MATHEMATICAL QUALITY OF INSTRUCTION (MQI)
-EXCERPT-

©2014 Learning Mathematics for Teaching/Heather Hill
Use of these copyrighted materials; including, but not limited to reproduction, modification, translation, publication, and creation of derivative works without the expressed written consent of the author is prohibited.

This material is based upon work supported by the National Science Foundation under grant numbers EHR-0233456, DUR-0335411 and DRL-0918383 and work supported by the U.S. Department of Education under cooperative agreement number R305C090023

Mathematical Quality of Instruction (MQI) - EXCERPT

This excerpt contains two MQI codes. The first, Linking between Representations, is part of the Richness of the Mathematics domain, and therefore refers to the richness of the *mathematical content*, without regard for who is doing the lining (teacher or students). The second, Task Cognitive Demand, is part of the Common Core-Aligned Student Practices Domain, and refers to the cognitive demand of the lesson *for students*- the extent to which the students, not the teacher, are engaging in cognitively demanding mathematics work. A brief overview of the four domains of the MQI is below.

Mathematical Quality of Instruction (MQI)

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.

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?

Working With Students and Mathematics

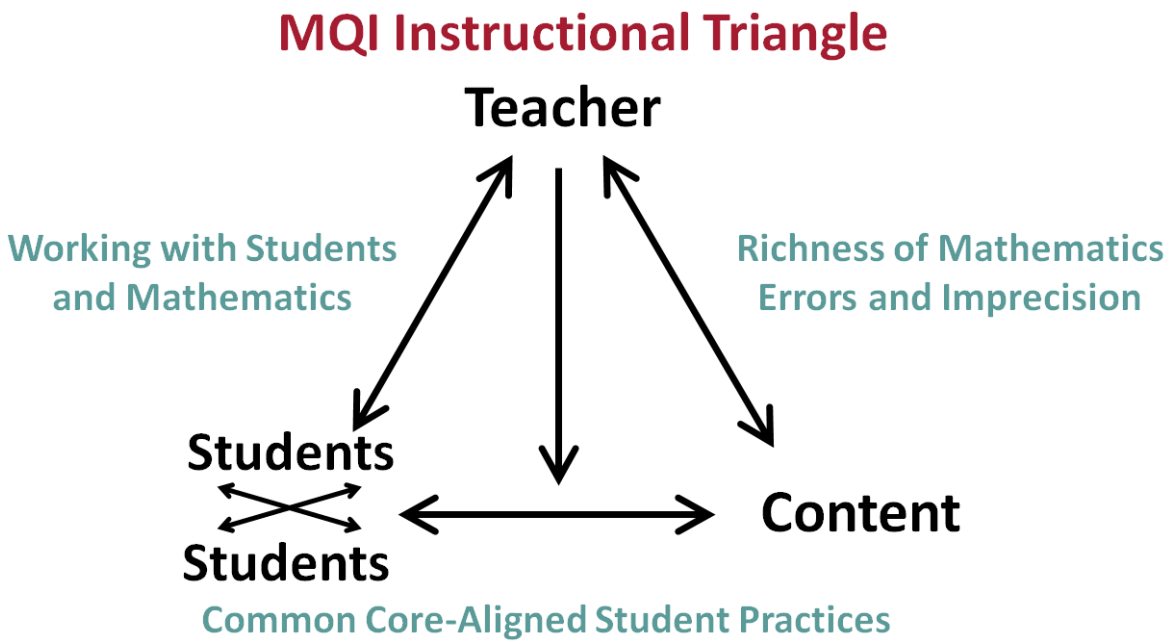
To what extent does the teacher use student mathematical ideas or misconceptions to move the lesson forward?

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?



Linking Between Representations

This code refers to teachers' and students' explicit linking and connections between different representations of a mathematical idea or procedure. To count, these links must occur across different representational "families" e.g., a linear graph and a table both capturing a linear relationship. So, two different representations that are both in the symbolic family (e.g., 1/4 and 0.25) are not candidates for being linked.

For Linking Between Representations to be scored above a Not Present:

- At least one representation must be visually present
- The explicit linking between the two representations must be communicated out loud

For Linking Between Representations to be scored Mid or High, two conditions must be satisfied:

- Both representations must be visually present
- The correspondence between the representations must be explicitly pointed out in a way that focuses on meaning (e.g., pointing to the numerator in 1/4, then commenting that you can see that one in the figure, pointing to the four in the denominator, pointing to the four partitions in the whole. "You can see the 1 in the 1/4 corresponds to the upper left-hand box, which is shaded, showing one piece out of four total pieces...")

For geometry, we do not count shapes as a representation that can be linked—we consider those to be the "thing itself." However, links can be scored in geometry if the manipulation of geometric objects is linked to a computation, e.g., showing that two 45-degree angles can be combined to get a 90 degree angle and linking that to the symbolic representation 45 + 45 =90.

Note: If links are made but underlying representation/idea is incorrect, do NOT count as linking between representations.

Not Present	Low	Mid	High
No linking occurs. Representations may be present, but no connections are actively made.	Links are present in a pro forma way; For example, the teacher may show the above figure and state that one quarter is one part out of four. These links will not be very explicit or detailed; both representations need not be present.	Links and connections have the features noted under High, but they occur as an isolated instance in the segment.	Links and connections are present with extended, careful work characterized by one of the following features: • Explicitness about how two or more representations are *related* (e.g., pointing to specific areas of correspondence) OR • Detail and elaboration about the relationship between two mathematical representations (e.g., noting meta-features; providing information about under what conditions the relationship occurs; discussing implications of relationship) These links will be a characterizing feature of the segment, in that they may in fact be the focus of instruction. They need not take up the majority or even a significant portion of the segment; however, they will offer significant insight into the mathematical material.

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

Guiding Questions for Describing Instruction using the MQI:

Linking Between Representations (from the Richness of the Mathematics domain)

- Are the two (or more) representations referred to from different "families"?
- How many of the representations are visually present?
- Is there an explicit link between the representations communicated out loud?
- Are the links made in a pro forma way with little detail?
- What is the level of explicitness or detail and elaboration used in the linking?
- Do these links occur as an isolated instance or are they a characterizing feature, the focus, of the clip?

Task Cognitive Demand (from the Common Core-Aligned Student Practices domain)\

- What are the mathematical tasks or activities students are engaged in?
- To what extent are the students, as opposed to the teacher, the ones *doing* the mathematics in the segment?
- Are the students engaged in cognitively undemanding or demanding activities?
    - What does the MQI provide as examples of cognitively undemanding activities?
    - What does the MQI provide as examples of cognitively demanding activities?
- Were the cognitively demanding activities brief or more sustained?
- Did the cognitive demand level vary?