Using Systematic Instruction to Teach Grade Aligned Math to Students with Moderate and Severe ID/ASD

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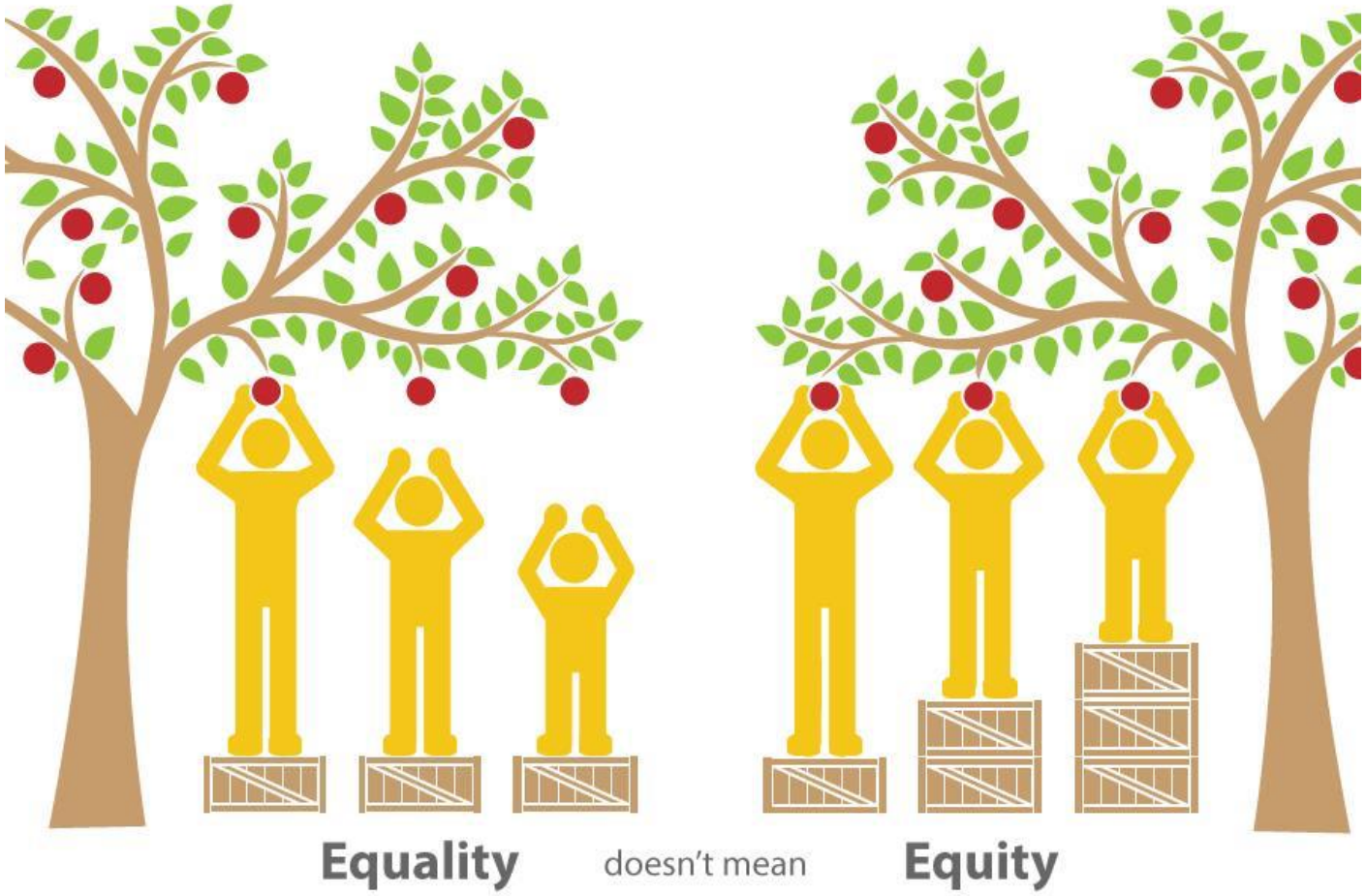
Math is right up there with snakes, public speaking, and heights.

Burns, M. (1998). Math: Facing an American phobia. New York: Math Solutions Publications.

Equity

NCTM's Equity Principle



NCTM's Equity Principle

- All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study--and support to learn--mathematics**. This does not mean that every student should be treated the same**. But all students need **access** each year they are in school to a coherent, challenging mathematics curriculum that is taught by competent and well-supported mathematics teachers. Too many students--especially students who are poor, not native speakers of English, disabled, female, or members of minority groups--are **victims of low expectations in mathematics**.

  (NCTM, 2000, pg. 12)

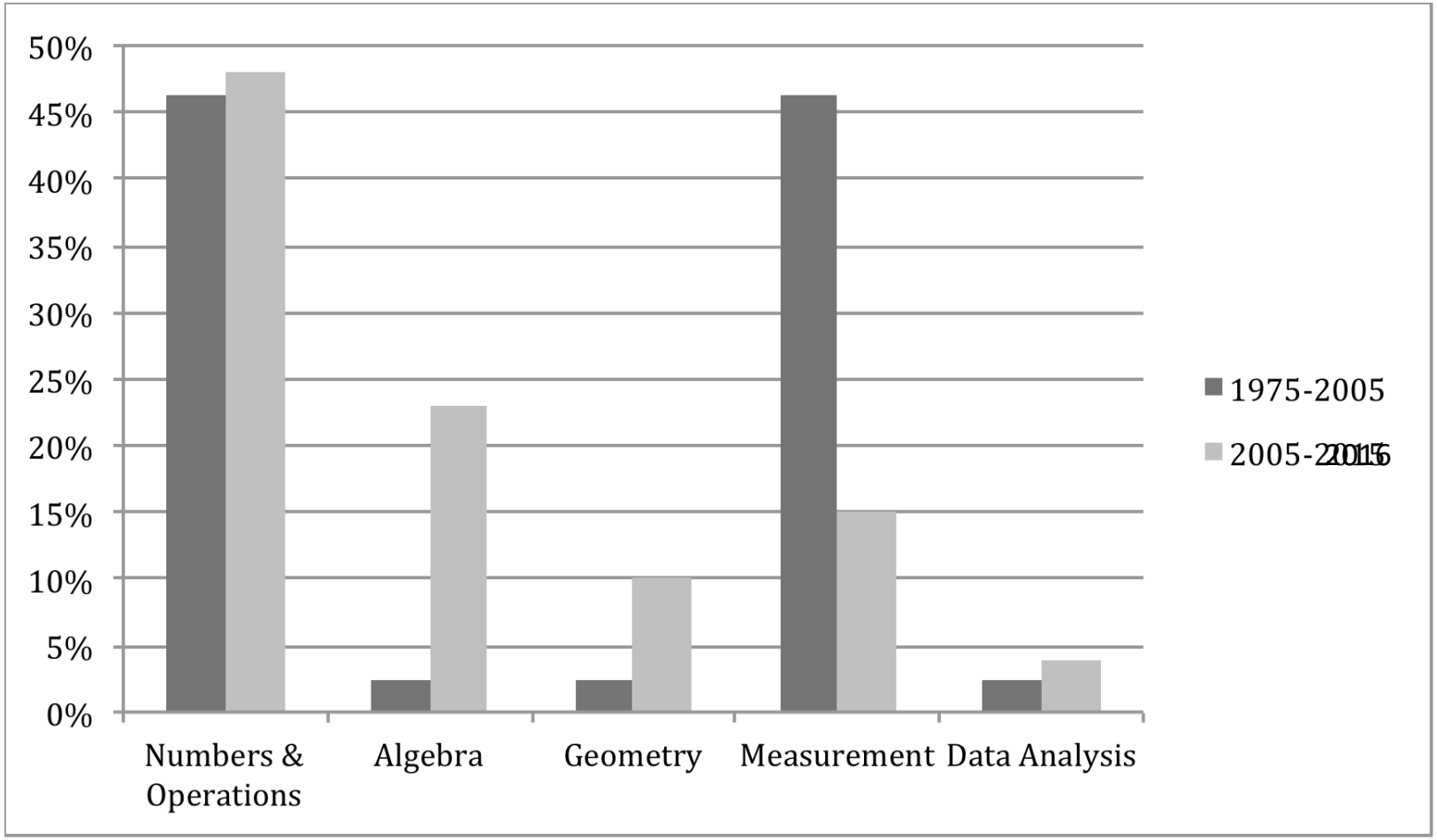


Figure 1. Comparison of findings by NCTM Standard. *Note:* The total number of NCTM standards addressed were analyzed for Browder et al. (2008; $n = 80$) and the present study (2016; $n = 48$). The percentages of these addressing each individual standard was calculated due to the uneven number of total studies to give a true representation of the spread.

(Spooner, Root, Saunders, & Browder, 2018)

What challenges do students with MSD face in mathematics?

Students may have…

- Communication challenges
  - Math requires reading, writing, and discussing
- Strategy deficiencies
  - Not being able to perform basic operations
- Lack of past instruction
  - Focus only on functional math like money
- Memory challenges
  - Math facts, math concepts

What are We Trying to Achieve through our Math instruction?

- To learn PROBLEM SOLVING is the ultimate goal for mathematics
- To be able to generalize mathematical learning to authentic contexts
- Increased independence, opportunities, & quality of life

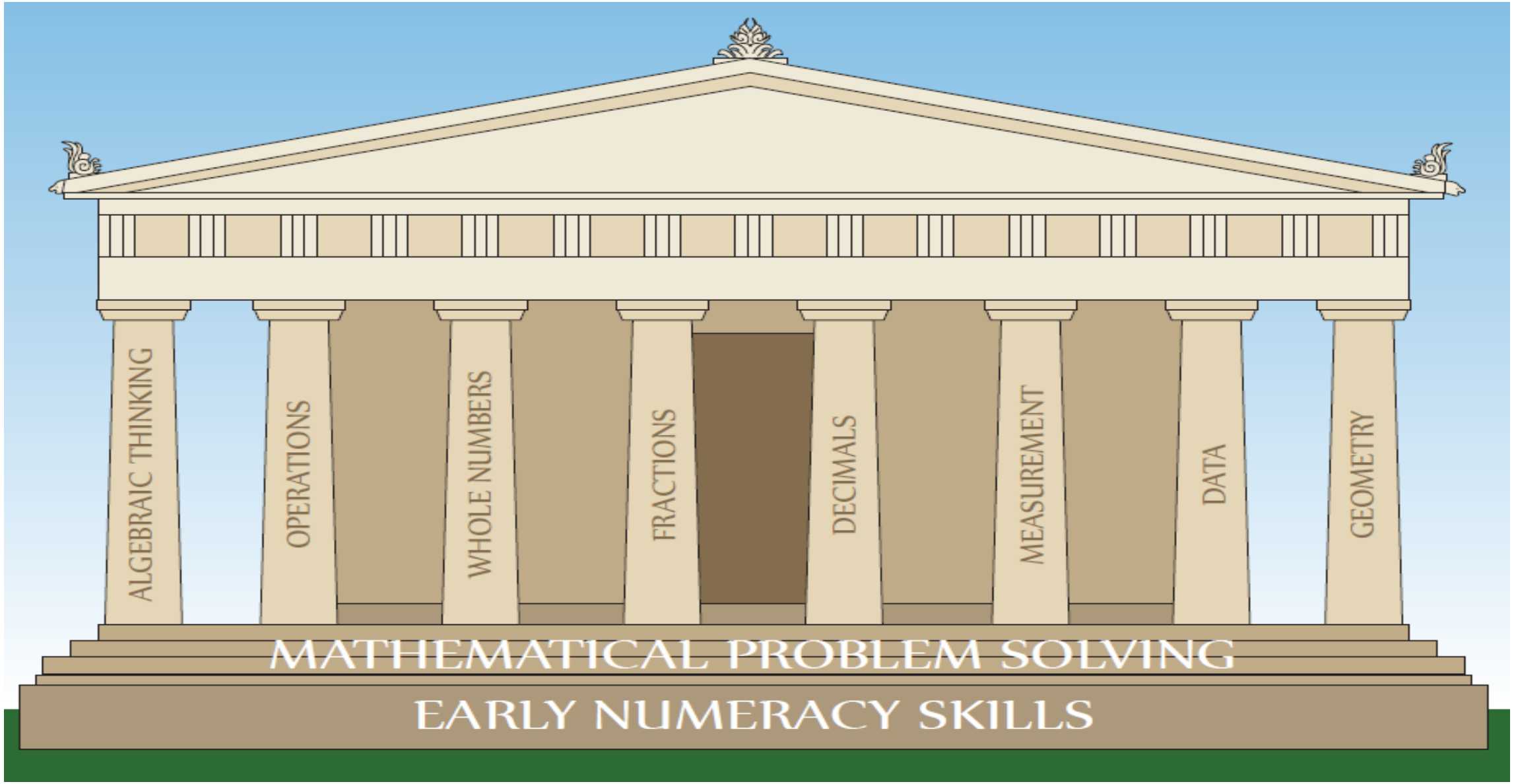
Number Sense is the “Phonics” of Mathematics

Reading

- Independence requires decoding with fluency (phonics)
- Supplement phonics instruction with read-alouds of age appropriate text to build comprehension

Math

- Independence requires number sense and computation with fluency
- Supplement early numeracy instruction with calculator use to do grade-aligned inclusive mathematics



Saunders, Root, & Jimenez (2017)

Some “Math” fun!

- Write down the name of a celebrity
  - Pass paper to the left
- Write down the first name of someone in this room
  - Pass paper to the left
- Write a NOUN
  - Pass paper to the left
- Write a NOUN
  - Pass paper to the left
- Write two numbers
  - Pass paper to the left

Put in the names, nouns, and numbers!

(celebrity) and (person in room) bought (1st noun) at the (2nd noun) store

(celebrity) bought (1st #) (1st noun).

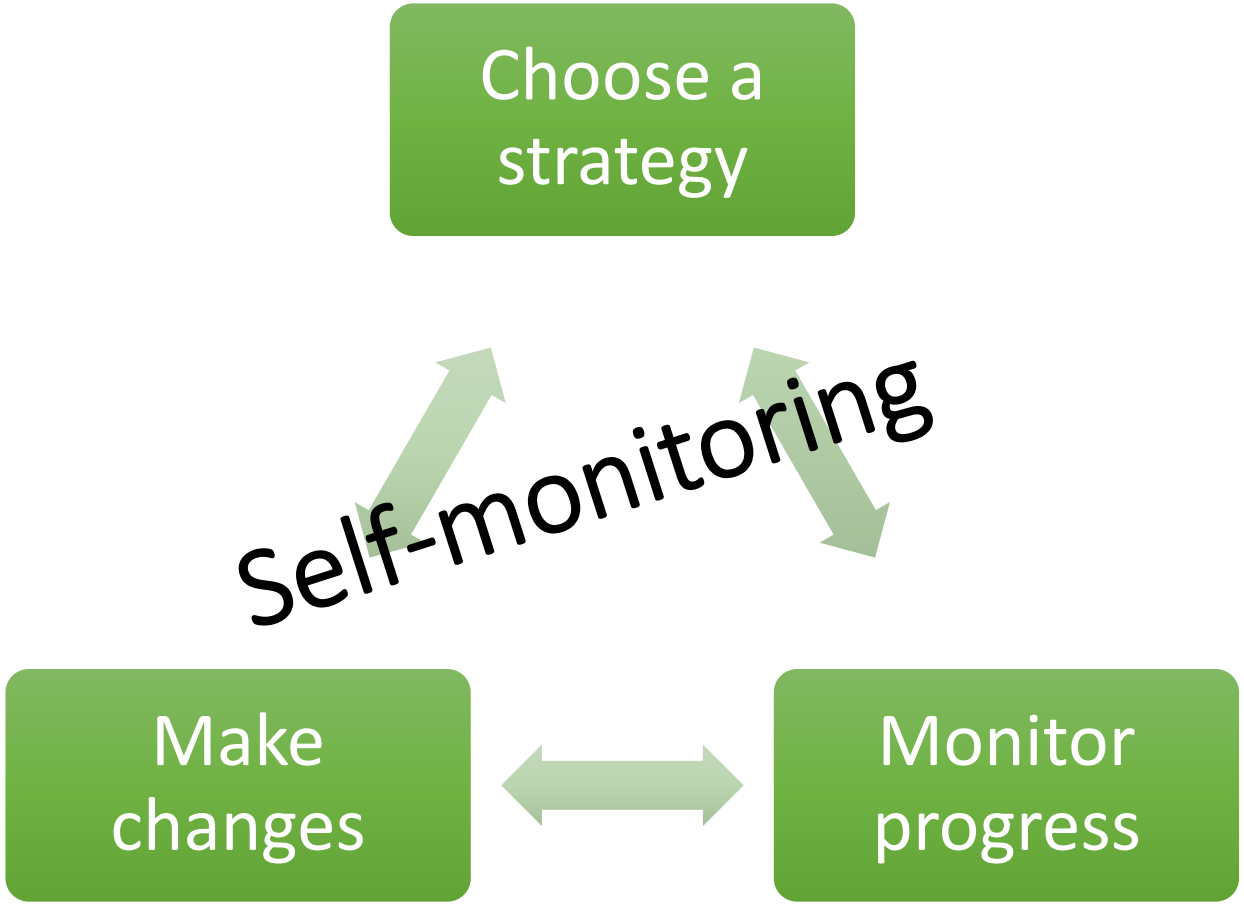
(person in room) bought (2nd #) (1st noun).

How many (1st noun) did (celebrity) and (person in room) buy?

Remember….What are We Trying to Achieve through our Math instruction?

- To learn PROBLEM SOLVING is the ultimate goal for mathematics
- To be able to generalize mathematical learning to authentic contexts
- Increased independence, opportunities, & quality of life

Problem Solving is a Functional Skill



When are students “ready for” problem solving?

- ALL students are “ready for” problem solving instruction

- MSBI is an evidence-based practice for teaching problem solving (Root, Henning, & Cox, 2019)
- Pre-requisite skills needed for MSBI:
  - Counting with 1:1 correspondence
  - Making sets (of up to 5 to start with)
  - Identifying numbers (of 1-5 to start with)

How Do We Make grade-aligned Math Accessible?

- Focus on the big ideas within math
- Relate math to familiar activities from daily life….***but beyond just money and time***
- Use evidence-based instructional practices to teach math concepts and procedures
- Use evidence-based instructional supports to compensate for cognitive challenges and skill deficits

Evidence-Based Practices for Teaching Mathematics to Students with ESN

Evidence-Based Practices for Teaching Mathematics to Students with Moderate and Severe Disabilities

Browder, Spooner, Ahlgrim-Delzell, & Wakeman (2008)

- Systematic Instruction
- In Vivo instruction
- Opportunities to Respond

Spooner, Root, Saunders, & Browder (2017)

- Technology-aided instruction
- Manipulatives
- Explicit Instruction
- Graphic organizers/heuristics

Resources for Teaching Grade-aligned Math to Students with MSD

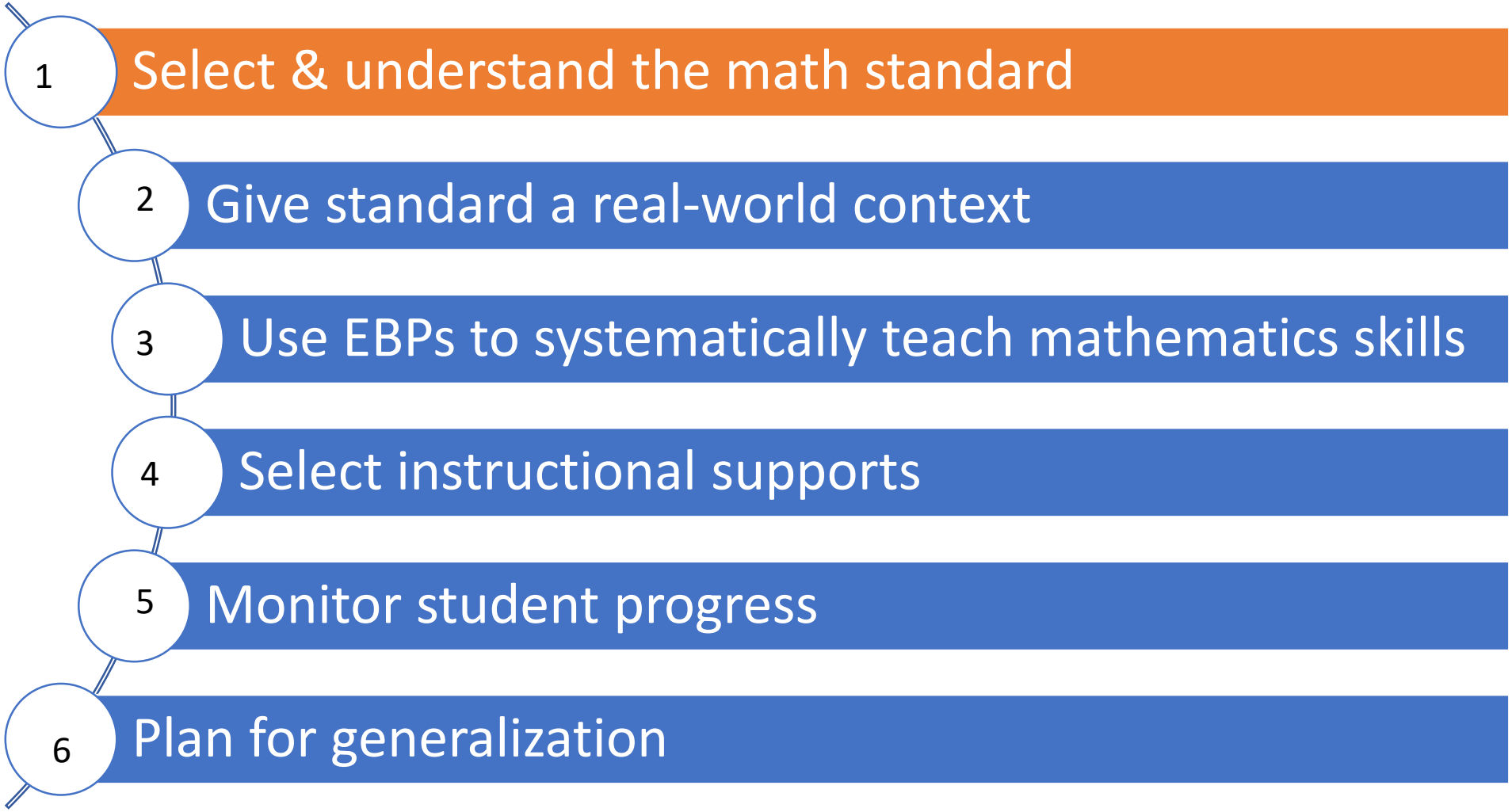
“Recipes”

- Saunders, A.F., Bethune, K.S., Spooner, F., & Browder, D. (2013). Solving the common core equation: Teaching mathematics CCSS to students with moderate and severe disabilities. *Teaching Exceptional Children, 45 (3),* 24-33.
- Spooner, F., Saunders, A., Root, J., & Brosh, C. (2017). Promoting Access to Common Core Mathematics for Students With Severe Disabilities Through Mathematical Problem Solving. *Research and Practice for Persons with Severe Disabilities, 42*, 172-186.

“Take out”

- Attainment’s Math Skills builder
- Attainment’s Teaching to standards math
- NCSC MASSIs

“Recipe” for Grade-Aligned Math



Saunders et al. (2013)

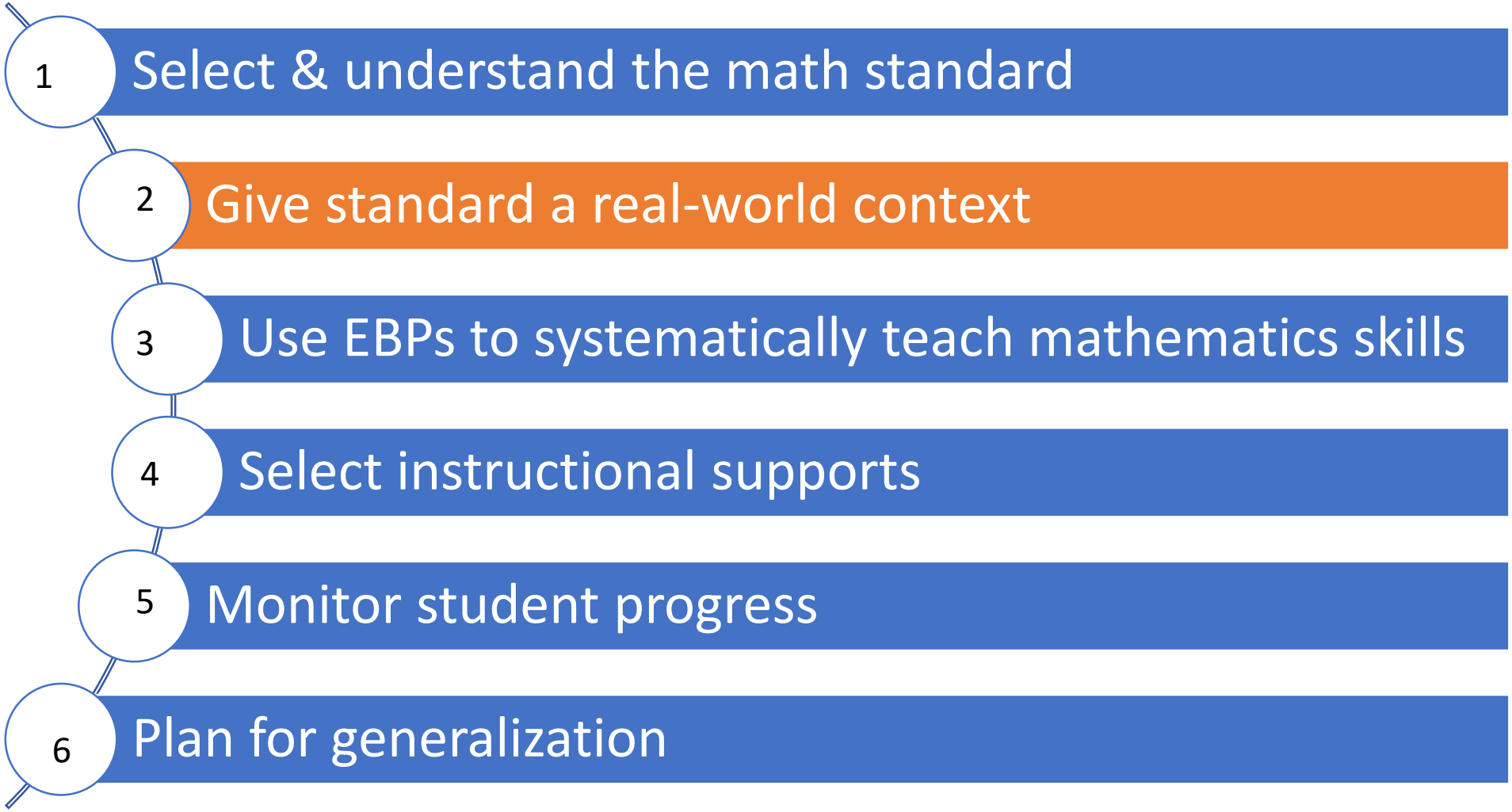
STEP ONE: Select **and understand** the math standard

- NCSC identified "Essential Understandings" (EUs) across math domains, which you can find on separate element cards for each domain of math - https://wiki.ncscpartners.org/index.php/Element_Cards#Mathematics_Element_Cards (also displayed on Florida Access project weebly!)
- View the NCSC MASSI Webinars for more detailed information and student/teacher videos
- https://accesstofls.weebly.com/math-resources.html

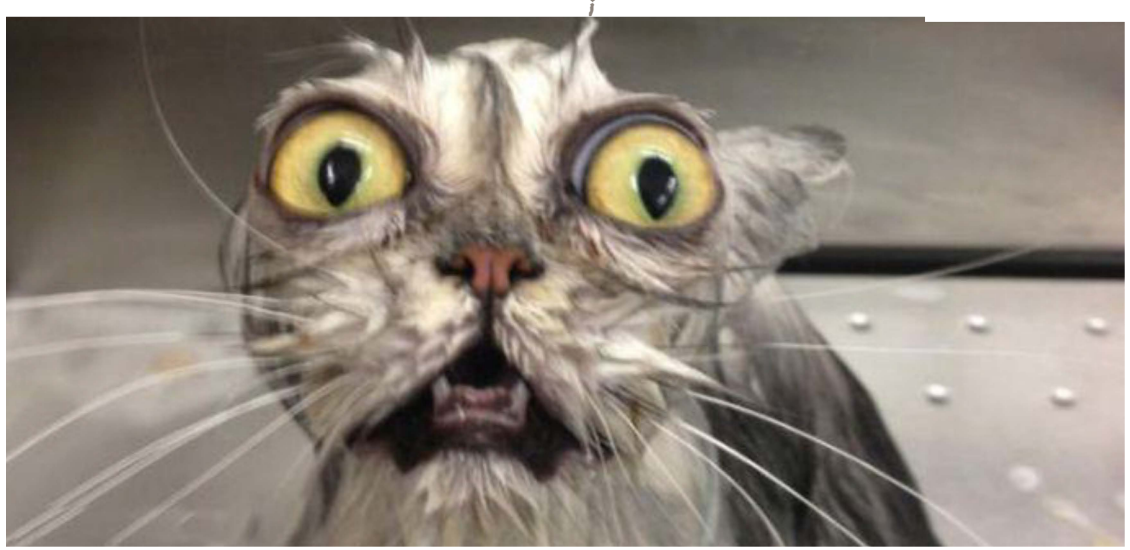
Analyze the standards within that identified domain/grade band

1. How do skill progress or build?
2. What are the "key" or "pivotal" skills students need to learn in order to continue making progress in that domain?

“Recipe” for Grade-Aligned Math



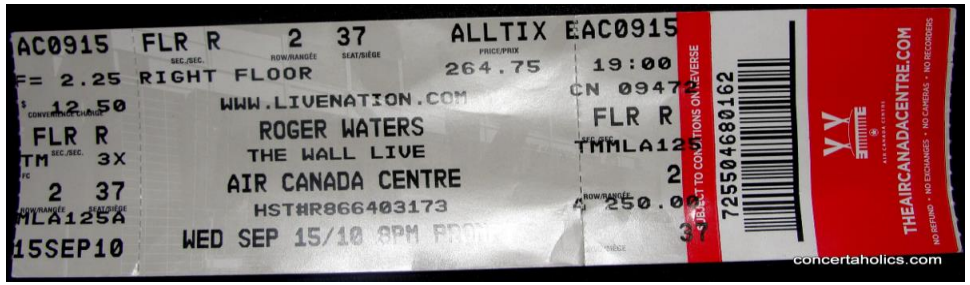
Saunders et al. (2013)



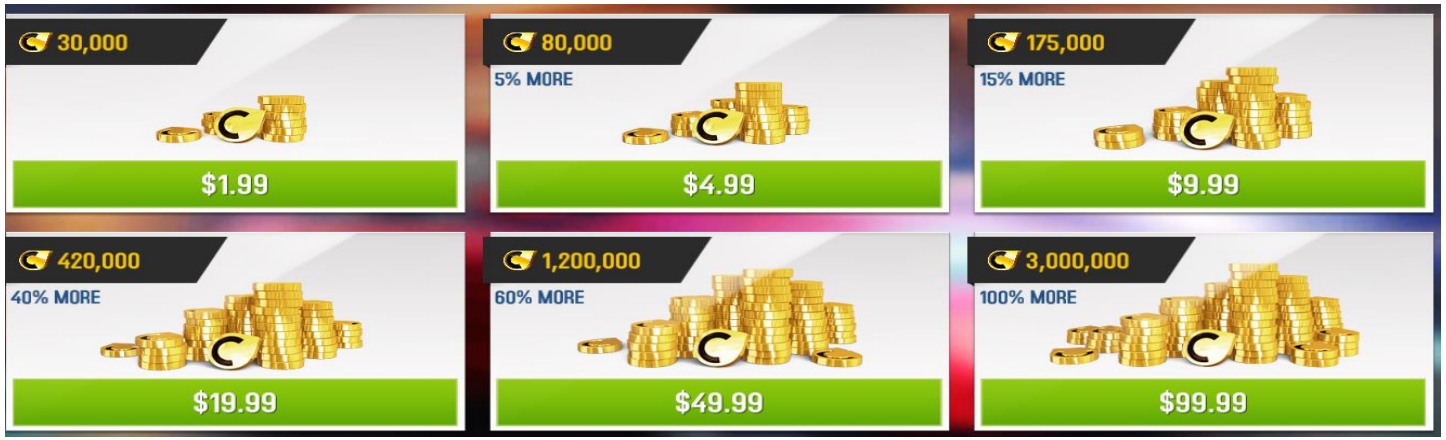
@KARIMI

STEP TWO: Give mathematics standard a real-world context

- Anchoring instruction has many purposes
  - Provide background information
  - Makes learning truly “functional”
  - Makes instruction meaningful & **personally relevant**
  - Opportunity to address *multiple priorities*



Importance of Mathematical Problem Solving



Contrasting Approaches

Traditional "Functional" Approach

1. Identify activity or skill that will increase student independence based on ecological inventory
2. Identify skills necessary for completing skill (e.g., task analysis)
3. Teach skills

Contemporary "Contextualized" Approach

1. Determine "big ideas" in grade level state standards
2. Identify skills necessary for standard
3. Teach skill/concept within real-life activities or natural routines

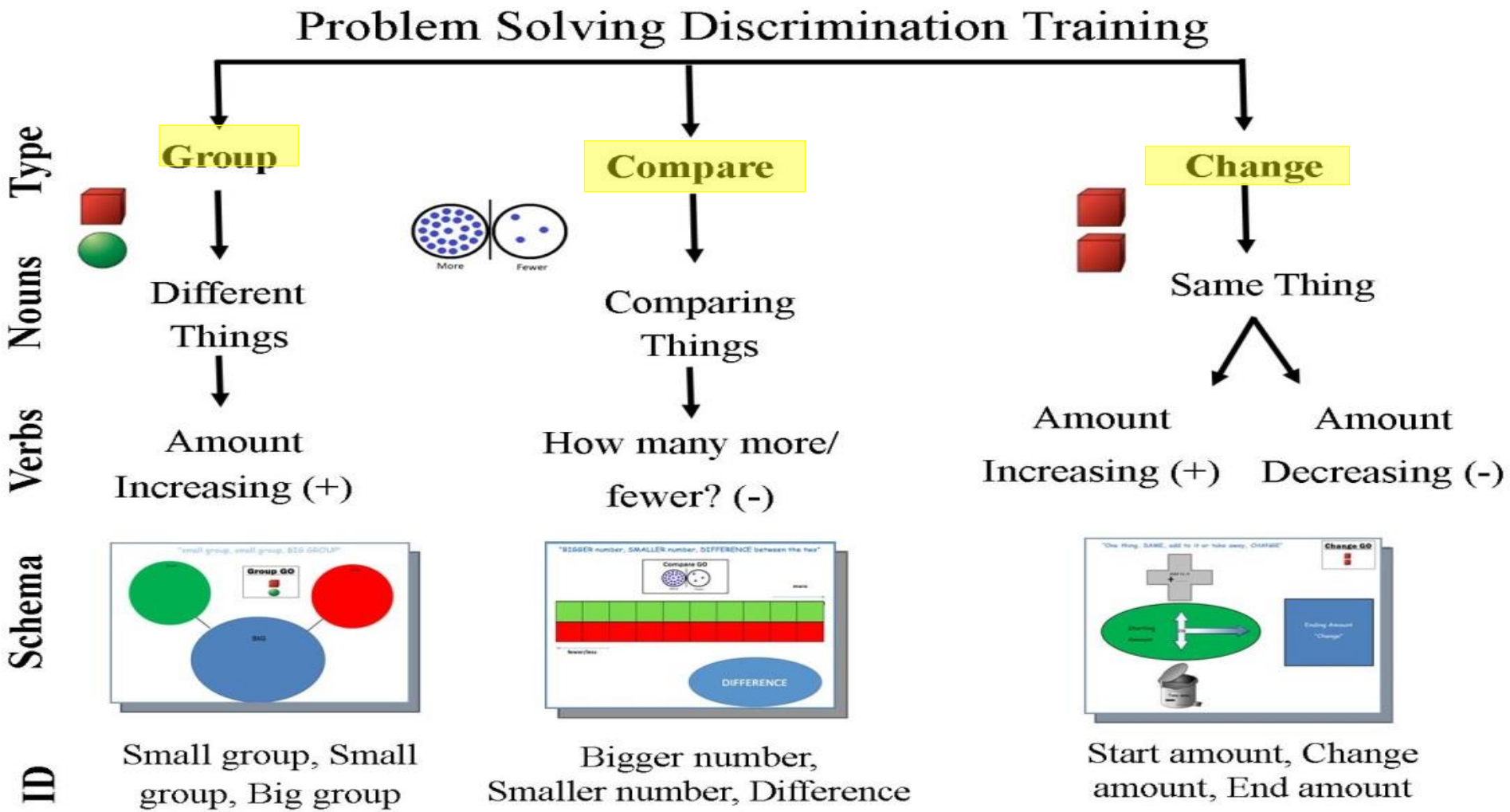
STEP TWO: Give mathematics standard a real-world context

- Could be in the format of a “math story” (e.g., *Early Numeracy Skills Builder*), a “word problem” (*e.g., Math Skills Builder)*, or just an “anchor”
- Regardless of format, choose a real-world context as a theme for instruction for the lesson/week/unit that is high interest and relevant
  - Scenarios students would encounter in future or current environments
  - Incorporate preferences
  - Embed transition, social skills, or other IEP goals
- Anchor each lesson for comprehension and engagement
  - Pictures
  - Videos
  - Objects
  - Movement

Make sure its still “real math”!

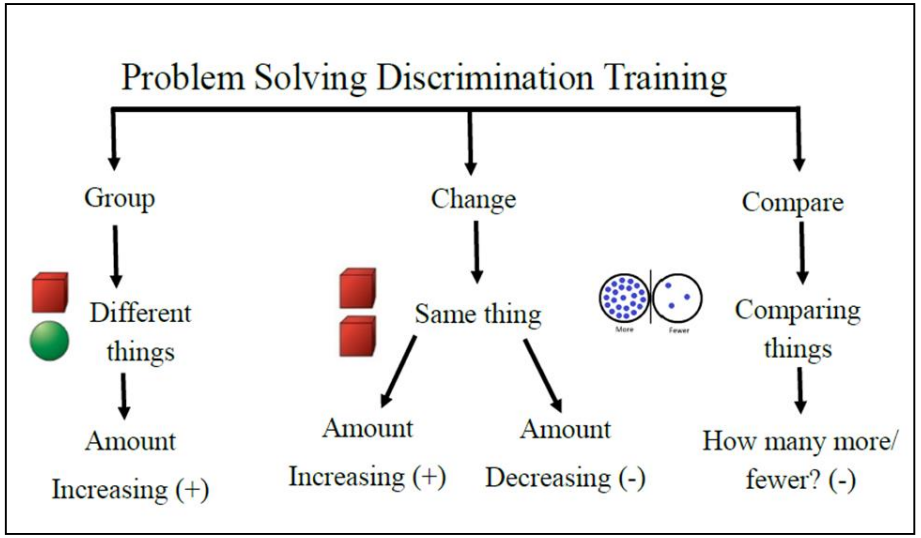
Don’t lose focus of instruction!

Additive Problem Types and Key Features



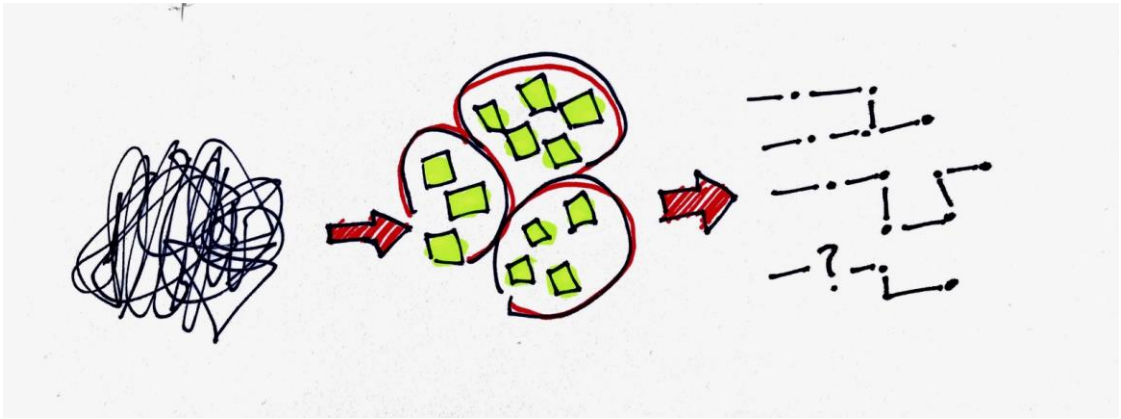
Sequence of Units

- Group
- Compare
- Group and Compare Discrimination
- Change (Addition, Subtraction, Mixed)
- Discrimination of All 3 Problem Types



Your job!

- You will need to fully understand the mathematical concept before attempt to plan a lesson to teach (to anyone, but especially students with ESN)
  - Learning progression: what skills come before, what come after
  - Key features: how will you emphasize to students the key features to attend to in order to (a) recognize problem type and (b) select a strategy for solving



Guidelines for Writing Word Problems
Avoid reliance on key words

- Students need to learn to focus on underlying schema relation or problem structure before solving the problem
  - Need to make a plan for solving based on “what is happening” in the problem
- Focus should be on teaching students to differentiate between problem types
- Keywords (i.e., total, more, left) do not always reflect problem types

Guidelines for Writing Word Problems

Avoid reliance on key words

Keywords do not always reflect problem types

John has 5 notebooks. Mary has 3 notebooks. How many **more** notebooks does John have than Mary?

Compare

John has to do math problems for homework. He has 5 problems to complete. He finished 2. How many **more** math problems does he have left?

Change

John has 3 books to read. Mary has 1 **more** than John. How many books do they have altogether?

Group (2 step)

Guidelines for Writing Word Problems

Word Choice

- Keep sentences the same length and use words which are easy to decode
- Use a *variety* of nouns (“things”) which are
  - Familiar
  - Concrete
  - Relate to the theme
  - Make sense

Guidelines for Writing Word Problems

Names

- Choose names that will increase engagement
  - Students within classroom
  - Familiar people (family, people around school)
  - Reflection of interest (celebrities, athletes, etc.)

Guidelines for Writing Word Problems

Numbers

- Intentionally choose numbers based on student ability
- Easiest to represent as numerals
- Zero or “none” is a difficult concept
- Sums of less than 10 for making sets
- Consider calculator use
- Alternate between putting smaller or larger number first in addition problems

Check for Bias

- Gender
  - Equal use of female and male characters and themes
  - Avoid gender stereotypes
- Culture
  - Avoid cultural or racial stereotypes
  - Use scenarios that all students including culturally and linguistically diverse students can relate to or understand
  - Use scenarios that are relevant and meaningful for students

Group Problem Examples Theme: School Basketball Game

Formula	Examples	
Anchor sentence	Aaron and Jose bought snacks at the school basketball game.	There are cheerleaders at the school basketball game.
# thing 1	Aaron bought 2 buckets of popcorn.	There are 2 boys on the cheerleading team.
# thing 2	Jose bought 1 hotdog.	There are 4 girls on the cheerleading team.
Question with label	How many snacks did they buy in all?	How many cheerleaders are on the team?

Group problems have two different nouns with something in common.

Beth went on a class trip to the zoo.

Beth saw 7 lions.

Beth saw 2 polar bears.

How many animals Beth see altogether?

There are many types of birds at the beach.

Ava saw ____ seagulls at the beach.

Ava saw ____ pelicans at the beach.

How many birds did Ava see at the beach?

There is a team of cheerleaders at the school basketball game.

There are 2 male cheerleaders on the team.

There are 8 female cheerleaders on the team.

How many cheerleaders are on the team?

Change Problem Examples Theme: School Basketball Game

Formula	Examples	
Anchor sentence	Aaron saved his money to go to the school basketball game.	Jose likes to eat sour straws at the basketball game.
1 Thing & beginning state (#)	Aaron had $5 to spend at the basketball game.	Jose had 8 sour straws.
Increase or decrease verb + increase or decrease amount	Aaron's mom gave him $3 more to spend at the basketball game.	Jose ate 3 sour straws.
Question with label	How much money does Aaron have now?	How many sour straws does Jose have left?

Change problems discuss one noun, and more is added to the noun or some is taken away. Dynamic problem.

Abby bought lemonade at the school dance.

She bought ____ lemonades.

Then she bought ____ more lemonades for friends.

How many lemonades did Abby buy?

Jose bought sodas for friends at the basketball game.

Jose bought _____ sodas.

Then he spilled _____ sodas.

How many sodas does Jose have now?

Sheep are supposed to stay in the pen at the farm.

There were ____ sheep in the pen.

____ sheep got out of the pen.

How many sheep are left in the pen?

Emily brings customers drinks on a tray.

Emily had 5 drinks on her tray.

She spilled 2 drinks.

How many drinks are left on Emily's tray?

Aiden took some dollars to buy snacks at the grocery store.

Aiden took $8 dollars to the grocery store.

Aiden paid $2 dollars for bag of chips.

How many dollars does Aiden have left?

Compare Problem Examples Theme: School Basketball Game

Formula	Examples	
Anchor Sentence	Aaron and Jose both like to go to basketball games.	Jose sees many coaches at the game.
Person/Thing 1 #	Aaron has been to 5 games.	Jose sees 4 female coaches.
Person/Thing 2 #	Jose has been to 2 games.	Jose sees 2 male coaches.
Question with label	How many more games has Aaron been to than Jose?	How many fewer coaches are male than female?

Ben and Kim went to the book fair at school.

Kim bought 6 books.

Ben bought 4 books

How many more books did Kim buy than Ben?

Caleb saw many different bears at the zoo.

Caleb saw ____ brown bears.

Caleb saw ____ polar bears.

How many fewer polar bears than brown bears did he see?

Mia compared rainy days in September and October.

September had 10 rainy days.

October had 8 rainy days.

How many fewer rainy days did October have than September?

Your turn!

- Share your problems with your partner. Did everyone follow the guidelines? Do they clearly indicate the problem type?

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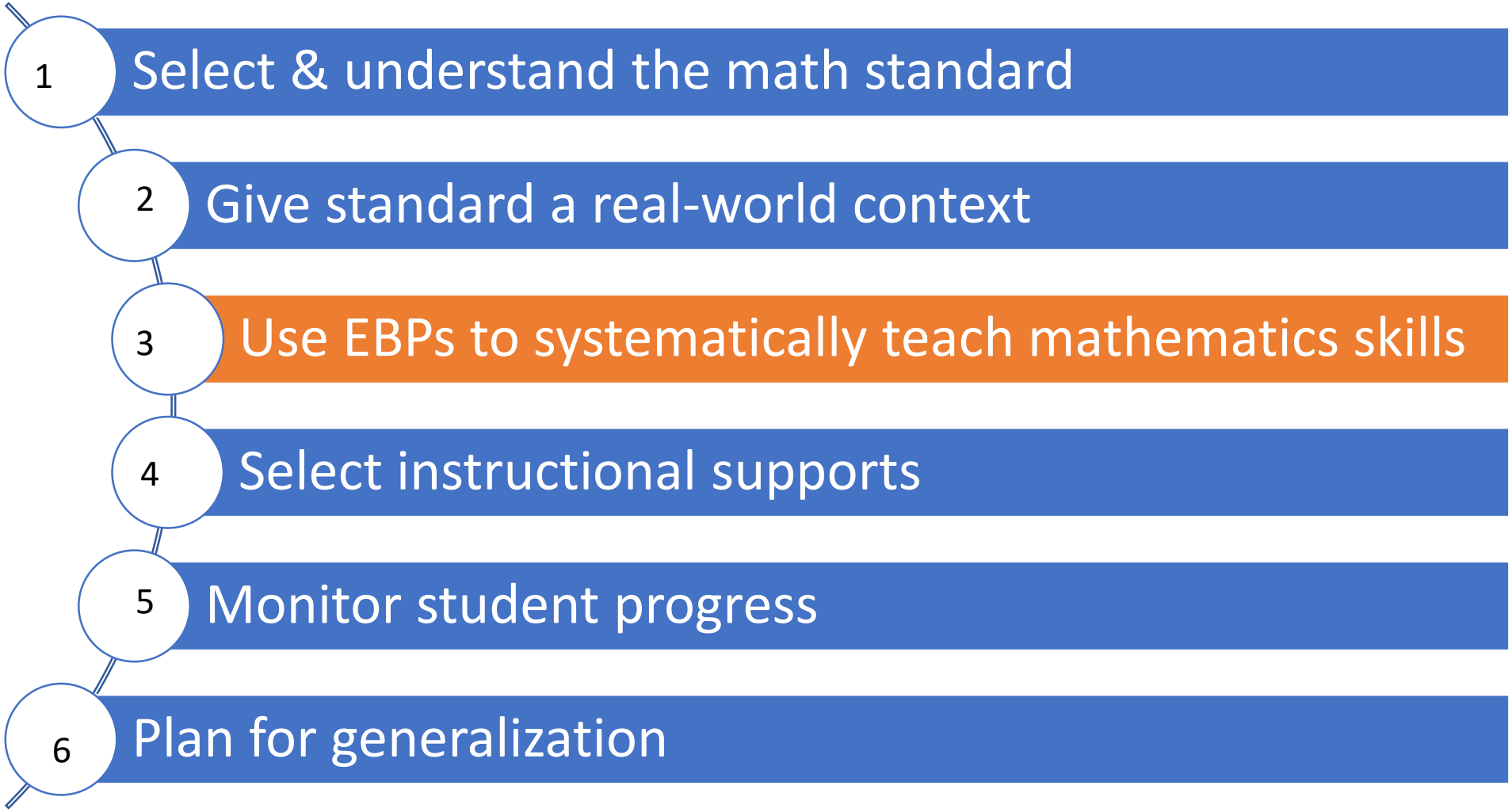
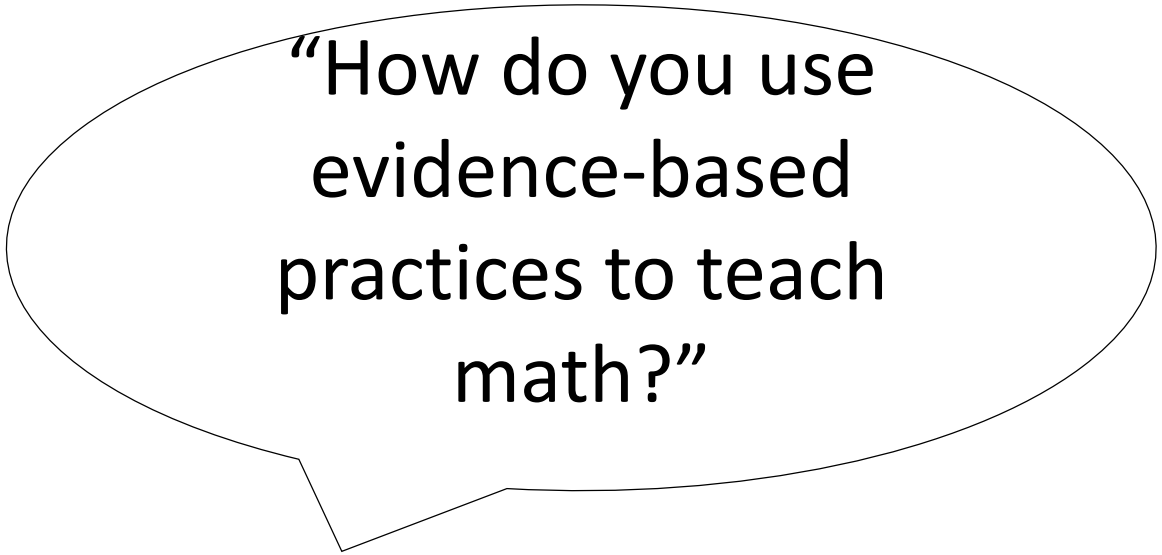
“Recipe” for Grade-Aligned Math



Saunders et al. (2013)

STEP 3: Use Evidence-Based Practices



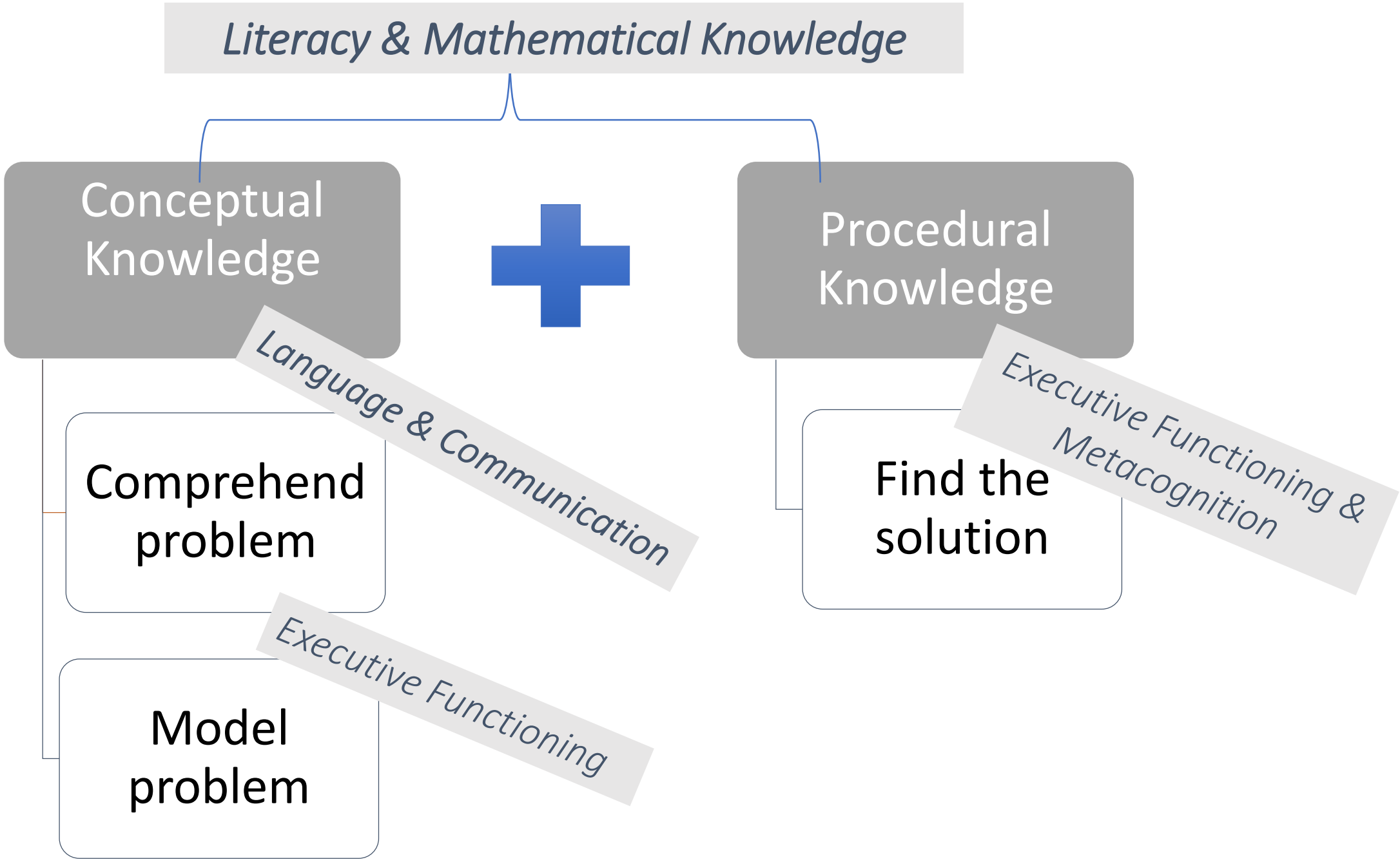
Evidence-Based Practices for Teaching Math to Students with MSD

Browder, Spooner, Ahlgrim-Delzell, & Wakeman (2008)

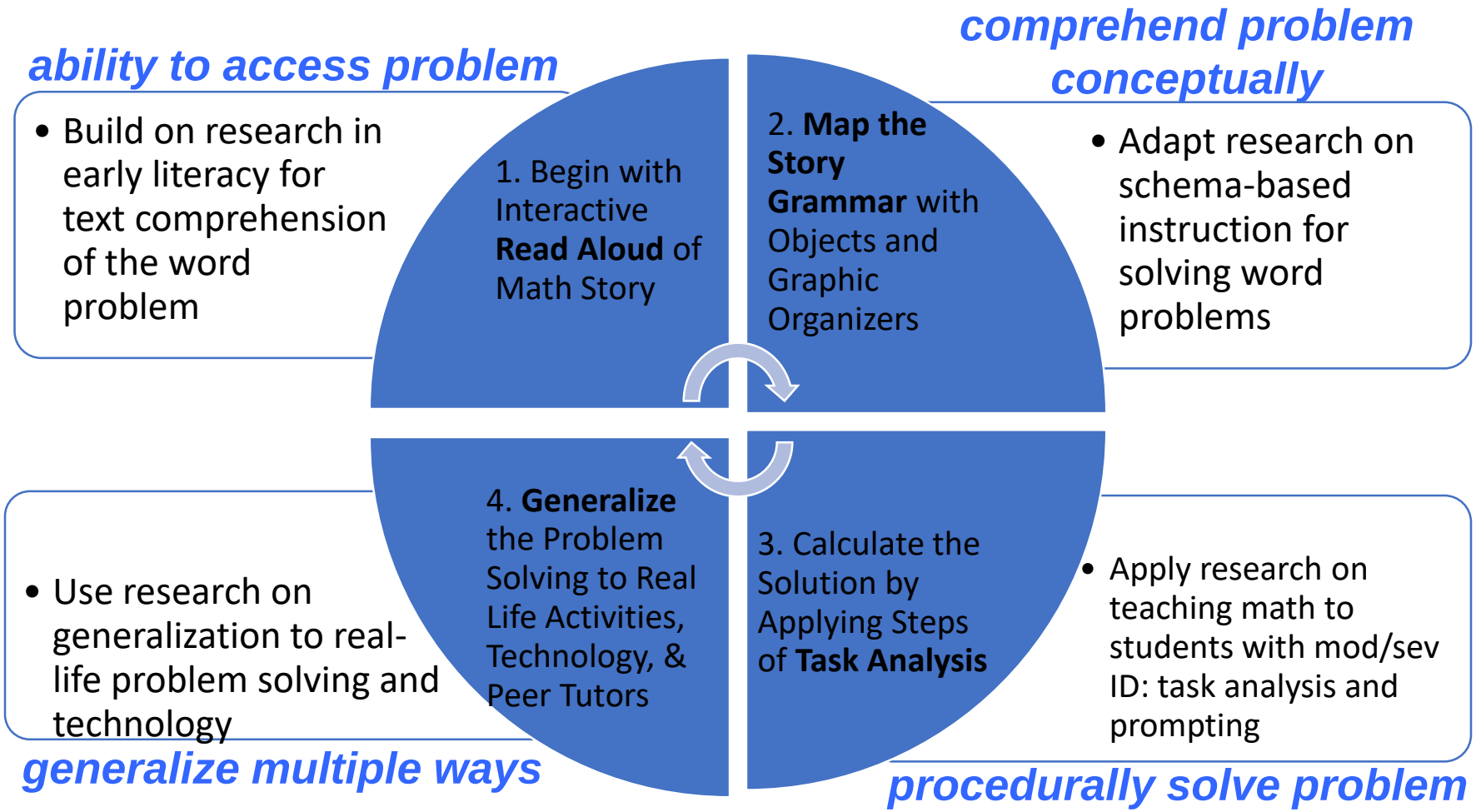
- Systematic Instruction
  - Time delay
  - System of least prompts
  - Task analysis
- In Vivo instruction
- Opportunities to Respond

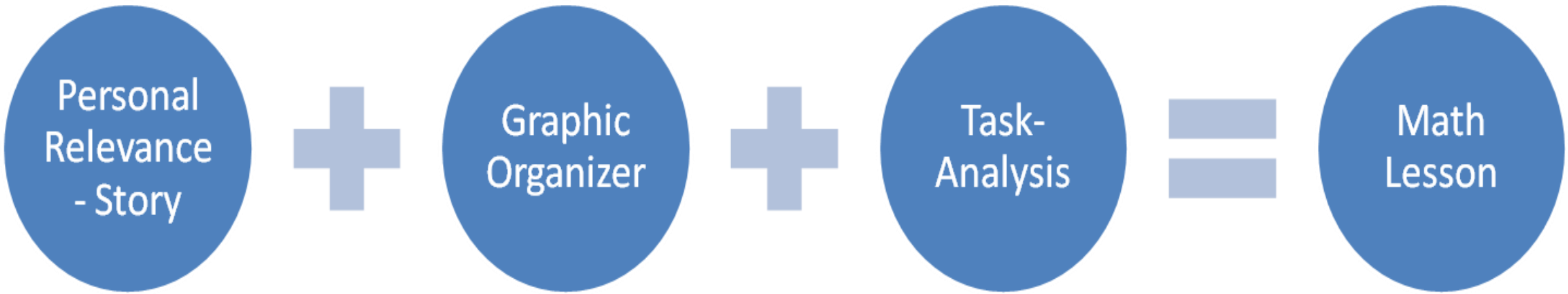
Spooner, Root, Saunders, & Browder (2018)

- Technology-aided instruction
- Manipulatives
  - Concrete & virtual
- Explicit Instruction
  - Model-lead-test
  - Multiple exemplars
  - Discrimination training
- Graphic organizers/heuristics
  - Number lines
  - Diagrams


Literacy & Mathematical Knowledge
Conceptual Knowledge
Procedural Knowledge
Comprehend problem
Model problem
Find the solution
Language & Communication
Executive Functioning
Executive Functioning & Metacognition

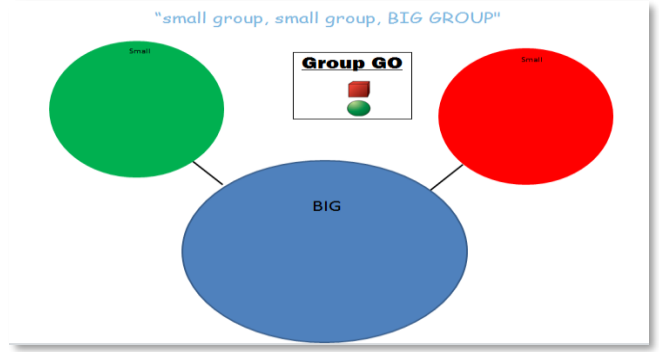
Modified Schema Based Instruction

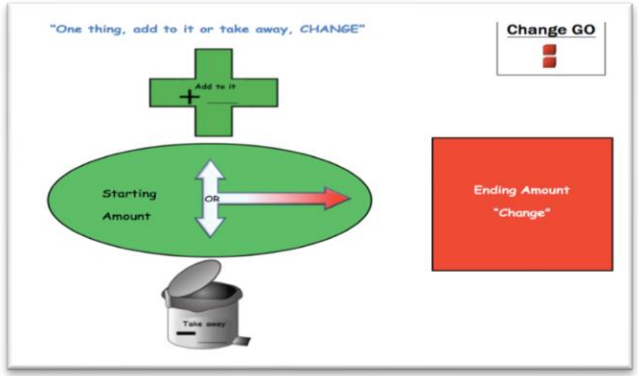


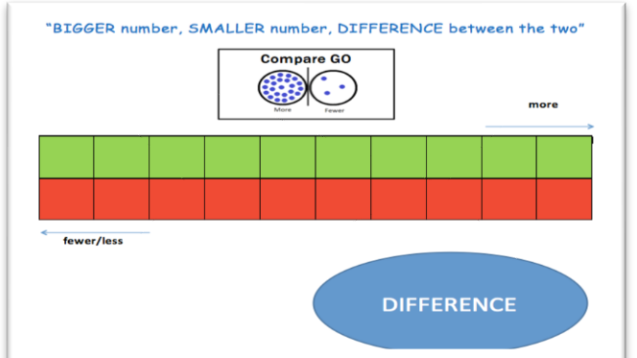

Personal Relevance - Story
Graphic Organizer
Task-Analysis
Math Lesson

Detailed Graphic Organizers with Visual Supports

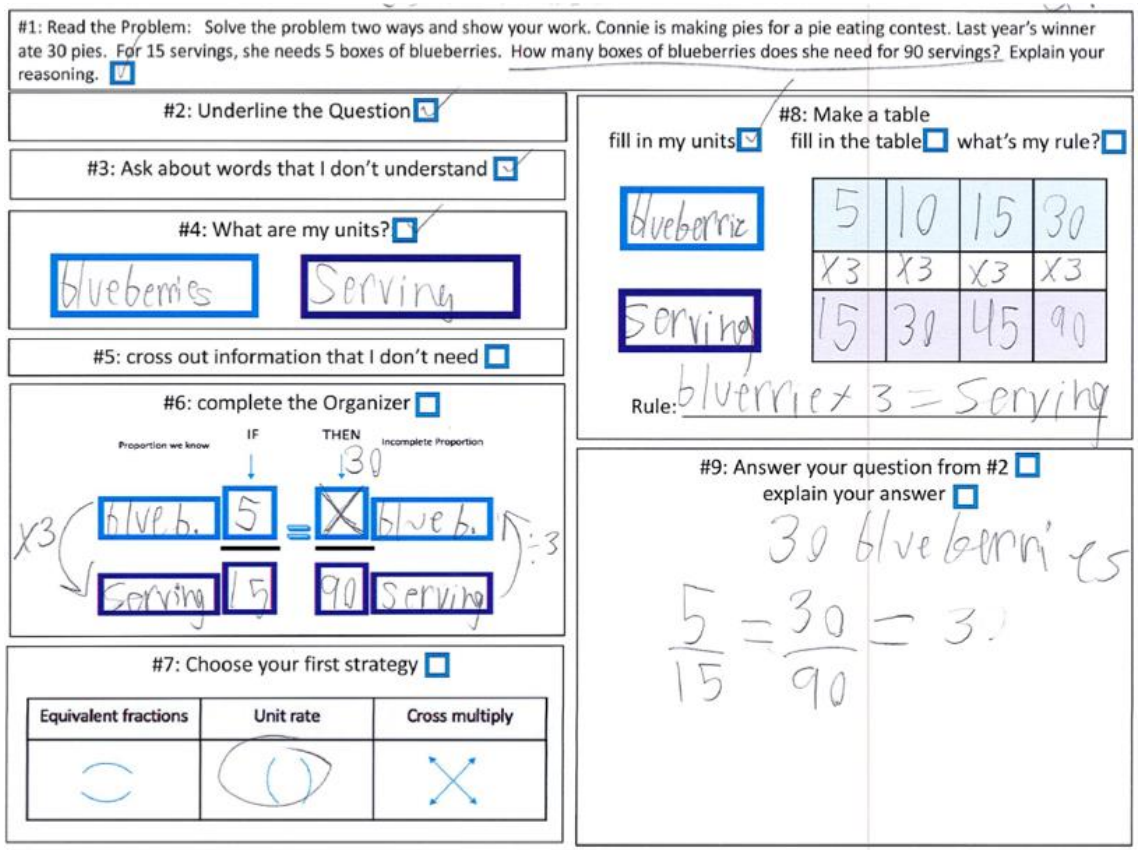
- Visually represent each problem type and relationship between quantities
- Purpose is to help students organize information from the problem
- Need space to use manipulatives (rather than writing in numbers)
- Color-coding and visual supports

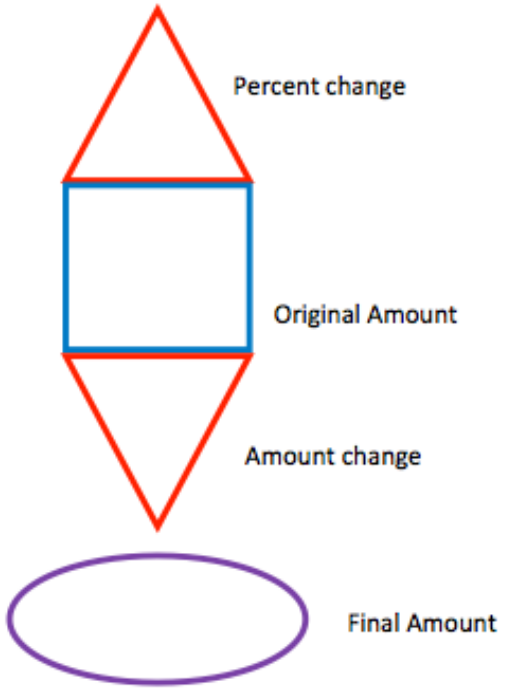






Additional Graphic Organizers





Multiplicative Comparison Problems

$\square \times \square = \square$ _____

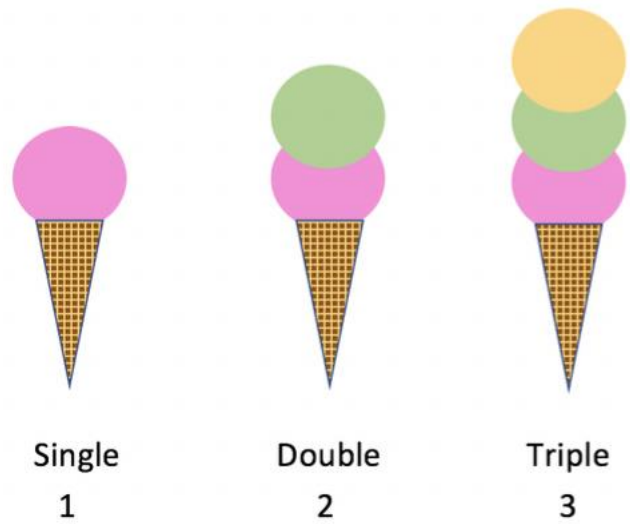
Factor 1:
Reference Set

Factor 2:
Multiplier

Product

Double or Twice = Two times as many = x 2

Triple = Three times as many = x 3

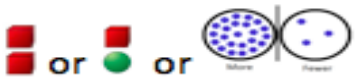


Heuristics/Task Analysis

- Two popular heuristics used in the literature:
  - **FOPS:** find the problem type, organize the information in the problem using the schematic diagram, plan to solve the problem, and solve the problem (Jitendra, 2008)
  - **RUNS:** read the problem, use a diagram, number sentence, and state the answer (Rockwell et al., 2011)

- Challenge for this population
  - Memorizing a heuristic may overload the working memory
  - Students may not have enough literacy skills to relate the letters of the heuristic to the words for which each letter stands

Student-Friendly Task Analysis (aka Self Instruction Sheet)

1.			Read the problem
2.			Circle the "what"
3.		How many ___? 	Find label in question
4.			same differe more/fewer?
5.			Use my rule
6.			Choose GO
7.		3	Circle the number
8.			Fill-in nu sentence
9.			+ or -
10.			Make Set
11.			Solve & v answer

Listen	Steps	With Help	By Myself	Directions
	1			Read or listen to the problem out loud.
	2			Mark and label the common unit. 
	3			Mark and label the common rate. 
	4			Mark and label what we are solving for in this problem.
	5		+	Calculate our product. 
	6			Count our total steps for self-monitoring and graphing.

1.		 Read the problem and  circle what we are solving for
2.		 Mark and label original cost
3.		 Mark and label percent change
4.		Identify type of change
5.		Calculate amount of change 
6.		Calculate final cost 

Example Teacher TA

Teacher	Target Response	Prompting	Reinforcement
“Show me the coordinate plane”	Points to the coordinate plane	Constant time delay “Here is coordinate plane” (0, then 4)	“Good. That is the coordinate plane”
“Show me the x axis”	Points to the x axis	CTD: “here is the x axis”	“Excellent. That is the x axis”
“Show me the y axis”	Points to the y axis	CTD: “here is the y axis”	“Yes. That’s the y axis.”
Etc. See TEC article p. 30			

Example Teacher TA

Task Analysis				
Step	***Teacher says***	***Target Student Response***	***Prompting***	***Reinforcement***
1. Read problem	Show me how to solve this problem	Student reads problem or asks for it to be read	Verbal: How do we get our problem started? Specific Verbal: If you need help reading, ask me Model: Ask me to read the problem	
2. Comprehend Story	What did James get at the bakery?	Says "strawberry cake" or uses response board	Verbal: Re-read word problem, restate question Specific Verbal: re-read 1 sentence from problem, restate question Model: re-read answer (while pointing to problem), restate question	Behavior specific praise, token
3. ID first amount	How much cake did James want?	Says"1/2", points to word problem, or uses response board	Verbal: "We are looking for a fraction of how much cake James wanted" Specific Verbal: "Listen for the fraction that tells us how much cake James wanted" (re-read sentence) Model: "We are looking for a fraction that shows how much cake James wanted" State answer (while pointing to problem). Restate question	Behavior specific praise
4. Create fraction for first amount	Color this circle to show how much cake James wanted.	Student colors 1 out of 2 sections of the circle.	Verbal: "Color in the fraction 1/2 in this circle." Specific Verbal: "Color one of the two sections of the circle to show ½" Model: "Watch me. I'm going to color 1 of the two sections for 1/2" (lightly color). "Your turn."	Behavior specific praise, Token

Example Teacher TA (cont'd)

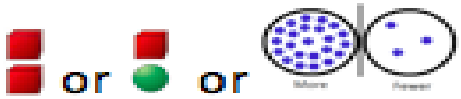
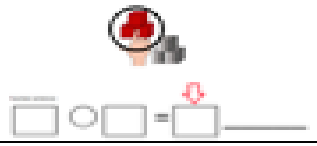
5. ID second amount	How much cake did the Baker give James?	Says "2/4", points in word problem, or uses response board	Verbal: "We are looking for a fraction of how much cake the Baker gave James" Specific Verbal: "Listen for the fraction that tells us how much cake the Baker gave James" (re-read sentence) Model: "We are looking for a fraction that shows how much cake the Baker gave James" State answer (while pointing to problem). Restate question	Behavior specific praise
6. Create fraction for second amount	Color this circle to show how much cake the Baker gave James.	Student colors 2 out of 4 sections of the circle.	Verbal: "Color in the fraction 2/4 in this circle." Specific Verbal: "Color two of the sections of the circle to show 2/4" Model: "Watch me. I'm going to color 2 of the two sections for 2/4" (lightly color). "Your turn."	Token
7. Determine if enough/not enough (equivalent fractions)	Did James get enough cake?	Says "Yes" or uses response board/sign language	Verbal: "Compare your two fraction circles" Specific Verbal: "Is your circle for James the same as the circle for the Baker?" Model: "These two circles show the same fraction. James had enough cake. Did James have enough cake?"	Token, turn 3 tokens in for reinforcement chosen from menu (small edible item or 30s access to preferred item)

Teach Using Explicit Instruction & Systematic Instruction

- Reminders:
  - Always secure student's attention first (e.g., redirect student's attention to problem or TA)
  - The instructional cue (e.g., "solve the word problem") is not a prompt
- Prompt Levels:
  - Prompt 1: nonspecific verbal & gesture; read and point to step on TA
  - Prompt 2: specific verbal; read step and provide additional information for student to perform step
  - Prompt 3: model then retest

Metacognitive Strategy Instruction

- Student self-instruction checklist (TA embedded into a checklist format and made student friendly)
- Rules for each problem type with hand motions to remember procedural steps
- Think alouds – model explaining WHY it is that problem type
  - “This is a group problem because it has two small groups of different things that I combine to make one BIG group.”
  - “This is a change problem. It is about the same thing, 1 thing. I need to select my change graphic organizer.”
  - “This is a compare problem. I see my compare phrase…How many fewer…”

1.	✓		Read the problem
2.	✓		Circle the "what"
3.	✓	How many ____? 	Find label in question
4.			same different more/fewer?
5.			Use my rule
6.			Choose GO
7.		3	Circle the numbers
8.			Fill-in number sentence
9.			+ or -
10.			Make Sets
11.			Solve & write answer

TA serves dual function:
Self-monitoring checklist to promote independence

Tamra wants to go see Fantasia's Christmas concert. She makes $10 per hour at her after school job. How many hours will she need to work in order to pay for one ticket?

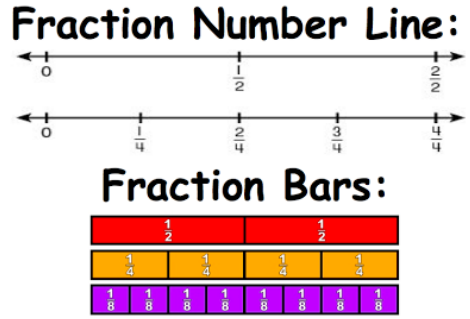
1.		$?	**Circle constant**
2.			**Circle goal amount**
5.		$□ x =$□	**Fill-in equation**
6.		÷	**Divide**
7.		x = □	**Write answer**

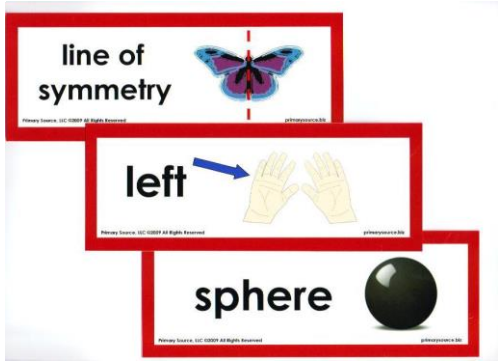
Hand motions

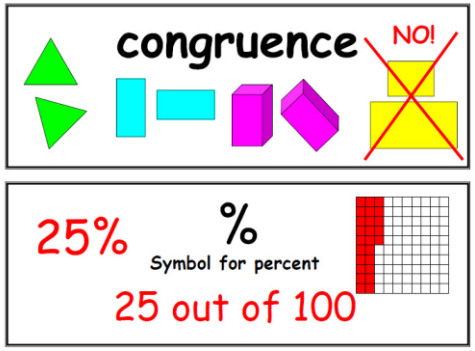
- http://player.attainmentcompany.com/webinars/math-skills-builder/

Mathematics Vocabulary

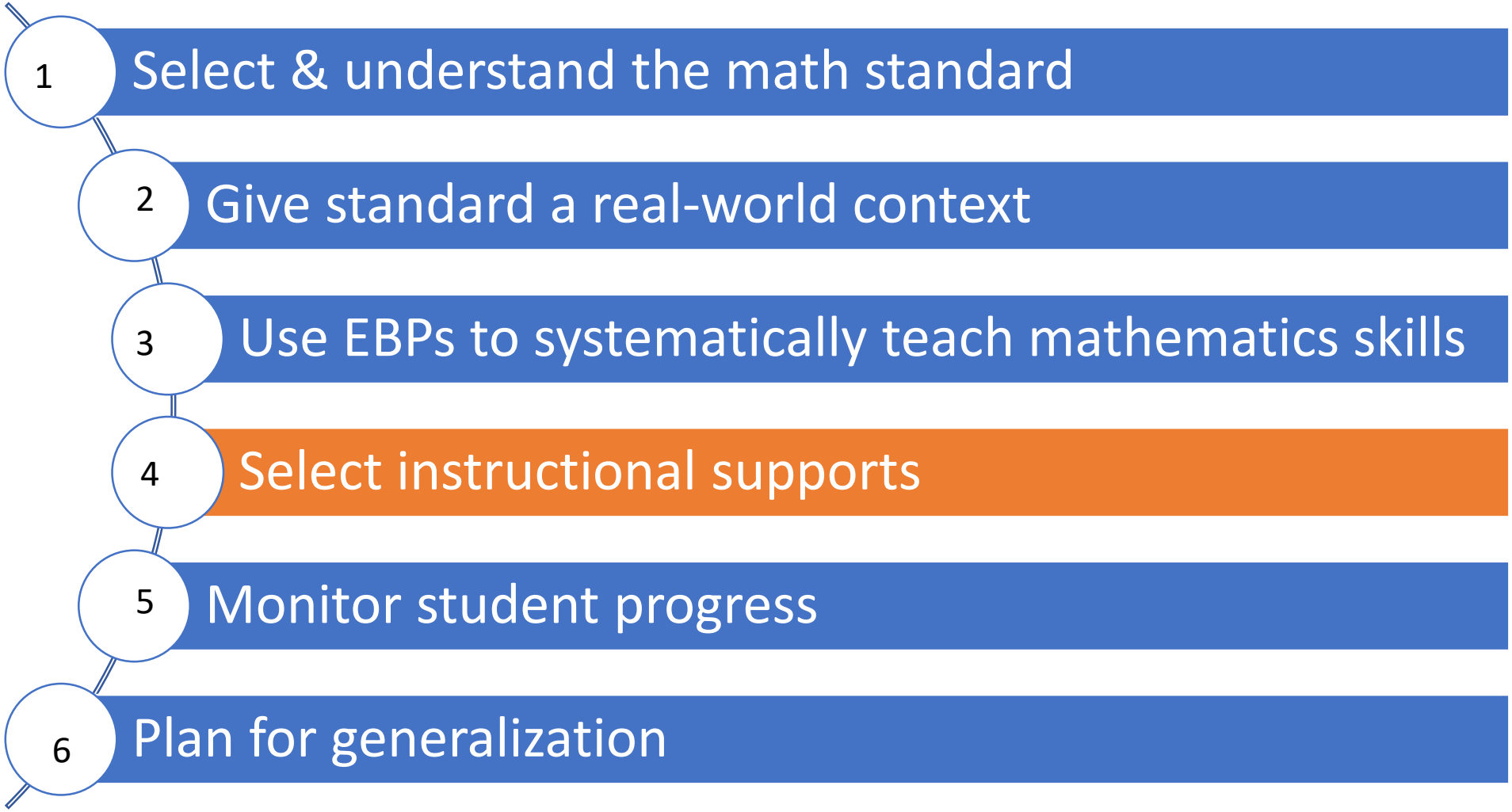
- Language plays an important role in mathematics
- Understanding of vocabulary and symbols will contribute to independence
  - Symbols (+, -, =,…)
  - Instructional supports (Graphic organizer, number sentence, etc.)
  - Terms (axis, plane, base, height, etc.)







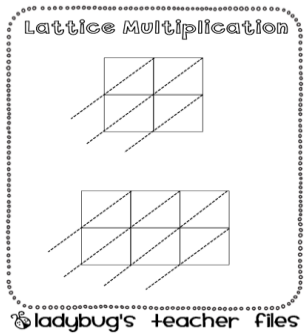
“Recipe” for Grade-Aligned Math

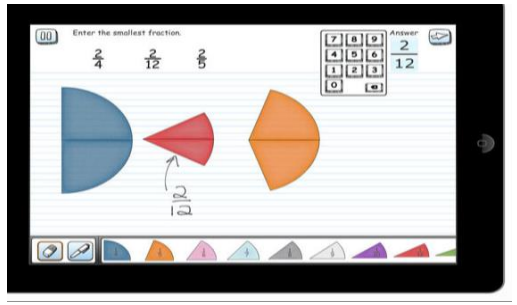


Saunders et al. (2013)

STEP FOUR: Include Instructional Supports

- Purpose of instructional supports is to increase independence
- Examples:
  - Manipulatives
  - Graphic organizer
  - Calculator
  - Technology
  - Whiteboard
  - Realia (real-life objects)
  - Others??

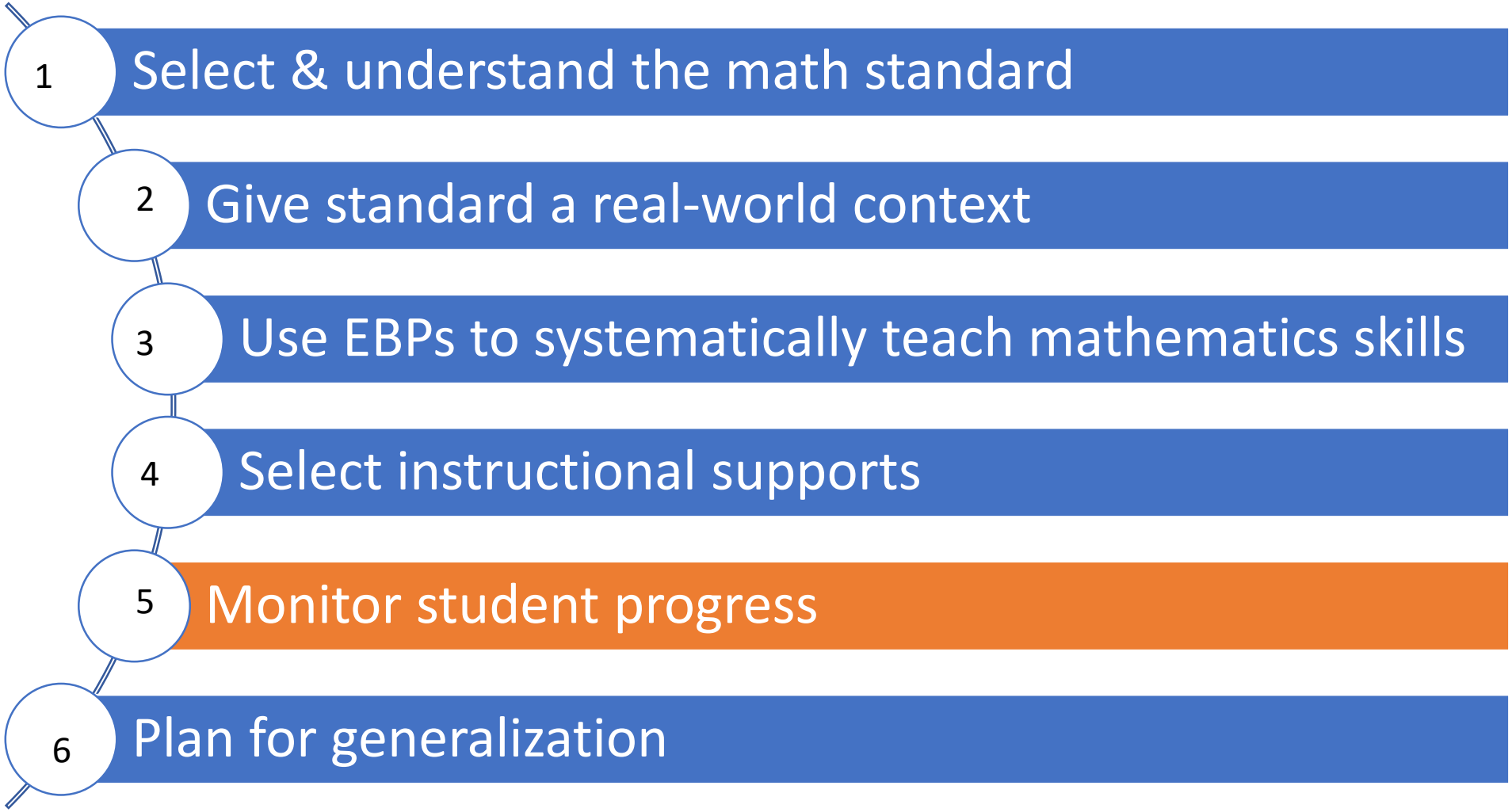




In this video…

How have the materials been modified for this student?

“Recipe” for Grade-Aligned Math



Saunders et al. (2013)

STEP FIVE: Monitor Student Progress

- We use data and progress monitoring to understand what WE can change with out instruction (not what the student is “doing wrong”)
- Steps:
  1. Graph data
  2. Analyze data
  3. Make instructional decision

Resources for making instructional changes due to lack of progress

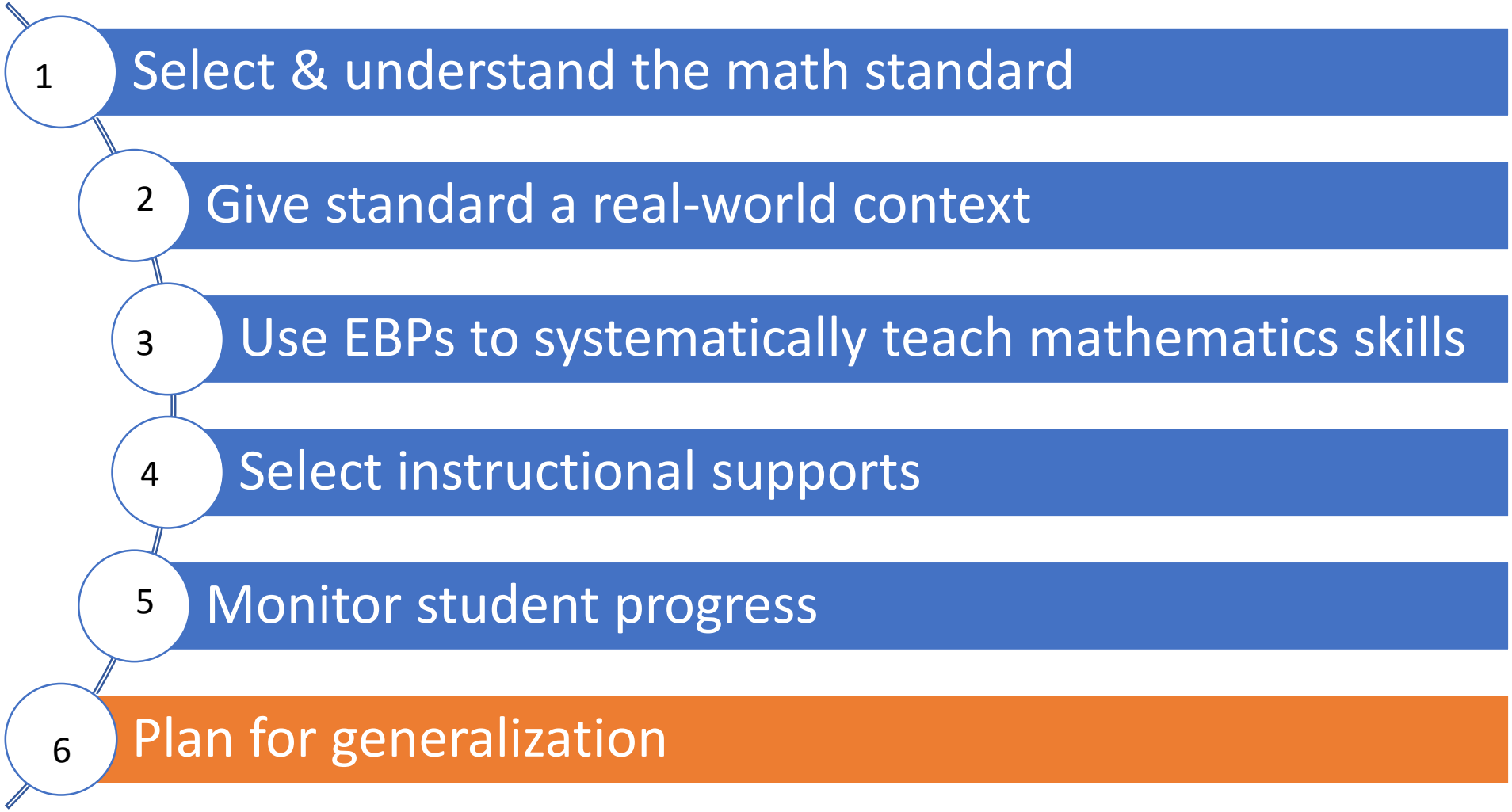
- NCSC MASSI Webinar on most severe disabilities

https://wiki.ncscpartners.org/index.php/MASSIs_Presentations

- TSM: Supporting active participation of students who access curriculum at a presymbolic level

https://www.attainmentcompany.com/downloads/dl/file/id/1227/product/1202/tsm_presymbolic.pdf

“Recipe” for Grade-Aligned Math



Saunders et al. (2013)

STEP 6: Plan for Generalization

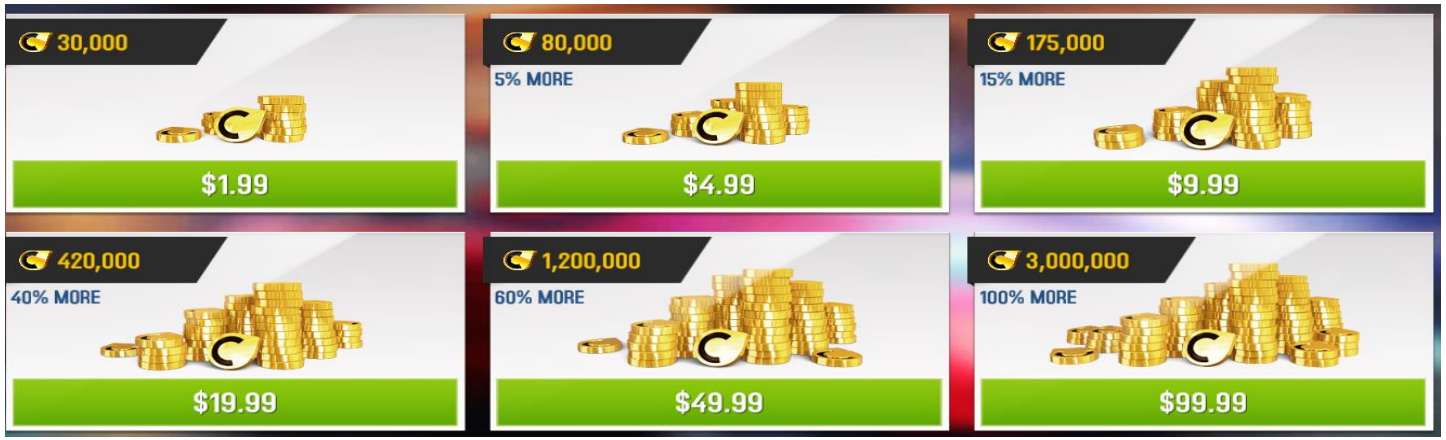
- Generalization is a known area of weakness for students with moderate/severe disabilities
- Regularly plan for generalization:
  - Rotate mathematics stories
  - Change numbers in stories
  - Use different materials (manipulatives, calculators)

6. Plan for Generalization

- Setting
  - Instructional format: 1:1, small group, whole group
  - Place: special education classroom, general education classroom, other school environment, community
- Materials
  - Different learning materials (e.g., paper-pencil & technology)
  - Remove or fade supports
- People
  - Peer, teacher assistant, special education teacher
- Behavior
  - Different (but related!) math skill

6. Plan for Generalization

- Use multiple realistic stimuli as instructional materials
- Promote *conceptual understanding* (vs. plug and chug)
- Plan with the end in mind – no more different than necessary !



“Take out” Option #1: Math Skills Builder

- Developed using findings from an IES Goal 2 Grant at UNCC
- Based on 3 years of research in real classrooms with real teachers
- First research and curriculum to teach problem solving to learners with ESN

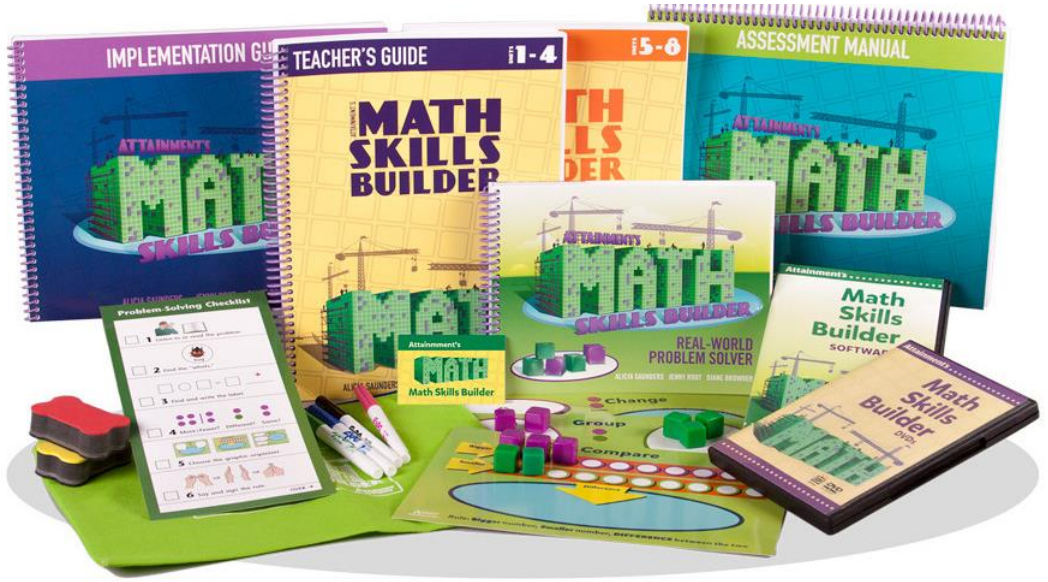


Table 1. Summary of Studies in The Solutions Project Supporting the Conceptual Model.

CCSS	Reference	Settings and participants	Intervention	Dependent variable	Results
CCSS.MATH.PRACTICE. MP1, MP2, MP4	Browder et al. (2017); this study was the primary foundational study in The Solutions Project	Eight students with moderate ID in elementary/middle self-contained classrooms in a large, urban school district	MSBI using a student task analysis, graphic organizers, and manipulatives to teach group, change, and compare problem types and discrimination between problem types	The number of steps completed independently during teacher instruction, total number of problems solved, the number of discriminations between problem type, and generalization to the SMART Board and real-world video-simulation problems	Functional relation between MSBI and students' word problem-solving abilities across four demonstrations
CCSS.MATH.PRACTICE. MP1, MP2, MP4, CCSS.1.OA.A.1, CCSS.4.OA.A.3	Root, Browder, Saunders, and Lo (2017)	Three elementary students with ASD and moderate ID in a large, urban district	MSBI to teach the compare problem type using virtual and concrete manipulatives	The total number of points awarded per problem for steps solved independently on the task analysis	A functional relation was found between MSBI and the use of concrete and virtual manipulatives, and the students' ability to solve mathematical word problems
CCSS.MATH. CONTENT.EE.A.1	Root, Saunders, Spooner, and Brosh (2017)	Three middle school students with Down syndrome and moderate ID in a large, urban district	MSBI using a calculator to solve personal finance word problems with two-digit numbers and decimals to teach the change problem type	The number of steps solved independently across two problems, total number of problems solved, the number of discriminations, and generalization to the iDevice (iPhone/iPad)	Functional relation between MSBI and students' ability to solve word problems with two-digit numbers and decimals and generalization to the iDevice
CCSS.MATH.PRACTICE. MP1, MP2, MP4	Ley Davis, Spooner, and Saunders (2017)	Four middle school students with moderate/severe ID and five general education peers in a large, urban school district	MSBI targeting the change problem type delivered by general education peer tutors	The number of steps completed independently during MSBI, the cumulative number of problems solved, and generalization across peer tutors	A functional relation was found between peer-mediated MSBI and mathematical problem solving with four demonstrations of effect across students
CCSS.MATH. CONTENT.6.EE.A.1	Root and Browder (2017)	Three middle school students with ASD and moderate ID in a large, urban district	MSBI targeting the group problem type with numerals missing in the medial and final position	The number of steps completed independently during MSBI, the cumulative number of problems solved, and generalization	A functional relation between MSBI and algebraic mathematical problem solving with three demonstrations of effect

(continued)

Table 1. (continued)

CCSS	Reference	Settings and participants	Intervention	Dependent variable	Results
CCSS.MATH.PRACTICE. MP1, MP2, MP4, CCSS.1.OA.A.1, CCSS.4.OA.A3	Saunders, Browder, Root, and Brosh (2017)	Three elementary students with ASD and mild/ moderate ID (two students were ELLs) in a rural district	MSBI using a student task analysis, graphic organizers, and manipulatives to teach group, change, and compare problem types, and discrimination between problem types	The number of steps completed independently during teacher instruction, total number of problems solved, the number of discriminations between problem types, and generalization to the SMART Board/iPad and real-world video-simulation problems	Functional relation between intervention and students' word problem-solving abilities, and generalization to the SMART Board/iPad and real-world video-simulation problems
CCSS.MATH.PRACTICE. MP1, MP2, MP4, CCSS.1.OA.A.1, CCSS.4.OA.A3	Saunders, Lo, and Browder (2017)	Three elementary students with ASD and moderate ID in a large, urban district	Computer-based video instruction to deliver MSBI to teach group and change problem types and discrimination between problem types	The number of steps completed independently during computer-based video instruction, the cumulative number of problems solved and discriminations, and generalization to paper-and pencil format	A functional relation was found between MSBI delivered through computer-based video instruction and students' problem solving of group and change problem types and discriminating between problem types
CCSS.MATH.PRACTICE. MP1, MP2, MP4, CCSS.1.OA.A.1, CCSS.4.OA.A3	Saunders, Spooner, and Ley Davis (2017)	Three middle school students with moderate ID in a large, urban district	Video prompting with systematic instruction to teach real-world problem solving of video-simulation change problems	The number of steps completed independently, the cumulative number of problems solved and discriminations, and generalization to paper-and-pencil format	A functional relation was found between video prompting and students' mathematical problem-solving skills. Participants were able to solve the video problems using the finger counting strategy taught through first-person perspective video modeling

Note. CCSS = Common Core State Standards; ID = intellectual disability; MSBI = modified schema-based instruction; ASD = autism spectrum disorder; ELLs = English language learners.

Take Out #2: Teaching to Standards Math

- Based on two years of research at UNCC
- First research that used grade-appropriate materials to teach grade-aligned standards while still building early numeracy skills
- Teaches state standards in mathematics:
  - Numbers & Operations
  - Geometry
  - Data Analysis
  - Algebra
  - Measurement

Take Out #3: MASSIs (Mathematics Activities for Scripted Systematic Instruction)

With a partner, choose 1 MASSI to view **in its entirety**.
Consider the following:

1. How do they embed numeracy skills in grade-aligned math?
2. What EBPs are incorporated?
3. Do they provide information on how to differentiate for students based on communication level, physical disability, and numeracy skills?

Additional Resources

NCSC WIKI - MASSIs

https://wiki.ncscpartners.org/index.php/Mathematics_Activities_for_Scripted_Systematic_Instruction

Mathematics Podcast by Dr. Root

https://tash.org/amplified/

Florida Access Weebly

http://accesstofls.weebly.com/math-resources.html

Dynamic Learning Maps:

http://dynamiclearningmaps.org/

Math Skills Builder

https://www.attainmentcompany.com/math-skills-builder

Teaching to Standards Mathematics

https://www.attainmentcompany.com/teaching-standards-math

Q&A

- Thanks to Dr. Jenny Root for content used in these slides
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