MQI COACHING

Implementation over materials: Manageable tweaks to make any task cognitively demanding

JONATHAN THOMPSON
Center for Education Policy Research
at Harvard University
jthompson@gse.harvard.edu

CLAIRE GOGOLEN | @MQIclaire
Center for Education Policy Research
at Harvard University
claire_gogolen@gse.harvard.edu

Watching a Mathematics Lesson

Predict:

Before watching what happens next, take a minute to predict independently:

- What do *you think* the cognitive demand will be in the next few minutes of this clip? Why?

We just watched a student read the following out loud:

"Asanya had two and one-thirds candy bars. She promised her brother that she would give him half of the candy bar. How much would she have left after she gives her brother the amount she promised?"

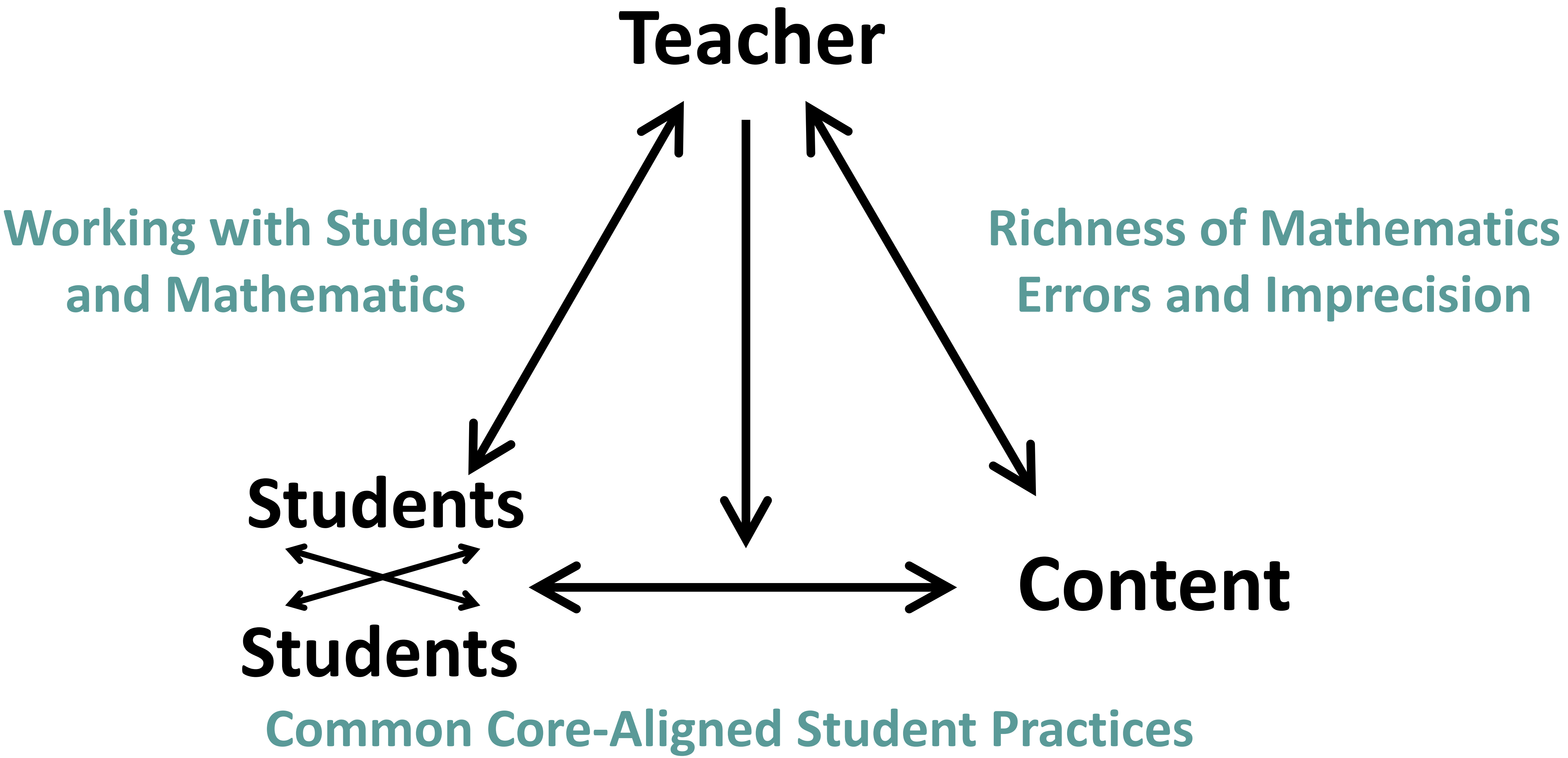
There's a range of possibilities!

There are a number of factors that might influence your answer:

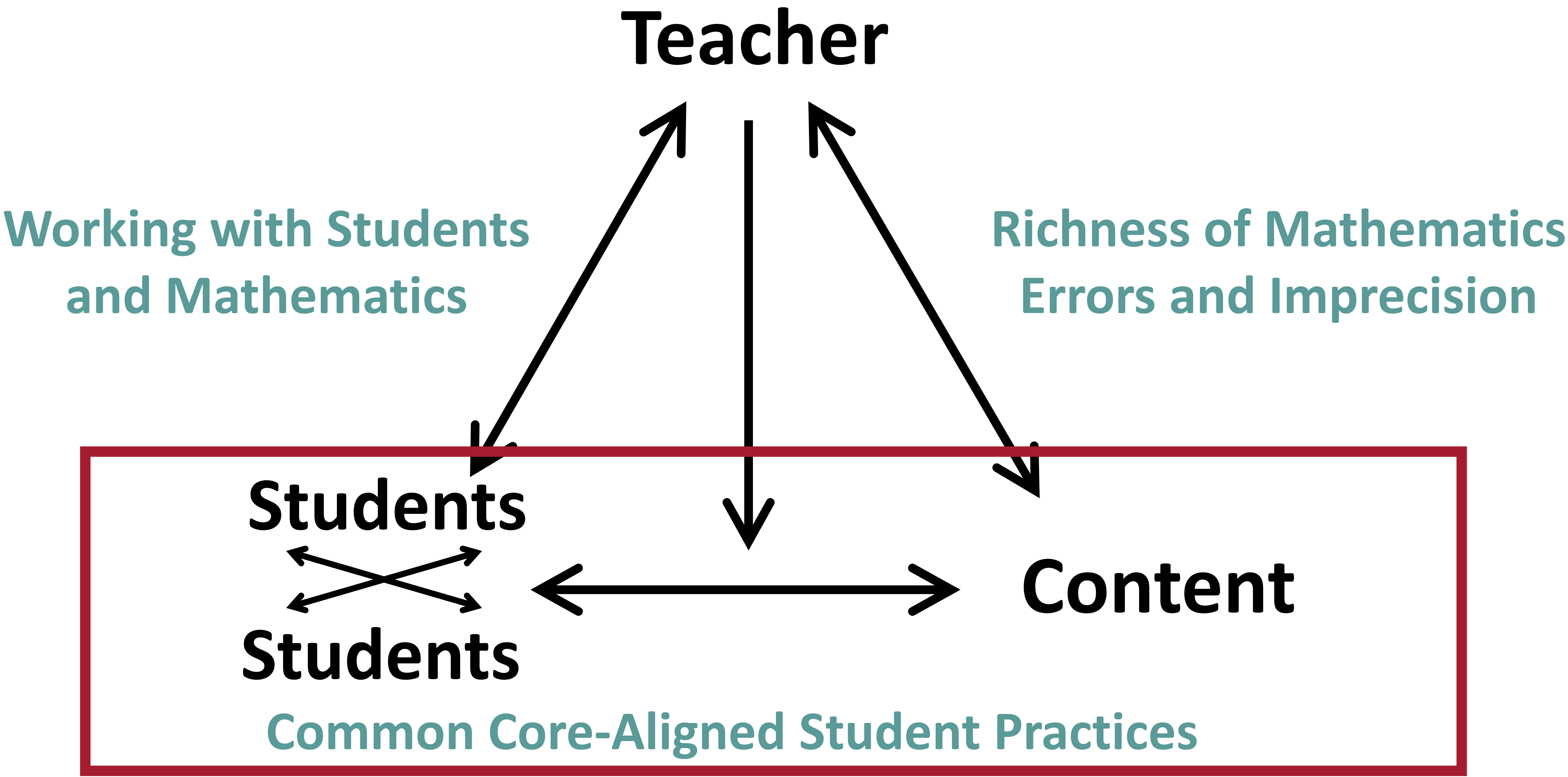
- How did you interpret the task? Do you think it is (or could be) a demanding task?
- How did you interpret the phrase "cognitive demand"?
- What did you expect the teacher and students to do next? What questions did you have?

Before we watch the rest of the clip, let's develop a shared understanding of what we mean when we say "cognitive demand".

The Mathematical Quality of Instruction (MQI)



The Mathematical Quality of Instruction (MQI)

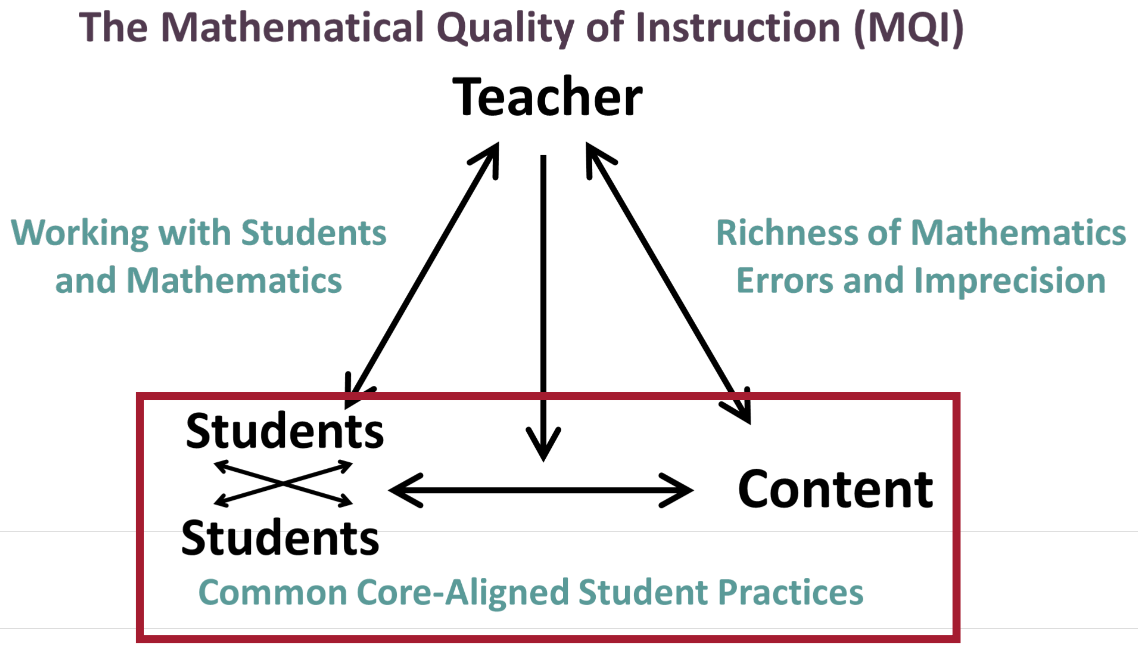


MQI COACHING

MQI Domain:
Common Core Aligned Student Practices

MQI Codes in the Common Core Aligned Student Practices domain

- Students Provide Explanations
- Student Mathematical Questioning and Reasoning
- Students Communicate about the Mathematics of the Segment
- **Task Cognitive Demand**
- Students work with Contextualized Problems



Take a few minutes to read the MQI code "Task Cognitive Demand"

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

Speculate – video of instruction

Using the MQI Code, "Task Cognitive Demand", what *might happen* in the next few minutes of this video if the instruction in the clip were to receive a score of:

- High?
- Not Present?

Note: do not change the problem or what we already saw, just try to imagine what the subsequent instruction *might look like* at both ends of the spectrum described in this MQI code.

Problem: *Asanya had two and one-thirds candy bars. She promised her brother that she would give him half of the candy bar. How much would she have left after she gives her brother the amount she promised?*

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

MQI COACHING

Watch
Abby: Mixed Number Subtraction

MQI COACHING

Describe the instruction: Task Cognitive Demand

- Now that you've seen what did happen, use the language of the MQI to describe what happened in this clip:
  - What score point would you assign?
  - What evidence supports your score?
    - From the clip?
    - From the rubric?

- Note: please don't (yet) talk about areas for growth or what you would have done differently. Just use evidence to describe what happened in these few minutes.

Elevate the instruction: Task Cognitive Demand

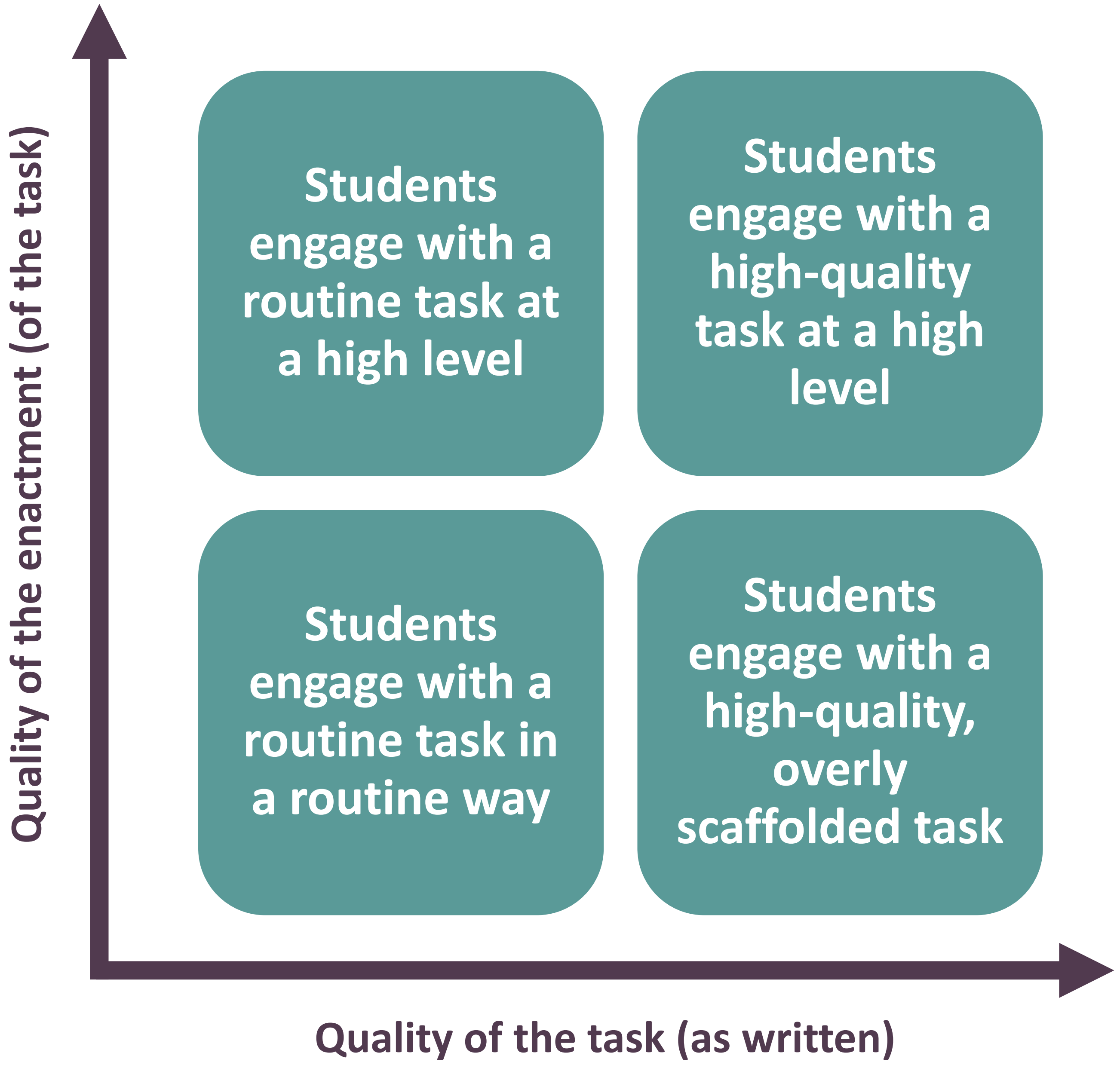
- What might this clip have looked like if it had been stronger on the Task Cognitive Demand code?
  - What would the students be saying or doing?
  - What could the teacher do to achieve that?

There are lots of possible ways to elevate!

Elevate by modifying the task	Elevate by modifying implementation
• • • • •	• • • • •

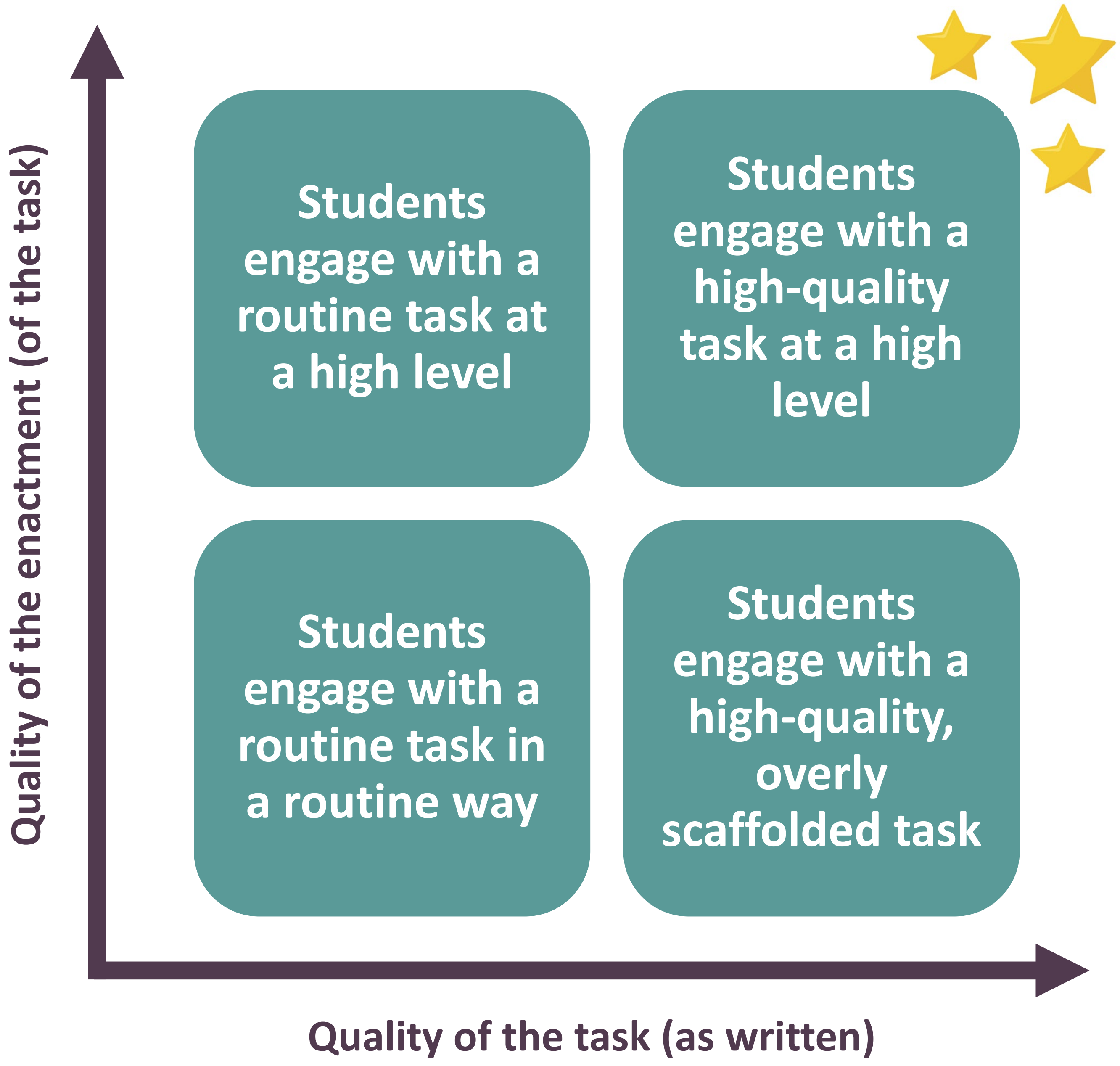
Task Cognitive Demand:

the interaction between the task as written and the enactment.



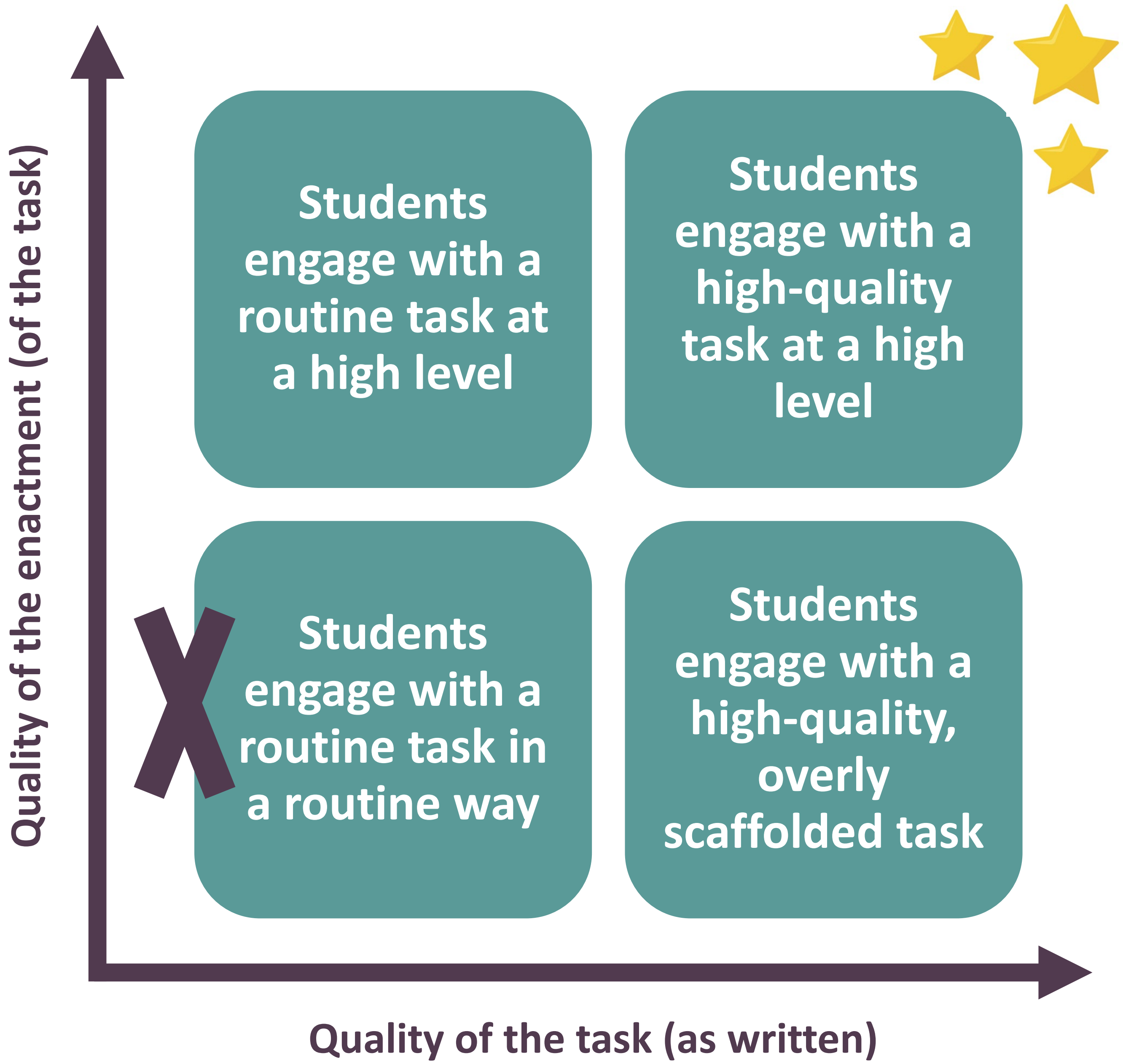
Task Cognitive Demand:

the interaction between the task as written and the enactment.

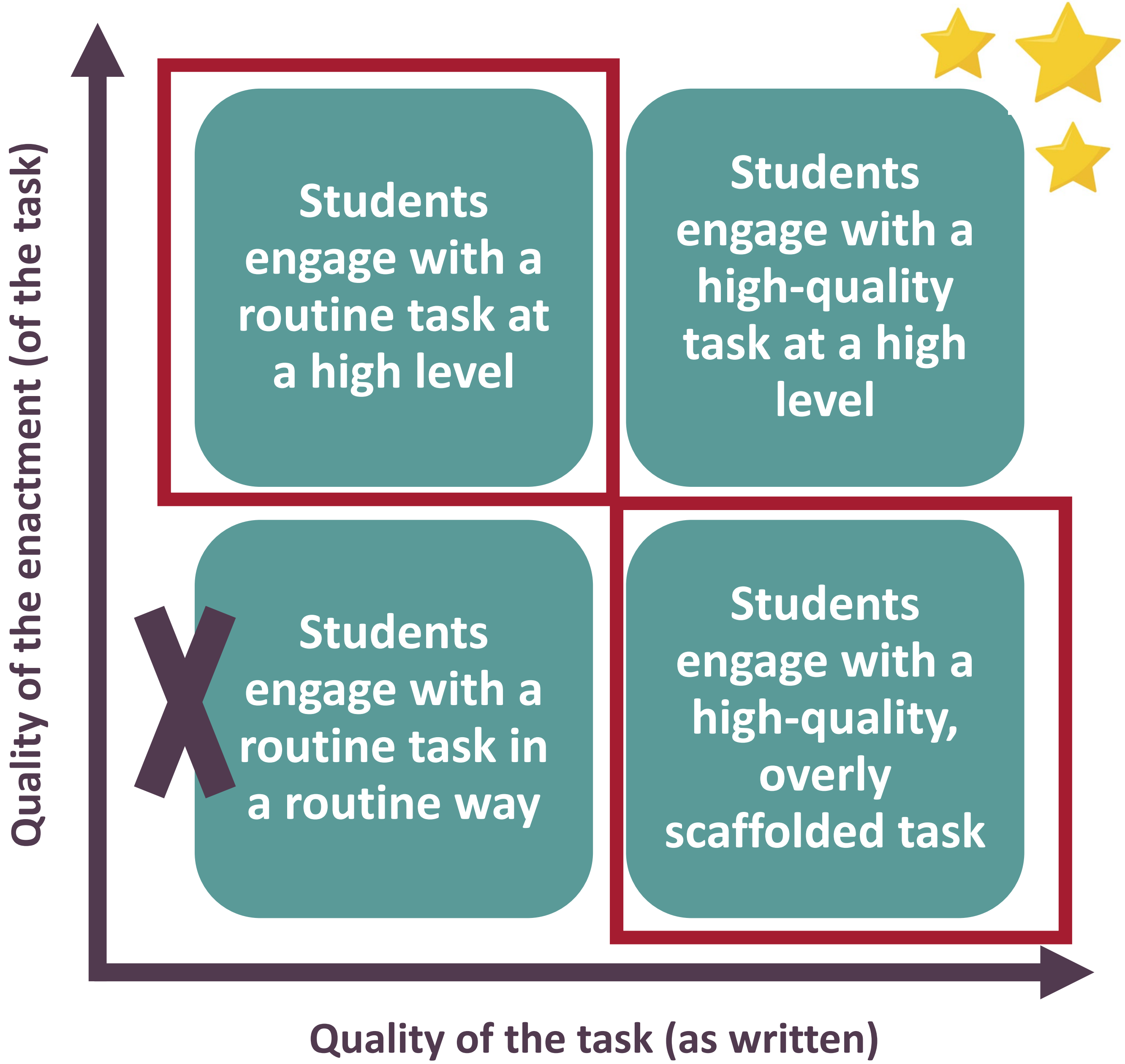


Task Cognitive Demand:

the interaction between the task as written and the enactment.

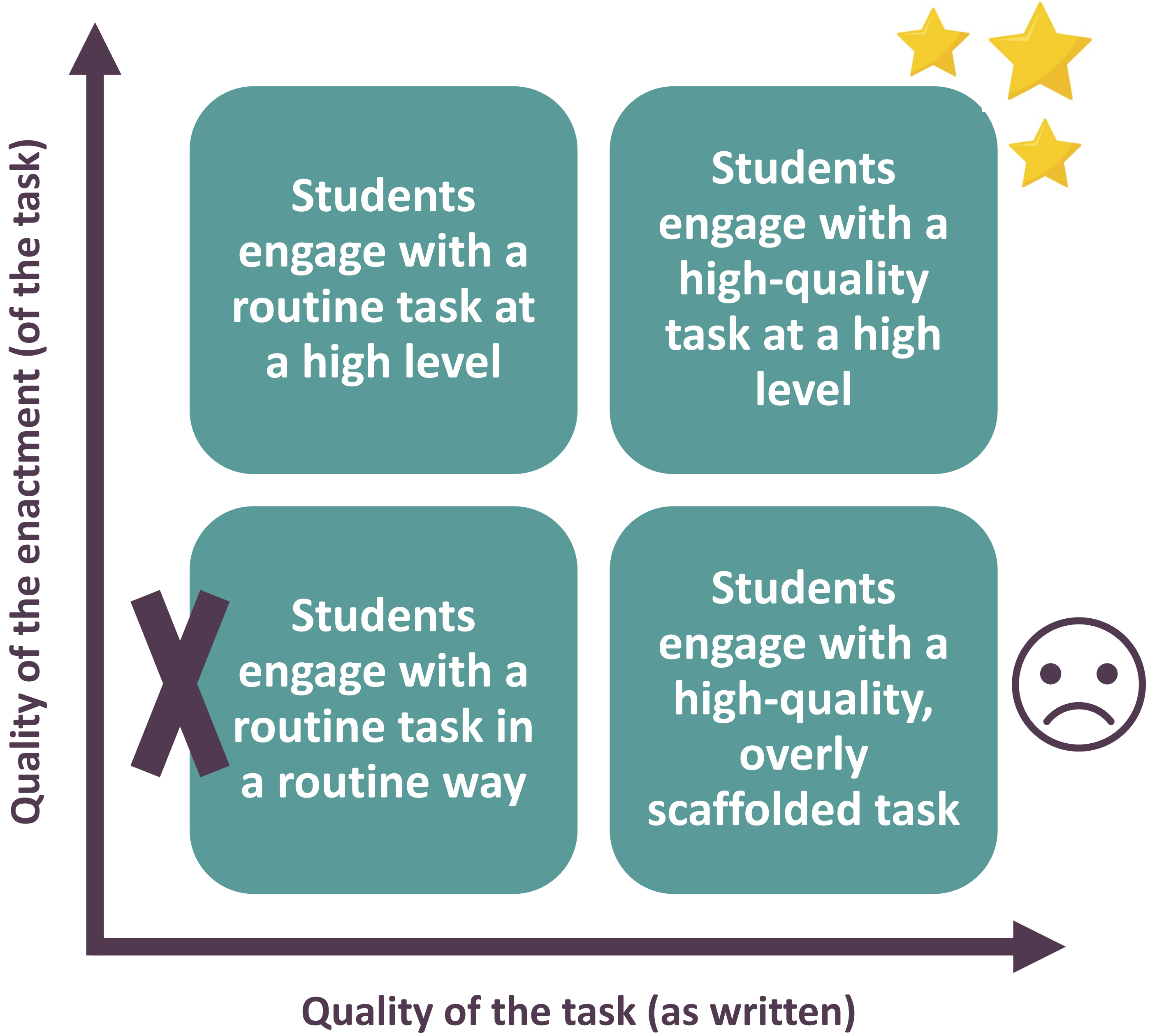


Task Cognitive Demand:
the interaction between the task as written and the enactment.

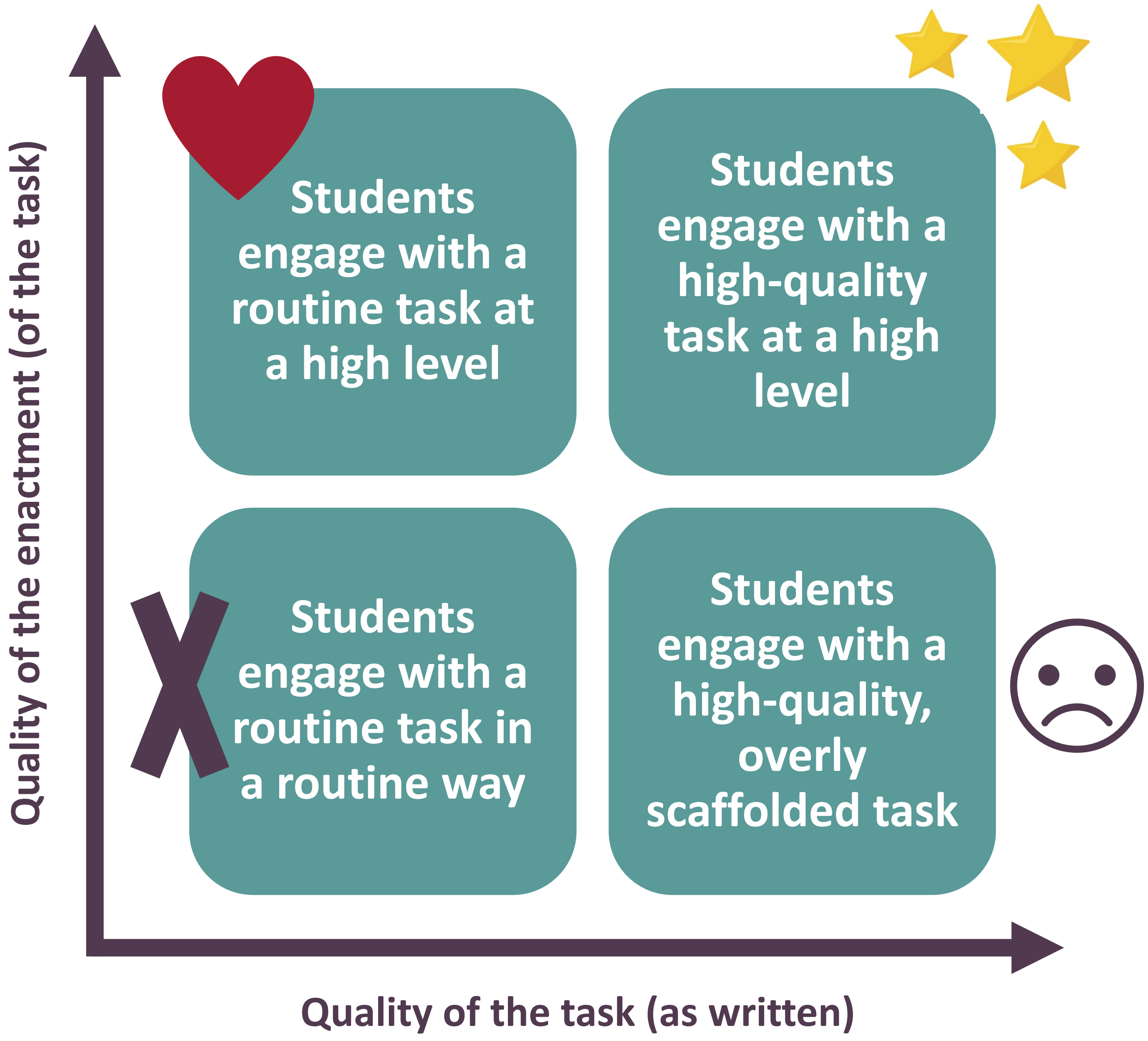


Task Cognitive Demand:

the interaction between the task as written and the enactment.



Task Cognitive Demand:
the interaction between the task as written and the enactment.



MQI COACHING

The Power of Small Instructional Tweaks

- **Agency**:
  - Can't always change core curriculum; can change the uses of the curriculum you have
  - Making these small tweaks is not one-size-fits-all. Each teacher can identify changes that feel right for them.
- **Immediacy**:
  - Choosing new materials, learning about them, and supporting their adoption takes substantial time
  - Small tweaks to implementation can be made to any lesson, *tomorrow*
- **Feasibility**:
  - Change is hard and scary. Suggesting many or large changes often results in resistance.
  - It's less overwhelming to discuss trying smaller changes. Small changes are more likely to be well-received.

Let’s talk about tasks!

Task 1:	**Task 2 (from Illustrative Mathematics):**
Solve the equation: $3(x + 2) = 15$	A town’s total allocation for firefighter’s wages and benefits in a new budget is \$600,000. If wages are calculated at \$40,000 per firefighter and benefits at \$20,000 per firefighter, write an equation whose solution is the number of firefighters the town can employ if they spend their whole budget. Solve the equation.

How could each of these tasks be implemented at both of the following levels of Cognitive Demand?

- High
- Not Present

Task 1 – Not Present

Task 1:

Solve the equation:

3(x + 2) = 15

- Students solve this and other problems like it on a worksheet or a whiteboard as classwork
  - *“Recalling and applying well-established procedures”*
- Students solved this problem for homework & share out their answers at the beginning of class
  - *“Going over homework with little additional student work (e.g., reporting numerical answers)”*
- Teacher solves this problem at the board, asking students to chime in with what the next step should be, e.g.
  - *“Listening to a teacher presentation with limited student input”*

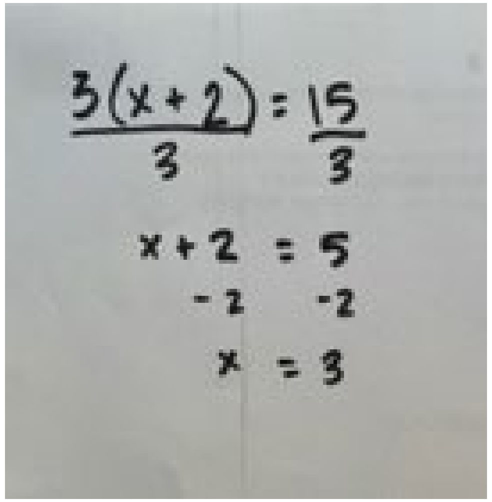
Task 1 – High

Task 1:

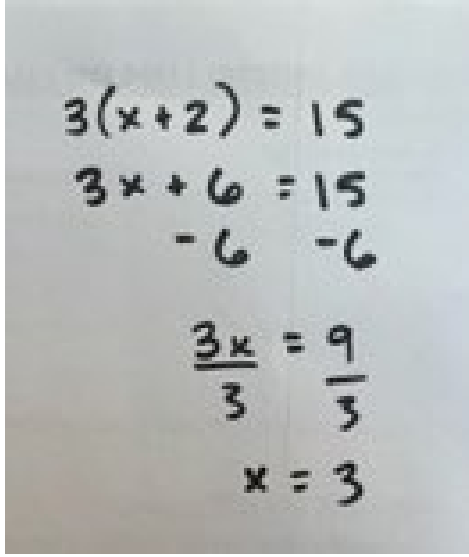
Solve the equation:

$3(x + 2) = 15$

Method 1: Divide



Method 2: Distribute



- **Error analysis:** Students work together in groups and compare solutions & methods. They share out what mistakes were made, and *why* those mistakes were incorrect.

  explain & justify

- **Comparing worked examples on the board:** "Let's take a look at two different solution methods for the problem"
  - "Can someone walk us through the first method?"
  - "Can someone walk us through the second method?"
  - "How are they similar?"
  - "How are they different?"
  - "Is one way more efficient? Why?"
  - Will that always be the case? Why?"

  Examine constraints; explain & justify

Task 2 - High

Task 2 (from Illustrative Mathematics):

A town’s total allocation for firefighter’s wages and benefits in a new budget is \$600,000. If wages are calculated at \$40,000 per firefighter and benefits at \$20,000 per firefighter, write an equation whose solution is the number of firefighters the town can employ if they spend their whole budget. Solve the equation.

- Students work on the activity independently initially followed by small group discussion
  - *"Determine the meaning of mathematical concepts, processes, or relationships"*

- Students share their own equations/strategies for the task – making sure to get to the "why" behind their decisions
  - *"Explain and Justify"*

- Students solve the problem by using either multiple equations, strategies, or representations and then compare and contrast each
  - *"Draw connections among different representations or concepts"*

Task 2 - Not Present

Task 2 (from Illustrative Mathematics):

A town's total allocation for firefighter's wages and benefits in a new budget is $600,000. If wages are calculated at $40,000 per firefighter and benefits at $20,000 per firefighter, write an equation whose solution is the number of firefighters the town can employ if they spend their whole budget. Solve the equation.

- Teacher solves the problem at the board while the students respond to step-by-step procedural questions with one or two word contributions
  - *"Listening to a teacher presentation with limited student input"*
- Students attempt the problem independently but without any progression forward – getting stuck
  - *"Unsystematic exploration"*
- Students solve the problem but in an overly-scaffolded way that involves only recalling of established procedures
  - *"Recalling or reproducing known rules, facts, or formulas"*

Let’s talk about YOUR tasks!

Think about a task you’ll be teaching next week:

1. How will you *avoid* implementing a task in a way that would score a Not Present on this MQI code?
2. How will you *plan for and then implement* a task in a way that would score a High on this MQI code?

Common elevation ideas to increase the Task Cognitive Demand of any Task

- Increase wait time
- Have students comment on each other’s mathematical thinking.
  - Do you agree with [student name]? Why or why not?
- Error analysis
  - Show a problem solved incorrectly.
  - “What is wrong?” “Why?”
- Compare & contrast (solution methods, representations, math concepts)
  - “How are these similar?”
  - “How are these different?”
  - “What can we learn from that?”
- Ask why:
  - “Why does that work?”
  - “Why did you make that decision?”
  - “Why did you choose that solution method?”

Questions?

How do you balance time spent on a cognitively demanding task verses fluency/practice of a concept in the lesson?

Where are examples of effective, differentiated scaffolds that support all students to perform this cognitive lift?

How to strategize for cultural and linguistic student identity in the math room?

How do you get teachers to see and understand the benefits of a student-centered classroom where students are doing the thinking?

MQI COACHING

Thank you! If you want to learn more:

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

MQI Fall Virtual Coach Training: registration closes next Friday!

JONATHAN THOMPSON
Center for Education Policy Research
at Harvard University
jthompson@gse.harvard.edu

CLAIRE GOGOLEN
Center for Education Policy Research
at Harvard University
Claire_gogolen@gse.harvard.edu