


Students With Disabilities **CAN** Do Math!

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 [@mathematize4all](https://twitter.com/mathematize4all)

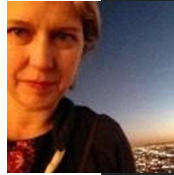
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agael@cookecenter.org

 [@bkdidact](https://twitter.com/bkdidact)



Rachel is a professor of disability studies at Chapman University in Los Angeles, California

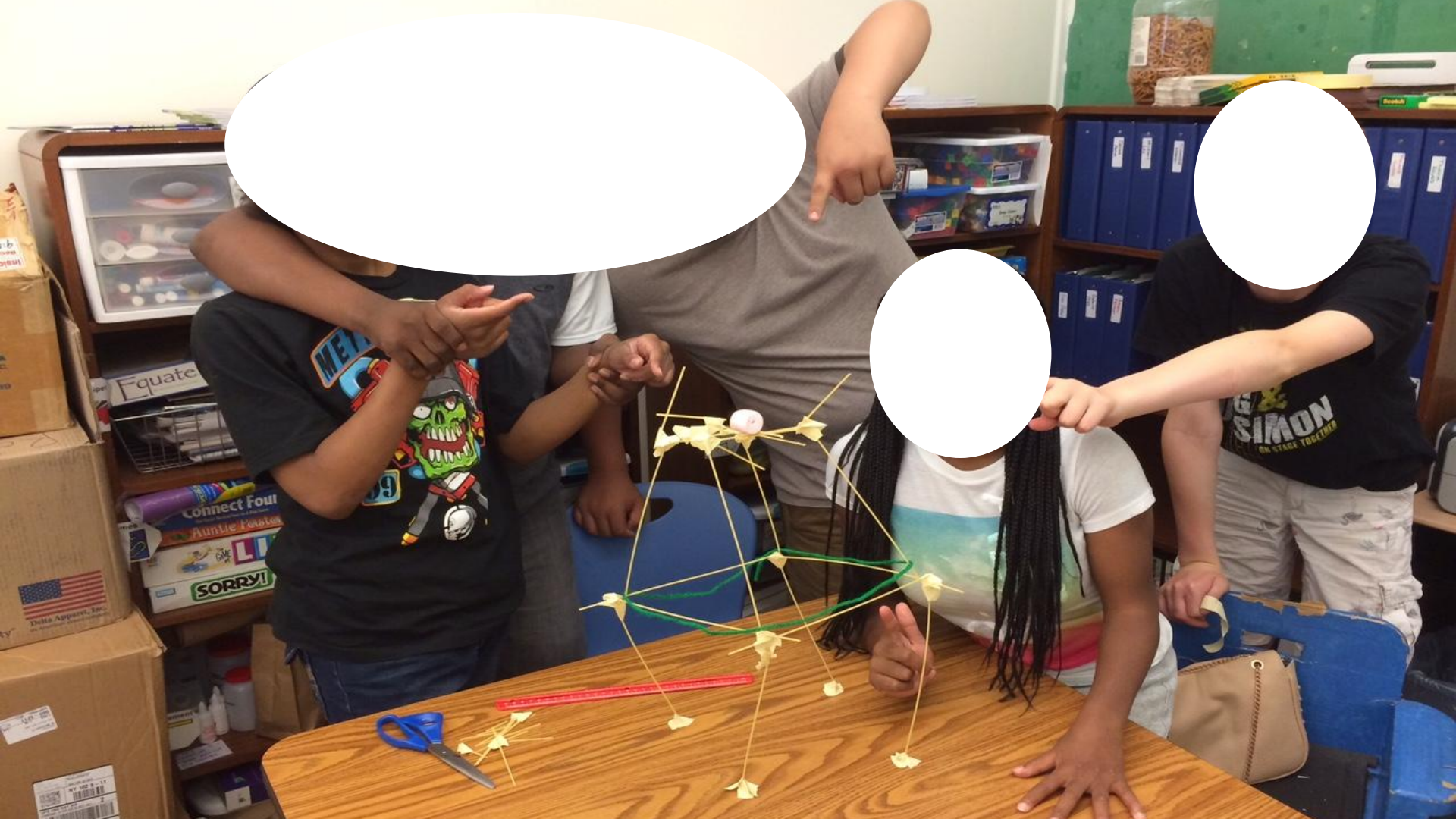


Danielle is a lead math & adaptive skills teacher at the Cooke Center Academy in New York City



Andrew is the coordinator of the Math & Science Department at the Cooke Center Academy in New York City

WHO are we talking about?



Neurodevelopmental Disorders...

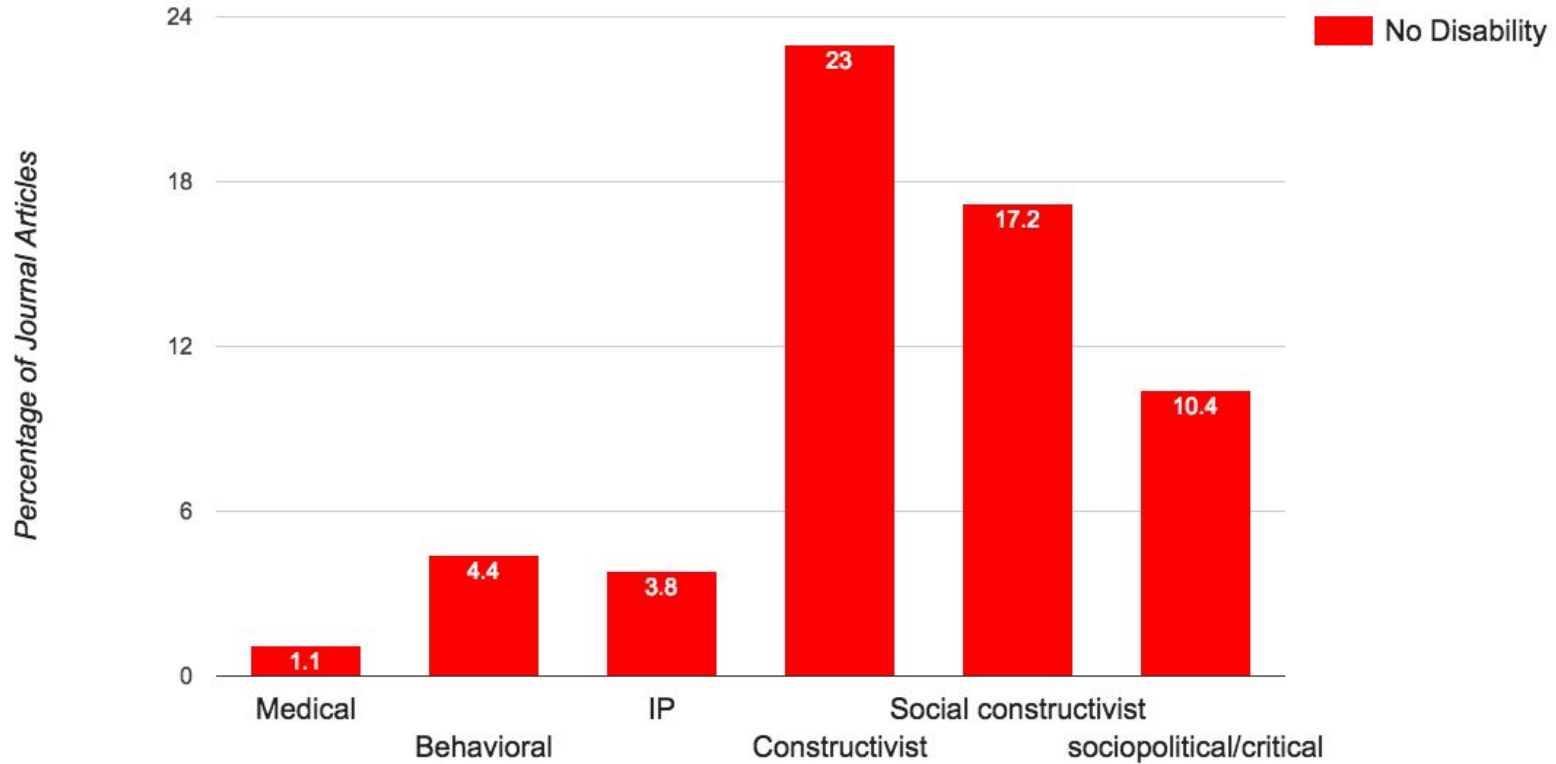
...are a group of conditions with onset in the developmental period...characterized by developmental deficits that produce impairments of personal, social, academic, or occupational functioning. The range of developmental deficits varies from very specific limitations of learning or control of executive functions to global impairments of social skills or intelligence” (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition).

This includes...

Intellectual Disabilities - Communication Disorders - Autism Spectrum Disorder - ADHD
Specific Learning Disorder - Motor Disorders - Other Neurodevelopmental Disorders

WHAT does the research say?

Pedagogical Orientation of Journal Article



Pedagogical Orientation of Journal Article

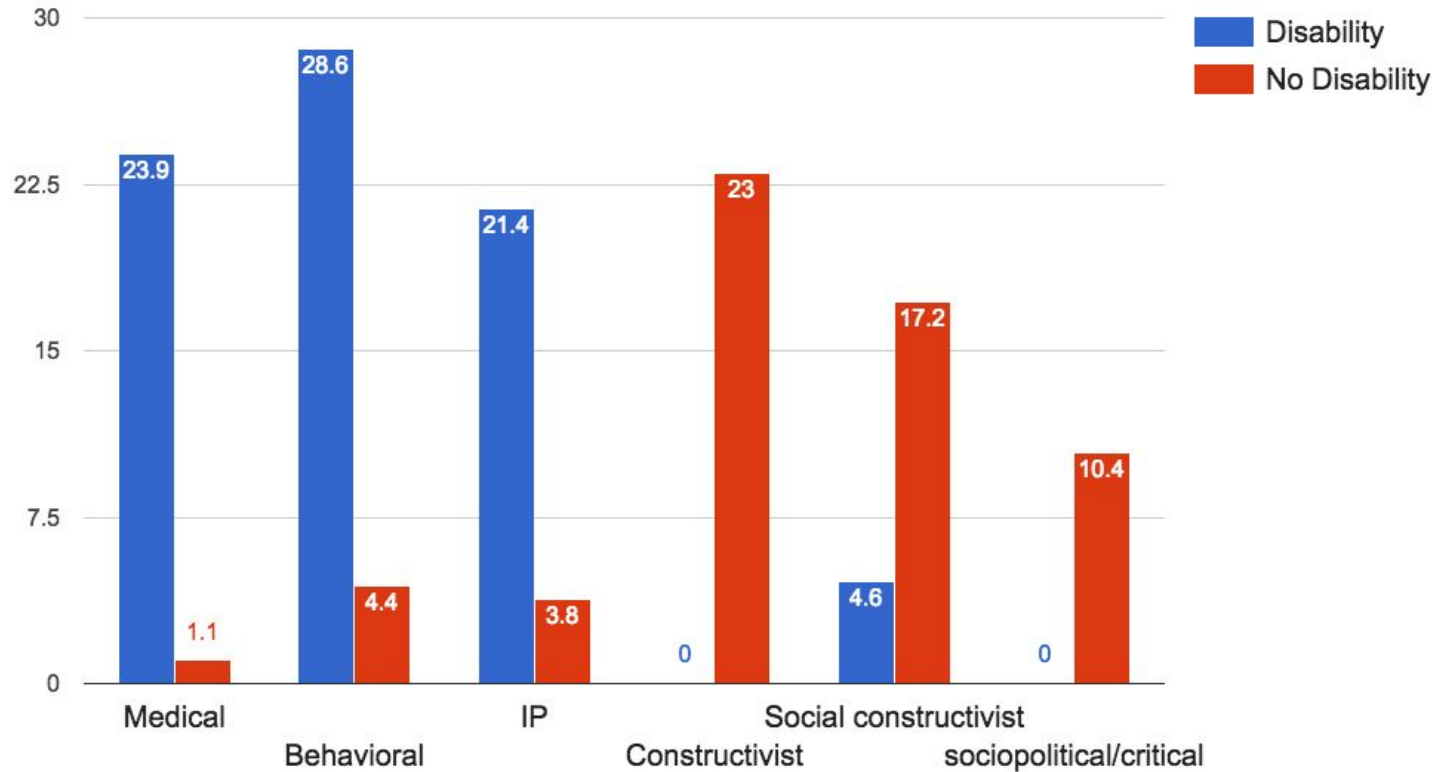
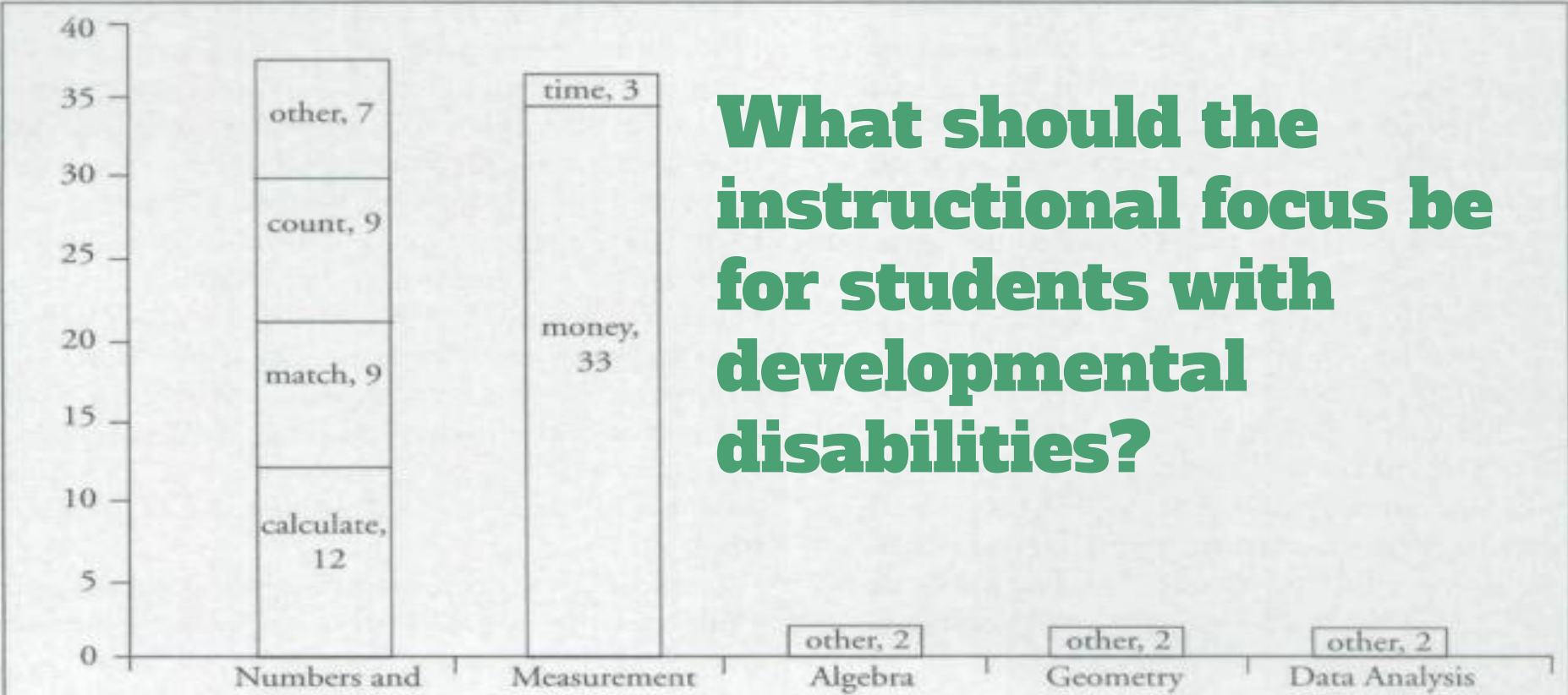


FIGURE 1

Mathematics Components Addressed in Studies Completed With Students With Significant Cognitive Disabilities



What should the instructional focus be for students with developmental disabilities?

(Browder, Spooner, Ahlgrim-Delzell, Harris, Wakeman, 2008.)

**Assumptions about
learners with
developmental
disabilities**

Limited
potential/intelligence

These students cannot
think independently

These students cannot
think abstractly

Assumptions about learners with developmental disabilities

Typical math instruction for these learners

$\begin{array}{r} 222 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 333 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 321 \\ \times 2 \\ \hline \end{array}$
$\begin{array}{r} 123 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 231 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 111 \\ \times 2 \\ \hline \end{array}$
$\begin{array}{r} 223 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 322 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 122 \\ \times 2 \\ \hline \end{array}$
$\begin{array}{r} 221 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 311 \\ \times 2 \\ \hline \end{array}$	$\begin{array}{r} 113 \\ \times 2 \\ \hline \end{array}$

Limited potential/intelligence

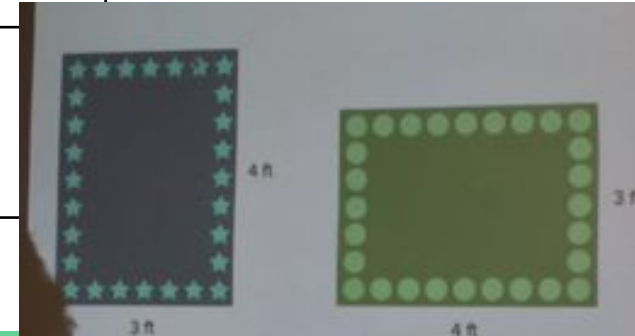
Stick to number and functional skills

These students cannot think independently

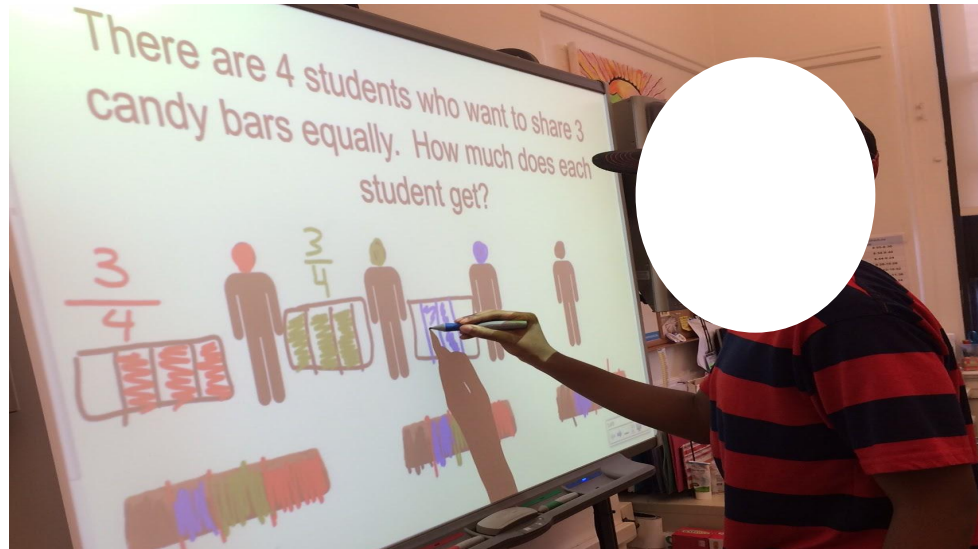
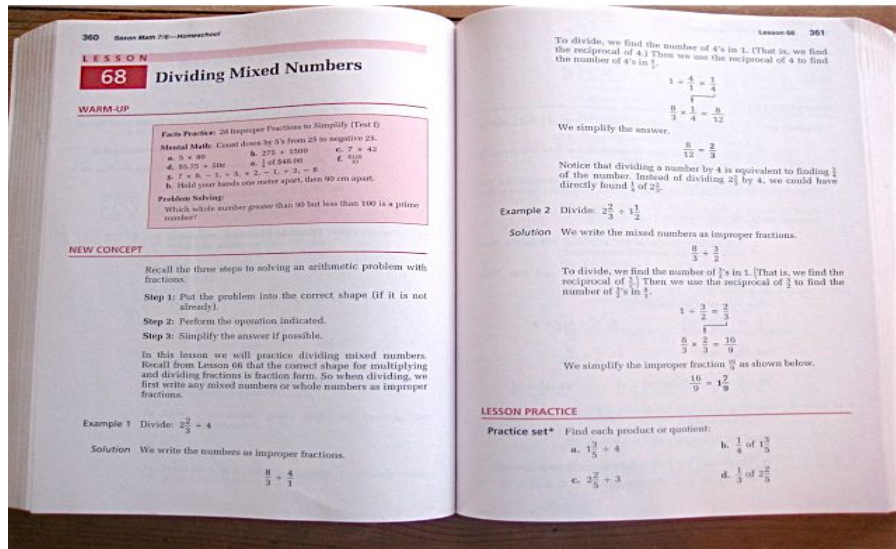
Direct Instruction
Memorization

These students cannot think abstractly

Simplify everything
(take the math out)



Shifting assumptions about learners, shifting teaching and learning of mathematics . . .



WHY do we do it differently?

Disability Rights Movement



Judy Moiseff, Disability Rights Activist & Willowbrook survivor



Justin Dart, founder of Justice for All (JFA)



Judith Heumann, Civil Rights Activist

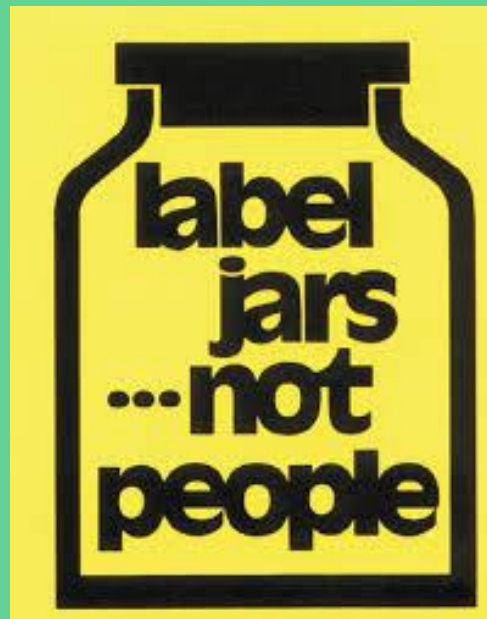


Harriet McBride Johnson, Lawyer & Disability Rights Activist



Nadina La Spina, Disability Rights Activist & Artist





"The language of disability is often unnoticed in daily conversations. Consider for example the following questions: "Are you blind?"; "Are you deaf?"; "Are you retarded?"; "Are you crazy?" Or the phrases: "a dumb question," "a lame answer," "a blind spot," "being shortsighted," and "the blind leading the blind." Or name-calling: "moron," "cretin," "lunatic," and "imbecile." The commonality among all of the above is that disability-related language reinforces the connection between disability and inability, negativity, undesirability, abnormality, and inferiority. Pervasiveness of such language use is most likely because people do not consider disability issues on a par with those of race, ethnicity, gender, and sexual orientation. Disability still remains a depository of bad images and associations, a concept that people continue to devalue and look down upon" (Valle & Connor, 2011, p. 24).

“I have cerebral palsy, and I prefer identity-first language. I consider my disability to be an inextricable part of my identity as a human being. It isn’t negative to say I’m disabled; it’s a statement of fact. [My disability] is a huge part of my identity and how I experience the world. To me, person-first language implies a degree of shame or negativity about disability. I embrace my disability because it influences so much of how I see and experience the world.”

— **Tonia**

“
IT ISN'T NEGATIVE
TO SAY I'M
DISABLED;
IT'S A STATEMENT
OF FACT.”

Tonia Says

The
MIGHTY



***We don't pathologize a calla lily by saying that it has a "petal deficit disorder." We simply appreciate its unique beauty...Similarly, we ought not to pathologize children who have different kinds of brains and different ways of thinking and learning.
(Armstrong, 2012)***

Neurodiversity in the Classroom

Positive Niche Construction is a strengths-based approach to inclusive education

- Comprehensive assessment of student's strengths
- The use of assistive technology and *universal design for learning*
- Collaboration between teachers and related service providers
- Implementation of strengths-based learning strategies
- Envisioning positive role models with disabilities (i.e. Albert Einstein)
- Affirmative career aspirations (related to student's strengths)
- Engineering of appropriate environmental modifications to support the development of neurodiverse students

From Thomas Armstrong's Neurodiversity in the Classroom

Universal Design for Learning Guidelines



Provide Multiple Means of
Engagement

Purposeful, motivated learners



Provide Multiple Means of
Representation

Resourceful, knowledgeable learners



Provide Multiple Means of
Action & Expression

Strategic, goal-directed learners

Find the barriers and design around them!

- How can the environment be made more accessible to all?
- How can relationships be more accessible to all?
- How can content be more accessible to all?
- How can routines and norms be more accessible to all?
- How can engagement in problem-solving be more accessible to all?
- How can strategic thinking be more accessible to all?



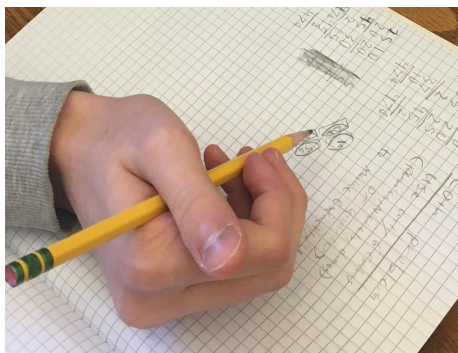
**Universally
Designed!**

#Multimodal

Universally Designed AND Cognitively Demanding

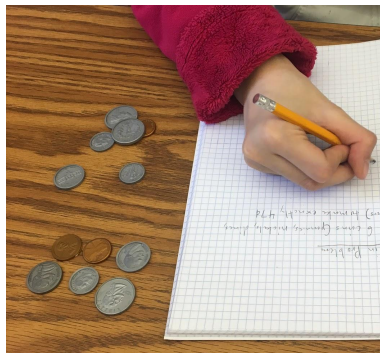
You have 47¢ in your pocket and exactly 6 coins. What pennies, nickels, dimes, and quarters could **you** have?

Adapted from Openmiddle.com



Abstract Representation
Algorithm

Concrete Representation
Manipulatives



Coin problem



Adaptive Expression
Assistive Tech

Expression By Modeling
Pictorial



Focus on the Standards for Mathematical Practice

MP.1. - Make sense of problems and persevere in solving them

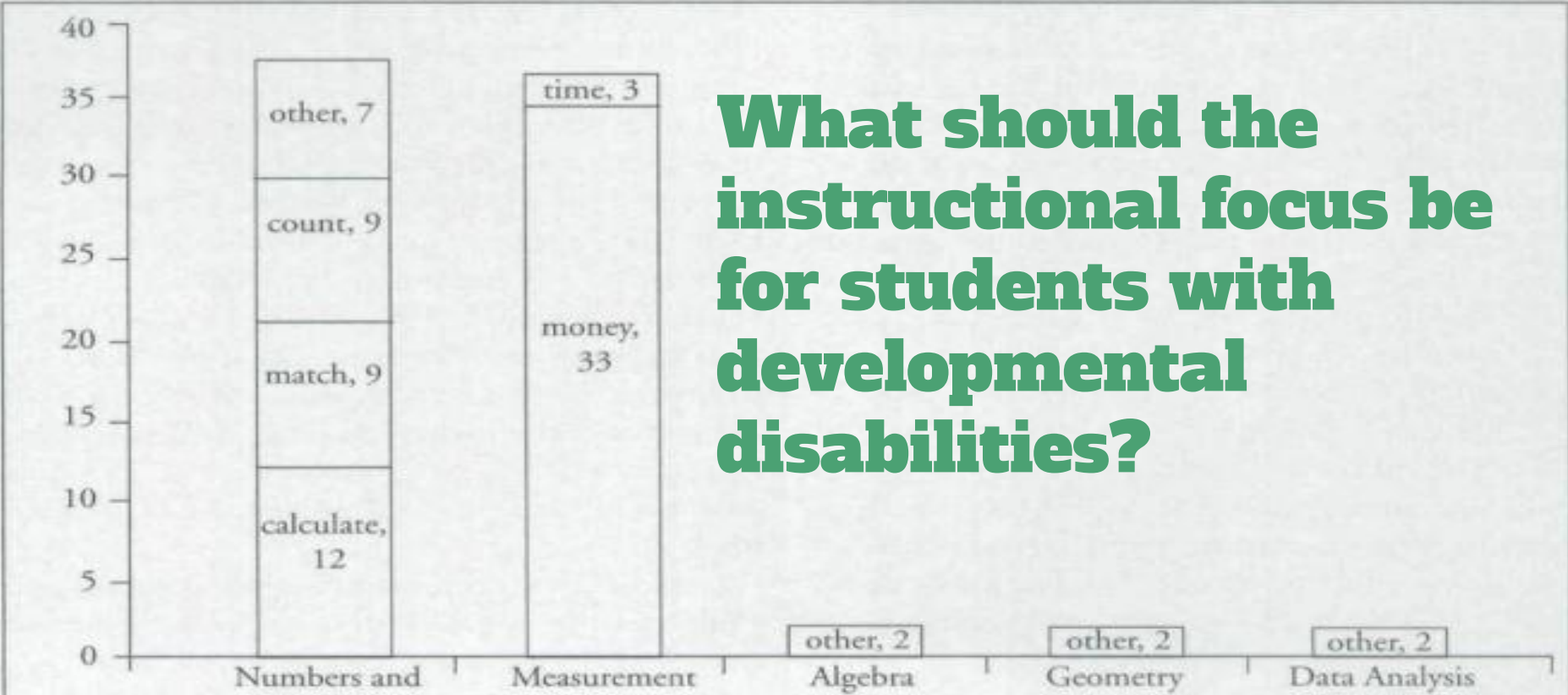
MP.2 - Reason abstractly and quantitatively

MP.7 - Look for and make use of structure

MP.8 - Look for and express regularity in repeated reasoning

FIGURE 1

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What should the instructional focus be for students with developmental disabilities?

(Browder, Spooner, Ahlgrim-Delzell, Harris, Wakeman, 2008.)

addition

+

plus

sum

and

subtraction

-

minus

difference
of

difference
between

total
of

in all

altogether

together

decrease
by

reduce
by

fewer
than

less
than

1. To raise money for a new science lab, Martinez Elementary is selling T-shirts **and** hats with the school's name on it. They sell 73 T-shirts **and** 29 hats. How many **more** T-shirts did they sell than hats?

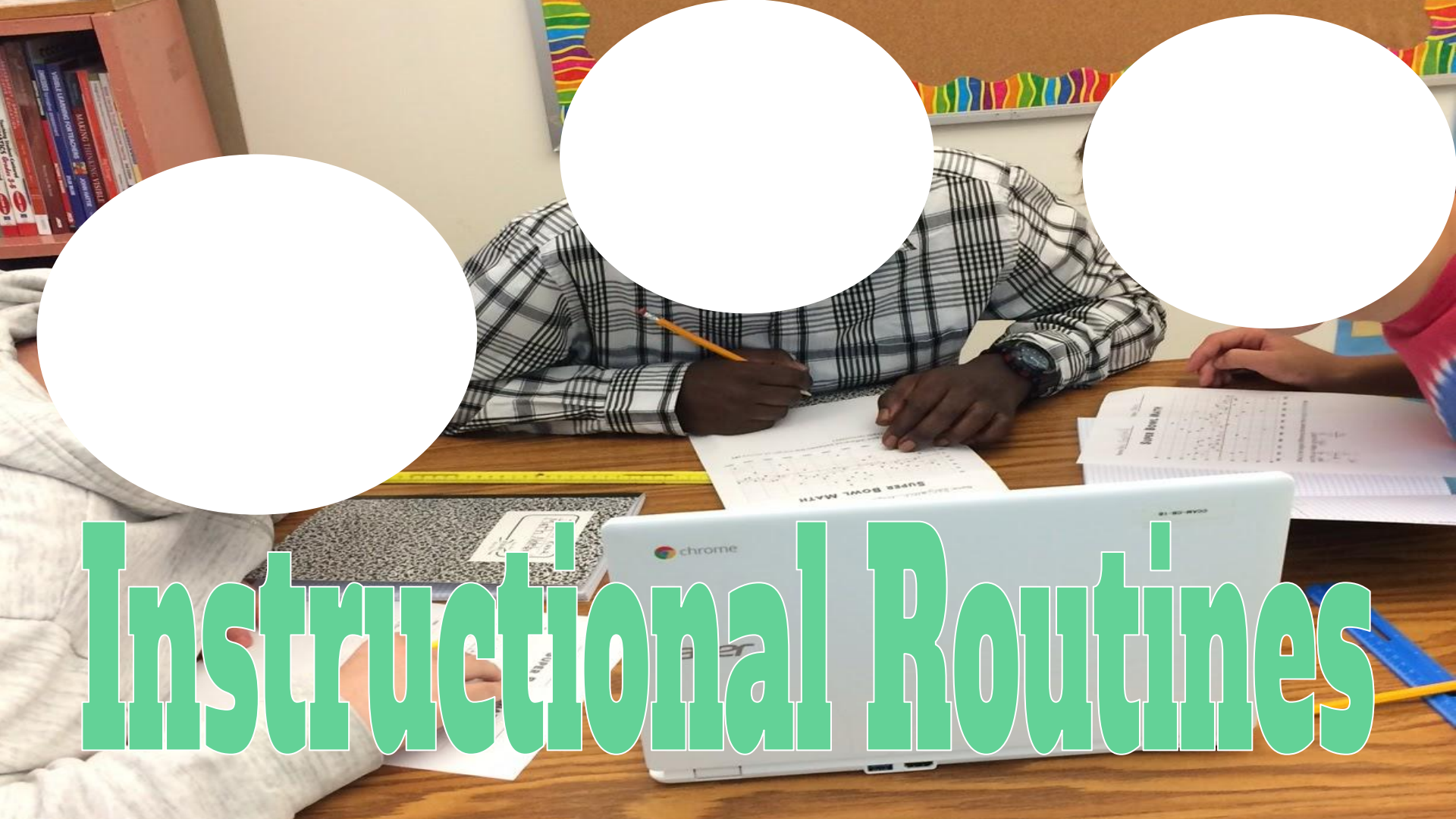


Word problems and the problems with words...

HOW *we* do it...

Instructional Routines:

- I Notice/ I Wonder
- Counting Collections
- Contemplate then Calculate



Instructional Routines

Instructional Routine

I Notice...

I Wonder...



from Dan Meyer

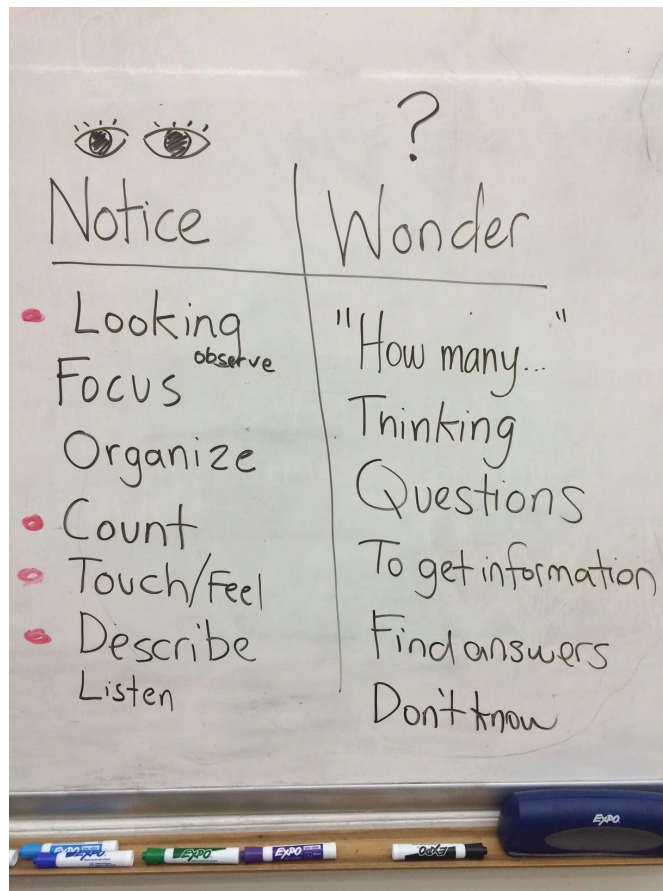
What do you notice?
What do you wonder?

Instructional Routine Norms

Allowing students to become familiar with the routines and expectations, will eventually give them the opportunity to engage with deeper mathematical thinking.

We began by exploring what it means to “notice” and what it means to “wonder”

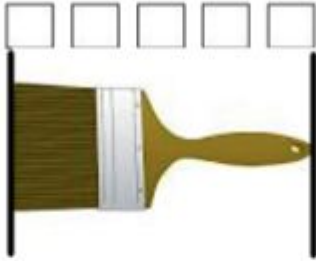
Now my students notice and wonder unprompted!



Name:

Date:

Measuring A Paintbrush



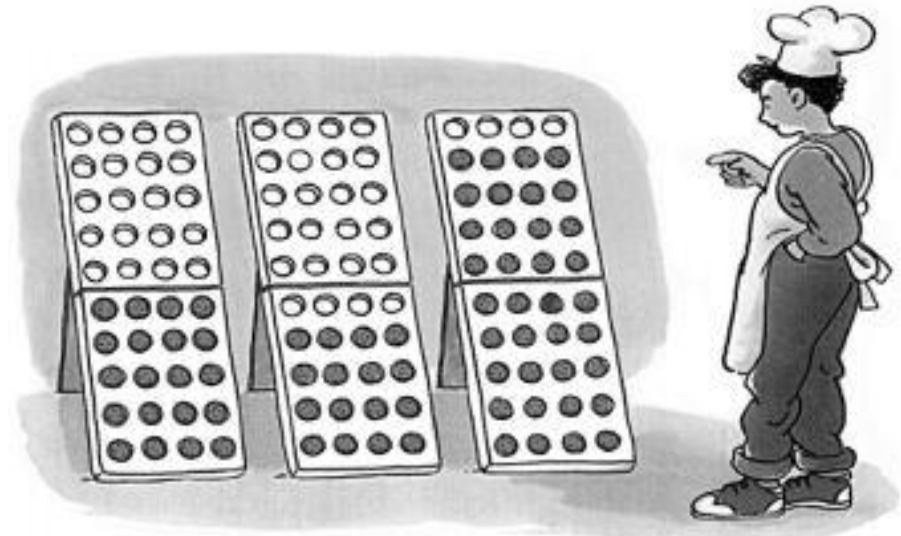
I notice...	I wonder...

My students **noticed**...

- The black lines that are straight
- There are 5 boxes
- The brush is brown
- The paintbrush is made out of wood or plastic
- The paintbrush is 5 measuring long
- There are two lines on the side of the paintbrush

My students **wondered**...

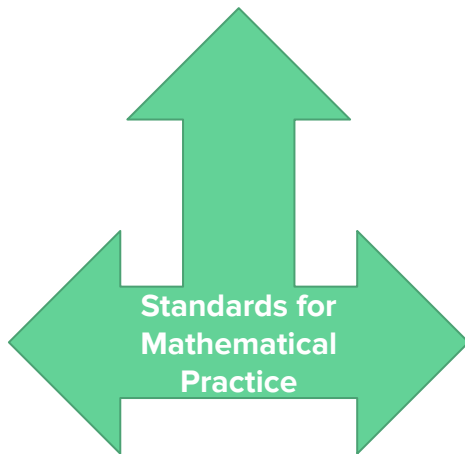
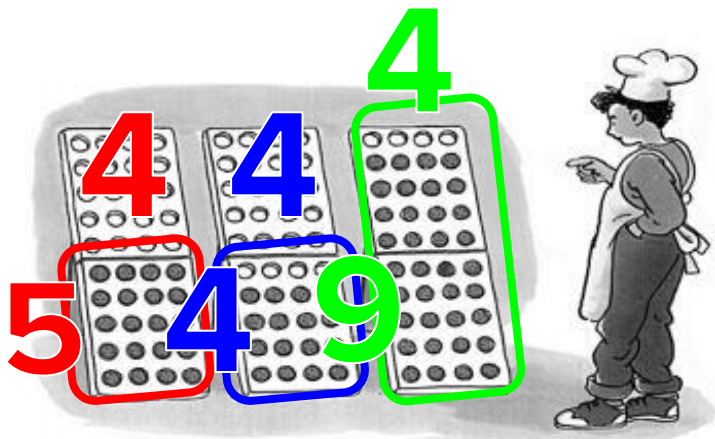
- How long is the paintbrush?
- Why are there lines on both sides?
- What are the squares for?
- How big is the paintbrush?
- What are the lines?
- What are the boxes?
- Why is the paintbrush not moving?



from Contexts for Learning Mathematics

What do you notice?
What do you wonder?

A baker wants to find out how many muffins he made this morning. He has three trays. One tray has 5 rows with 4 muffins in each row. The second tray has 4 rows with 4 muffins in each row. The third tray has 9 rows with 4 muffins in each row.

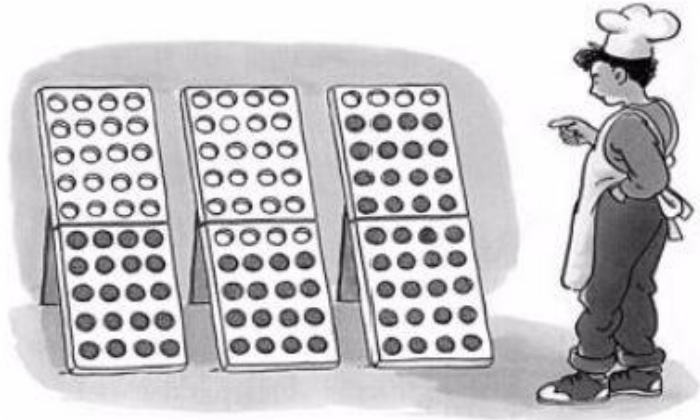


$$(5 \times 4) + (4 \times 4) + (9 \times 4)$$
$$20 + 16 = 36 = 72$$

Researchers in mathematics and mathematics education and cognitive psychologists have long recognized that a very important, if not essential, component of problem solving is the ability to translate between different symbolic representations of information (Webb, Gold, Qi, 1990).

Name: _____

Date: _____



I notice...	I wonder...

Universal Design for Learning Guidelines



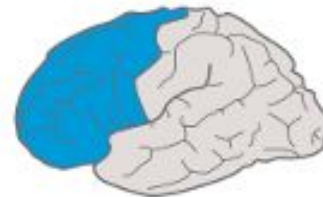
Provide Multiple Means of
Engagement

Purposeful, motivated learners



Provide Multiple Means of
Representation

Resourceful, knowledgeable learners



Provide Multiple Means of
Action & Expression

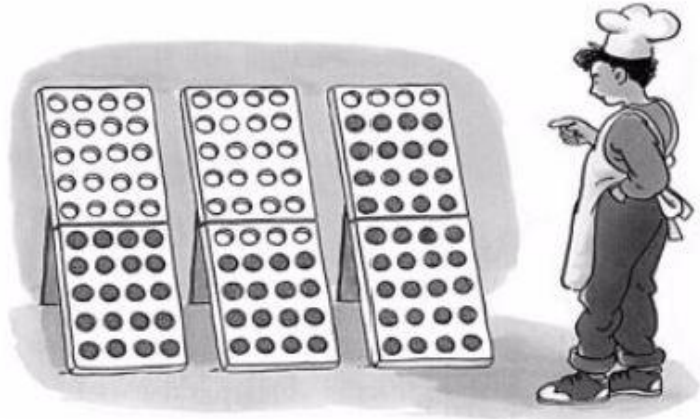
Strategic, goal-directed learners

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- How can strategic thinking be more accessible to all?

Name: _____

Date: _____



I notice...	I wonder...

T-Chart Graphic Organizer

- Supports ***executive functioning*** during problem solving
- Prepares use of ***receptive/expressive language***
- Reduces load on ***working memory***

For more information about
I notice/I wonder visit **MathForum.org**

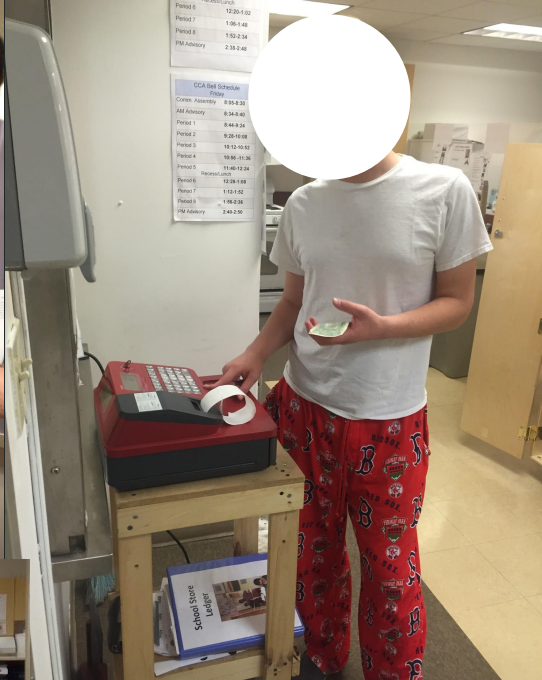
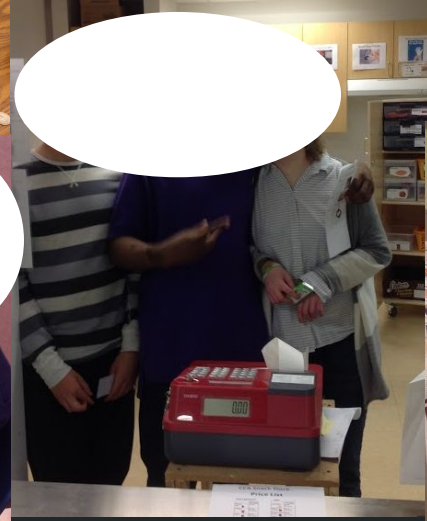


The Math Forum
PEOPLE LEARNING MATH TOGETHER

Instructional Routine

Counting Collections

School Store

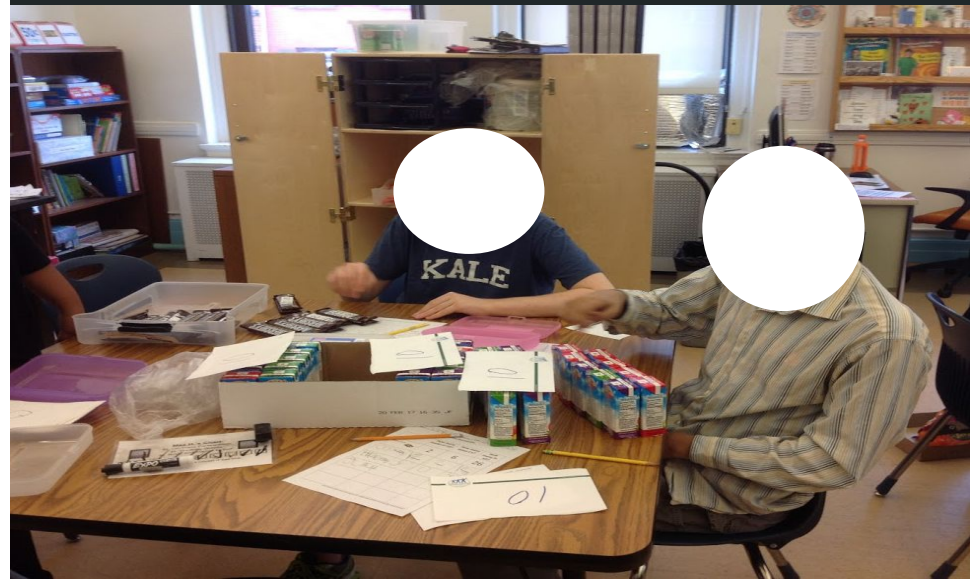
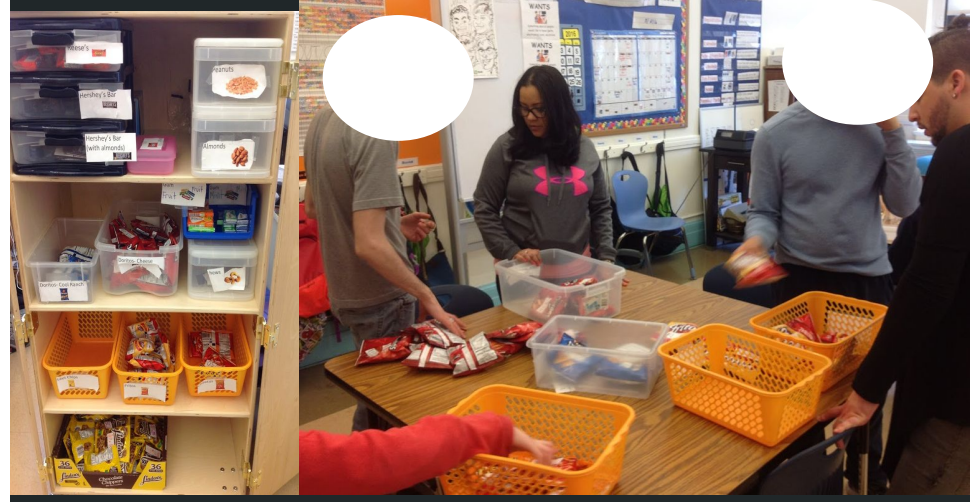


SCHOOL STORE

Less than 10

Have		Need to buy	
Doritos-Cheese  <u>14</u>	Cheetos  <u>0</u>		
Doritos-Cool Ranch  <u>9</u>	Fritos  <u>10</u>		
Lays Chips  <u>3</u>	Cuties  <u>44</u>		
Hershey's Bar  <u>2</u>	Hershey's Bar (with almonds)  <u>37</u>	Hershey's Bar 	
Nuts  <u>7</u>	Cookies  <u>22</u>	Lays Chip: 	Doritos-Cool Ranch 
Reese's  <u>13</u>	Kit Kat  <u>1</u>	Hershey's Bar (with almonds) 	Kit Kat 
Juice  <u>20</u>	Ginger Ale  <u>0</u>	Nuts 	Ginger Ale 
Gum (mint)  <u>3</u>	Gum (fruit)  <u>16</u>	Cheetos 	Cheetos 
		Gum 	

[Extend Page](#)



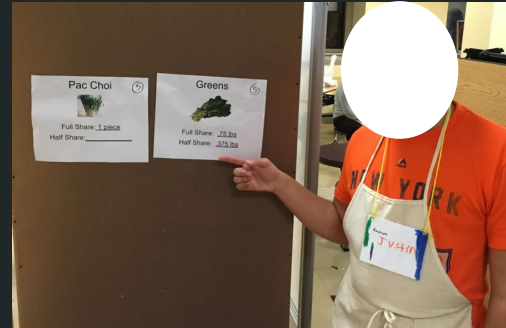
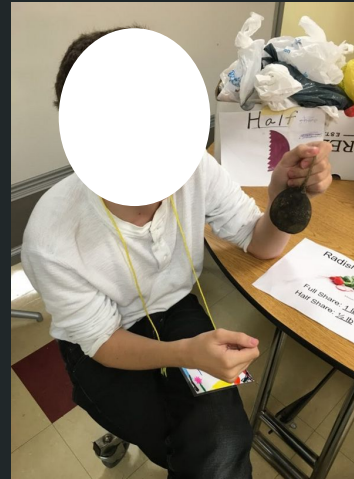


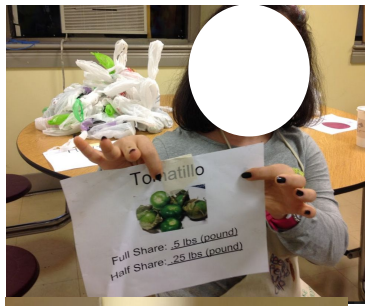
CSA

"A math/science project by the LC-Egic/UC-LaFrance cohorts. At the CSA, we count and weigh vegetables and fruit. The fruits and vegetables come from Norwich Meadows Farm. We sell vegetables and fruit to customers. The customers are teachers and students." -Ms. Egic's students

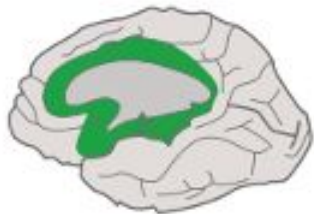








Universal Design for Learning Guidelines



Provide Multiple Means of
Engagement

Purposeful, motivated learners



Provide Multiple Means of
Representation

Resourceful, knowledgeable learners



Provide Multiple Means of
Action & Expression

Strategic, goal-directed learners

Find the barriers and design around them!

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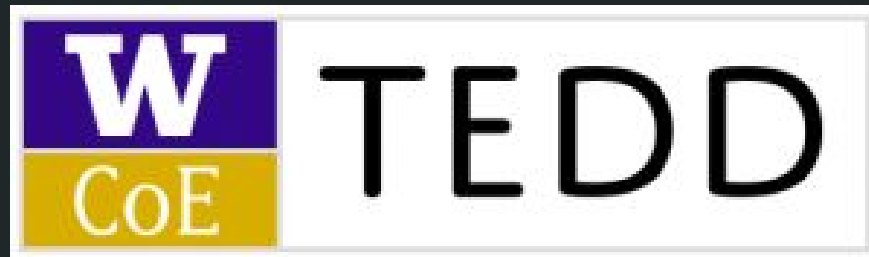


Realia

- Makes problem solving and mathematical thinking more **concrete**
- Cooperative learning structures for **multiple means of expression** of knowledge.
- Use of **space outside the classroom** to support the social and physical environment for learning



For more information about
Counting Collections visit **TEDD.org**



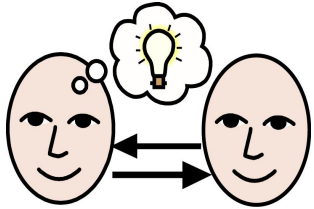
Instructional Routine

Contemplate

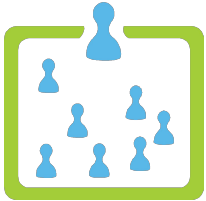
Then Calculate



Notice



Pair Share



Group Share



Reflect

***Contemplate
then Calculate
Sequence***





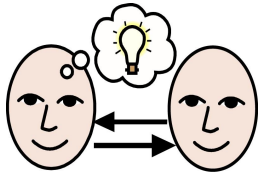
Get Ready to Notice...





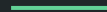
What Do You Notice?





Pair Share

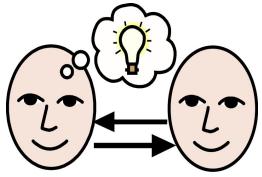
I noticed _____





What Do You Notice?





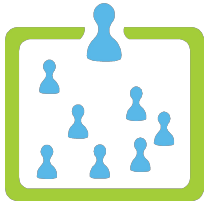
Pair Share

Shortcuts?

A shortcut is _____

it works because...





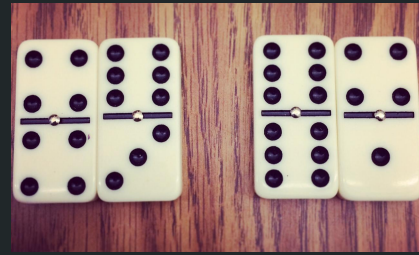
Group Share

Fill in the blanks with your partner

We noticed _____ so we _____

We knew _____ so we _____

Our shortcut works because _____



Listen to others

They noticed _____ so they _____

They knew _____ so they _____

Their shortcut works because _____



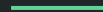
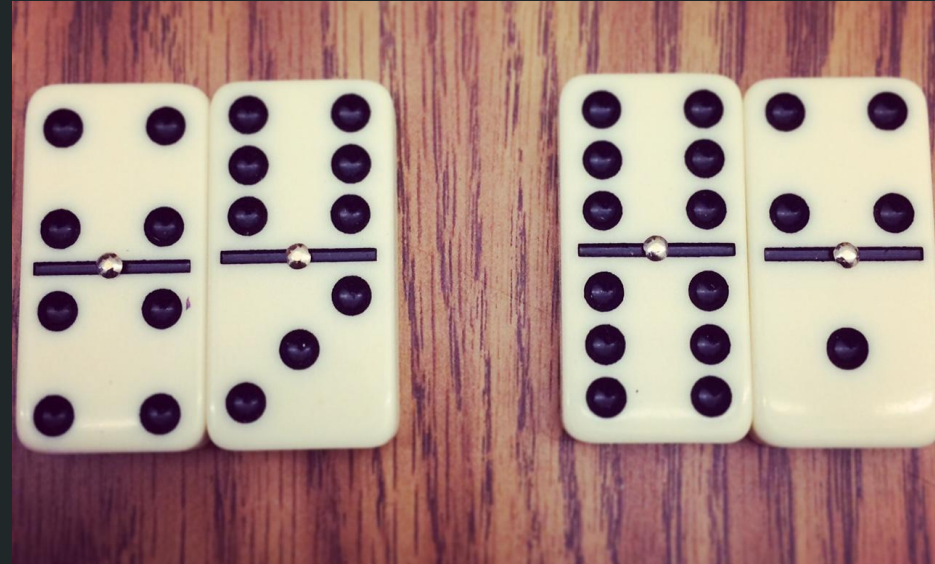
Reflect

Choose One...

Paying attention to _____ is helpful because...

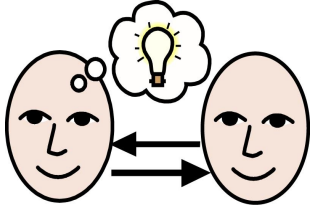
Next time I will...

Something I learned about dominoes is...

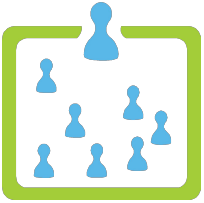




Notice



Pair Share



Group Share



Reflect

**Universally
Designed!**

Universal Design for Learning Guidelines



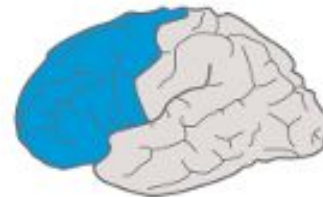
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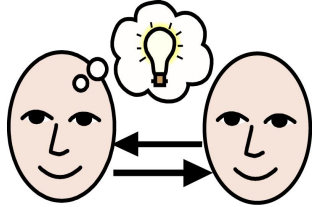
Strategic, goal-directed learners

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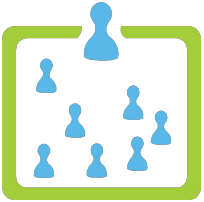
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Notice



Pair Share



Group Share



Reflect

**Universally
Designed!**

Guided Sequence

- Supports **executive functioning** during problem solving
- Sentence frames aid **receptive/expressive language**
- Visual aids cue **working/short term memory**

For more information about
Contemplate then Calculate visit
Math.Newvisions.Org



**New Visions
for Public Schools**

**Have your assumptions about learners
with developmental disabilities shifted?
How?**

Any other
questions?



thelearningkaleidoscope.wordpress.com

MATHEMATIZING4ALL
.wordpress.com

You can find out more about us and our work on our blogs...

