CORE LEARNING

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Let’s Talk! Engaging Learners in Meaningful Math Discourse

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Moderator

Cyndia Acker-Ramirez, M.Ed.

Director, Professional Learning, CORE

Today's Discussion Will Cover:

- How math discourse makes deep math learning accessible to all students
- What's needed to create an environment and culture that supports math discourse
- Key considerations when planning and preparing for math discussions that are engaging and affirming for students
- How to leverage math language routines to advance student thinking

Panelists

Tatiana Mirzaian, M.Ed.

Program Manager, CORE

Former high school math teacher and a clinical faculty at Loyola Marymount University

Kathleen Stevens, M.Ed.

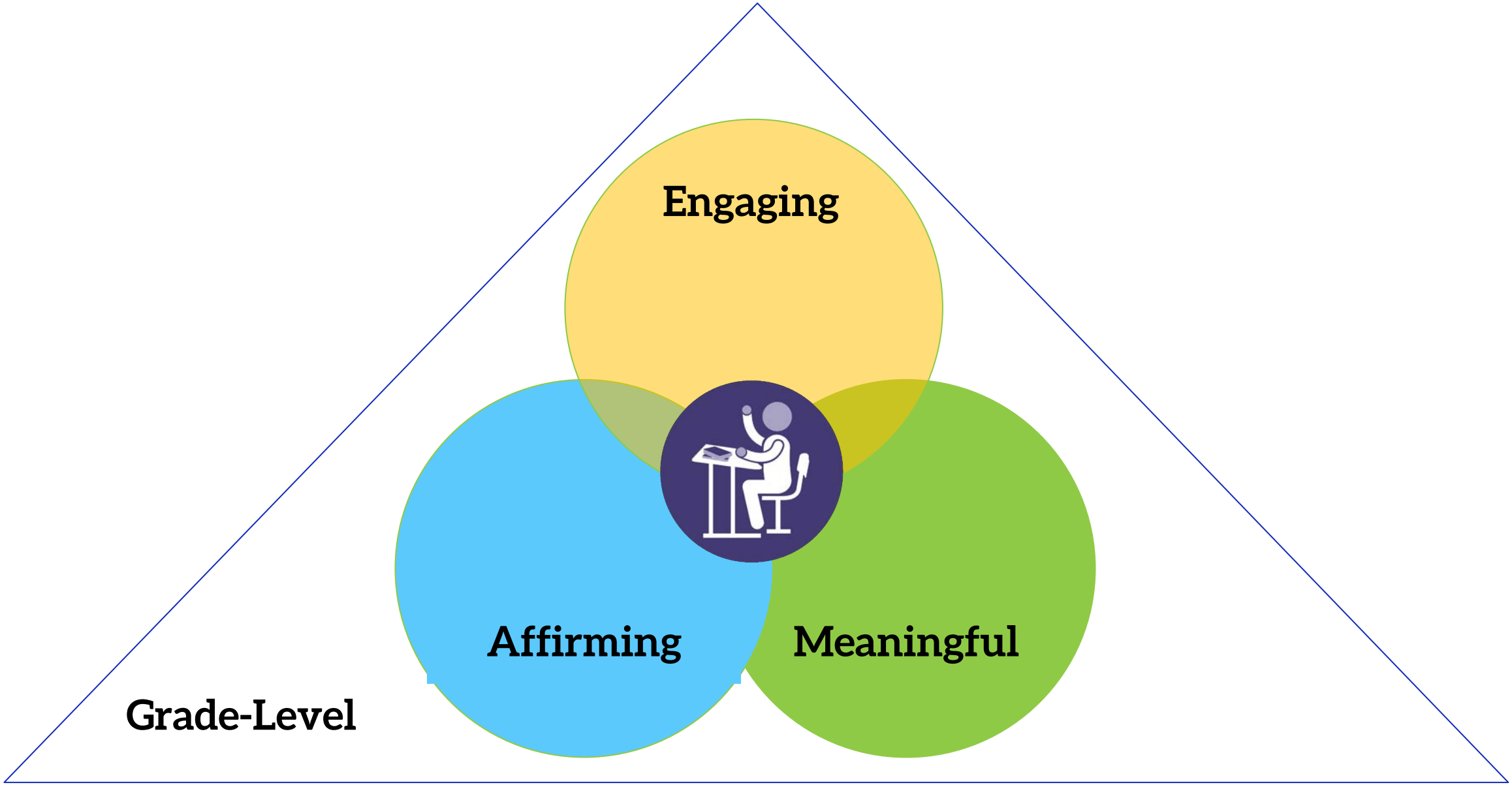
Director, Curriculum Services, CORE

Former middle school math teacher, curriculum coach, instructional technology coordinator, and district level director

Rolanda Baldwin

Vice President, Mathematics, UnboundEd

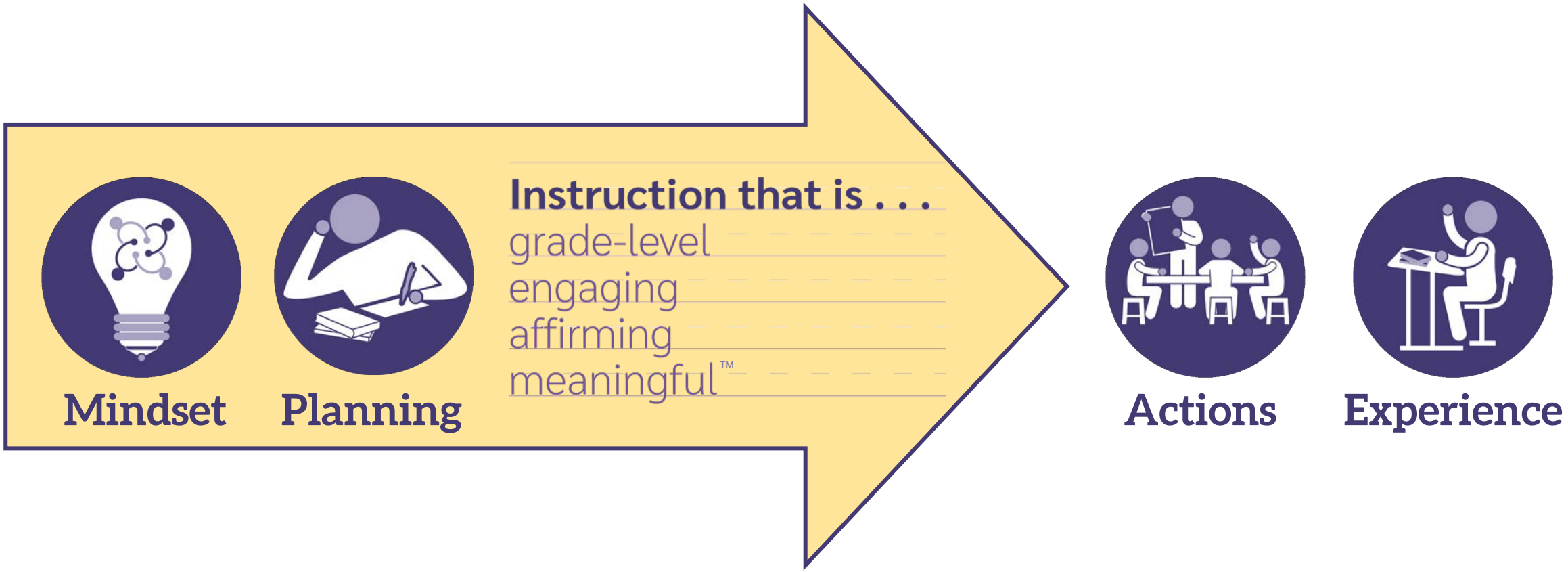
Former middle and high school math teacher, instructional coach, and curriculum coordinator


Engaging
Affirming
Meaningful
Grade-Level

> I argue that the first problem that teachers confront is believing that successful teaching for poor students of color is primarily about 'what to do.' Instead I suggest that the problem is rooted in how we think—about the social contexts, about the students, about the curriculum, and about instruction.
>
> — Gloria Ladson-Billings

Source: Ladson-Billings, 2008

Our GLEAM™ Hypothesis



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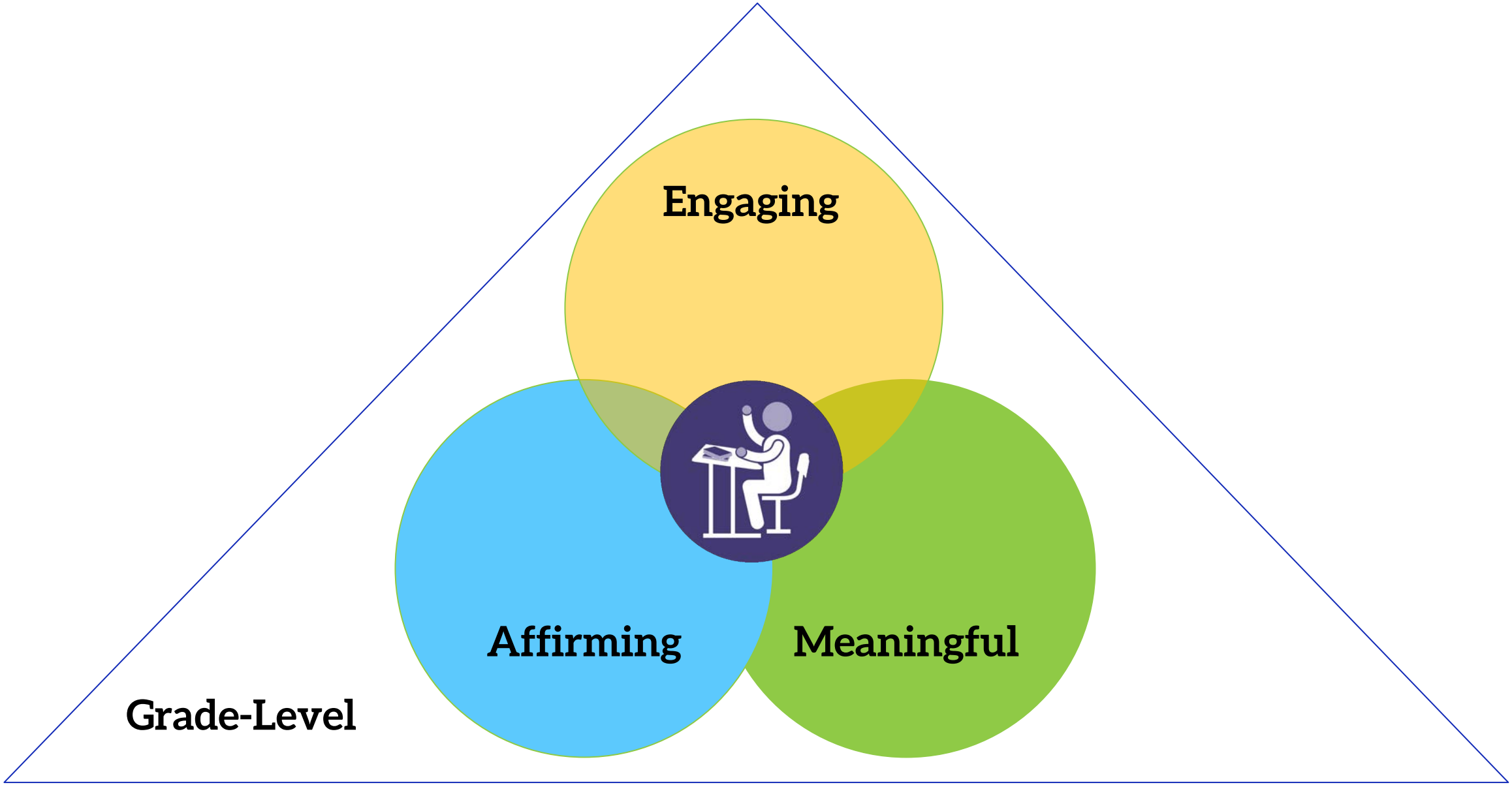

Engaging
Affirming
Meaningful
Grade-Level

> Math identity is defined as the dispositions and deeply held beliefs that students develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics in powerful ways across the context of their lives.
>
> — Aguirre, Mayfield-Ingram, & Martin

Source: Aguirre, Mayfield-Ingram, & Martin, 2013

What are some ways that we can foster positive student beliefs about their ability to participate and perform effectively in mathematical contexts?

> Classrooms of students can exhibit *collective mathematical agency* when teachers and their students act together to solve problems, working from the shared belief that viable strategies can be developed and solutions can be found.
>
> — Aguirre, Mayfield-Ingram, & Martin

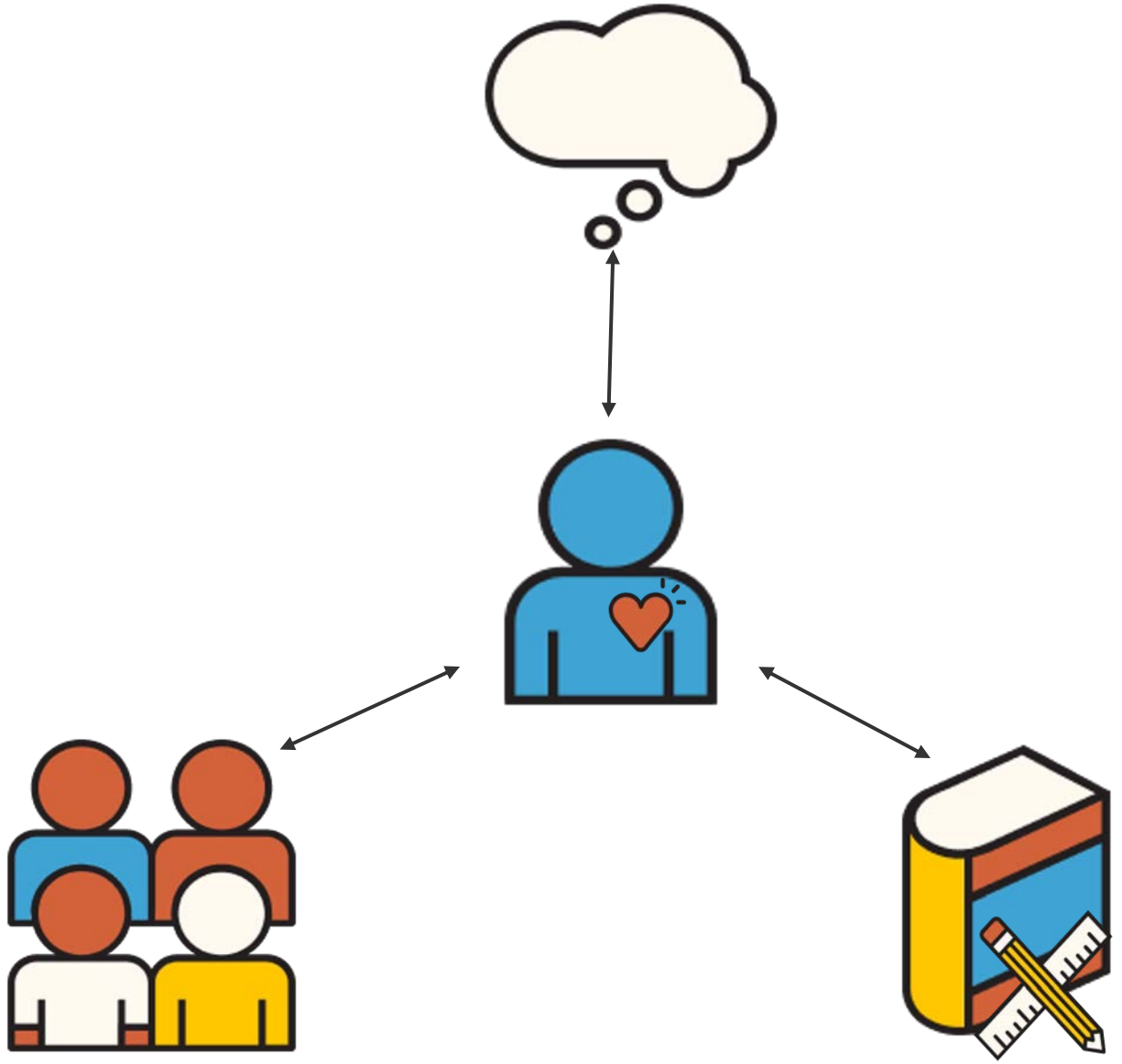
Source: Aguirre, Mayfield-Ingram, & Martin, 2013

The goal of this discourse is to

(1) transition from teacher as the sole questioner to teachers and students as questioners,
(2) encourage students to explain their mathematical reasoning,
(3) allow students' math ideas to influence the direction of the lesson, and
(4) promote student responsibility for learning and evaluating their progress and the progress of others

–Hufferd-Ackles Fuson, & Sherin, 2004

What student mathematical thinking will I see and hear?



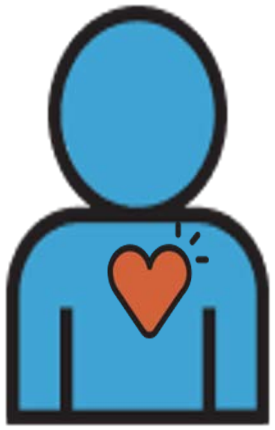
adapted Elmore, City, Teitel, 2009

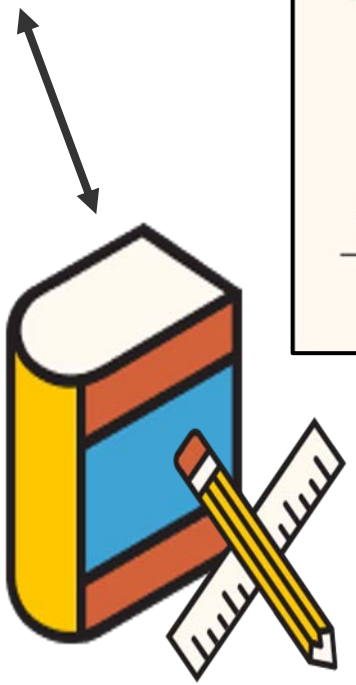
4th Grade Standard

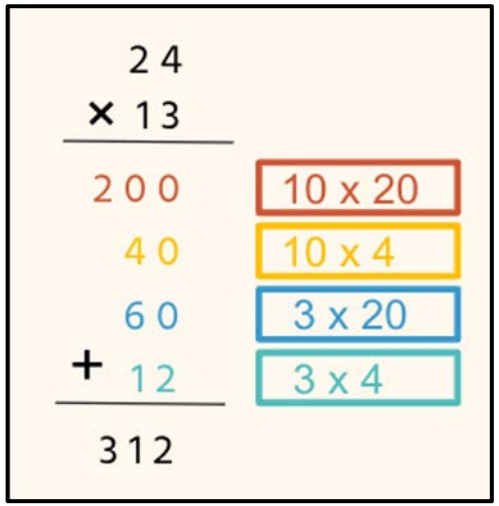
Multiply a whole number of up to four digits by a one-digit whole number and multiply two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models

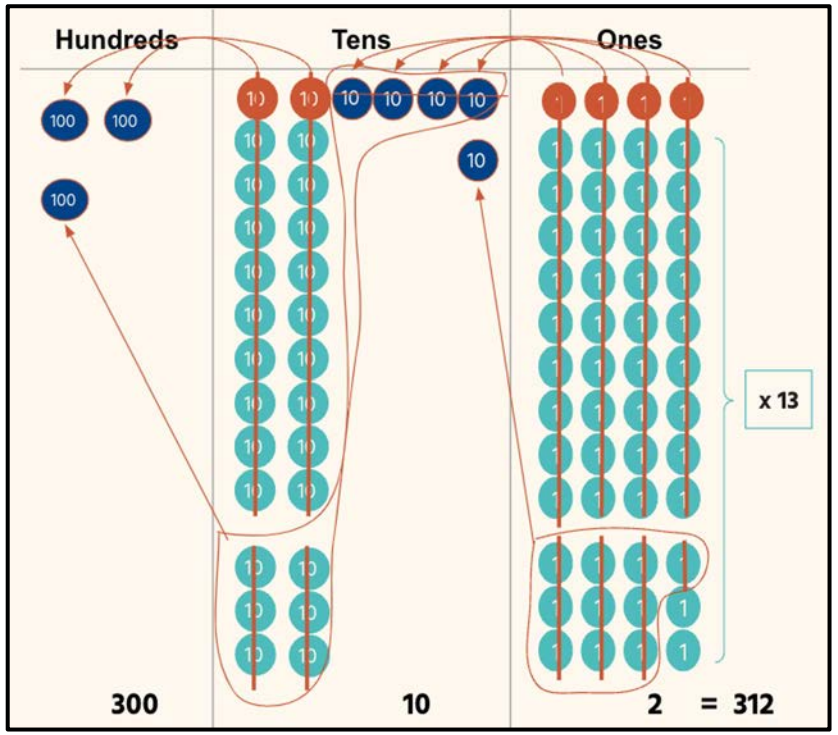
Student ⟷ Math Task Interaction

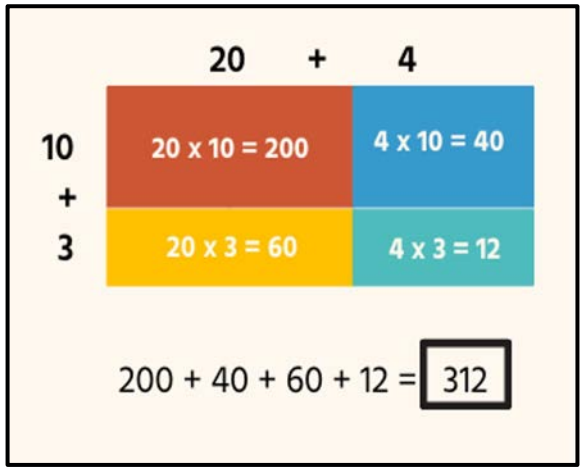
Predict Representations & Strategies











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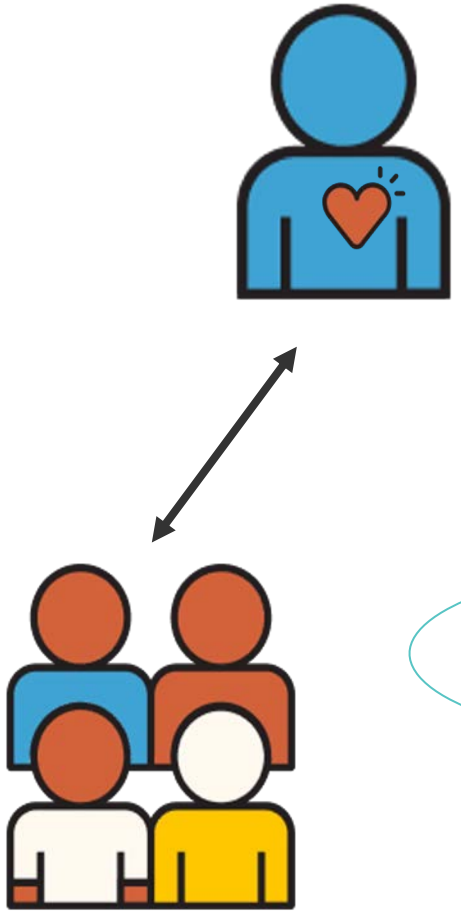
Student ⟷ Student Interaction

Predict Student **Reasoning** & Connections



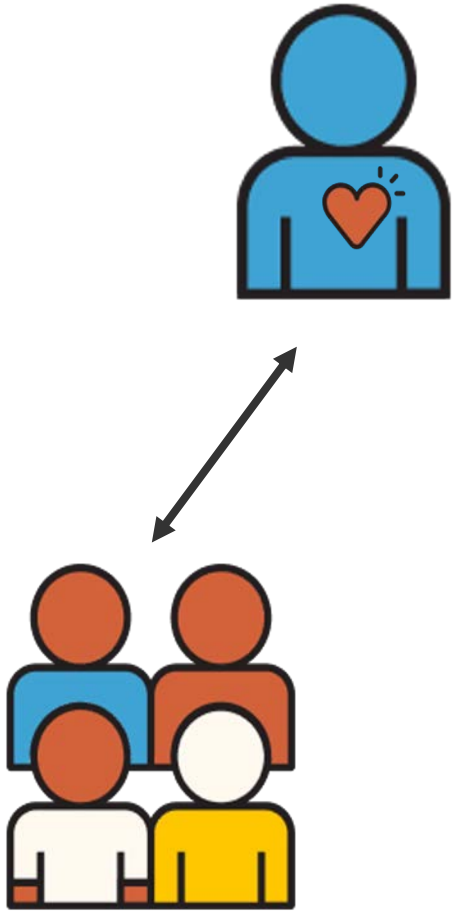
24		
× 13		
200	10 x 20	
40	10 x 4	
60	3 x 20	
+ 12	3 x 4	
312		

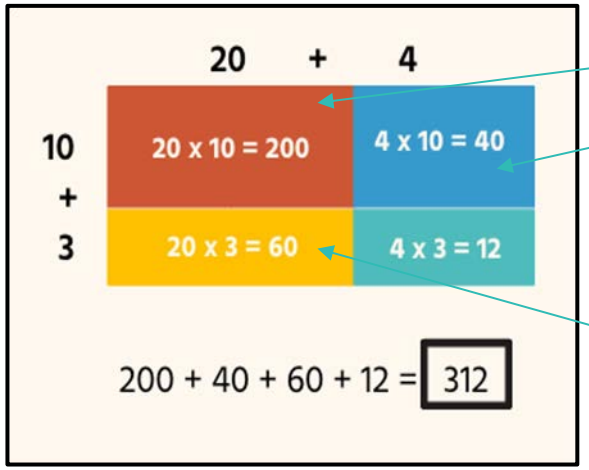
1 ten times 2 tens

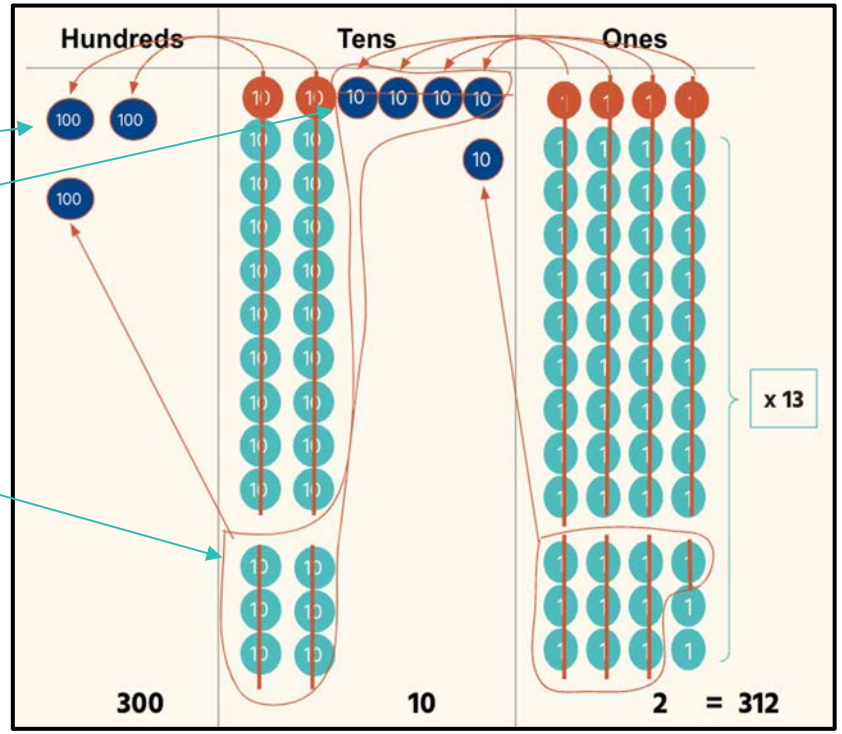
Add up all the products

Student ⟷ Student Interaction

Predict Student Reasoning & **Connections**

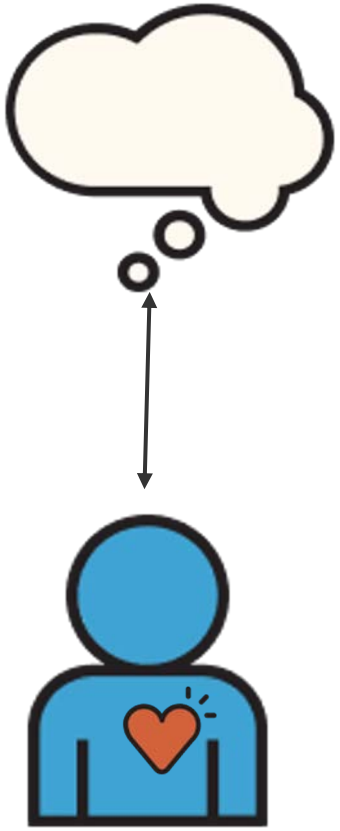


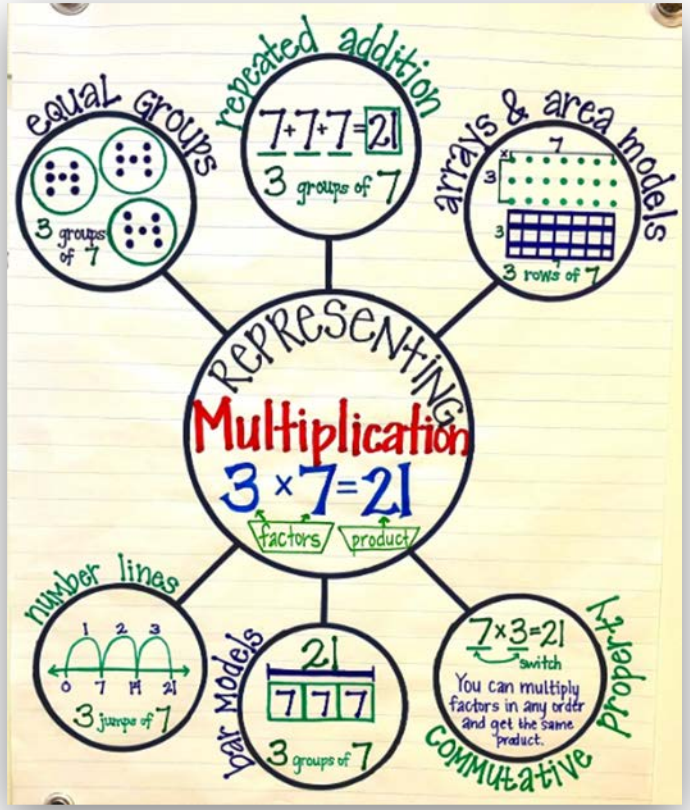


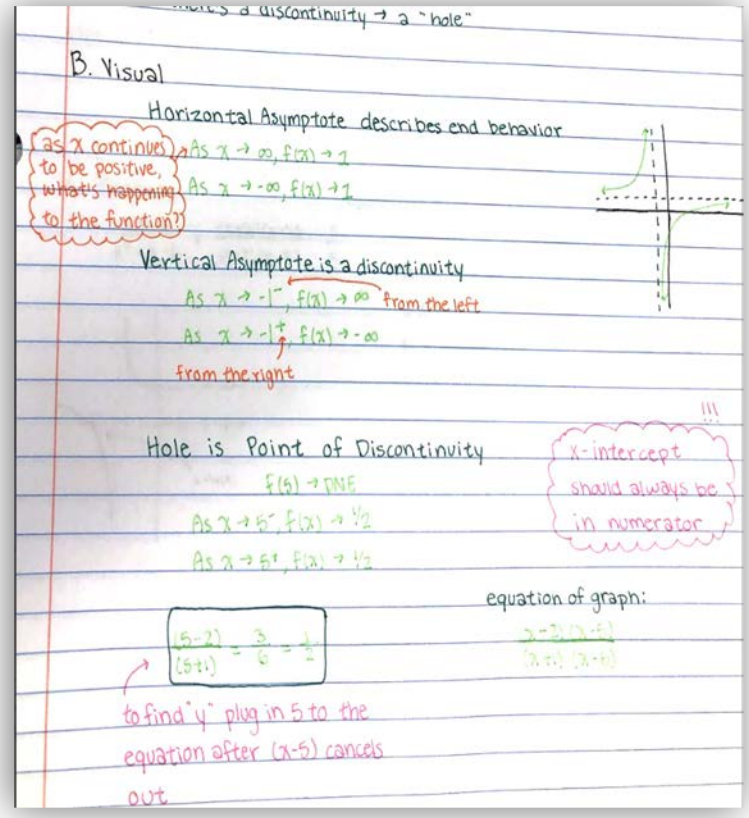


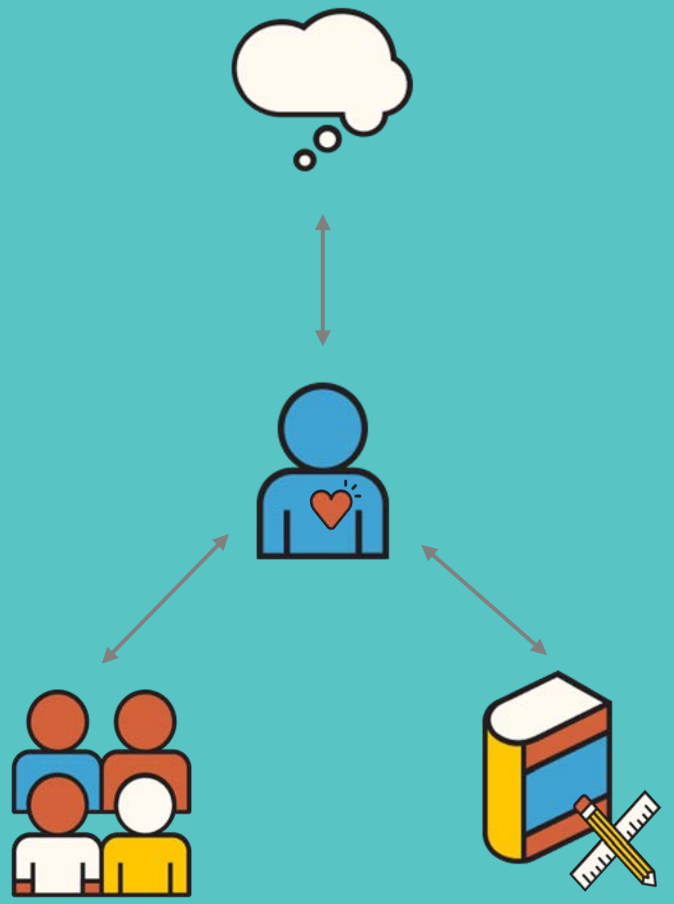
Student ⟷ Self Interaction

Student Reflection & Adjustments





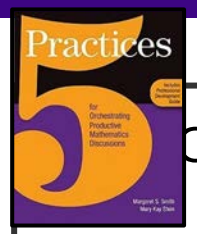
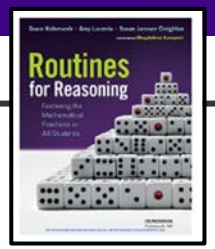
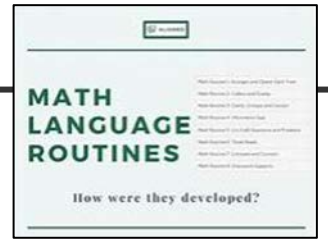




What student mathematical thinking are you looking to see and hear?

- Predict Representations & Strategies
- Predict Reasoning & Connections
- Student Reflection & Adjustments

Instructional Routines

 Orchestrating Productive Mathematics Discussion	 Routines for Reasoning	 Math Language Routines
Anticipating	Capturing Quantities	Stronger and Clearer Each Time
Monitoring	Connecting Representations	Collect and Display
Selecting	Decide and Defend	Clarify, Critique and Correct
Sequencing	Contemplate then Calculate	Information Gap
Connecting	3 Reads	Co-Craft Questions and Problems
	Recognizing Repetition	Compare and Connect

What are Routines:

Routines are an essential part of mathematics classrooms because they **give structure to time and interactions**, letting students know what to expect in terms of participation, supporting classroom management and organization, and promoting productive classroom relationships for teaching and learning.

*If the goal in mathematics teaching and learning is to support student success with mathematical proficiency, then we must be explicit about using instructional routines that focus on **student engagement** in activities that support **reasoning and sense making, communication with and about mathematical ideas**, making **meaningful connections**, building **procedural fluency from conceptual understanding**, and **productive struggle**.*

NCTM Presentation: Thinking about Instructional Routines in Mathematics Teaching and Learning; Robert Q. Berry, III, PhD

What are Mathematical Language Routines?

Mathematical Language Routines are structured but adaptable formats for amplifying, assessing, and developing students' language.

Zwiers, J., Dieckmann, J., Rutherford-Quach, S., Daro, V., Skarin, R., Weiss, S., & Malamut, J. (2017). Principles for the Design of Mathematics Curricula: Promoting Language and Content Development. Retrieved from Stanford University, UL/SCALE website: http://ell.stanford.edu/content/mathematics-resources-additional-resources

Mathematical Language Routines

MLR 1 – Stronger and Clearer Each Time

MLR 2 – Collect and Display

MLR 3 – Critique, Correct, and Clarify

MLR 4 – Information Gap

MLR 5 – Co-Craft Questions and Problems

MLR 6 – Three Reads

MLR 7 – Compare and Connect

MLR 8 – Discussion Supports

MLR 1: Stronger and Clearer

Purpose:
To provide a structured and interactive opportunity for students to revise and refine both their ideas and their verbal and written output (Zwiers, 2014).

Goal:
To have students think and write individually about a question, use a structured pairing strategy to have multiple opportunities to refine and clarify their response through conversation, and then finally revise their original written response. Conversations and second drafts should naturally show evidence of new ideas, language, communication/expression, and refinement in precision and reasoning about mathematical concepts.

Connections to the Standards for Mathematical Practice:

1: Make sense of problems and persevere in solving them

3: Construct viable arguments and critique the reasoning of others

6: Attend to precision

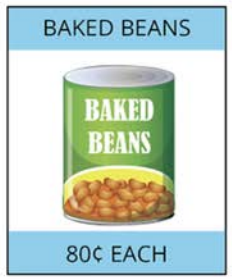
As students verbalize and review in writing the strategies they used and justification of those strategies, students have the opportunity to get feedback which can be used to critique the precision of their solution strategy and answer.

https://illustrativemathematics.blog/2022/02/17/math-language-routines-discourse-with-a-purpose/

MLR 1: Stronger and Clearer

Student-Facing Task Statement

Four different stores posted ads about special sales on 15-oz cans of baked beans.



1. Which store is offering the best deal? Explain your reasoning.

2. The last store listed is also selling 28-oz cans of baked beans for $1.40 each. How does that price compare to the other prices?

https://access.openupresources.org/curricula/our6-8math/en/grade-6/unit-3/lesson-5/teacher.html

How it works

1. Individual Pre-write/ First Draft

2. Think Time

3. Pair Share (2-3 times)

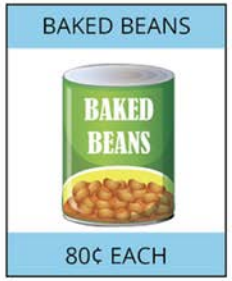
4. Individual Revision of Pre-write/ Final Draft

Individual Pre-Write and Think Time

Purpose	What Happens
An Initial Draft	• Write or draw their initial thoughts • Give a minute to think about what they will say to the first partner to explain what they are doing, or did, to solve it.

Student-Facing Task Statement

Four different stores posted ads about special sales on 15-oz cans of baked beans.



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Pair Shares (#1-3)

Purpose

Opportunity to refine and clarify the response through conversation

What Happens

Use a structured pairing strategy to facilitate students having 2–3 meetings with different partners. Each meeting gives each partner an opportunity to be the speaker and an opportunity to be the listener.

- As the speaker, each student shares their ideas
- As a listener, each student should:
  (a) ask questions for clarity and reasoning
  (b) press for details and examples
  (c) give feedback that is relevant for the goal

Individual Revision of Draft

Purpose

Revise their original response using ideas from partners to craft a more precise response.

Student-Facing Task Statement

Four different stores posted ads about special sales on 15-oz cans of baked beans.

1. Which store is offering the best deal? Explain your reasoning.

2. The last store listed is also selling 28-oz cans of baked beans for $1.40 each. How does that price compare to the other prices?

What Happens

This draft should naturally reflect borrowed ideas from partners, as well as refinement of initial ideas through the communication with partners.

The second draft will be stronger (better evidence of mathematical content understanding) and clearer (more precision, organization, and features of mathematical language).

https://access.openupresources.org/curricula/our6-8math/en/grade-6/unit-3/lesson-5/teacher.html

MLR 8: Discussion Supports

Purpose:
To support rich and inclusive discussions about mathematical ideas, representations, contexts, and strategies (Chapin, O'Connor, & Anderson, 2009). Rather than another structured format, these instructional moves can be combined and used together with any of the other routines. They include multimodal strategies for helping students make sense of complex language, ideas, and classroom communication.

Goal:
Invite and incentivize more student participation, conversation, and meta-awareness of language. Eventually, students should begin using these strategies themselves to prompt each other to engage more deeply in discussions.

Connections to the Standards for Mathematical Practice:

1: Make sense of problems and persevere in solving them

3: Construct viable arguments and critique the reasoning of others

4: Use appropriate tools strategically

5: Attend to precision.

Using discussion supports helps students to see the reasoning of others as well as identify which tools to solve are most appropriate. In using these supports, students can be successful with in-depth or multistep problems with support from teachers and classmates.

https://illustrativemathematics.blog/2022/02/17/math-language-routines-discourse-with-a-purpose/

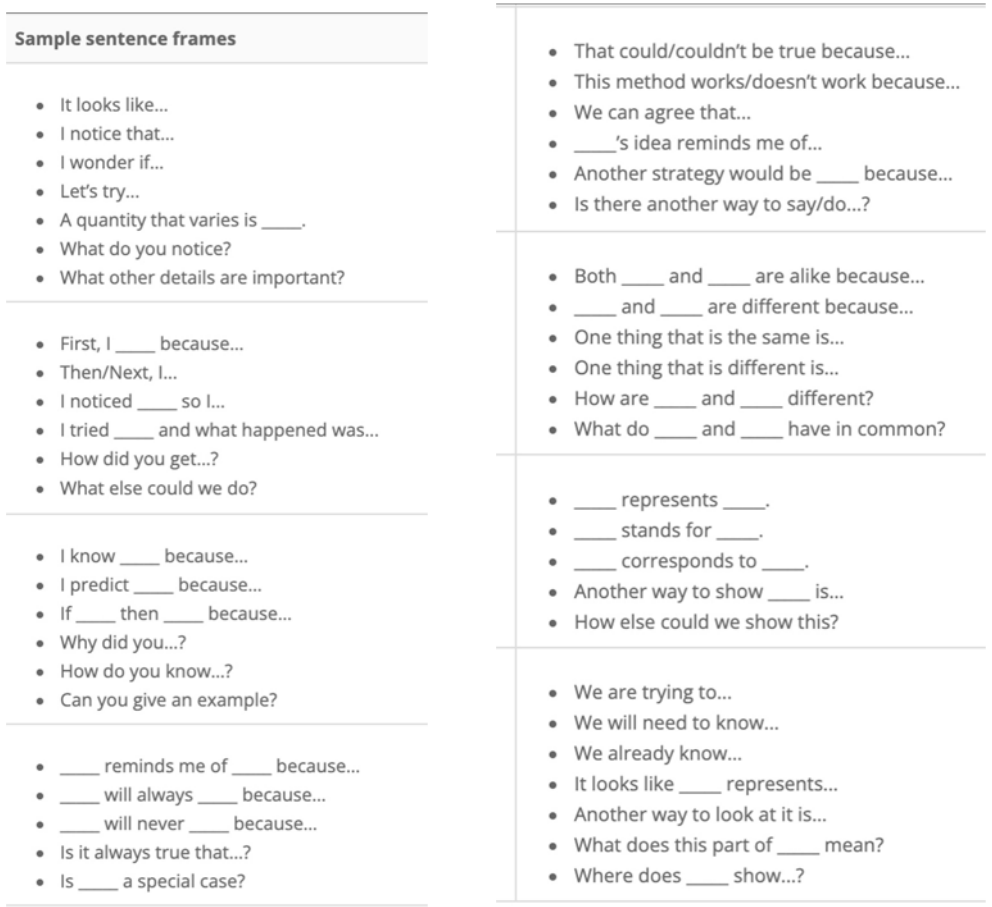
MLR 8: Discussion Supports For Whole Class

Examples of possible strategies:

- **Revoice student ideas** to demonstrate mathematical language use by restating a statement as a question in order to clarify, apply appropriate language, and involve more students.
- **Press for details** in students' explanations by requesting for students to challenge an idea, elaborate on an idea, or give an example.
- **Think aloud** by talking through thinking about a mathematical concept while solving a related problem or doing a task.
- Practice phrases or words through **choral response**.
- Give students time to make sure that everyone in the group can **explain or justify each step or part of the problem**. Then make sure to vary who is called on to represent the work of the group so students get accustomed to preparing each other to fill that role.

Discussion Supports for Pair Share/Group

Sentence frames can support student language production by providing a structure to communicate about a topic. Helpful sentence frames are open-ended, so as to amplify language production, not constrain it.



Sample sentence frames

- It looks like...
- I notice that...
- I wonder if...
- Let's try...
- A quantity that varies is ____.
- What do you notice?
- What other details are important?

- First, I ____ because...
- Then/Next, I...
- I noticed ____ so I...
- I tried ____ and what happened was...
- How did you get...?
- What else could we do?

- I know ____ because...
- I predict ____ because...
- If ____ then ____ because...
- Why did you...?
- How do you know...?
- Can you give an example?

- ____ reminds me of ____ because...
- ____ will always ____ because...
- ____ will never ____ because...
- Is it always true that...?
- Is ____ a special case?

- That could/couldn't be true because...
- This method works/doesn't work because...
- We can agree that...
- ____'s idea reminds me of...
- Another strategy would be ____ because...
- Is there another way to say/do...?

- Both ____ and ____ are alike because...
- ____ and ____ are different because...
- One thing that is the same is...
- One thing that is different is...
- How are ____ and ____ different?
- What do ____ and ____ have in common?

- ____ represents ____.
- ____ stands for ____.
- ____ corresponds to ____.
- Another way to show ____ is...
- How else could we show this?

- We are trying to...
- We will need to know...
- We already know...
- It looks like ____ represents...
- Another way to look at it is...
- What does this part of ____ mean?
- Where does ____ show...?

https://learnzillion.com/wikis/178276-mlr8-discussion-supports/

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