Student Success in Mathematics Partnership Meeting

March 3, 2020
Harrisonburg, Virginia

VA Student Success in Mathematics Partnership: REL AP Staff

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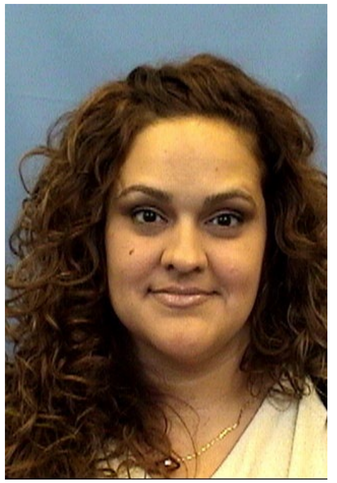
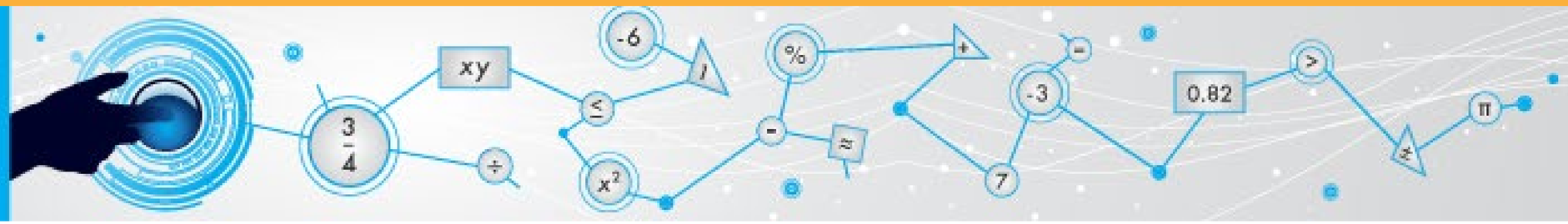


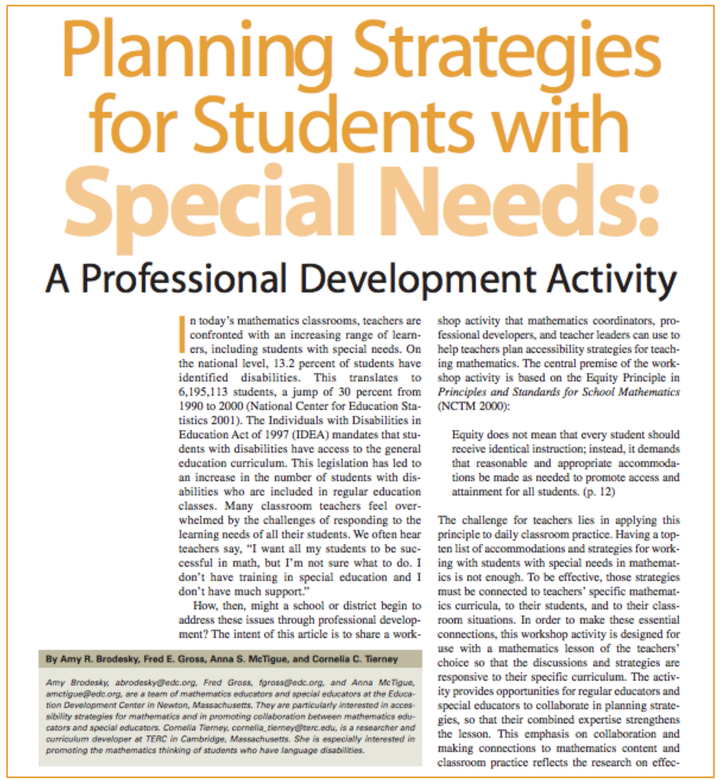
Carmen Araoz
Partnership Liaison

Improving mathematics instruction for students with disabilities & difficulties

Amy Brodesky, Education Development Center (EDC) mathematics education expert

ADDRESSING ACCESSIBILITY IN MATHEMATICS





Planning Strategies for Students with Special Needs:

A Professional Development Activity

In today's mathematics classrooms, teachers are confronted with an increasing range of learners, including students with special needs. On the national level, 13.2 percent of students have identified disabilities. This translates to 6,195,113 students, a jump of 30 percent from 1990 to 2000 (National Center for Education Statistics 2001). The Individuals with Disabilities in Education Act of 1997 (IDEA) mandates that students with disabilities have access to the general education curriculum. This legislation has led to an increase in the number of students with disabilities who are included in regular education classes. Many classroom teachers feel overwhelmed by the challenges of responding to the learning needs of all their students. We often hear teachers say, "I want all my students to be successful in math, but I'm not sure what to do. I don't have training in special education and I don't have much support."

How, then, might a school or district begin to address these issues through professional development? The intent of this article is to share a workshop activity that mathematics coordinators, professional developers, and teacher leaders can use to help teachers plan accessibility strategies for teaching mathematics. The central premise of the workshop activity is based on the Equity Principle in *Principles and Standards for School Mathematics* (NCTM 2000):

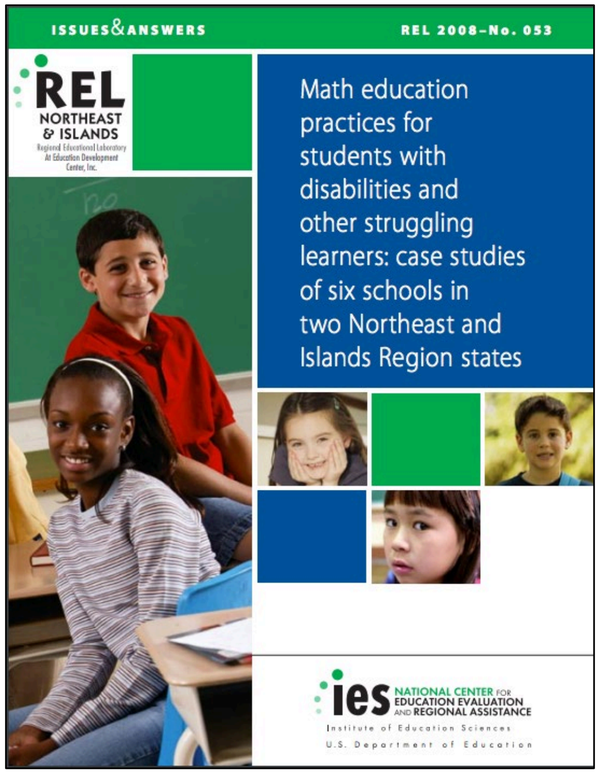
> Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students. (p. 12)

The challenge for teachers lies in applying this principle to daily classroom practice. Having a ten list of accommodations and strategies for working with students with special needs in mathematics is not enough. To be effective, those strategies must be connected to teachers' specific mathematics curricula, to their students, and to their classroom situations. In order to make these essential connections, this workshop activity is designed for use with a mathematics lesson of the teachers' choice so that the discussions and strategies are responsive to their specific curriculum. The activity provides opportunities for regular educators and special educators to collaborate in planning strategies, so that their combined expertise strengthens the lesson. This emphasis on collaboration and making connections to mathematics content and classroom practice reflects the research on effec-

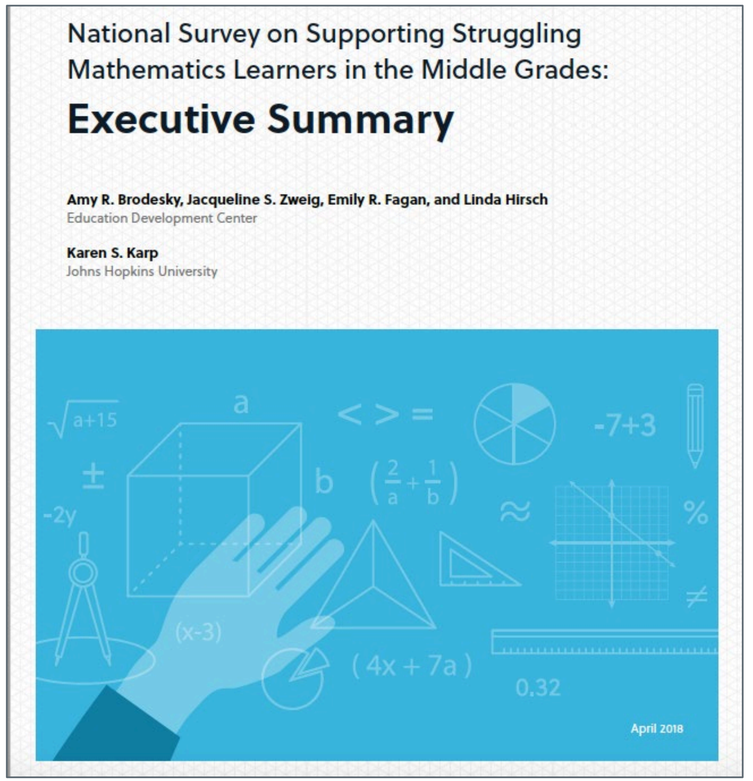
By Amy R. Brodesky, Fred E. Gross, Anna S. McTigue, and Cornelia C. Tierney

Amy Brodesky, abrodesky@edc.org, Fred Gross, fgross@edc.org, and Anna McTigue, amctigue@edc.org, are a team of mathematics educators and special educators at the Education Development Center in Newton, Massachusetts. They are particularly interested in accessibility strategies for mathematics and in promoting collaboration between mathematics educators and special educators. Cornelia Tierney, cornelia_tierney@terc.edu, is a researcher and curriculum developer at TERC in Cambridge, Massachusetts. She is especially interested in promoting the mathematics thinking of students who have language disabilities.

Professional Development



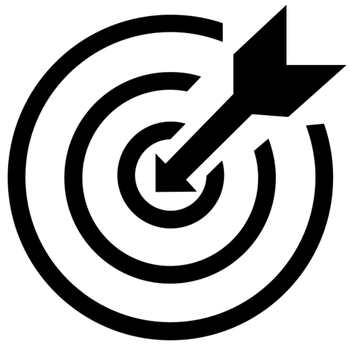
Research



Math Instruction & Intervention

Presentation goals

- Learn about recommended instructional practices for students who have mathematics disabilities and difficulties.
- Use a process for planning high-quality, accessible mathematics lessons.
- Explore ways to strengthen professional collaboration.
- Experience examples of professional development (PD) activities.
- Leave with ideas to apply in your district.



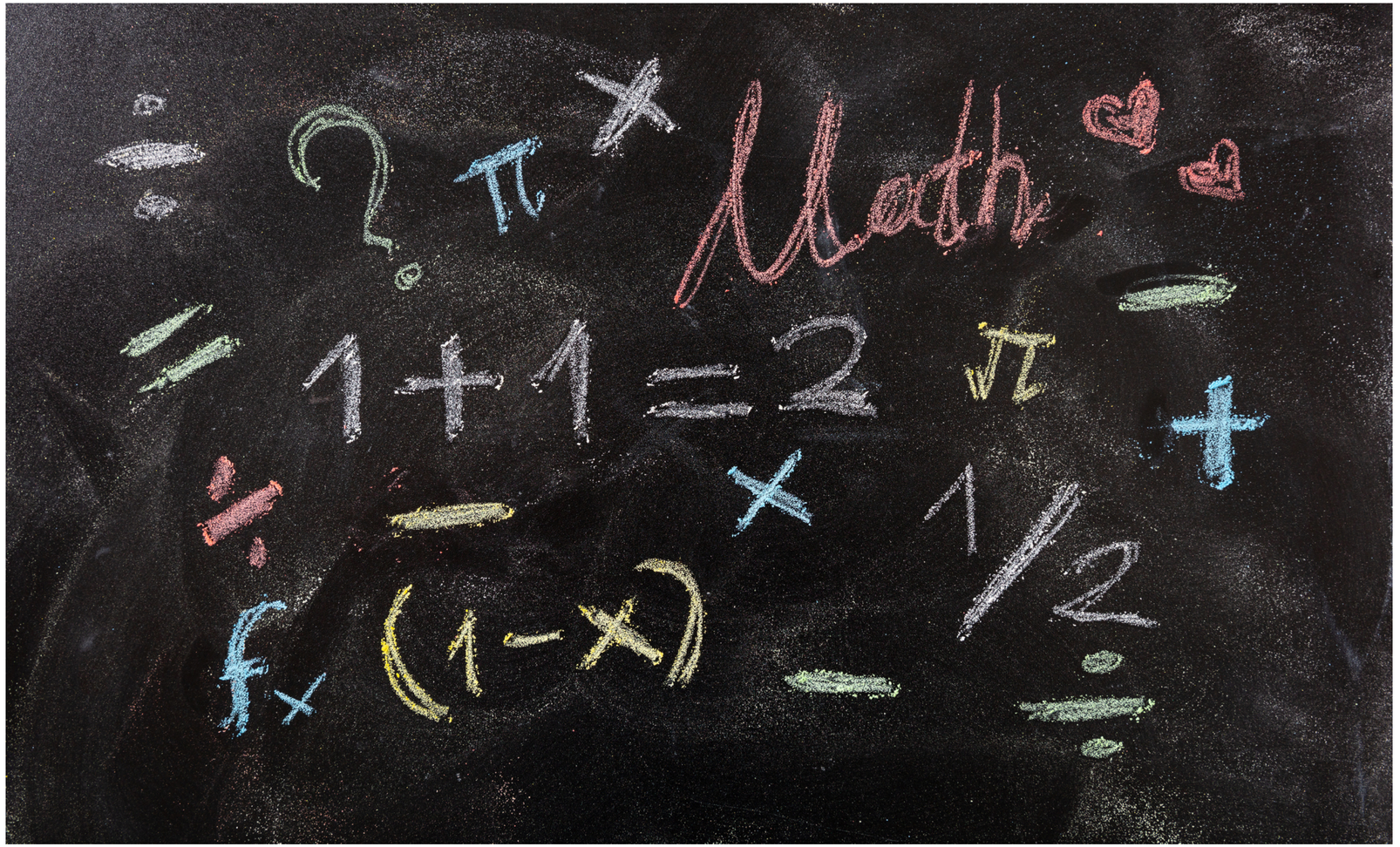
Topics

1. Students with mathematics disabilities and difficulties

2. Tier 1: High-quality, accessible mathematics instruction
   - 2A. Recommended instructional practices
   - 2B. Student communication and participation

3. Professional collaboration

1. Students with mathematics disabilities and difficulties



Specific learning disability (SLD)

- 14 percent of U.S. public school students are served by Individuals with Disabilities Education Act (IDEA): **7 million students**

- 34 percent have a "specific learning disability"

A disorder in one or more psychological processes involved in:

- Listening
- Speaking
- Basic reading
- Reading comprehension
- Written expression
- Arithmetic calculation
- Mathematical reasoning

U.S. Department of Education, Office of Special Education Programs, Individuals with Disabilities Education Act (IDEA) database, Section 300.8, 2018. https://www2.ed.gov/programs/osepidea/618-data/state-level-data-files/index.html#bcc

Mathematics learning disability (MLD)

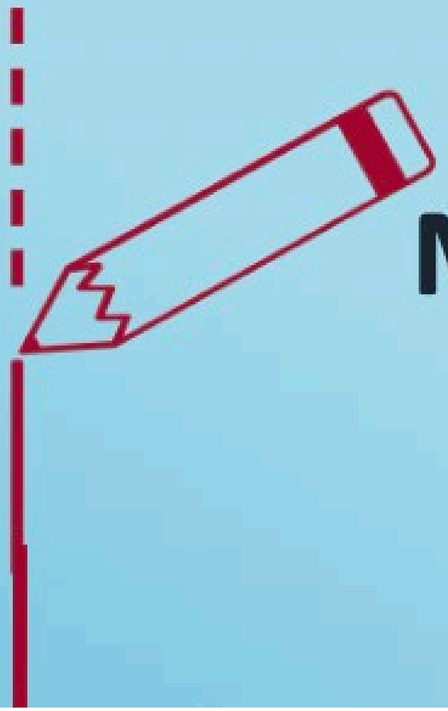
- *Prevalence:* About 5–8 percent of public-school students in the United States have MLD
- *Students with MLD tend to:*
  - Have persistent difficulties with math facts
  - Use problem-solving procedures that younger students use
  - Make frequent errors when executing procedures
  - Have a poor understanding of foundational concepts.
- *Possible causes:*
  - Underdeveloped cognitive structures, which are the mental processes necessary to connect new information with prior knowledge
  - Memory deficits related to working memory

(Geary, 2004, 2011)

MLD research issues

Lack of consensus about where to draw the line between:

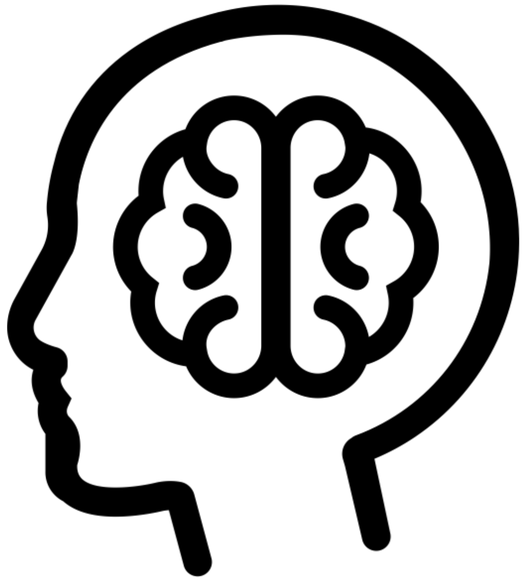
Mathematics Disabilities



Mathematics Difficulties

(Lewis & Fisher, 2016)

Research highlights: Common areas of difficulty



- Number sense
- Fluency with math facts
- Word problems
- Moving from concrete to abstract
- Reflecting on thinking—metacognition

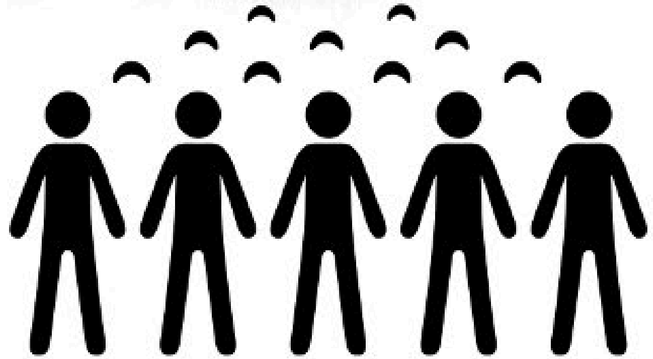
(Allsopp, Lovin, & Vaningen, 2018).

Students who struggle with mathematics over time may:

- Experience mathematics anxiety
- Have learned helplessness
- Take a passive approach to learning
- Become discouraged easily
- Not know how to ask for help
- Try to hide that they are having difficulty.

(Allsopp, Lovin, & Vaningen, 2018).

Neurodiversity of learners



- We all learn differently.
- Students with disabilities are part of a **continuum** of learners.
- We should view disabilities as **differences** not deficits.

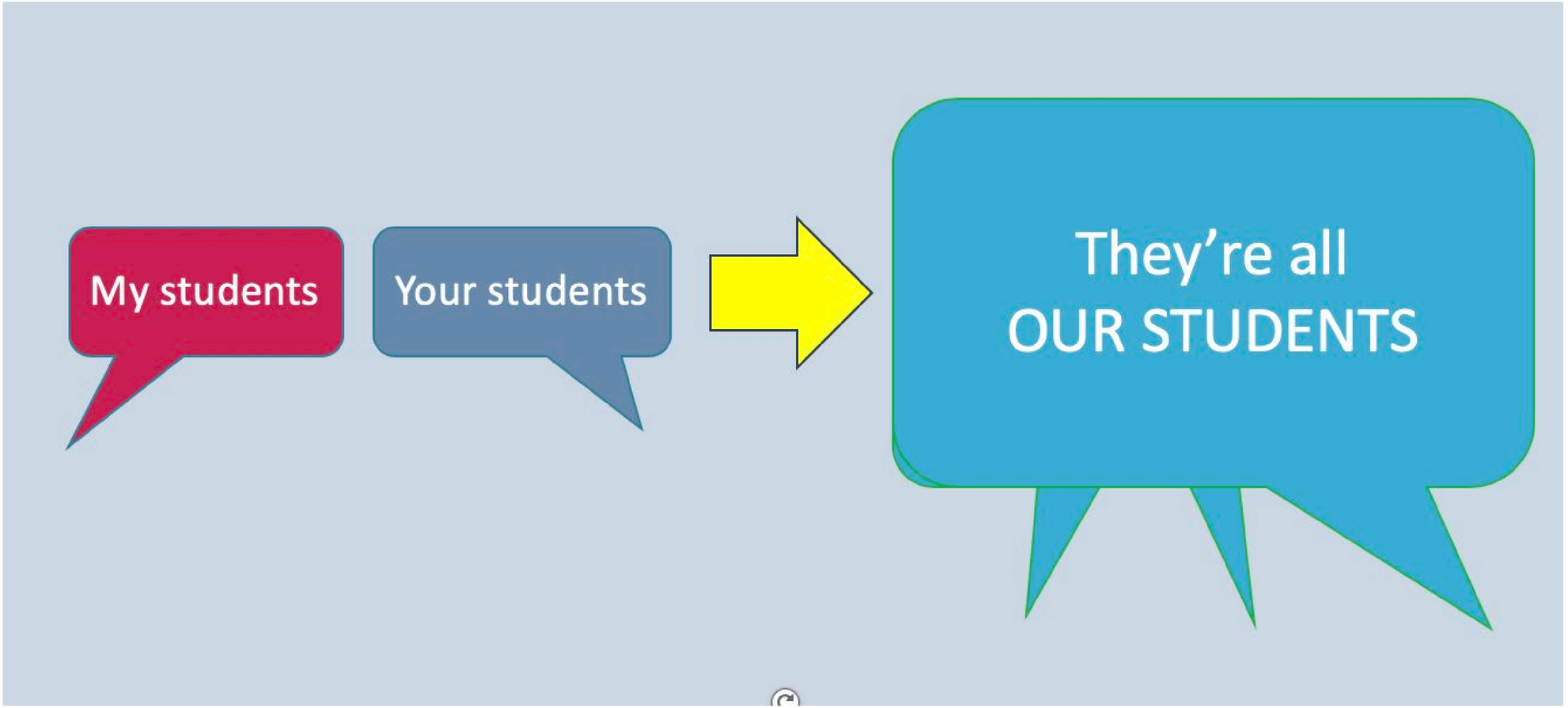
(Lambert, 2018)

Essential shifts

Deficit Models of Students with Disabilities

Strengths-Based Approaches

Essential shifts



Tier 1: High-quality, accessible mathematics instruction

Equity Principle

"Excellence in mathematics education requires equity—high expectations and strong support for all students."

" Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students."

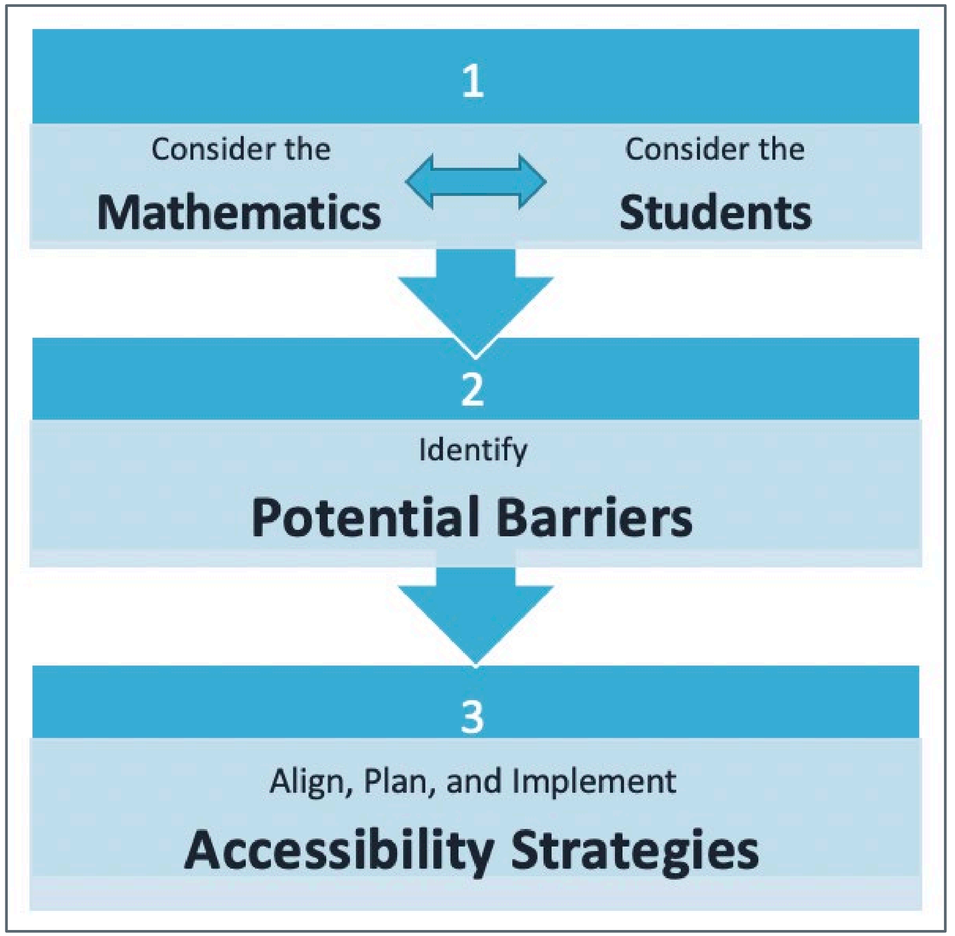
(National Council of Teachers of Mathematics, 2000)

High-quality, accessible mathematics instruction for Tier 1

- Meets the needs of a range of learners while maintaining the integrity of the math.
- Teaches math meaningfully to build students' understanding.
- Uses research-based strategies.
- Sets high expectations for student learning.
- Provides accommodations and support while also helping to build student independence.

PD Activity:

Use a mathematics accessibility planning process



Handout, Page 1

PD activity: Patterns task

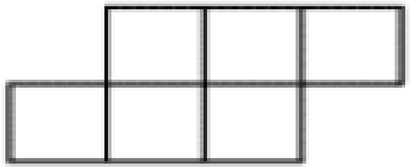


Figure 1

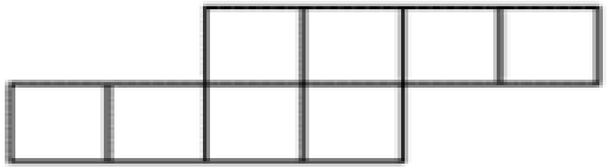


Figure 2

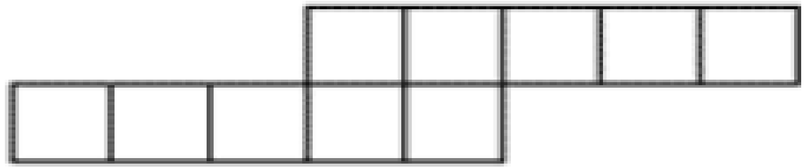


Figure 3

Based on this pattern, how could you figure out the number of small squares in any figure? Write an expression to find the number of squares in Figure *n*.

Directions

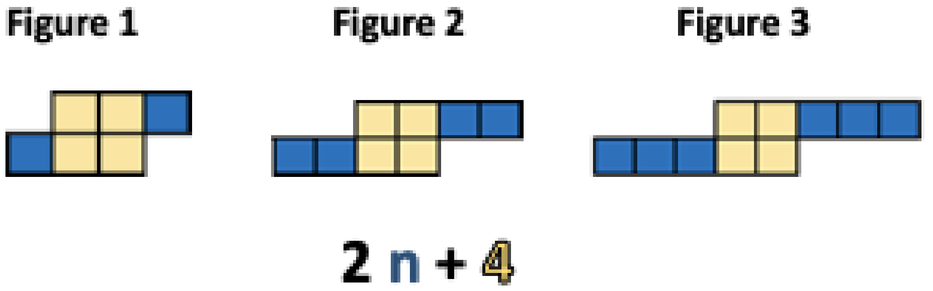
1. Get to know the problem by doing it yourself.

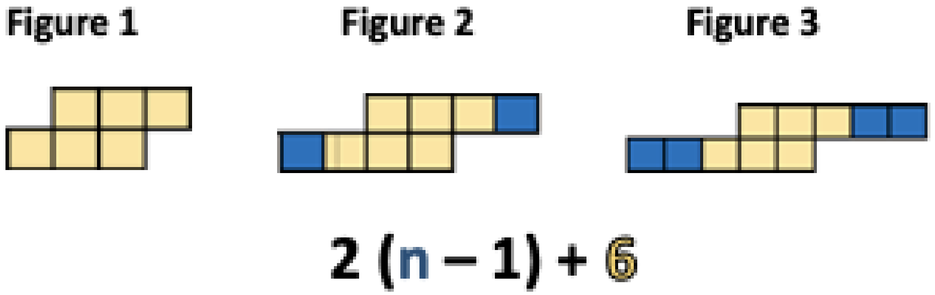
2. Talk with a partner: How did you see the pattern?
How did you move from the pattern to the expression?

Handout, Page 2

How did you see the pattern?

Different ways of seeing the pattern connect to different expressions





Part 1. Consider the mathematics goals

- Analyze and extend a visual pattern.
- Represent a visual pattern by using an algebraic expression.

Relevant Standards

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problems.

MP1. Make sense of problems and persevere in solving them.
MP7. Look for and make use of structure.

(National Governors Association Center for Best Practices, Common Core State Standards, 2010)

Handout, Page 1

Part 1. Consider the mathematics task

A. What kinds of **task demands** does the problem place on students?

- Conceptual?
- Language?
- Visual-spatial?
- Other?

B. Consider: Which task demands are essential to the goals?

Handout, Page 1

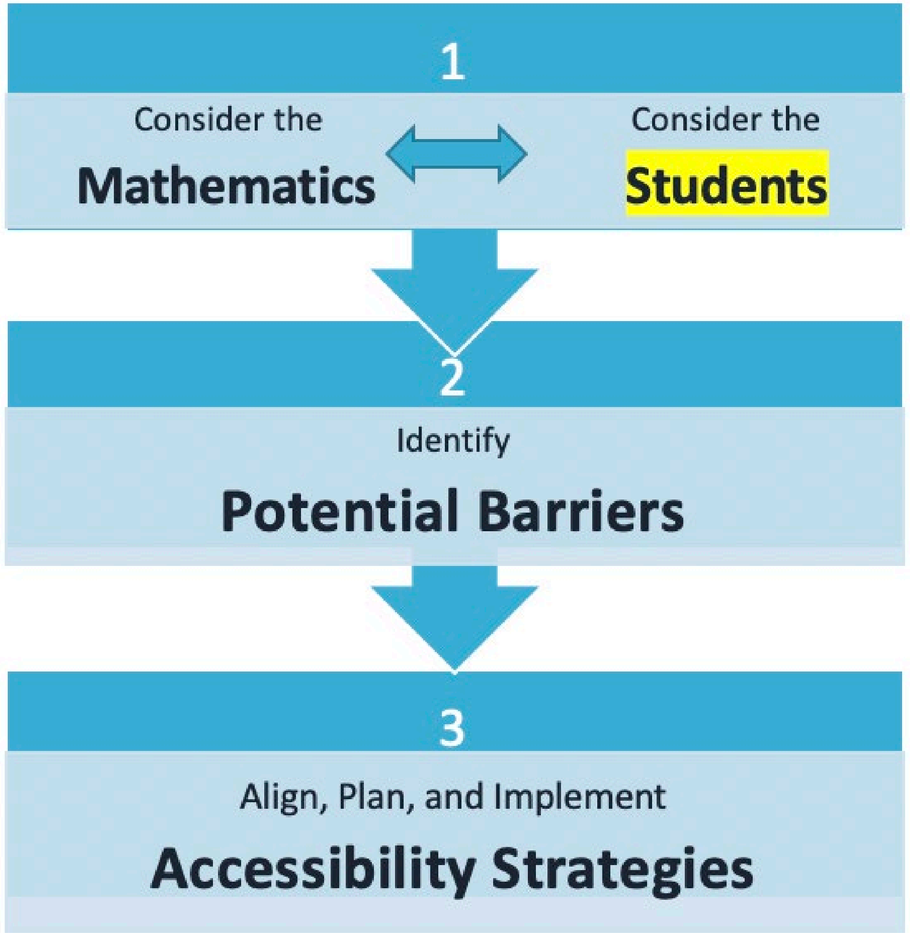
Part 1. Consider the students

Directions

A. Read about the sample students on **page 3.**

B. Each person picks a student.

C. List your student's **strengths** and **difficulties** on the Planner, page 1.

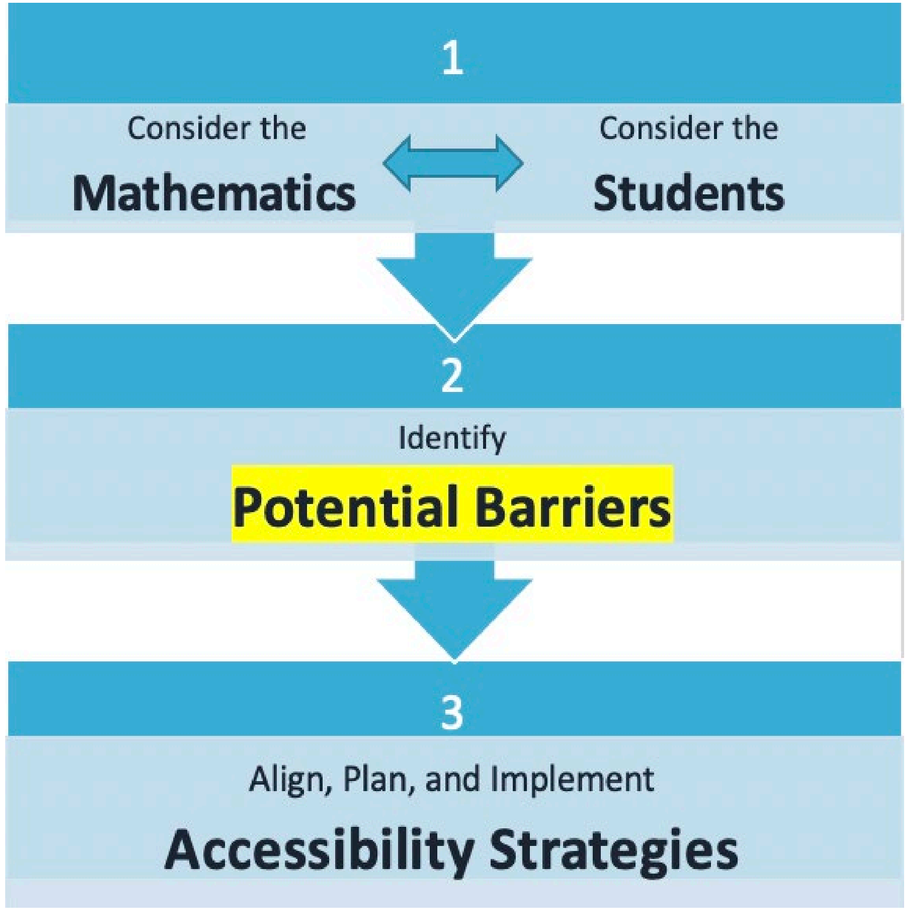


Part 2. Identify potential barriers

What is the match or mismatch of the Patterns task with your focus student's strengths and difficulties?

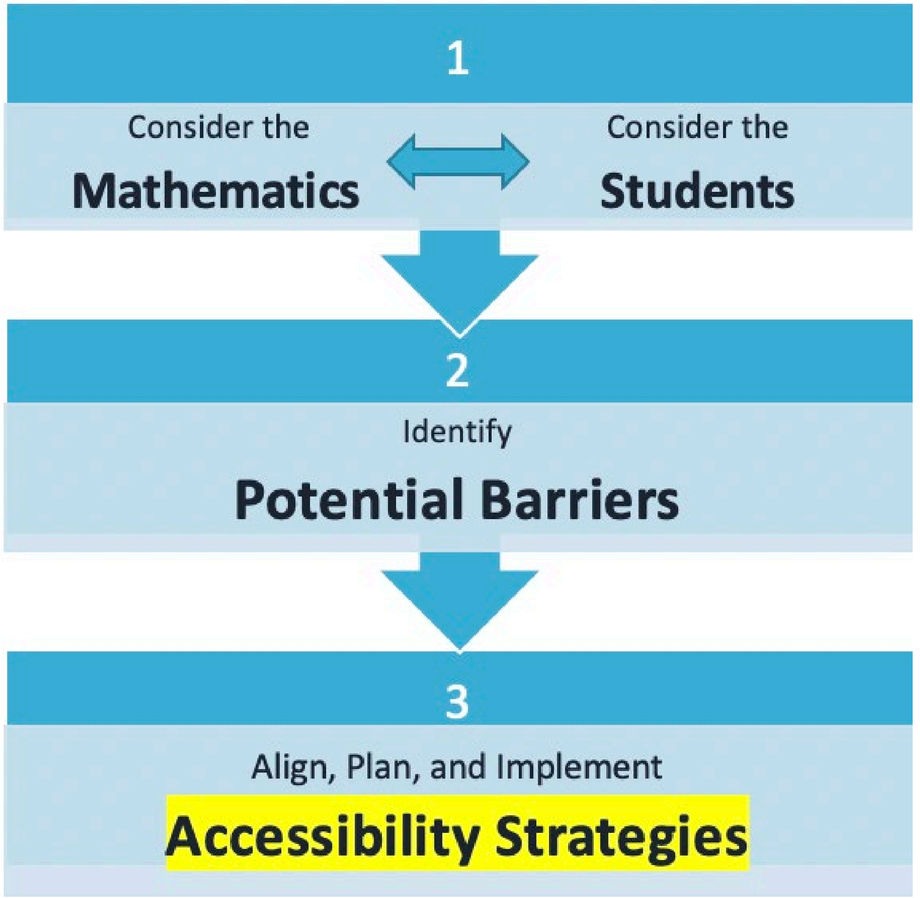
1. What **strengths** does your focus student bring to this task?

2. What **potential barriers** might the **Patterns task** pose for your focus student?



Part 3. Align accessibility strategies

- Consider a wide variety of strategies.
- *Align* strategies with students' strengths and difficulties and the math goals.
- Build on students' strengths.



Strategy card activity

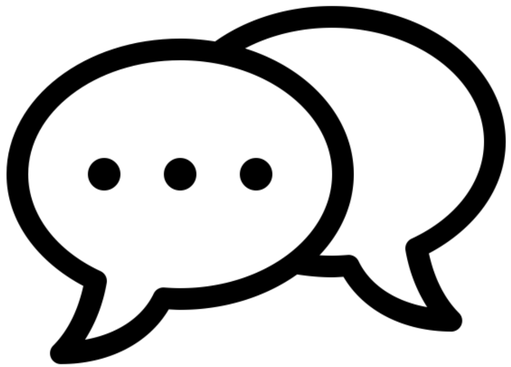
Directions

1. Each person gets four strategy cards to start.

2. Find **two strategies** that are a *particularly good match* to your student.
   - You can trade for new cards.
   - Place rejected cards face up in the middle so others can use them.
   - Work together to find good strategies for each student.

3. After everyone has identified two strategies, share with the group:
   - Which strategies did you select for your student? Why?
   - How would you use this strategy for the Patterns task?

Share strategies



- Which strategies did you select for your student? Why?
- How does your strategy align with the math goals and the student's strengths and needs?

Resource: Strategies List, page 4

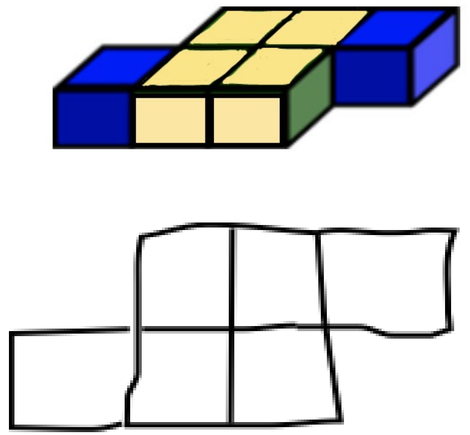
Sample strategies for Celia

Difficulty: Moving to the Abstract

It's a big leap from building and drawing the pattern to writing an algebraic expression!

Concrete, semi-concrete, abstract (CSA)

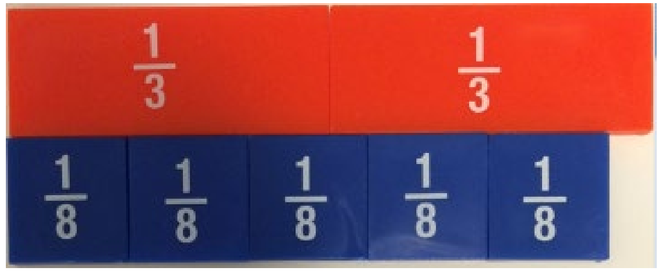
- **Concrete**: manipulatives
- **Semi-concrete:** drawings
- **Abstract:** numerical, symbolic, table, graph, expression, and equation



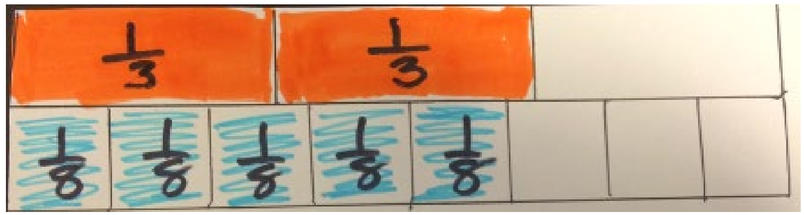
(Gersten et al., 2009)

CSA example: Comparing fractions

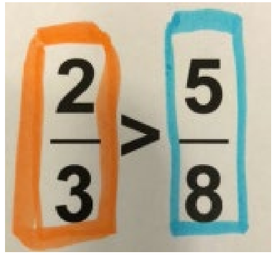
- Concrete

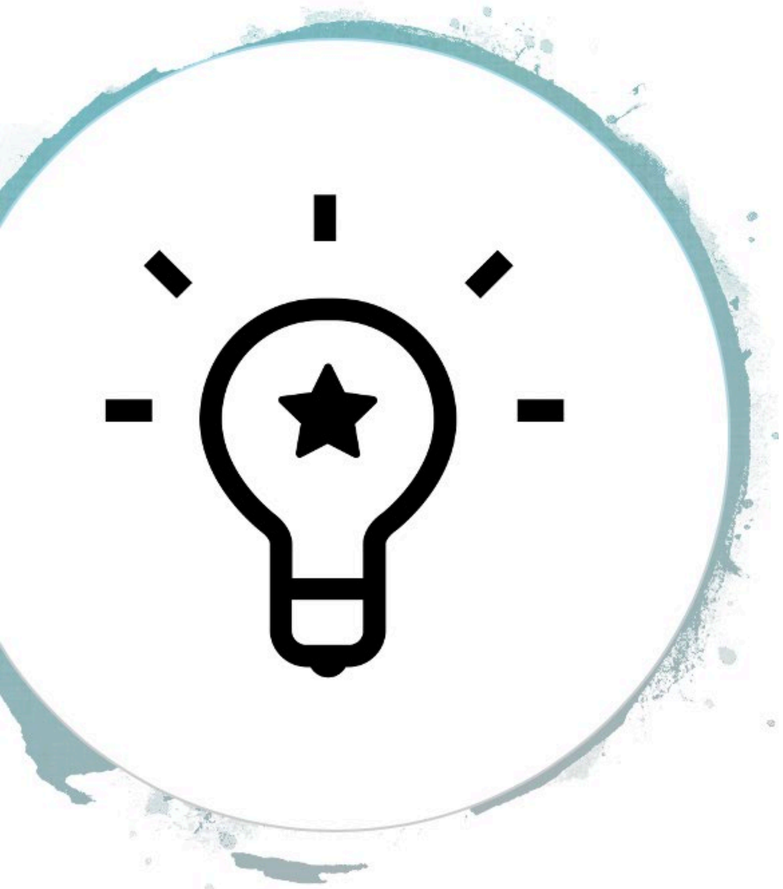


- Semi-concrete



- Abstract



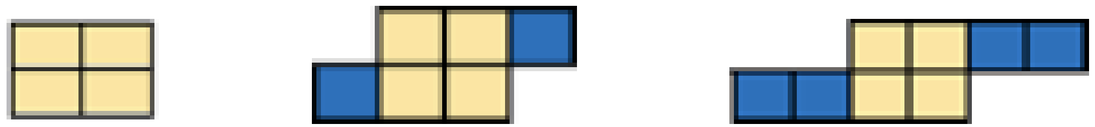


Suggestions for CSA

- Help students build meaningful understanding of each level.
- Have students work with and **connect** the representations: use of CSA does *not* need to be sequential.
- Use consistent language across the representations.
- Incorporate concrete and semi-concrete tasks in assessments (not just abstract).

Use color-coding to connect representations

Figure 0 Figure 1 Figure 2

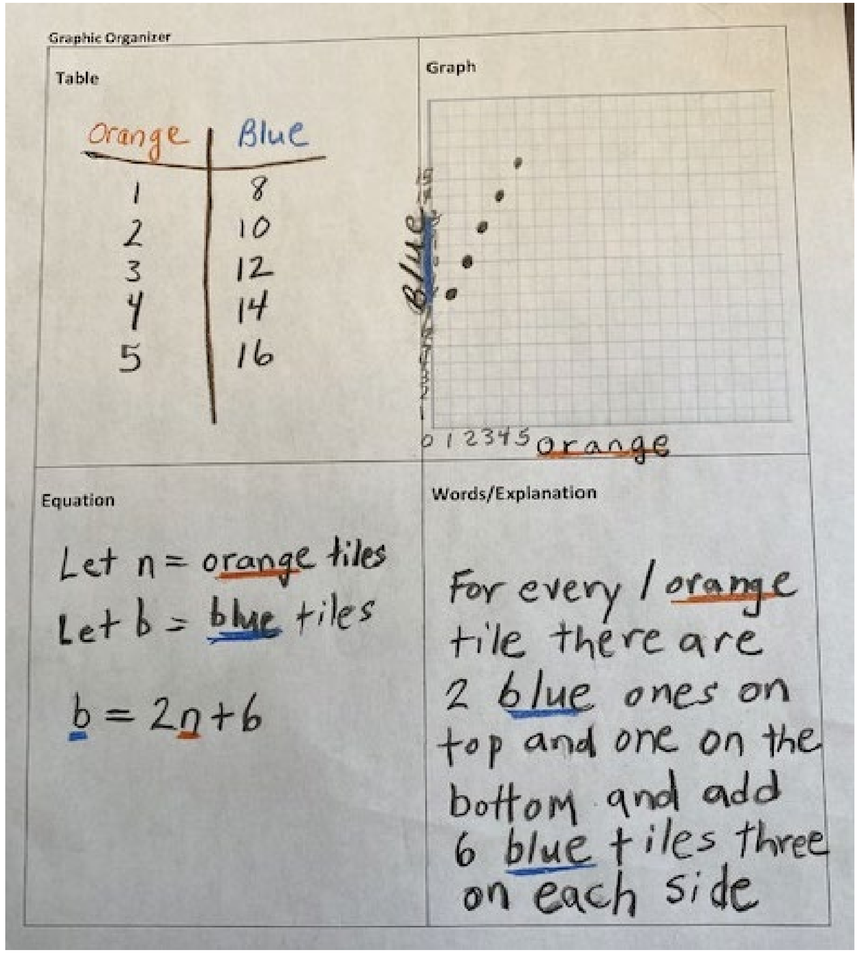


	squares	Number of yellow squares	Total squares
0	0	4	4
1	2	4	6
2	4	4	8
3	6	4	10
4	8	4	12
n	2n	4	2n+4

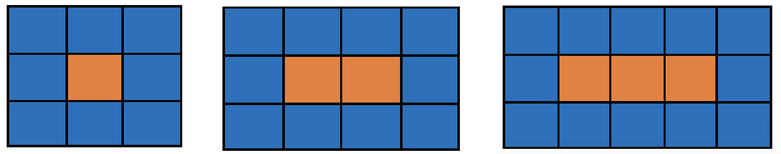
4 + 2n or 2n + 4

Strategy #3

Graphic organizers: Link sheet or rule of 4



Tiling Garden Beds Task



Garden 1 Garden 2 Garden 3 Garden 4 Garden 5

Accessibility Planning

Goals

- Build on students' strengths.
- Provide access to learning key mathematics content.
- Be proactive.
- Plan strategies to have in your back pocket.
- Support students in being independent

Cautions

- Making adaptations that lose important mathematics.
- Setting expectations too low.

Just-in-case vs. Just-in-time scaffolding

"The key is to provide the scaffolding **just in time** rather than just in case students need it. Just-in-time scaffolding helps to develop **productive perseverance** by allowing students to engage in demanding tasks on their own and then assisting them in maintaining the engagement when they struggle by using teacher questioning as the means of support."

(Dixon, 2018)

Discuss PD activity

What are your takeaways from doing this PD activity?

Any questions?

PD Suggestion:

Focus Students Approach

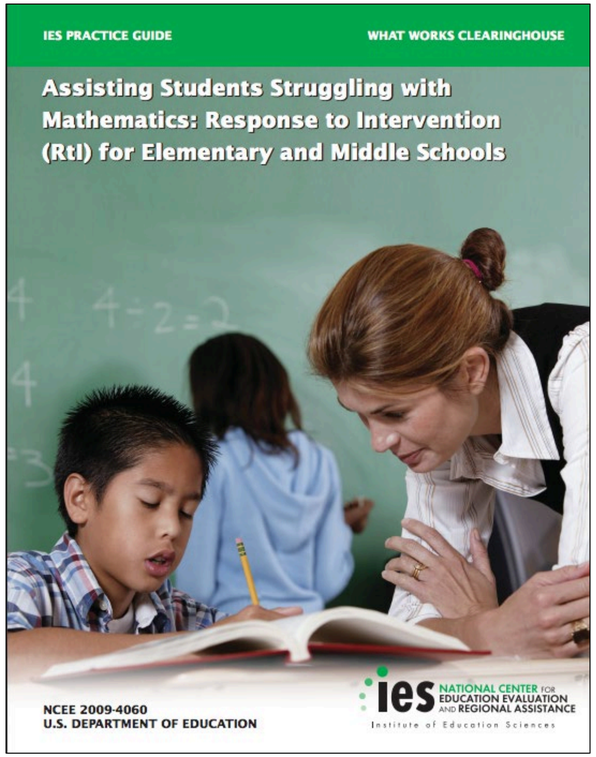
Choose three students to serve as proxies for the range of learners in your class. For example, a student who struggles, a typical student, and a high-performing student.

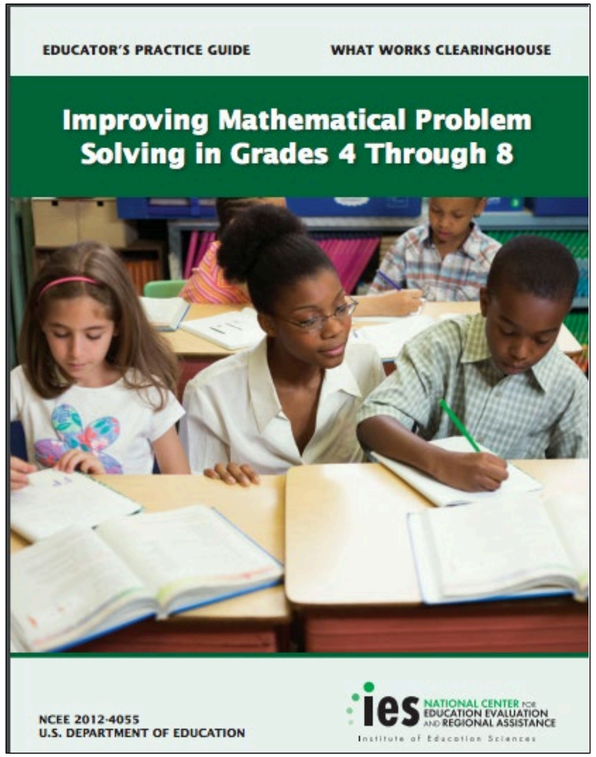
Planning with those students in mind will help you to address the range of learning needs.

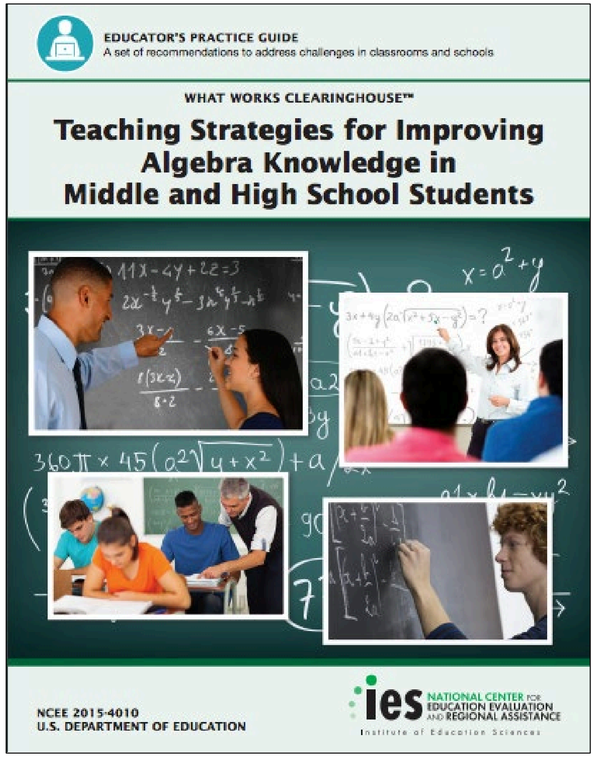
This can serve as a first step in accessibility planning. Some students will also need individual accommodations.

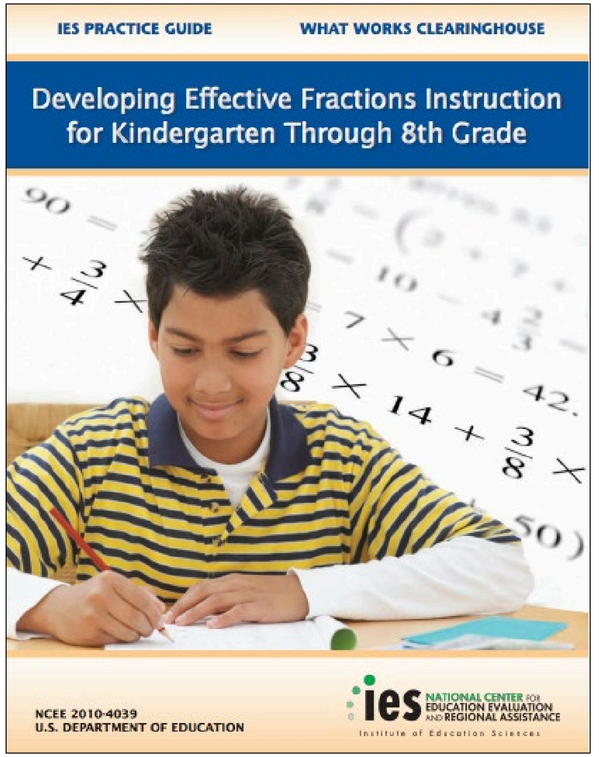
2A. Recommended instructional practices

Meeting the needs of a range of learners



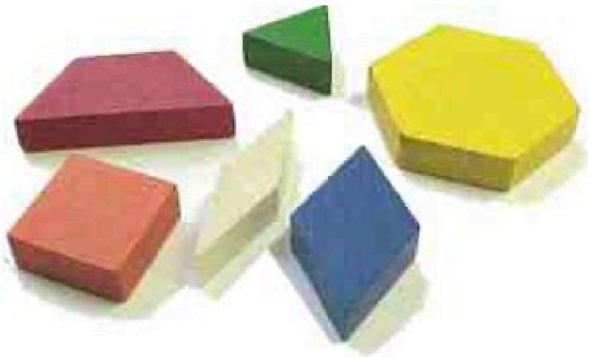


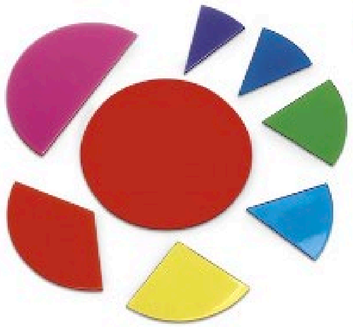




Research-Recommended Practices

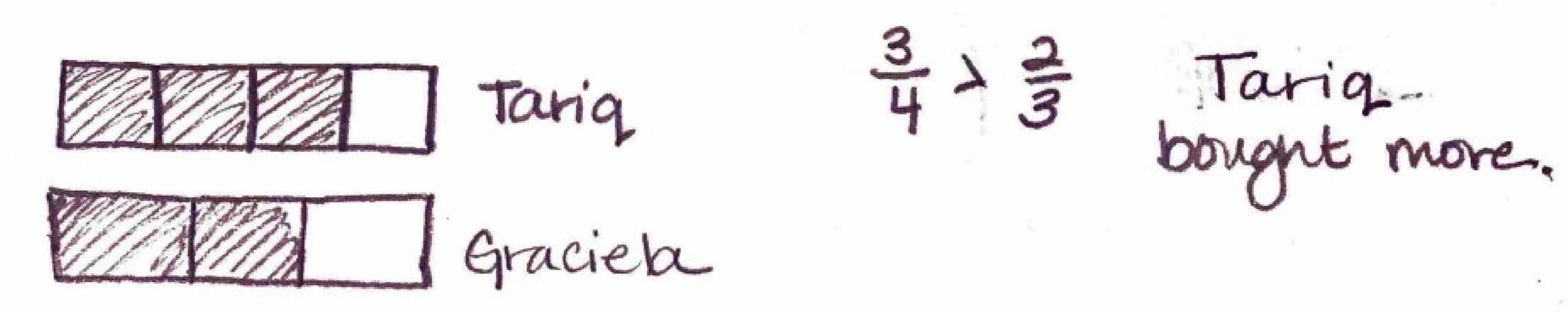
IES Practice Guides





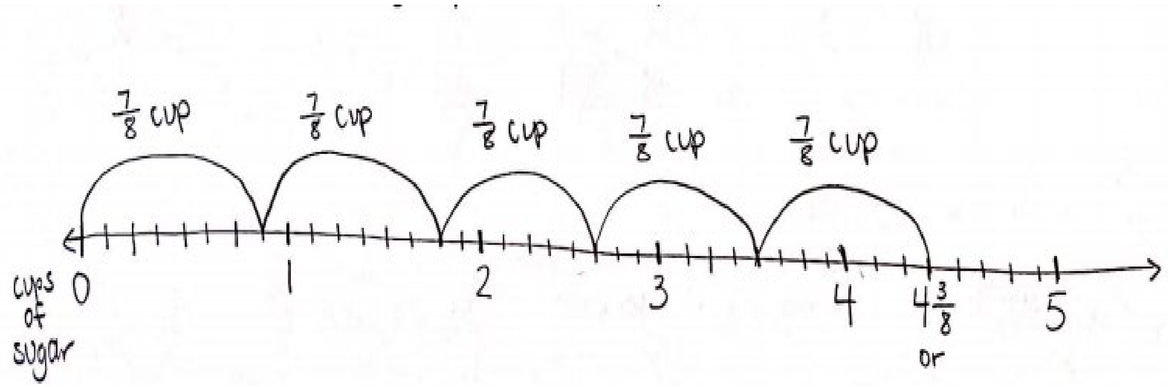
Use manipulatives

Use visual representations



(Gersten et al., 2009)

Use number line representations

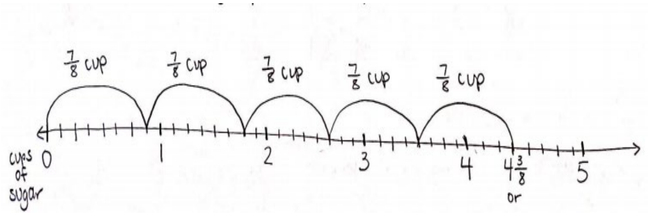


$\frac{35}{8}$

$\frac{7}{8} \times \frac{5}{} = 4\frac{3}{8}$

(Siegler et al., 2010)

Number line representation

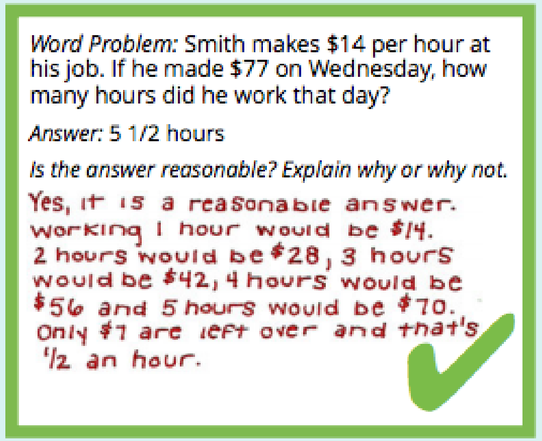


- Number lines help students build understanding that fractions are numbers with magnitude.
- An intervention program that strongly emphasized the number line representation for fractions found larger gains for at-risk learners than a program that focused primarily on the part-whole approach.

(Fuchs et al., 2013; Siegler et al., 2010)

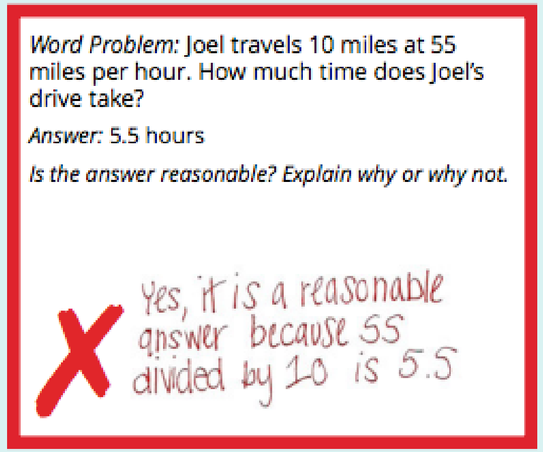
Worked examples: Correct and incorrect examples

Anya gave a **good** response for this problem. Here is what she wrote:



- Explain why 100 hours would have been an unreasonable answer.

Preston **didn't** give a good response for this problem. Here is what he wrote:



- How could Preston have figured out that his answer didn't make sense?
- Without solving the problem, give a number that would be a more reasonable answer to the problem. Explain.

(Booth, Cooper, Donovan, Huyghe, Koedinger, & Pare-Blagoev, 2015)

Research highlights: Worked examples

But, won't struggling learners get confused by incorrect examples?

Findings

- Using incorrect examples with self-explanation prompts was particularly beneficial to students with low prior knowledge.

- Combining correct and incorrect examples was more helpful than using only correct examples.

(Booth, Lange, Koedinger, & Newton, 2013)

Research highlights: Worked examples

Barriers for students

- Irrelevant information
- Extra steps
- Length

Findings

- Students with math learning disabilities do worse than peers when the first two features are present.
- Students who have both mathematics and reading disabilities have the lowest performance on word problems

(Berch & Mazzocco, 2007; Fuchs & Fuchs, 2002)

Recommendation: Avoid the key word approach

Key word approach: Linking a word with a single operation, such as:

- In All: +
- Left: –
- Each: ×
- Share: ÷

If students use the key word approach, what operation might they use for these problems?

Amy bought 5 bags of apples. Each bag has 8 apples in it. How many apples does she have *in all*?

Pam got a bag of candy to *share* with friends. After she gave away 16 candies, she had 4 candies *left* over. How many candies were in the bag?

Suggestions for helping students with word problems

- Contexts that are familiar, appealing, and personalized
- Improved readability of problems
- Problem-solving processes and graphic organizers
- Concrete and visual representations
- Acting out the situations
- Use schema-based instruction
- 3-Reads strategy
- Sorting activities
- Numberless word problems

(Karp, Bush, & Dougherty, 2019; Powell & Fuchs, 2018)

2B. Student communication and participation

Discuss

What are some reasons that students with mathematics disabilities or difficulties may be hesitant to talk about their math ideas in class?

Student participation is an issue of equity

Low-achieving students tend to participate less and make fewer mathematical contributions than their higher-performing peers.

Equitable participation can be promoted through teachers' use of classroom structures, high expectations, resources, such as concrete materials, and other supports.

(Baxter, Woodward, & Olson, 2001; Foote, & Lambert, 2011)

Suggested approach: Whiteboard questioning

Show me an example of…

- A shape that has a large perimeter and a small area

(Swan, 2005)

More prompts

Show me an example of…

a. Two fractions that have a sum that is greater than 1.

b. Two integers that have a sum of -2.

c. A set of five numbers with a range of 6 and a mean of 10.

Benefits of "Show me an example..."

- Having a visual helps students commit to an answer and talk about their ideas.
- It helps make the discussion more concrete.
- Students can easily erase and change their work on the whiteboard – "rough draft."

(Swan, 2005)

Choose math tasks that promote communication

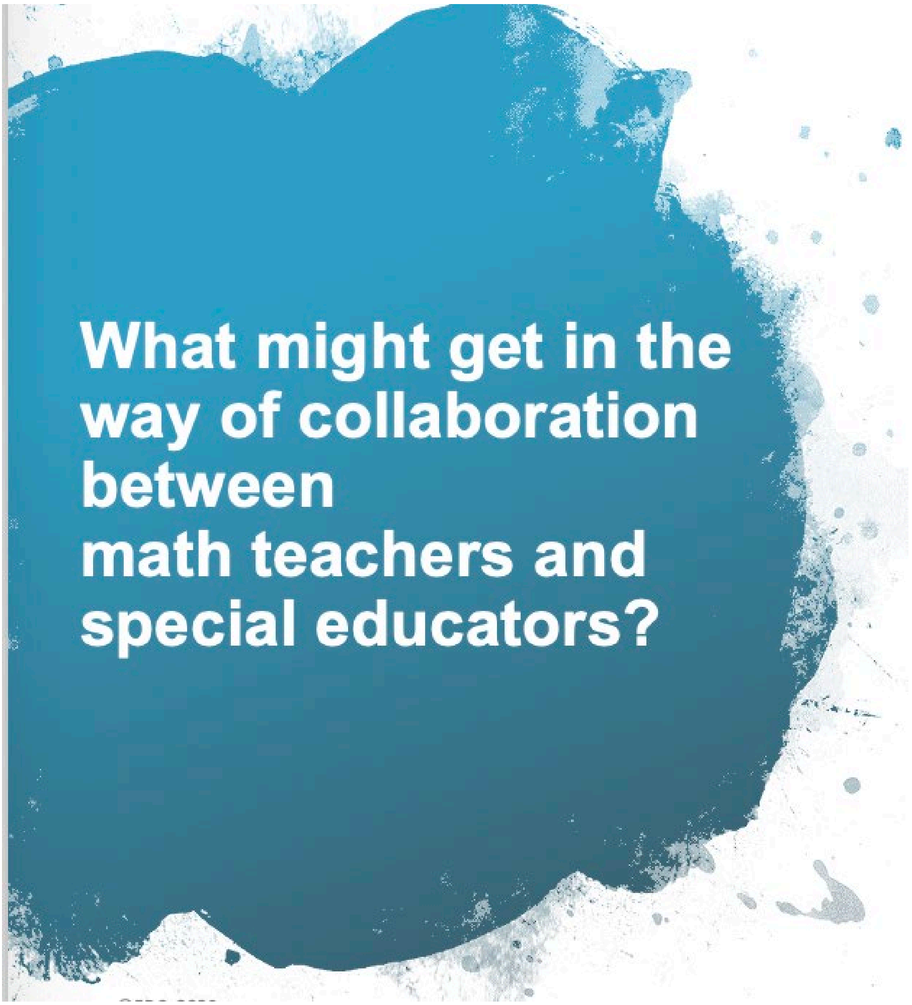
- Does the task allow for multiple approaches or solutions?
- After one student answers, will other students be able to say something different?
- Does it allow for a range of responses?
- Does it motivate discussion?
- Is it accessible?
- Does it provide entry points for all students to feel able to contribute?

3. Professional collaboration

What stands out to you in this definition of **collaboration?**

Collaboration is a shared professional effort that requires:

- A commitment on the part of each individual
- A shared goal
- Careful attention to communication skills
- Equity in relationships and time allotments.



- Lack of co-planning time
- Tensions in approaches
- Lack of knowledge of mathematics content or of accommodations
- Specialized “jargon” of each discipline
- Negative beliefs about students
- Unwillingness to give up control
- Unclear roles and accountability
- IEP meetings
- Paperwork

Co-teaching definition

- Two teachers have the same level of licensure and different expertise.
- Typically, there is a general education teacher and a special education or English as a Second Language (ESL) teacher.
- Teachers have equal ownership of all students' work and classroom responsibilities.

(Friend, 2010)

Six Models of Co-teaching

1. One teaching, one assisting
2. One teaching, one observing
3. Alternative teaching
4. Stations teaching
5. Parallel teaching
6. Team teaching

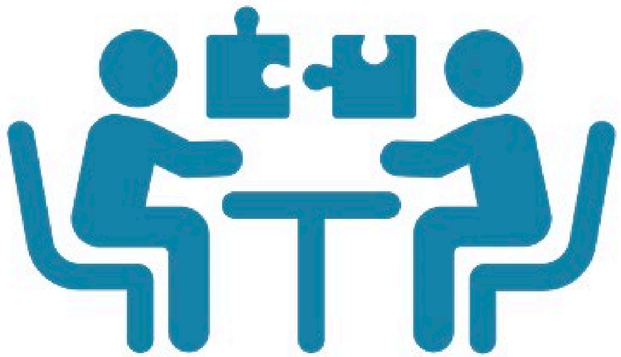
Common Challenge:

Only One Model Is Used

1. One teaching, one assisting
2. One teaching, one observing
3. Alternative teaching
4. Stations teaching
5. Parallel teaching
6. Team teaching

Let's unpack this issue:

Why do co-teachers tend to use the One Teaching, One Assisting model and *not* other models?



PD activities to strengthen co-teaching

1. **Brainstorm roles**: While one teacher is…., the other teacher is…
2. **Discuss scenarios of common co-teaching issues.**
3. **Co-planning** using a structured process and planning template/tools.

Co-teaching roles

Teachers need roles that enable them to…

- Use their own expertise
- Learn from each other's expertise
- Feel like professionals
- Meet students' needs.

PD activity 1: Brainstorm possible roles

One teacher's actions	What might the other teacher do?
1. Give directions to the whole class. 2. Have students share their approaches with the whole class. 3. Work with students in a whole group.	

PD activity 2: Scenarios

Thelma and Louise have been newly teamed this year. Louise has been teaching math for 11 years. She has co-taught before and liked the arrangement. Thelma is unfamiliar with the math program and co-teaching. For the past 7 years, she taught in a self-contained special education classroom.

Thelma doesn't want to step on Louise's toes, so she tends to sit back and wait to be told what to do. Both women feel somewhat frustrated. Louise wants Thelma to be more involved and Thelma wants to feel more like a professional than an aide.

Handout, Page 5

Discuss

1. What are the issues for each teacher?
2. What suggestions do you have for addressing these issues?
3. What would you say to start a conversation about these issues with the other teacher?

Co-planning needs to be:

- In schedule
- Protected
- Used productively.

PD activity 3: Co-planning

Before the PD

- Identify a lesson or topic that you want to co-plan at the PD.

During the PD

- Look at examples: Co-teaching Mathematics Instructional Plans from Virginia Department of Education.
- Co-plan a lesson using a structured process, planning tools, etc.

After the PD

- Co-teach the lesson, reflect and debrief, and prepare to share experiences at the next PD session.

Suggestions for school and district leaders

- Set clear expectations for roles and responsibilities.
- Communicate messages about joint ownership of students.
- Conduct classroom observations and debriefs with a focus on co-teaching.
- Provide scheduled co-planning time and support for using it productively.
- Provide support and continuity for co-teaching partners.

What would you add?


Questions?

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Photos and Icons

Photos: www.istock.com

Icons: https://thenounproject.com/

Thank You!

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Questions and answers

Discussion questions

- What should division leaders keep in mind when **designing professional learning activities** to increase understanding and strategies to support students with mathematics disabilities and difficulties?
- What are ways for division leaders to **communicate and support** the importance of providing high-quality, inclusive mathematics instruction?
- What kinds of **data** can division leaders collect to gather evidence of teachers' planning and teaching of high-quality, inclusive mathematics lessons?

Please contact us as needed.

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