The Problem-Solving PLC Cycle

From Student Work to Instructional Action: A Practical PLC Framework

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We needed a shift in our PLC discussions

From: What did students get right or wrong?



To: What does their work reveal about their thinking?

From: What lesson comes next?



To: What instructional response will move thinking forward?

We wanted to keep Problem Solving at the Center of our PLCs

Examine Student Thinking — Identify patterns in student work.

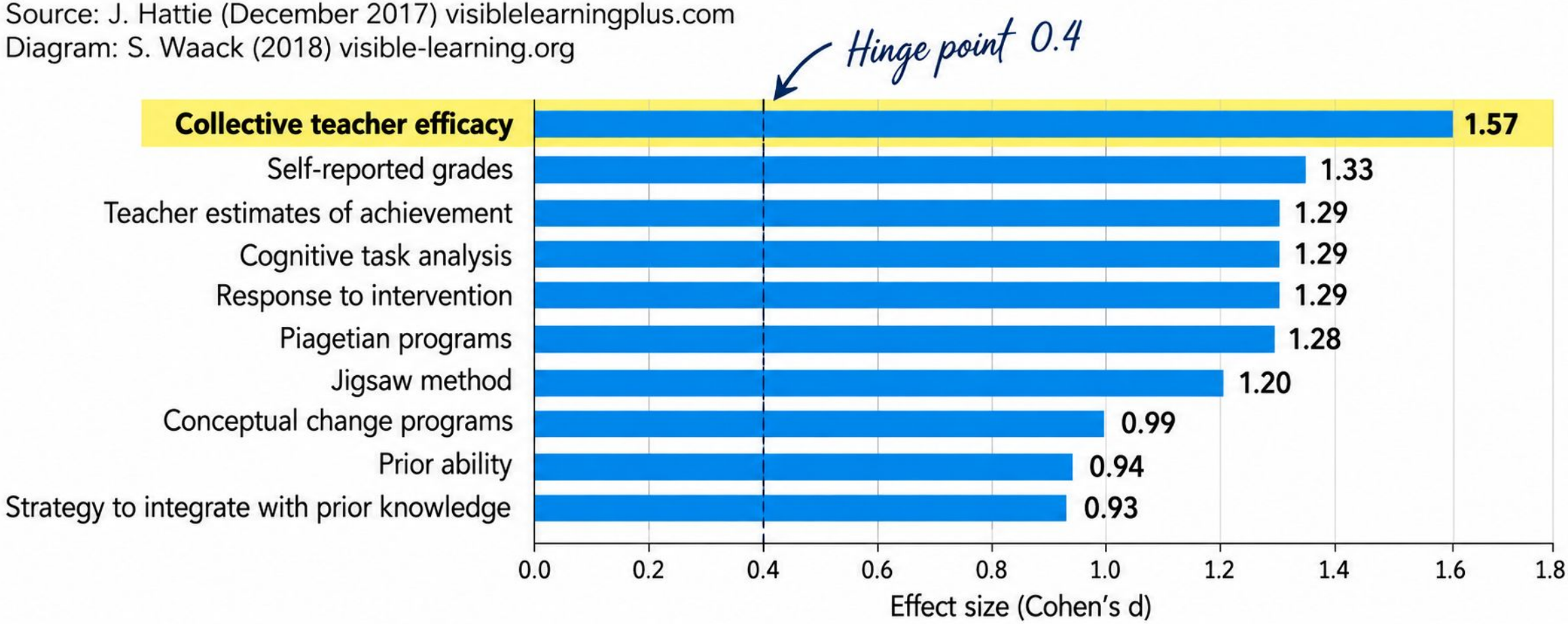
Turn Evidence into Action — Plan responsive instruction.

Build Collective Efficacy — Learn together and celebrate impact.

- ***Developed a 7-Step Problem-Solving PLC Cycle***

Hattie's 2018 updated list of factors related to student achievement: 252 influences and effect sizes (Cohen's d)

Source: J. Hattie (December 2017) visiblelearningplus.com
Diagram: S. Waack (2018) visible-learning.org



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Problem Solving - Working Definition

Problem solving is an active process in which students make sense, think flexibly, apply strategies, justify their reasoning, and persevere to deepen mathematical understanding. *Pólya (1945); Boaler (2016)*

Problem solving is ***not*** *just about finding an answer. It's about making student thinking, reasoning, and learning visible.*

Problem of Practice - Working Definition

A problem of practice is a specific, high-leverage challenge in student learning, identified through evidence, that a PLC collaboratively investigates and addresses through intentional instructional action. *Richard DuFour (2004)*

Identify a student learning need, investigate the thinking behind it, take instructional action, and examine the impact.

Transferable skills, Big Ideas, What is worth digging into?

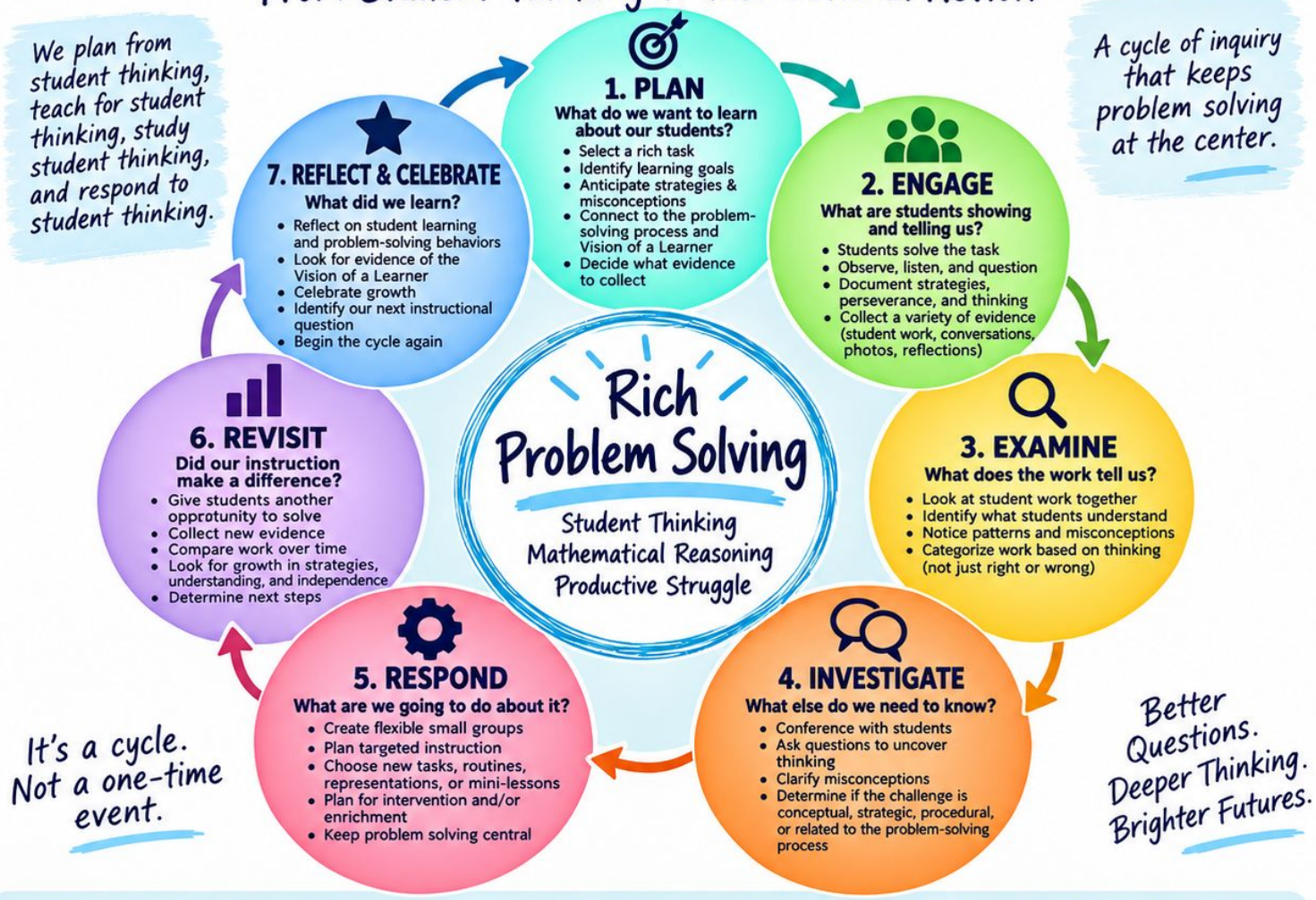
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The Problem-Solving PLC Cycle

From Student Thinking to Instructional Action

We plan from student thinking, teach for student thinking, study student thinking, and respond to student thinking.

A cycle of inquiry that keeps problem solving at the center.



It's a cycle. Not a one-time event.

Better Questions. Deeper Thinking. Brighter Futures.

STUDENT THINKING
What are students showing, saying, trying, revising, and understanding?

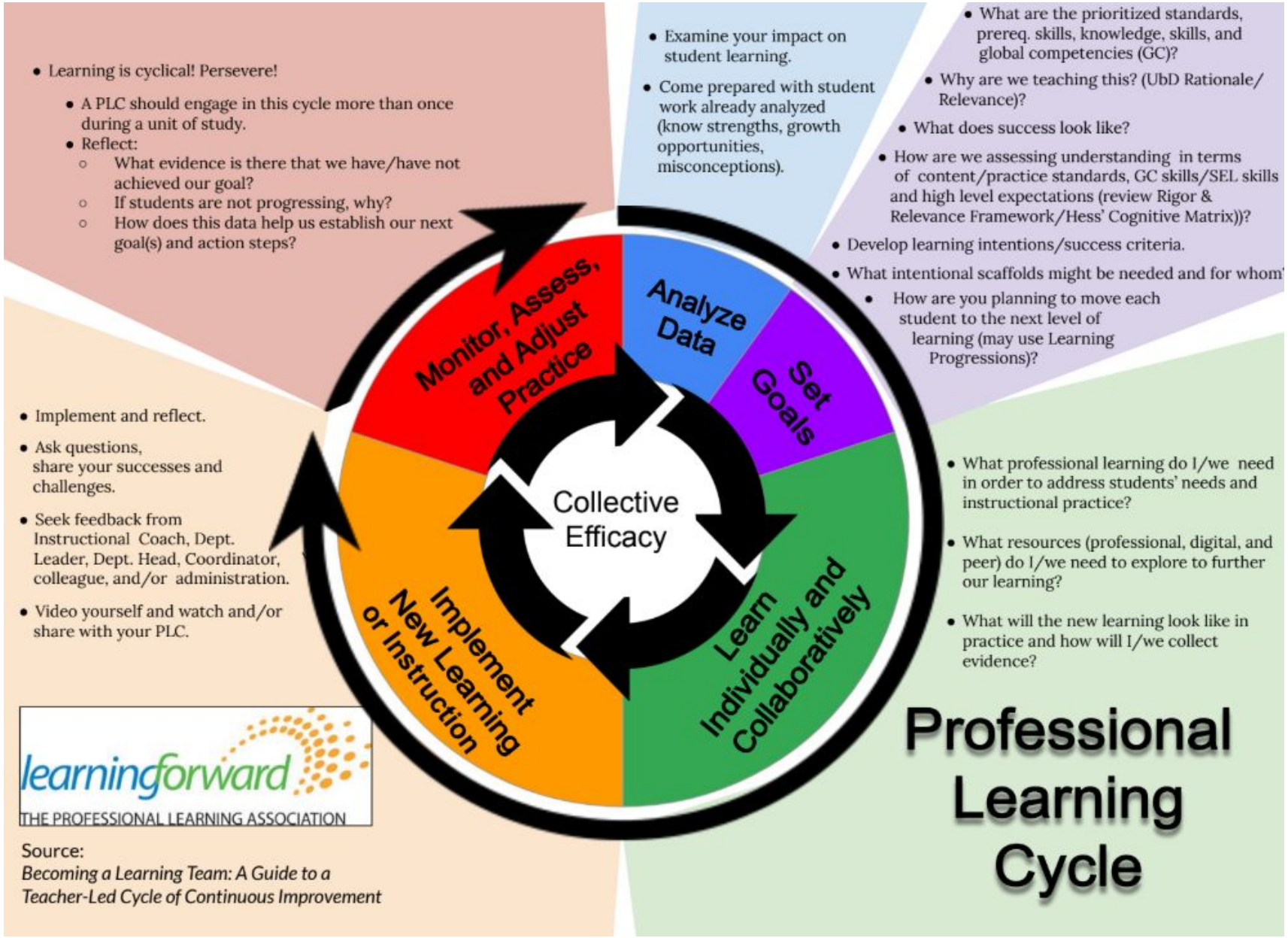
THE PROBLEM-SOLVING PROCESS
How are students making sense, selecting strategies, persevering, explaining, revising, and reflecting?

VISION OF A LEARNER
What evidence do we see of critical thinking, creativity, collaboration, communication, perseverance, and reflection?

Don't start with the score. Start with the thinking.

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Our Vision of a Learner: Global Competencies



Collaborators

Collaborators engage through communication in constructive and critical dialogue by listening for and articulating thoughts, questions, and ideas in diverse environments. Collaborators exercise flexibility and willingness to be contributors and listeners while making necessary compromises and working together in virtual and traditional settings to accomplish a shared goal.



Critical Thinkers

Critical thinkers ask thoughtful questions, gather relevant information, consider multiple perspectives, and evaluate ideas to draw well-reasoned conclusions. They reflect on their thinking, remain open to alternative viewpoints, and revise their understanding as needed to make informed decisions and solve complex problems.



Creative Innovators

Creative Innovators challenge and improve existing standards by designing, implementing, and communicating original ideas. Creative Innovators exhibit curiosity, imagination, and flexibility. The creative and curious person is open and responsive to new and diverse perspectives and views failure as an opportunity to learn. They show resilience and persevere through multiple solutions and challenges, making valuable contributions to the world around them.



Self-Directed and Resilient Learners

Self-directed and resilient learners take initiative, set goals, and take responsibility for their learning. They are persistent, adaptable, and open to feedback. They reflect on their progress, learn from their experiences, and demonstrate a growth mindset as they navigate challenges and pursue their interests.

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Standards for Mathematical Practice



1 Make sense of problems and persevere in solving them.

2 Reason abstractly and quantitatively.

$3 + 4 = 7$

$\frac{3}{4} + \frac{1}{8} = \frac{7}{8}$



3 Construct viable arguments and critique the reasoning of others.

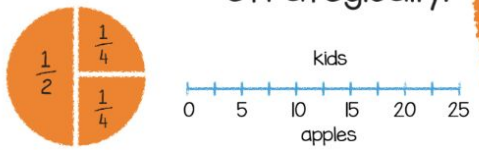


4 Model with mathematics

5 apples for every kid

$$\frac{5 \text{ apples}}{1 \text{ kid}} \longrightarrow \frac{?}{5 \text{ kids}}$$

5 Use appropriate tools strategically.



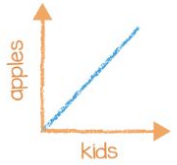


6 Attend to precision.

7 Look for and make use of structure.

36 × 24 =	30	6
20	600	120
4	120	24

8 Look for and express regularity in repeated reasoning.



kids	apples
1	5
2	10
3	15
4	20
5	25

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National Governors Association Center for Best Practices, Council of State School Officials. Common Core State Standards: Standards for Mathematical Practice. Washington, DC: National Governors Association Center for Best Practices, Council of State School Officials, 2010.

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PROBLEM-SOLVING PROCESS



UNDERSTAND the problem:

- Read the task.
- What do you need to find out?
- Write an "I have to…", "I need to…", "The question is…" sentence.
- Identify important information.



THINK of your plan:

- Consider possible strategies.
- Choose the strategy you want to use.
- Write an "I will…," "My strategy is…," "My plan is…," sentence.



SOLVE the problem:

- Use your strategy to solve the problem.
- Show your answer.



REVIEW your solution (all your work including your answer):

- Did you show your thinking?
- Did you state an answer(s)?
- Did you use at least 2 terms and/or math symbols?
- Did you make an accurate representation?

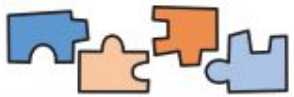
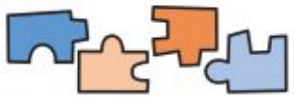
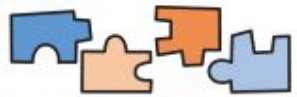
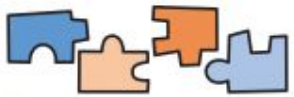
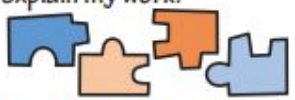
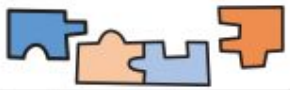
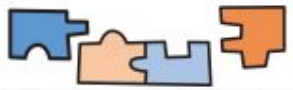
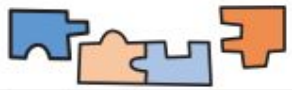
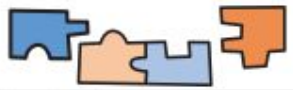
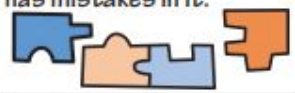
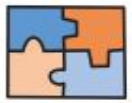
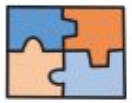
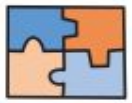
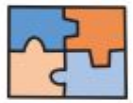
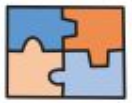
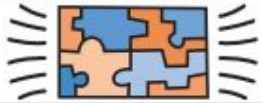
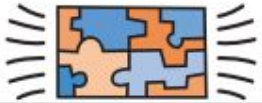
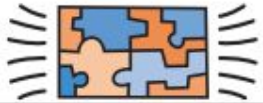
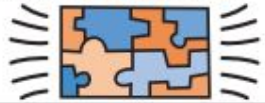
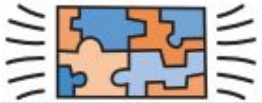


MAKE a connection (some examples include):

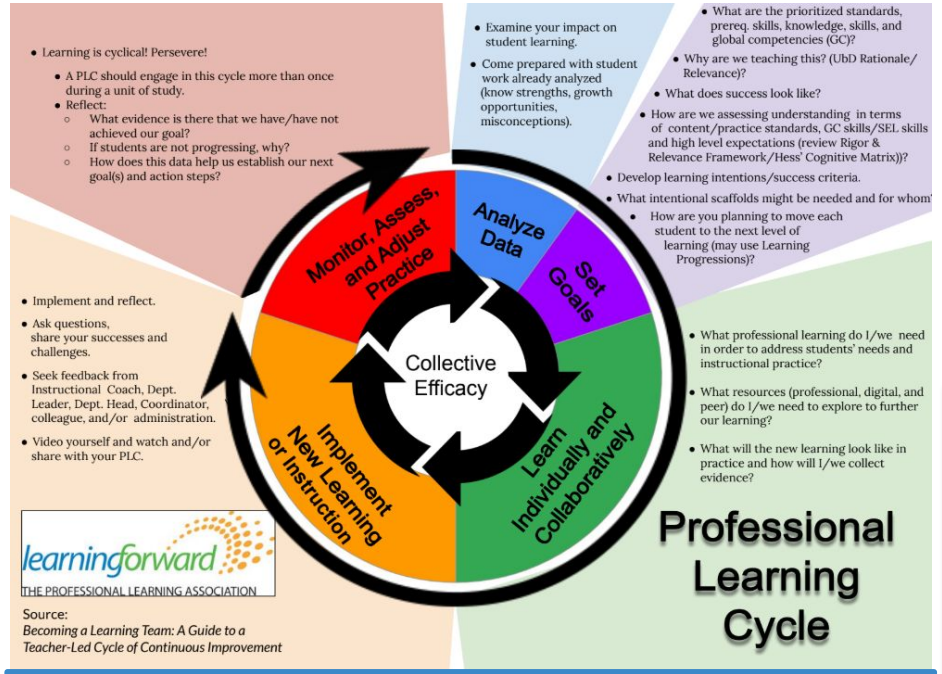
- Make an observation(s).
- Find a pattern(s).
- Recreate or continue the problem.
- Use a different strategy to solve the problem.
- State a phenomenon (something that is always true).
- Discover a rule.

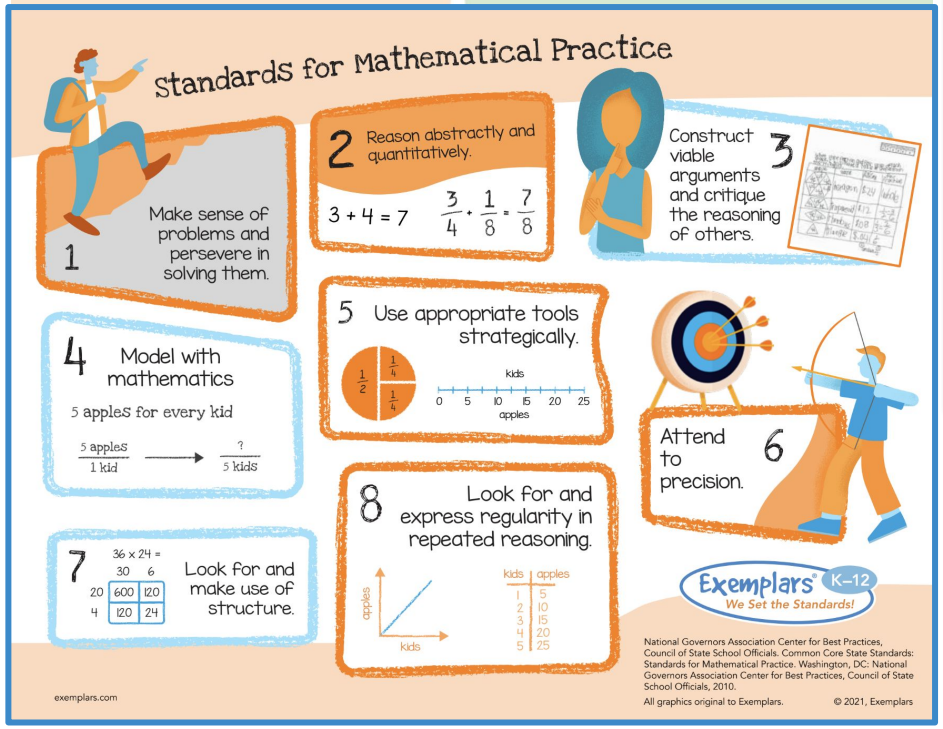
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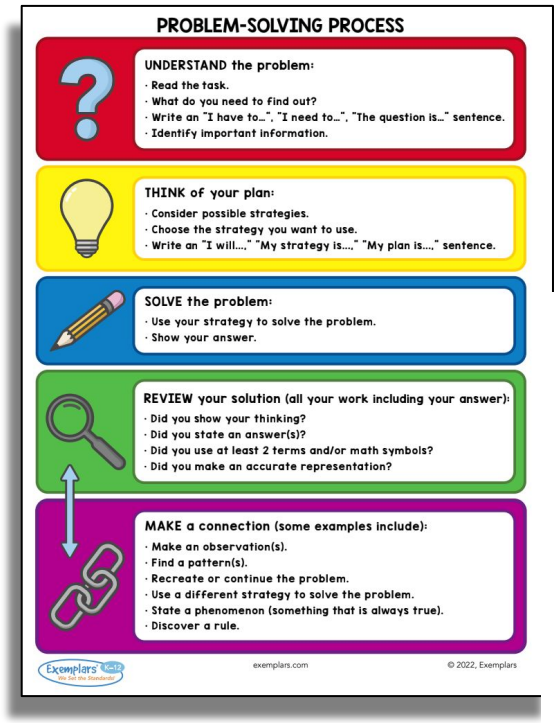
Exemplars® Jigsaw Student Rubric

Level	Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Novice Makes an effort No or little understanding	I did not understand the problem. 	My math thinking is not correct. 	I used no math language and/or math notation. 	I did not notice anything about the problem or the numbers in my work. 	I did not use a math representation to help solve the problem and explain my work. 
Apprentice Okay, good try Unclear if student understands	I only understand part of the problem. My strategy works for part of the problem. 	Some of my math thinking is correct. 	I used some math language and/or math notation. 	I tried to notice something, but it is not about the math in the problem. 	I tried to use a math representation to help solve the problem and explain my work, but it has mistakes in it. 
Practitioner Excellent Clear Strong understanding Meets the standard	I understand the problem and my strategy works. My answer is correct. 	All of my math thinking is correct. 	I used math language and/or math notation accurately throughout my work. 	I noticed something about my math work. 	I made a math representation to help solve the problem and explain my work, and it is labeled and correct. 
Expert Wow, awesome! Exceptional understanding!	I understand the problem. My answer is correct. I used a rule, and/or verified that my strategy is correct. 	I showed that I knew more about a math idea that I used in my plan. Or, I explained my rule. 	I used a lot of specific math language and/or notation accurately throughout my work. 	I noticed something in my work, and used that to extend my answer and/or I showed how this problem is like another problem. 	I used another math representation to help solve the problem and explain my work in another way. 

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PLAN — Design for thinking



PLAN — Design for thinking



In the Bethel Public Schools

1. We dedicated a deep focus for problem solving
2. School Improvement Plans included Problem Solving
3. We committed to keeping rich tasks at the center of our work
4. Aligned rich tasks to our curriculum in every grade K-3
5. Created a Looking at Student Work Protocol

PLAN — Design for thinking



We ask ourselves-

a. What is a high leverage, transferable skill that is worth our time during this cycle?
b. What do you want to explore in your own practice?
c. What are you most curious about with regards to student thinking and reasoning?

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Guiding Questions for the PLC

- ***What do we want students to understand?***
- ***What task will reveal that understanding?***
- ***What strategies or misconceptions might we***
- ***see?***
- ***What evidence of mathematical thinking and learner competencies will we collect?***

This step asks us to work backwards from student thinking rather than choosing the task first.

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ENGAGE — Listen while students solve



ENGAGE — Listen while students solve



1. While students are problem solving…..
   - scoot up next to them
   - watch them work
   - listen to their thinking
   - take observational notes
2. If you are just giving students tasks on paper- it might be just grading
3. We have committed to the “interview” mindset- we want to know what happens before and after the pencil hits the paper
4. BTC- Vertical Boards have become a routine and common practice

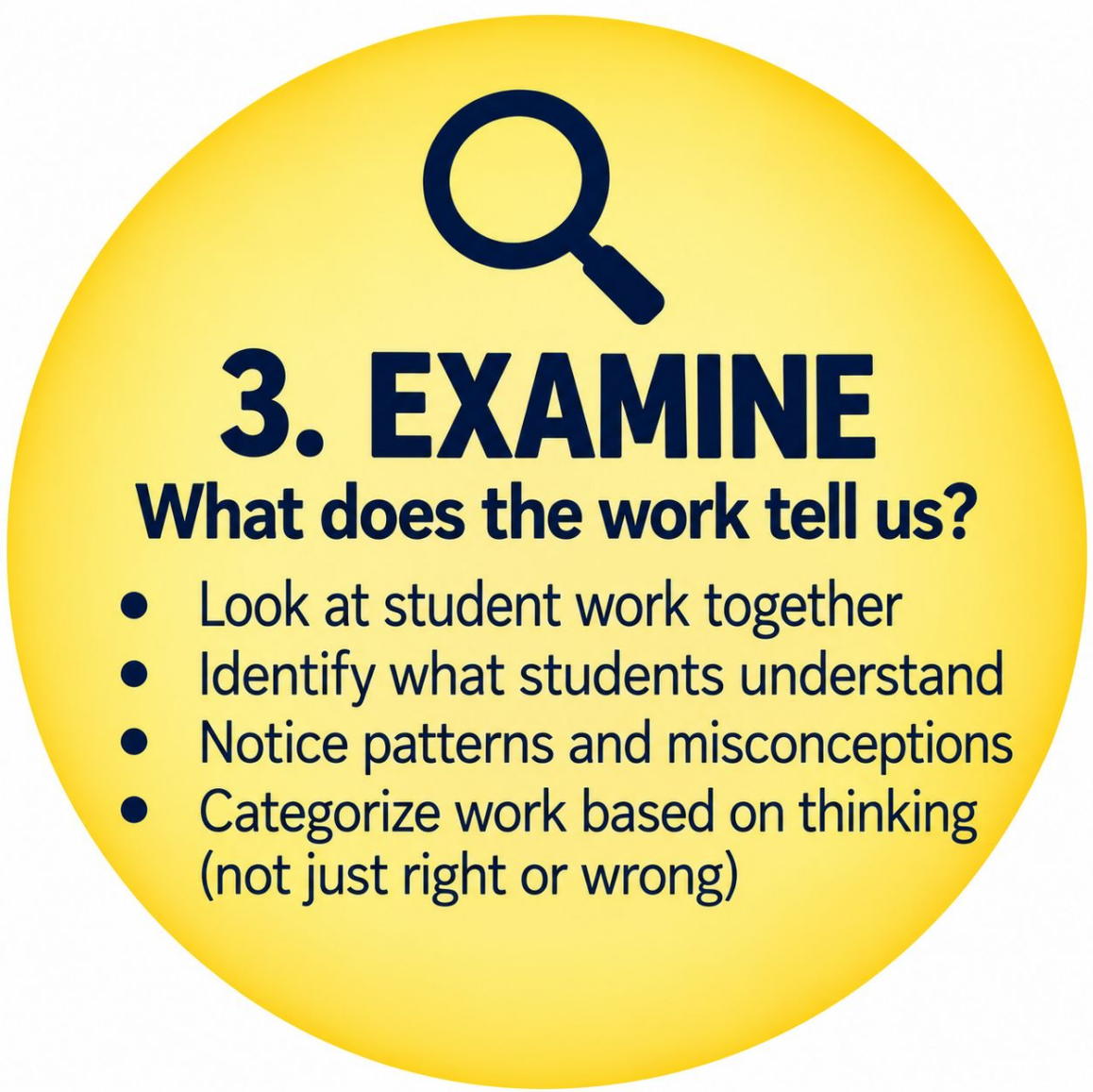


Guiding Questions for the PLC

- ***What are students actually doing as they solve?***
- ***What strategies are they choosing?***
- ***Where are they getting stuck?***
- ***What are we hearing and observing that may help us understand their thinking better?***
- ***What might not appear on the finished paper?***

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EXAMINE — Look at student work together

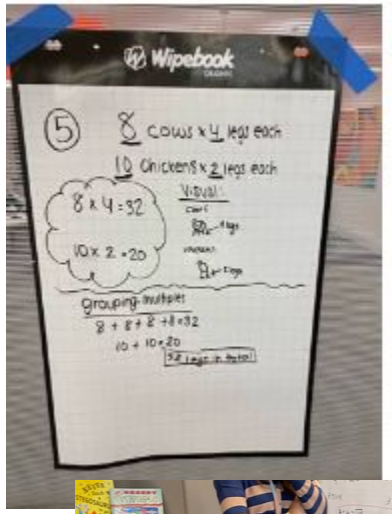


3 EXAMINE — Look at student work together

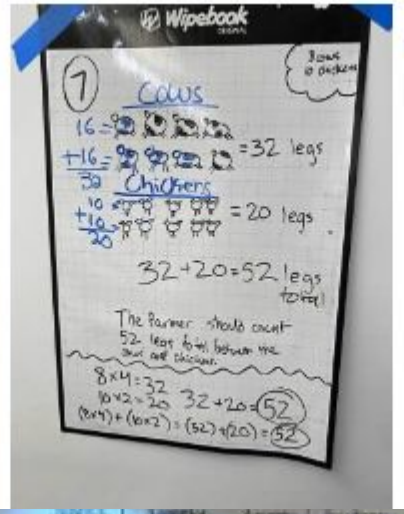
3. EXAMINE

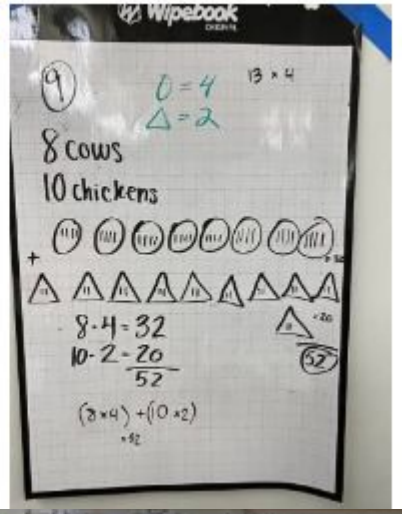
What does the work tell us?

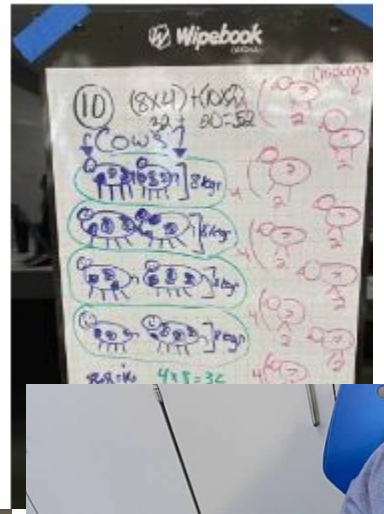
- Look at student work together
- Identify what students understand
- Notice patterns and misconceptions
- Categorize work based on thinking (not just right or wrong)

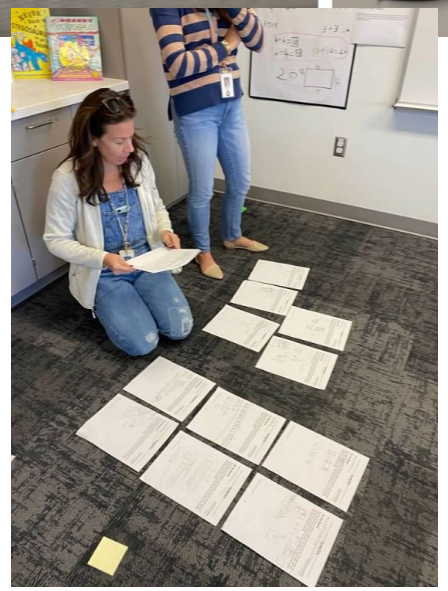


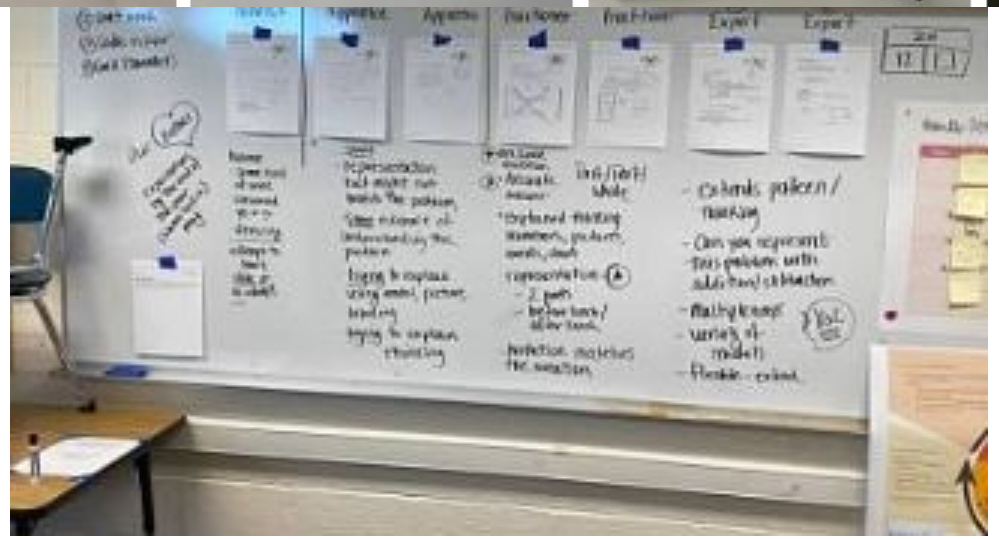


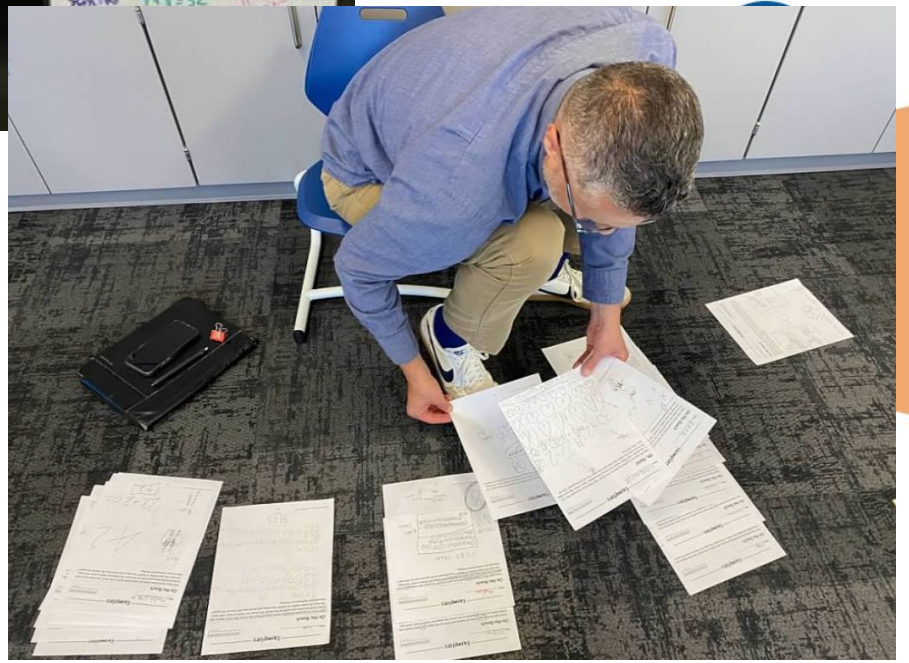




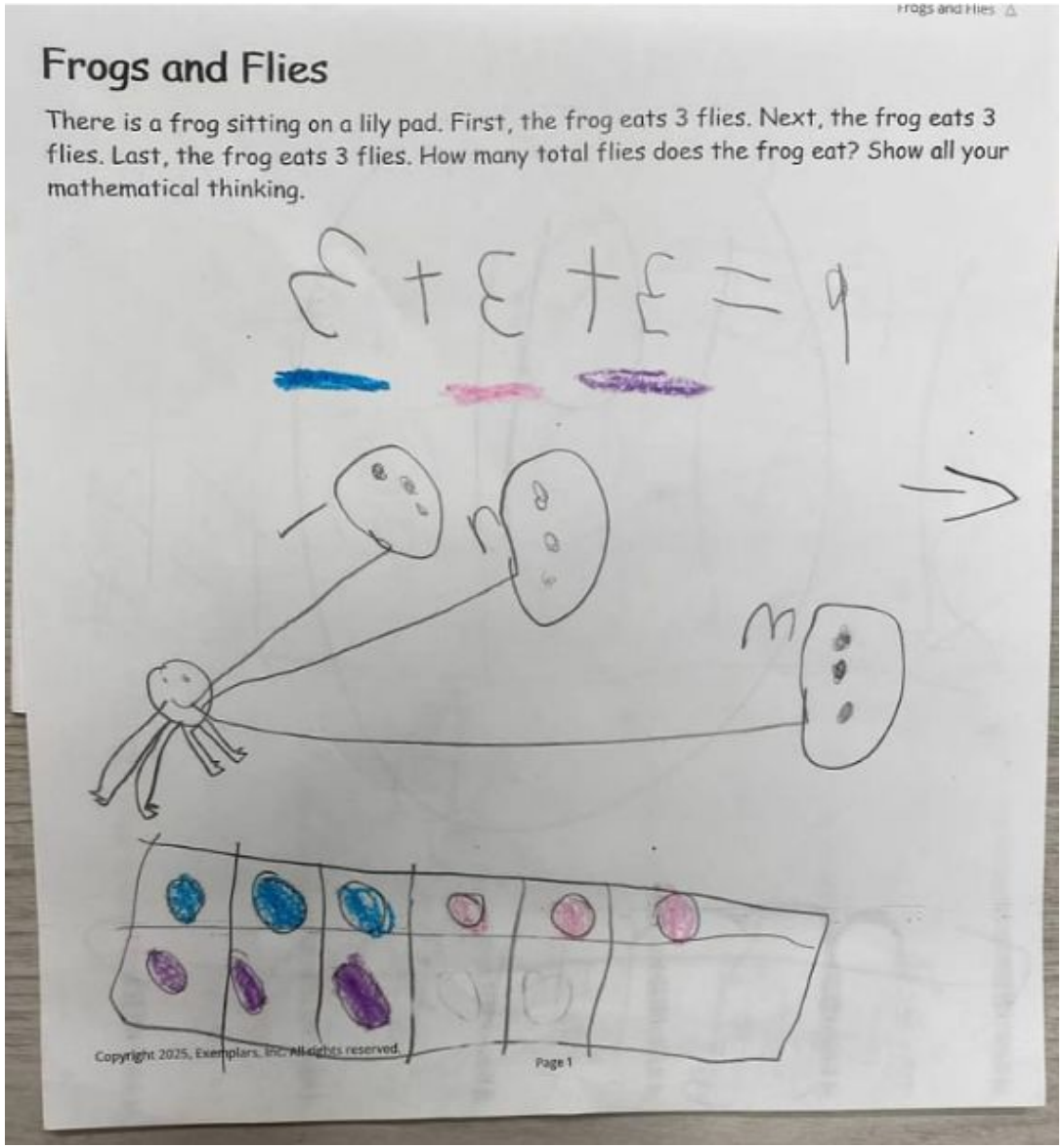


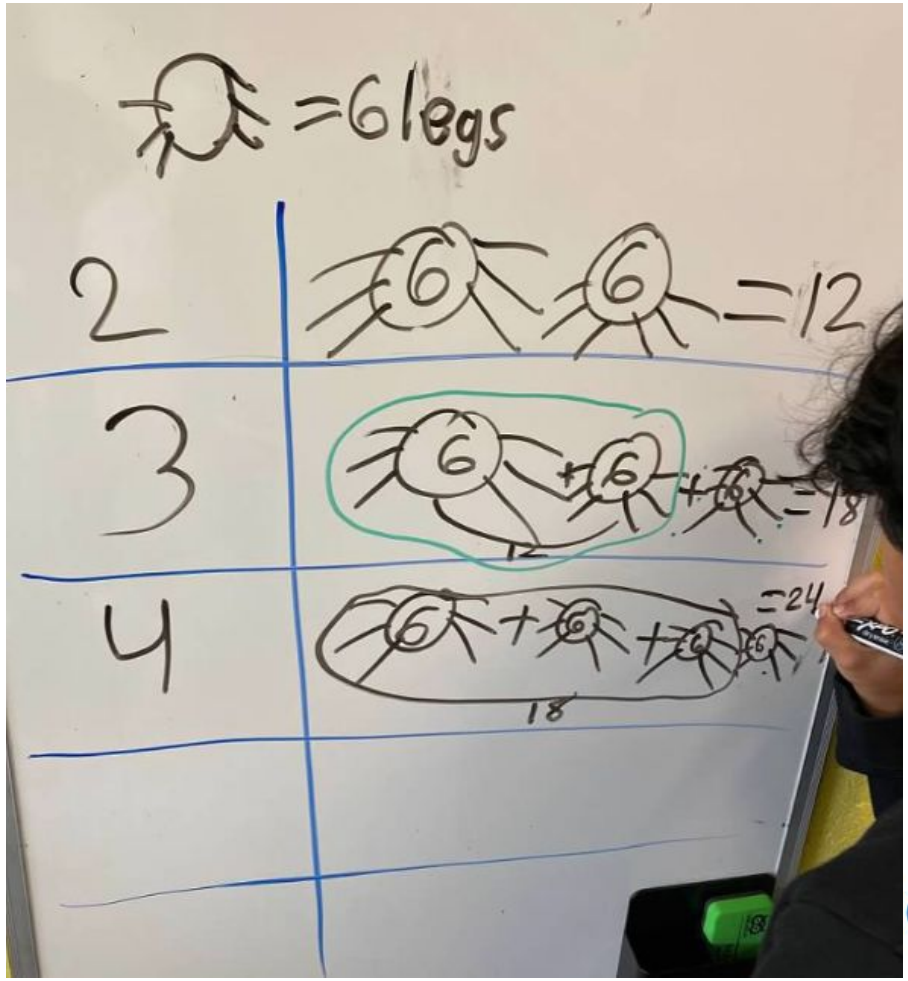






EXAMINE — Look at student work together





3. EXAMINE

What does the work tell us?

- Look at student work together
- Identify what students understand
- Notice patterns and misconceptions
- Categorize work based on thinking (not just right or wrong)

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3 EXAMINE — Look at student work together

3. EXAMINE

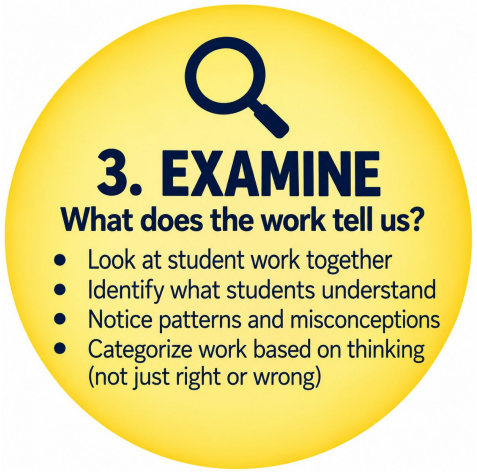
What does the work tell us?

- Look at student work together
- Identify what students understand
- Notice patterns and misconceptions
- Categorize work based on thinking (not just right or wrong)

Math - Analyze Data, Set Goals			
What NEW data are we examining?	Strengths	Areas for Growth	Action Steps

Math - Assess & Adjust Practice			
Revisit Goal(s) from September	Any Further Action Steps Needed?		

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Guiding Questions for the PLC

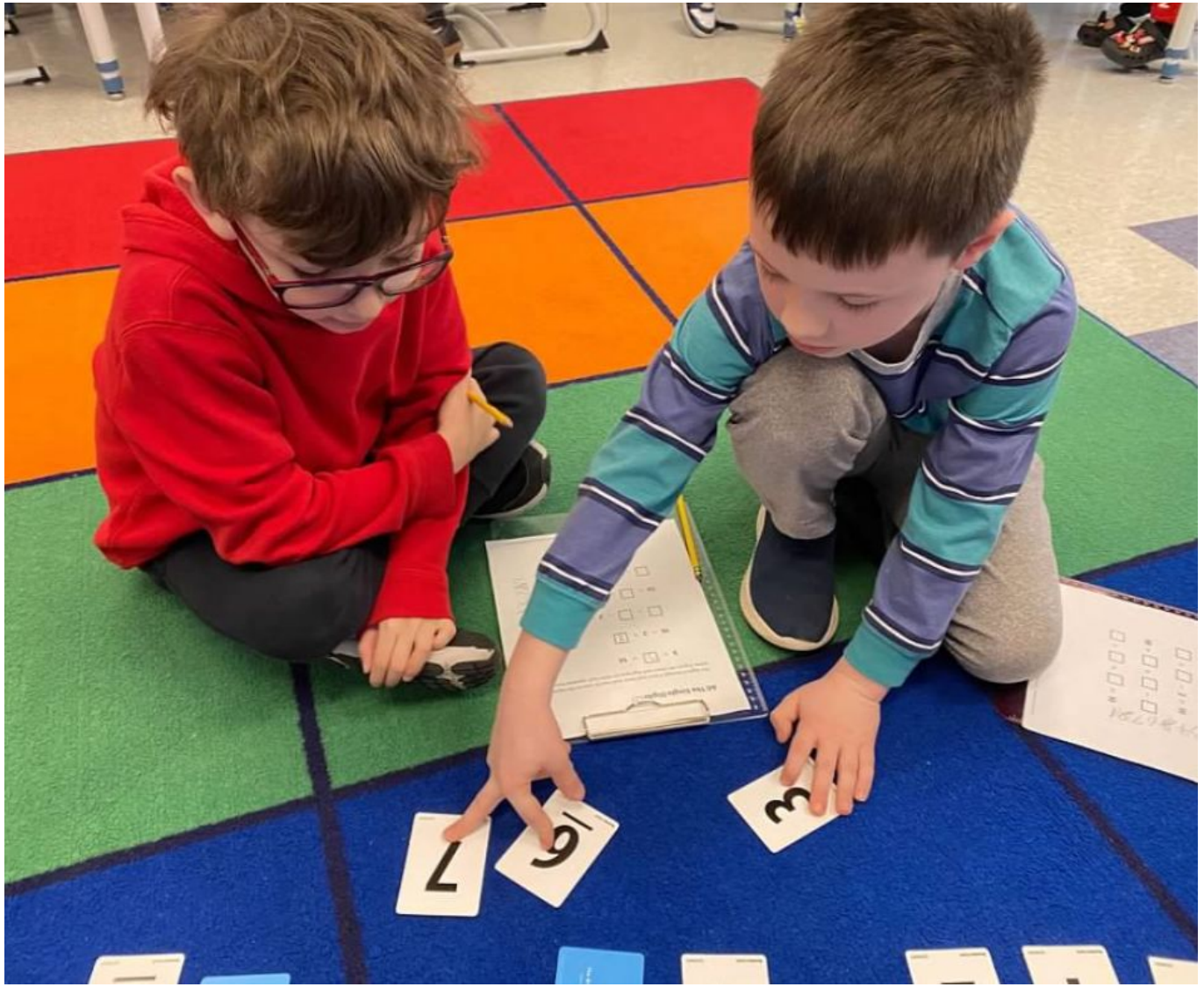
- ***What do we notice?***
- ***What does the work tell us students understand?Be specific***
- ***What patterns do we see across students and across classrooms?***
- ***How are students generalizing?***
- ***How might we categorize work based on thinking rather than scores?***

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INVESTIGATE — Go beyond the paper



INVESTIGATE — Go beyond the paper

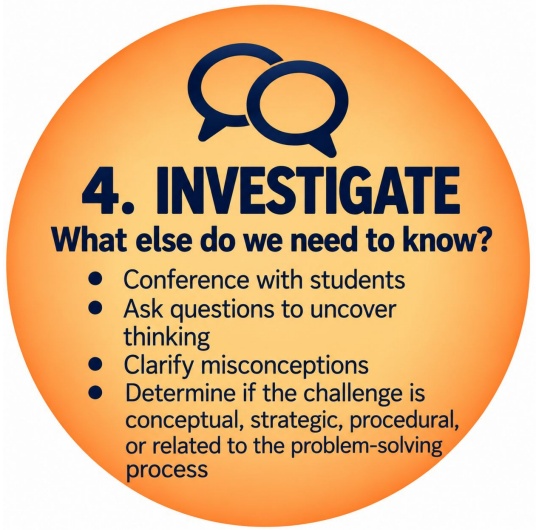


4. INVESTIGATE

What else do we need to know?

- Conference with students
- Ask questions to uncover thinking
- Clarify misconceptions
- Determine if the challenge is conceptual, strategic, procedural, or related to the problem-solving process

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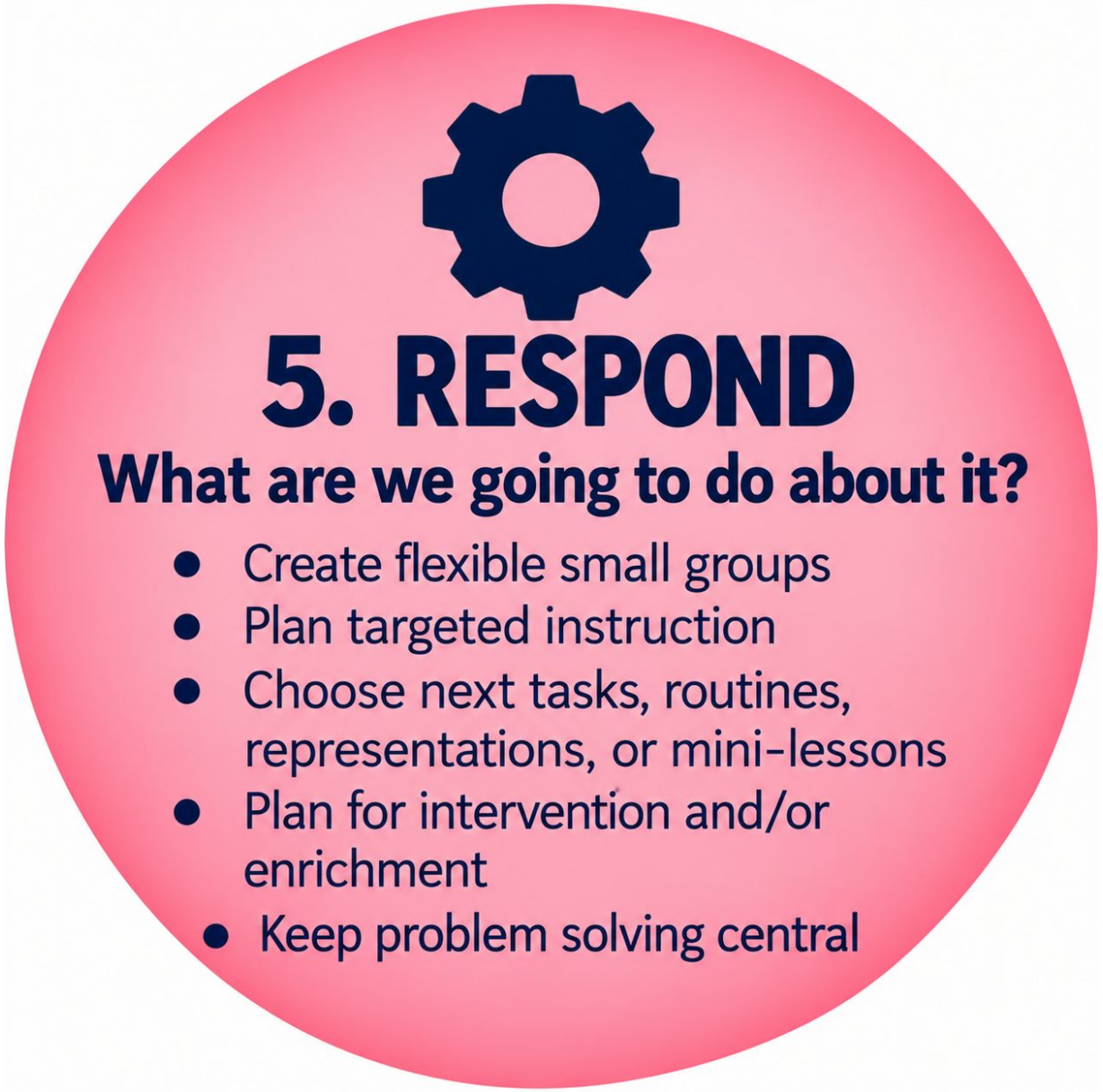


Guiding Questions for the PLC

- ***What can't we tell from the paper?***
- ***Which students should we talk with?***
- ***What do we want to ask in a follow up interview?***
- ***What questions could uncover their thinking?***
- ***Is this a misconception, strategy issue, conceptual gap, or something else?***

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RESPOND — Make an instructional move





Guiding Questions for the PLC

- ***Based on our evidence, what should happen next?***
- ***Which students have similar needs?***
- ***What small-group instruction would move their thinking forward?***
- ***Who needs support, another representation, a new strategy, or greater challenge?***
- ***What is next on their problem solving journey?***

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REVISIT — Look for transfer and growth

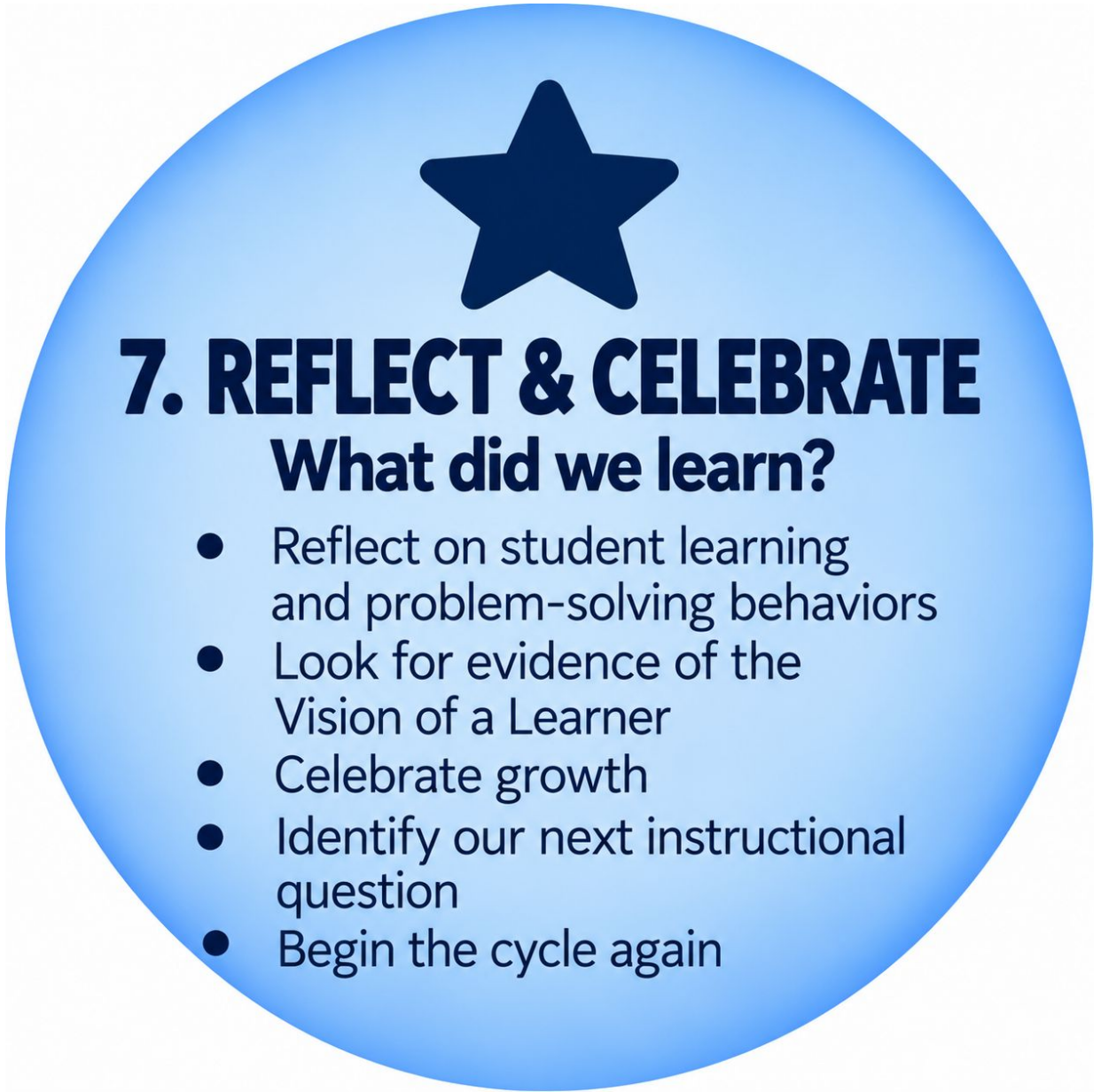




Guiding Questions for the PLC

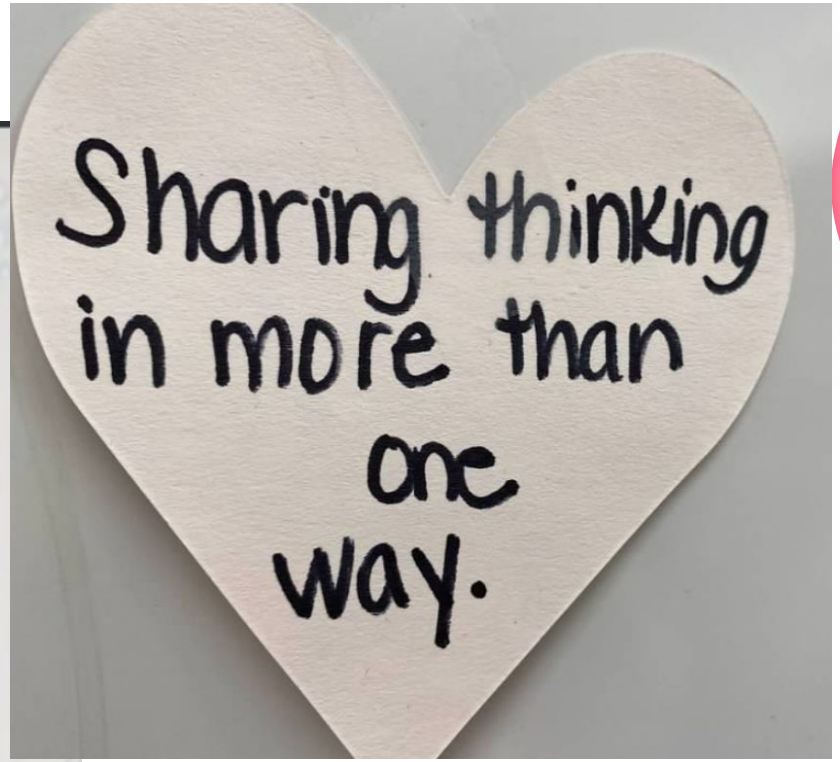
- ***What changed?***
- ***Are students using new or more efficient strategies?***
- ***Can students transfer learning to another problem?***
- ***Who is becoming more independent, and who still needs support?***

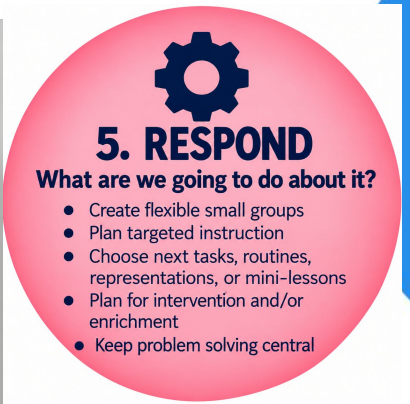
REFLECT & CELEBRATE

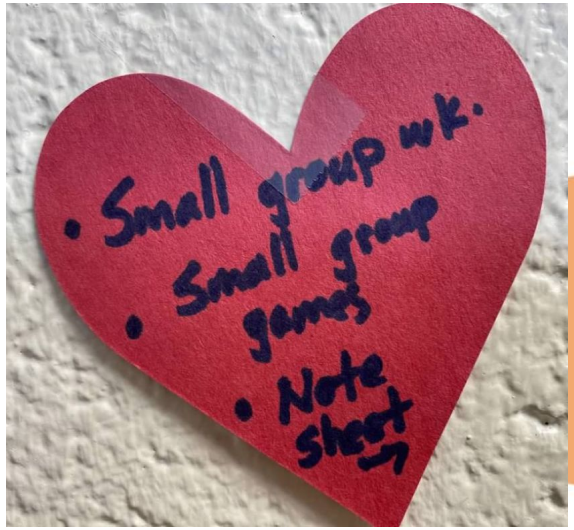


RESPOND — Make an instructional move









"We conferenced with students more often and were curious about their thinking- not their answers" PLC Notes

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Guiding Questions for the PLC

- ***What growth do we see?***
- ***What did students learn about themselves as problem solvers?***
- ***Where do we see Vision of a Learner evidence?***
- ***What specific instructional moves did we make that impacted student growth?***
- ***What does this evidence tell us to plan next?***

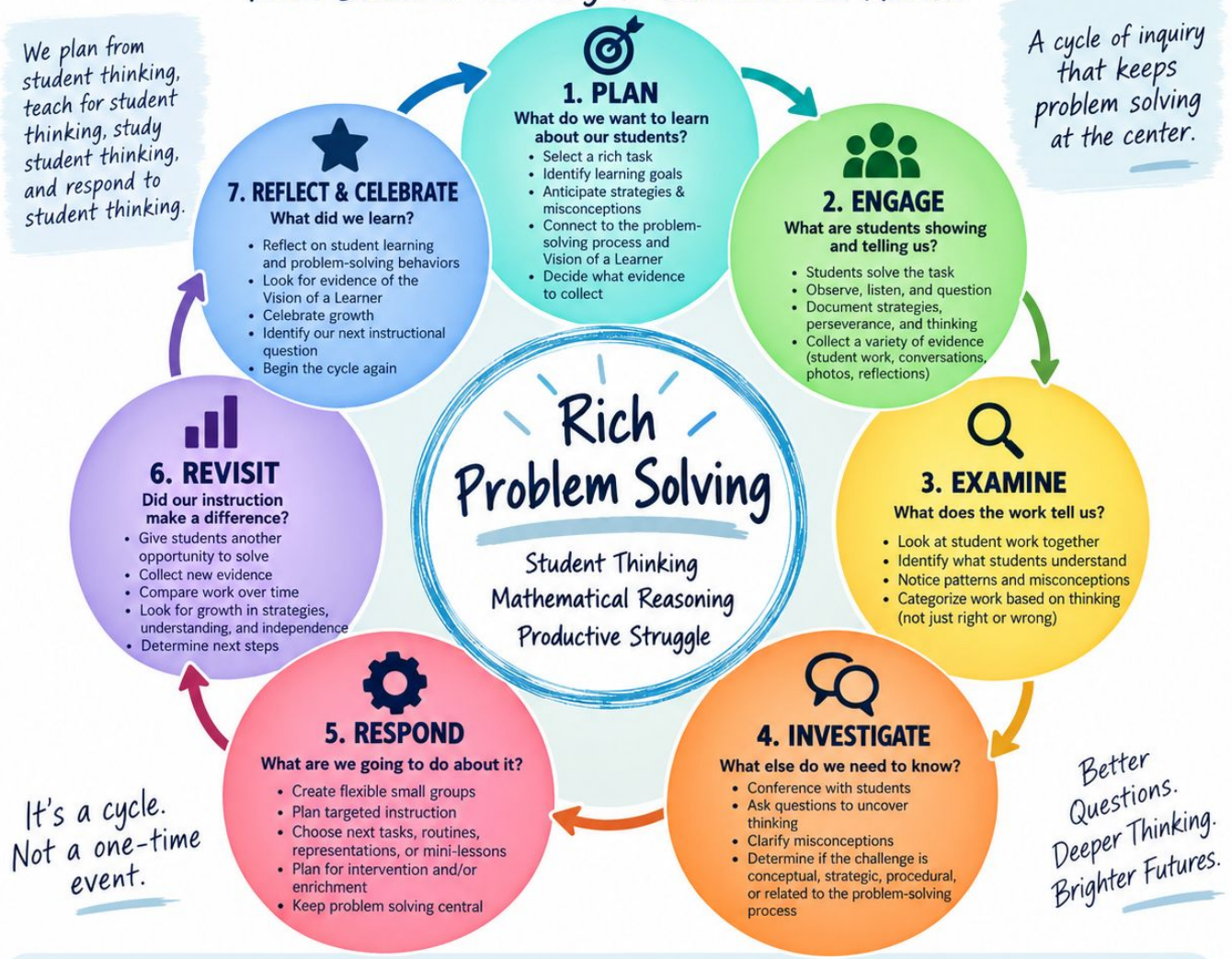
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The Problem-Solving PLC Cycle

From Student Thinking to Instructional Action

We plan from student thinking, teach for student thinking, study student thinking, and respond to student thinking.

A cycle of inquiry that keeps problem solving at the center.



It's a cycle. Not a one-time event.

Better Questions. Deeper Thinking. Brighter Futures.

STUDENT THINKING
What are students showing, saying, trying, revising, and understanding?

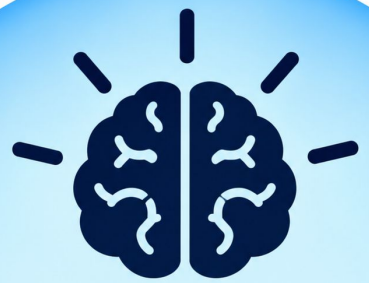
THE PROBLEM-SOLVING PROCESS
How are students making sense, selecting strategies, persevering, explaining, revising, and reflecting?

VISION OF A LEARNER
What evidence do we see of critical thinking, creativity, collaboration, communication, perseverance, and reflection?

Don't start with the score. Start with the thinking.

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Throughlines across all seven steps



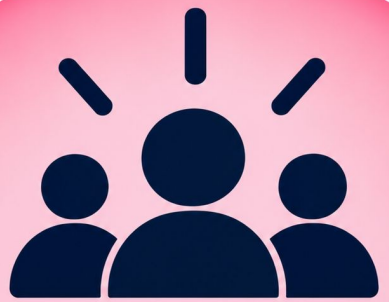
STUDENT THINKING

What are students showing, saying, and revising?



PROBLEM-SOLVING PROCESS

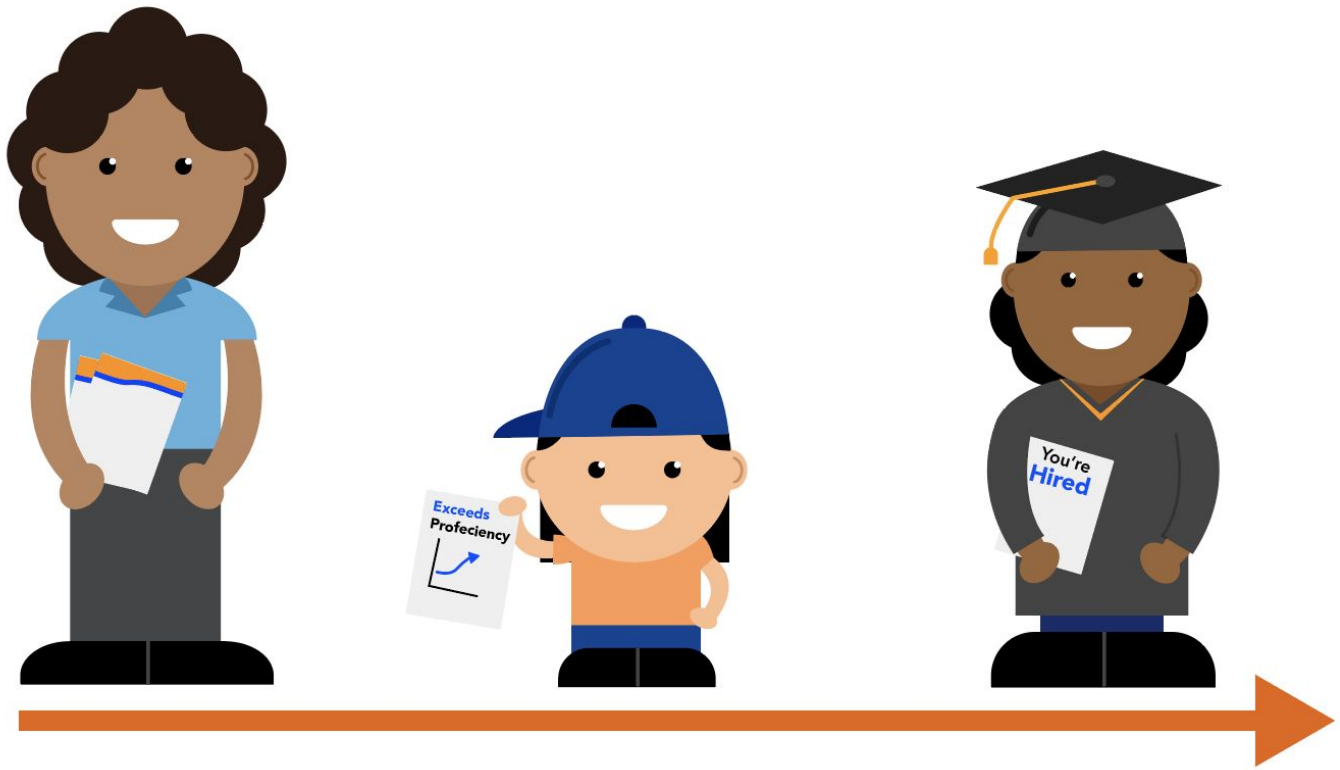
How are they making sense and reasoning?



COLLECTIVE EFFICACY

What can we accomplish together through evidence-based action?

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Plan your Problem Solving PLC cycle today!

Log into the Exemplars Math Library to choose your next task ...

Exemplars® LIBRARY
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Prepare your students to solve any problem put in front of them.

Set small goals … Ready, Set, Solve!



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https://bit.ly/Exemplars-PLC
https://exemplars.com/professional-development/PLC-resources

Thank you!

"My definition of a good teacher has changed from "one who explains things so well that students understand" to "one who gets students to explain things so well that they can be understood."

- *Problem Solving - "Knowing what to do when you don't know what to do"*

(Steven C. Reinhart, "Never Say Anything a Kid Can Say!" *Mathematics Teaching in the Middle School* 5, 8 [2000]: 478)