognitive Demand

This code captures student engagement in tasks in which they think deeply and reason about mathematics. This code refers to the *enactment* of the task, regardless of the initial demand of the curriculum/textbook task or how the teacher sets up the task for students.

Notes:

- Student confusion does not necessarily suggest that students are engaging with the content at a high cognitive level.
- Working on review tasks or on ideas discussed in previous lessons does not necessarily mean that students use lower order thinking skills.
- This code should not be confounded with the difficulty of the task or whether it is appropriate for a certain grade-level.
- Code a student presentation of a solution method at the same level of cognitive demand as the task itself was coded.

Not Present	Low	Mid	High
Students are engaged in cognitively undemanding activities. Examples of cognitively *undemanding* activities include: • Recalling and applying well-established procedures • Recalling or reproducing known facts, rules, or formulas • Listening to a teacher presentation with limited student input • Going over homework with little additional student work (e.g., reporting numerical answers) • Unsystematic exploration (i.e., students do not make *systematic and sustained progress in developing mathematical strategies or understanding*)	There is a brief example of a cognitively demanding activity, e.g. • A momentary think-pair-share where students define a term • Direct instruction with one or two examples of student explanations or SMQR • Tasks with a momentary high cognitive demand element • Tasks that are not completely routine, but are heavily scaffolded for students with hints or directions	Segment features mix of demanding and undemanding tasks and activities, e.g. • Tasks with variable enactment (e.g., demanding tasks followed by a transition to undemanding tasks; or, when working in small groups, some groups work on a high-demand task while some groups work on an undemanding task) • Direct instruction with student explanations and/or SMQR input at certain points • Tasks with middling cognitive demand	Students engage with content at a *high* level of cognitive demand. Examples of cognitively *demanding* activities include when students: • Determine the meaning of mathematical concepts, processes, or relationships • Draw connections among different representations or concepts • Make and test conjectures • Look for patterns • Examine constraints • Explain and justify