SUPPORTING STUDENTS IN LEARNING TO CRITIQUE MATHEMATICAL ARGUMENTS: LEARNING FROM OTHERS' TEACHING

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THE CORE CHALLENGE OF TEACHING

- Teaching complex mathematical knowledge and skill *(i.e., not just procedural technique)*

- Making complex mathematical knowledge and skill accessible to all students, and enabling all students to be successful with complex mathematics *(i.e., not just some students)*

What does this involve?

COMMON CORE: MATHEMATICAL PRACTICES

- MP1.   Make sense of problems and persevere in solving them.

- MP2.   Reason abstractly and quantitatively.

- MP3.   Construct viable arguments and critique the reasoning of others.

- MP4.   Model with mathematics.

- MP5.   Use appropriate tools strategically.

- MP6.   Attend to precision.

- MP7.   Look for and make use of structure.

- MP8.   Look for and express regularity in repeated reasoning.
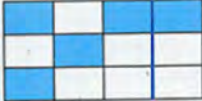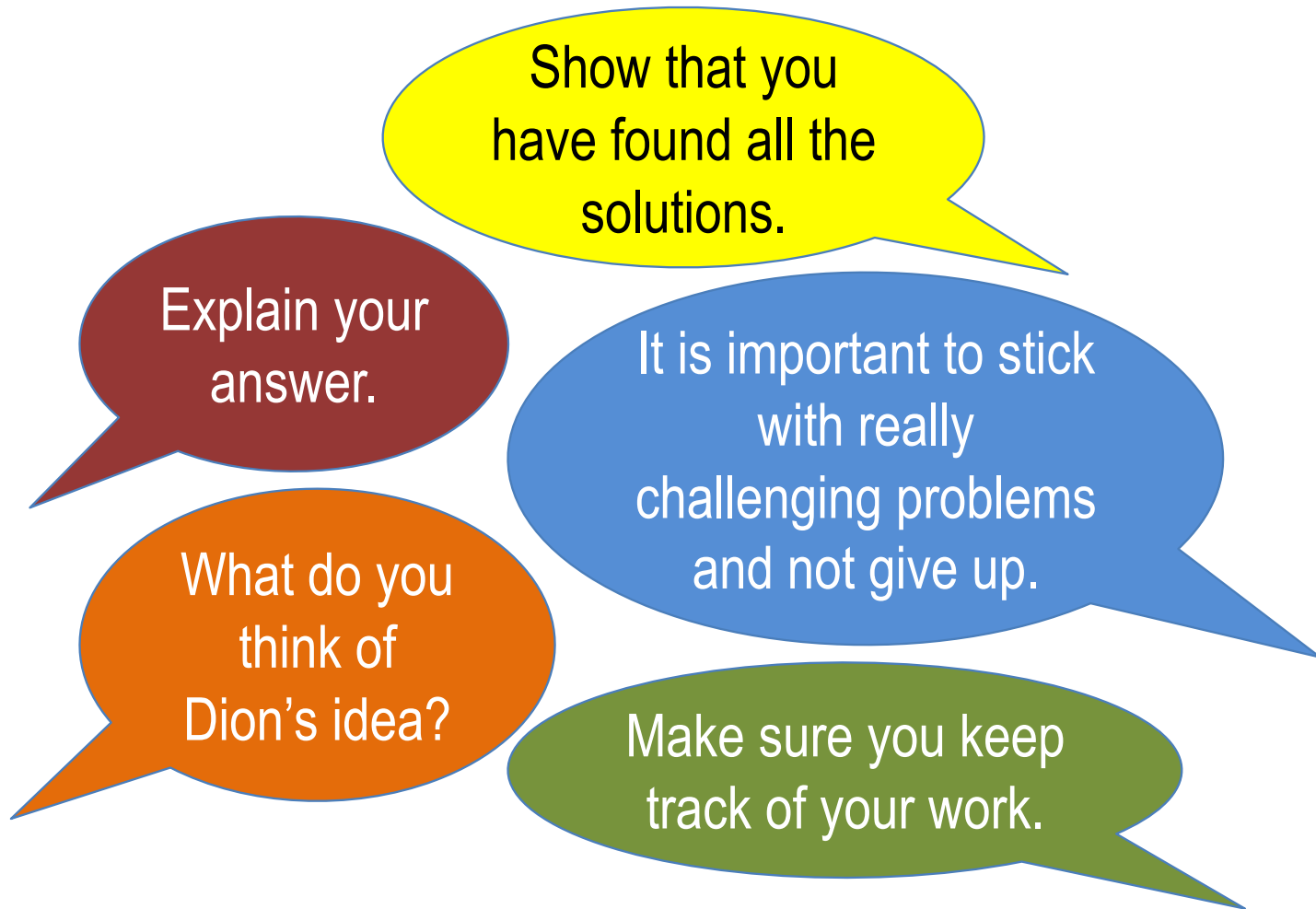
REQUESTING ≠ TEACHING

- For students, simply being **requested** — asked or assigned – to solve rich challenging problems, is **not teaching** them to do complex mathematical work

- Making complex mathematical work accessible to all students requires explicitness in instruction.

    (Shaughnessy, Ball, Mann, & Garcia, 2015)

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REQUESTING ≠ TEACHING: AN EXAMPLE

C. What fraction of the big rectangle is shaded blue? $\frac{5}{12}$

The answer is right but the explanation is not that good they sould of put more details! like, the whole and the parts, are not equal.

Explain.

I made a line and then I counted.

ⓐ IS THIS STUDENT'S ANSWER RIGHT? WHY OR WHY NOT?

MP3.   Construct viable arguments and critique the reasoning of others.

- What work is the teacher doing to support students in engaging in the practice?

- What is being made explicit about what it means to construct an argument?

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TEACHING MATHEMATICAL PRACTICE #3: EXAMINING A SEGMENT OF INSTRUCTION

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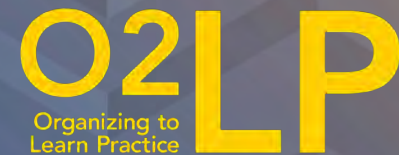
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STRUCTURE OF OUR WORK TOGETHER

- Examining a lesson plan, including suggesting revisions

- Viewing a segment of instruction with a particular viewing focus

- Examining student work

- Debriefing the examination of the segment of teaching

CONTEXT FOR THE TEACHING AND LEARNING

A context for the design and study of teaching:

- 10-day summer mathematics program for fourth graders in partnership with a local school district
- Live setting for the study of teaching, learning, and mathematics by teachers and school district leaders
- Source of unusual records of practice
- Teacher is an experienced elementary teacher with expertise in making her teaching practice public

TRAJECTORY OF STUDENTS' ENGAGEMENT WITH CRITIQUING ARGUMENTS

- Critiquing others' ideas requires understanding the ideas being shared, including:
    - Being able to restate the ideas
    - Asking questions about the ideas
    - Considering how the argument answers the question
- Engaging students in critiquing arguments requires supporting students in listening to others' arguments

EXAMINING A LESSON PLAN

Begin by solving the following problem:

How many different three-digit numbers can you make using the digits 4, 5, and 6 and using each digit only once? How do you know that you have them all?

How would you show that you had them all? What would you look for in someone else's argument?
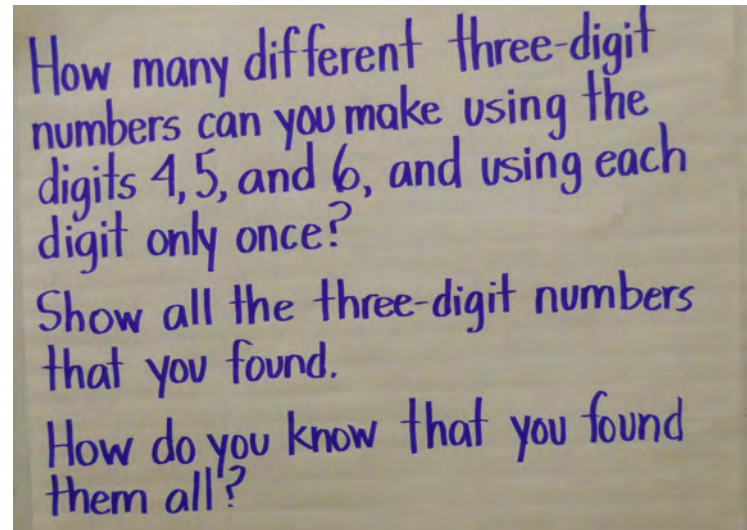
EXAMINING A LESSON PLAN

Read the lesson plan and consider:

- Is this a good problem to support developing student skill with building and critiquing arguments?

- How would you facilitate the discussion around conditions of the problem and solutions?

- How might you focus the discussion to ensure that conditions of the problem and the proof are explicit for all students?

CONTEXT FOR THE VIDEO

- Fourth day of the ten-day program
- Students have completed the problem independently
- Students have experience with identifying "conditions" of a problem
- Most students have recorded 6 unique solutions but do not have a systematic way to record them or explain that they have them all

How many different three-digit numbers can you make using the digits 4, 5, and 6, and using each digit only once?

Show all the three-digit numbers that you found.

How do you know that you found them all?

IN WHAT WAYS DO YOU SEE STUDENTS BUILDING AND CRITIQUING ARGUMENTS?

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WHAT WORK IS THE TEACHER DOING TO SUPPORT STUDENTS IN BUILDING AND CRITIQUING ARGUMENTS?

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STUDENT WORK

- Following the discussion, students respond to the following prompt:

  Write in your notebook right now. Do you think that this [Jamari's method] shows that you can't make any other ways?

- What additional evidence of students building and critiquing arguments do you see in their written work?

DEBRIEFING THE EXAMINATION OF A SEGMENT OF TEACHING

- Building arguments:
  - What are we noticing about these students' strengths in building arguments?
  - What work did the teacher do to support these students in constructing arguments?

- Critiquing arguments:
  - What are we noticing about these students' strengths in critiquing one another's ideas?
  - What work did the teacher do to support these students in critiquing arguments?

DEBRIEFING THE EXAMINATION OF A SEGMENT OF TEACHING

- What features of this problem make it a useful for working on critiquing arguments?

- What might you want to work on next with these students and how would you do that?

CONSIDERING OUR NEXT STEPS

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REFLECTING ON OUR WORK TOGETHER

What strategies might you try to build students' skills with critiquing arguments?