Explaining the M-Powering Automated Feedback Measures

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This Explaining the M-Powering Automated Feedback Measures document was developed by the MQI Coaching project at the Center for Education Policy Research at Harvard University.

Our work was funded under National Science Foundation grants No. 2241583 and No. 1348144 and draws on NCTM's 5 Math Practices as well as scholarship within the field of mathematics education (e.g., Alic, et al., 2022, Herbel-Eisenmann et al., 2013). The opinions expressed herein are those of the authors and do not necessarily reflect those of the National Science Foundation.

Contact samantha_booth@gse.harvard.edu for information about coaching programs that complement and support teachers' use of the M-Powering measures.

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Talk Distribution and Length

This captures the extent to which students communicate their mathematical ideas during the lesson, either in whole group or small group settings. In some instances, students use very few words in a math classroom – providing one-word answers or responding to closed-ended questions. In other instances, students offer lengthier contributions that offer more substantial insight into their thinking. Providing students with the opportunity to communicate their thinking and engage in classroom discourse promotes students as sense-makers and builds a shared understanding of math concepts.

When students provide lengthier responses, they often contribute in one or more of the following ways:

- Presenting solution methods publicly
- Discussing solution methods
- Commenting on the reasoning of others
- Asking mathematical questions
- Describing the meaning of a term
- Offering an explanation

Brief/minimal student mathematical talk	Lengthier/substantial amounts of student mathematical talk
• Student talk makes up a small portion of the classroom discourse • Student communication consists mostly of brief (one- or two-word) answers with occasional longer responses.	• Students are engaging in discussion and doing the bulk of the talk in the classroom. • Student communication is characterized by longer responses that fall into one of the categories listed in the examples above.

Examples of Ways to Promote More/Substantial Student Talk

- Follow up student contributions with "how" or "why" questions:
  - "How did you solve the problem?"
  - "Why did you choose that strategy?"
- Intentionally plan for and allow students ample individual think time/wait time before expecting them to respond (either in partners/groups, or whole class).
- Use "turn and talks" as a way for students to share their thinking in smaller groups.
- Provide sentence starters as scaffolds to support students in coming up with lengthier responses:
  - "One strategy I could use to solve this problem is to…"
  - "I know this is true/correct because…"
  - "I notice…"
  - "My next step is to…"
  - "I agree/disagree with what you said because..."
  - "My strategy is the same/different than yours because…"
- Provide references around the classroom that students can draw upon when responding:
  - Lists of problem-solving strategies
  - Math vocabulary word wall
  - Content-specific resources (e.g., place value chart, labeled graphs, labeled shapes, etc.)
- Reinforce classroom norms that encourage students to share their thinking (correct or incorrect) and respectfully listen to classmates.

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Student Reasoning (Reasoning)

Reasoning occurs when students express their thinking and reasoning out loud. Talking about their reasoning allows students to refine their understanding of mathematical ideas, makes student mathematical ideas public, and supports mathematical discussion and debate. Encouraging student reasoning also allows teachers insight into students' understandings and misunderstandings about lesson material.

Examples of Student Reasoning:

- Offering explanations or attending to sense-making about:
  - why a procedure works
  - the meaning behind the steps taken to solve a problem (attending to "why" vs. just "how" or "what")
  - what an answer, quantity, or expression/equation means
  - the suitability of some solutions methods as opposed to others
  - the reasonableness of an expression, solution method, or answer
  - connections between mathematical ideas and representations
- Providing a claim/conclusion that differs from another student's
- Asking mathematical questions
- Making observations about expressions, representations, or patterns

Less/some student reasoning	**More/substantial student reasoning**
• Students may talk infrequently OR • Student talk is focused on "how" and "what" contributions rather than student reasoning	• Students are engaging in one or more types of reasoning frequently

Examples of Ways to Promote Reasoning

- Plan for and implement tasks that explicitly elicit reasoning. Prompts can include:
  - Justify your answer
  - Explain your reasoning
  - Solve using at least two methods/representations
- Ask open-ended questions to students to allow them to further explain their thinking:
  - "Why did you ___?"
  - "What does that [answer/picture/representation] mean?"
  - "Why does that [step/method] work?"
  - "How is [topic] similar/different from [other topic]?"
- Promote multiple solution paths, and when sharing out encourage students to share why they picked that particular method and/or compare multiple methods.
  - "I noticed you ___. Tell me more about why you chose to solve in that way."
  - "What is similar/different between these two methods?"
- Offer sentence starters to students to help them explain their thinking:
  - "I chose this method because..."
  - "I agree/disagree with [Student B] because…"
  - "I solved using ___ method/strategy because…"
  - "I know this isn't true because…"
  - "Based on the pattern, I think…"

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Teacher Uptake of Student Ideas (Uptake)

Uptake captures when a teacher acknowledges and/or uses student contributions in the math lesson. Uptake is a way for teachers to affirm students' thinking, demonstrate that students' mathematical ideas are heard, and emphasize key pieces from students' contributions. When done throughout a lesson, a teacher can strategically weave student ideas into the development of the mathematics.

Minimal uptake of students' ideas	**Some/stronger uptake of students' ideas**
Teacher briefly responds/acknowledges student contribution. Examples include: - Acknowledging a student response as correct or incorrect and immediately moving on to the next step or problem ("that's right" or "ok, what did you do next?") - Recognizing a student contribution as interesting but without specificity or using it further ("interesting thought!")	Teacher response and use of student contributions is more substantial. Examples include: - Revoicing/restating a student idea - Expanding upon a student idea "Simone's strategy is effective because…" - Emphasizing key ideas in a students' statement ("Tori said that she noticed a pattern…") - Identifying a student with an idea ("Jose's method connects to...")

Examples of Ways to Promote Uptake

- While lesson planning, anticipate student responses and consider what methods or key ideas you might highlight.
- While students are working, circulate to monitor and select student work to amplify during whole group discussion.
- Follow-up student contributions by revoicing what they are saying and expanding on their mathematical ideas.
    - "So [Student 1] is saying that [summarize Student 1's thinking]. This is interesting because ___."
    - "[Student 2] is noticing [summarize Student 2's thinking]. This becomes important when ___."
    - "[Student 3] did something really interesting in their solution. [Summarize Student 3's solution.] Would this work for other problems, too?"
- Ask students follow-up questions after they contribute a line of thinking to gather additional information and to progress student learning:
    - "I noticed that you said ___. Why do you think that?"
- Revoice a student idea, and then ask other students to comment:
    - "I heard [Student 1] say ___. Do others agree or disagree, and why?
    - "I see that [Student 2] solved using [strategy/operation] and [Student 3] solved using [other strategy/operation]. Let's compare their methods to see what we think."
- Validate students when they contribute mathematical thoughts and ideas and explain why their contribution helpful to the learning community:
    - "That's a great thought! It connects to what we're working on ___."
    - "I like how you ___ because..."

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Teacher Focusing Questions (Questioning)

Questioning happens all throughout a math lesson. The metric on focusing questions attends specifically to teacher questioning that is meant to open up space for student talk and reasoning. Focusing questions probe students to voice their ideas, reflect on their own or other students' thinking, and to deepen their understanding of the mathematics. When teachers ask focusing questions, they treat students' contributions as valuable ideas for further exploration and sense making. This contrasts with asking questions that direct students towards a desired solution path without much attention to the students' method and reasoning (Alic, et al., 2022).

Infrequent use of focusing questions	Frequent use of focusing questions
• Teachers rarely ask questions that focus students' ideas and often direct students toward a teacher-preferred solution or strategy (e.g., "And next, look at the ones. What is 8 + 8?")	Teachers frequently use focusing questions to open up space for student talk and reasoning.

Examples of Common Types of Focusing Questions

- **What** - "What else could you try?" "What do you think about that?" "What does your answer mean?" "What else do we know about ___?"
- **How** - "How did you come up with that solution?" "How else might you think about the problem?" "How did you know where to start?" "Did you pull that [number/operation] from the [representation/word problem]?"
- **Why** - "Why do you think that method works?" "Why did you start with that part?" "Is that estimate reasonable?"
- **Tell me more** - "Okay. Go ahead. Tell me more about the strategy you chose."
- **Comparing to similar/different methods** - "How is this similar/different to Student A's method?" "That's an interesting method. Does it work here?"
- **Comparing to similar concepts** - "How are the attributes of [geometric shape] similar to the [other geometric shape] we learned last week?"
- **Possibility of New Scenarios** - "What might happen if ___?" "What else would have to happen?"
- **Responding to Peers** - "I hear her saying ___. Does anyone else know what she means when she says that?" "Can someone revoice what Student Z just said?"

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Math Language

This captures teacher and students' use of math vocabulary. Teachers serve as "native speakers" of mathematics for students, modeling the fluent use of terms, reinforcing their meaning, and encouraging students to use that vocabulary themselves. When students use mathematical vocabulary, they have an opportunity to consolidate their knowledge of and practice using specific terms.

Low frequency of mathematical vocabulary	High frequency of mathematical vocabulary
• Teacher rarely uses mathematical vocabulary, uses general terms instead of technical terms • Students rarely use mathematical vocabulary, use general terms instead of technical terms	• Teacher uses mathematical terminology/vocabulary frequently • Students are frequently using mathematical vocabulary

Examples of Ways to Promote Use of Mathematical Language

- While lesson planning, identify key math terms and how you will incorporate it into the lesson
- Model frequent use of mathematical language during the lesson
- Define math terminology
- Provide resources (e.g. word wall, previewing vocabulary) to support student use of technical terms
- Use both the colloquial/student language and the technical/precise math terms side-by-side to help students learn the terminology:
    - Student: "I timesed it"
    - Teacher: "Oh great! You *multiplied* it? That's the word mathematicians use for 'timesing.'"
- Repeat students when they accurately use mathematical language in a way that reinforces the use of the vocabulary and recognizes its use, e.g.,
    - "I heard [Student C] use the word factor. What did they mean when they used that word?"
- Encourage students to use mathematical vocabulary words when they are describing a math process in more general terms
    - "I heard you talking about the 'bottom of the fraction.' What math vocabulary word might we have used there?"

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