

A decorative background featuring a cluster of interlocking gears in various colors including teal, blue, purple, yellow, and red, arranged in the upper left corner.

Multisensory Access to Math

Slides are posted here:

Multisensory Access to Math



Madalaine Pugliese
Assistive Learning Technologies, LLC

Karen Janowski
EdTech Solutions, LLC



Presentation Overview

- Definitions: UDL and Differentiated Instruction, multisensory learning
- Overview of math challenges
- Brief overview math intervention
- NCTM listserv comments = real world implementation
- Stages Math: Number Sense - features
- Stages Math Intervention Kit
- Stages Math: Number Sense – demo
- Hands-on Stations

Definition - UDL

- Multiple means of representation, to give learners various ways of acquiring information and knowledge
- Multiple means of expression, to provide learners alternatives for demonstrating what they know
- Multiple means of engagement, to tap into learners' interests, offer appropriate challenges, and increase motivation



Definition - UDL

- Based on creating flexible goals, methods, materials, and assessments that consider diversity.
- Centers the need for multiple approaches to meet the needs of diverse learners
- Mirrors the universal design movement in architecture (curb cuts, and close-captioned television – all universally designed to accommodate a wide variety of users)
- Features that support challenges benefit everyone.
- Uses technology's power and flexibility to make education more inclusive and effective for all

Definition

Differentiated Instruction

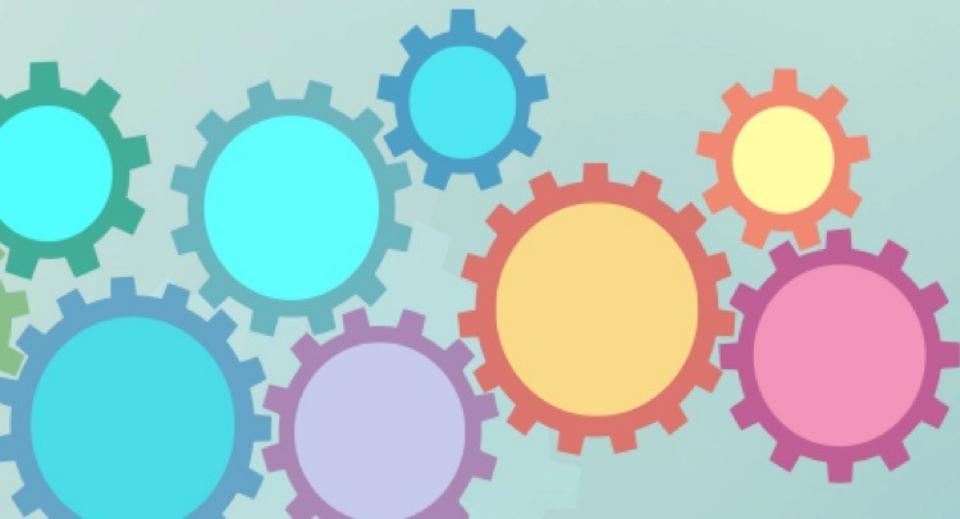
- Strategies that enable all students to participate and make progress in the general curriculum
- Educators provide additional support to students who need it during regular instruction
- Facilitates being able to individualize instruction for a diverse group

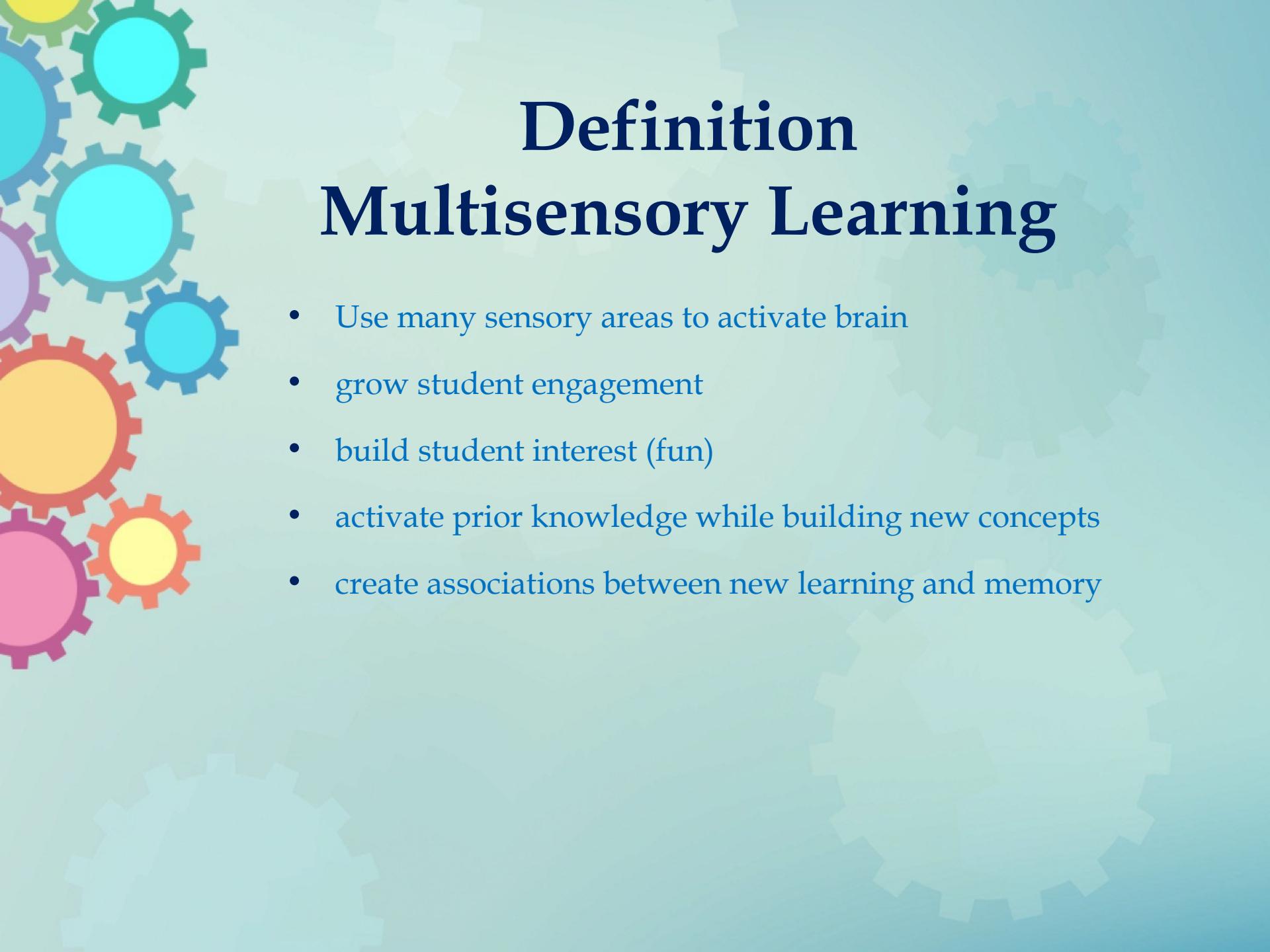


Definition

Differentiated Instruction

- Can be enhanced with the use of technology scaffolds
- Technology scaffolds increase teacher capacity to individualize instruction
- Especially useful in support of learners with math, reading or writing difficulties

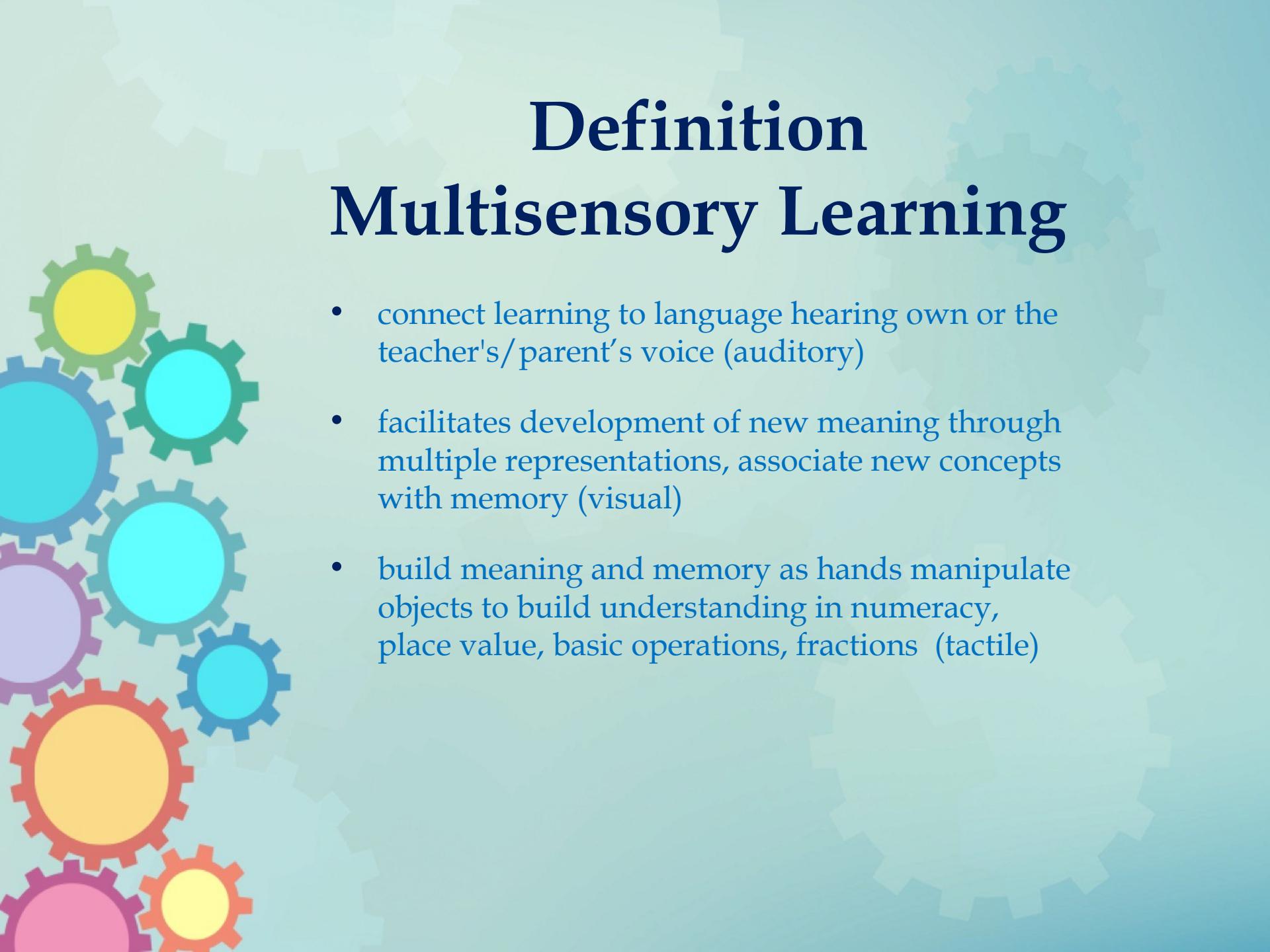




Definition

Multisensory Learning

- Use many sensory areas to activate brain
- grow student engagement
- build student interest (fun)
- activate prior knowledge while building new concepts
- create associations between new learning and memory



Definition

Multisensory Learning

- connect learning to language hearing own or the teacher's/ parent's voice (auditory)
- facilitates development of new meaning through multiple representations, associate new concepts with memory (visual)
- build meaning and memory as hands manipulate objects to build understanding in numeracy, place value, basic operations, fractions (tactile)

Make Your Own Math for Multisensory Learning

- Use cardboard, markers and scissors to make your own Cuisenaire rods or pattern blocks
- Food for fractions (pizza, corn chips...)
- Egg cartons for sorting, counting and place value

Sources

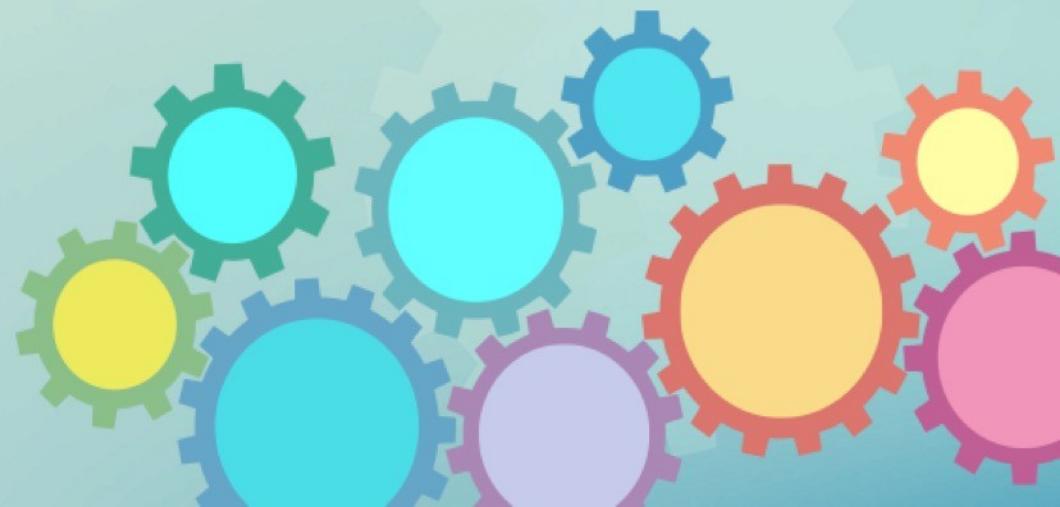
“Math Toolbox in Every Home” <http://mathcats.org/>

Printable instructions for making and using manipulatives

“15 Homemade Math Manipulatives”
<http://theendinmind.net/15-homemade-math-manipulatives-2/>

Math Challenges

- Learning challenges in mathematics are complex.
- There is no single mathematics challenge.



Math Challenges

- Students may be strong in some areas of math and weak in others.
- From 6-7% of all students exhibit challenges in one or more areas of math.



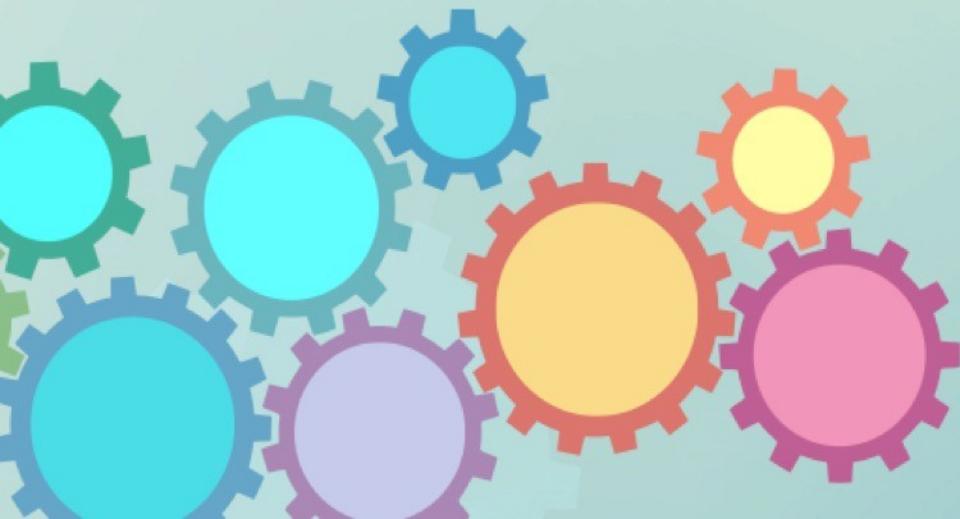
Math Challenges

- Some mathematics challenges are independent of reading disability and some are not.
- Research about math challenges has progressed more slowly than research about reading challenges.



Signs of a Math Challenge

- Has difficulty keeping track of numerical information while counting.
- Forgets arithmetic facts or doesn't remember as many.
- May use immature problem solving procedures.



Signs of a Math Challenge

- Has difficulty with the abstract concepts of time and direction.
- When writing, reading and recalling numbers: adds, substitutes, transposes, omits, and reverses numbers.
- Demonstrates poor mental math ability.



Signs of a Math Challenge

- Has difficulty keeping score during games; loses track of whose turn it is.
- Unable to grasp and remember math concepts, rules, formulas, sequence (order of operations), and basic math facts.
- Gets lost or disoriented easily; may have a poor sense of direction.

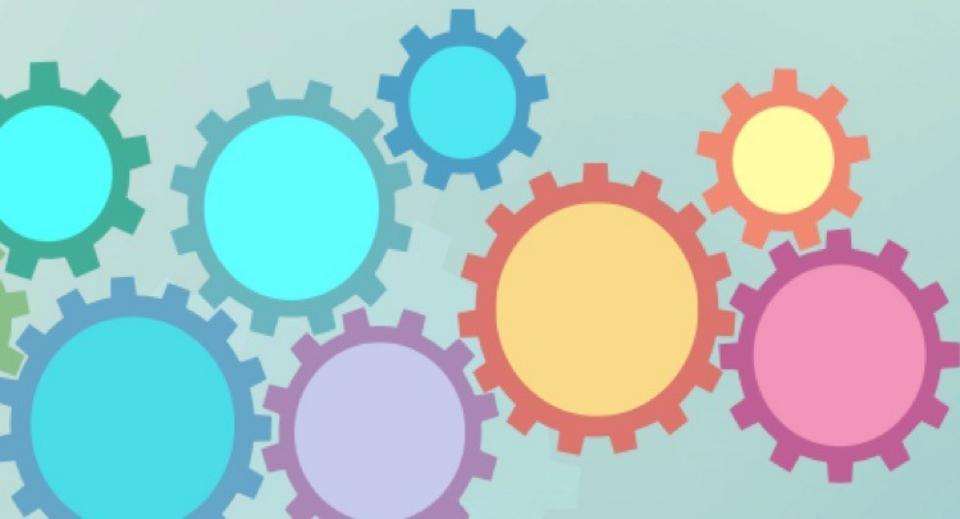


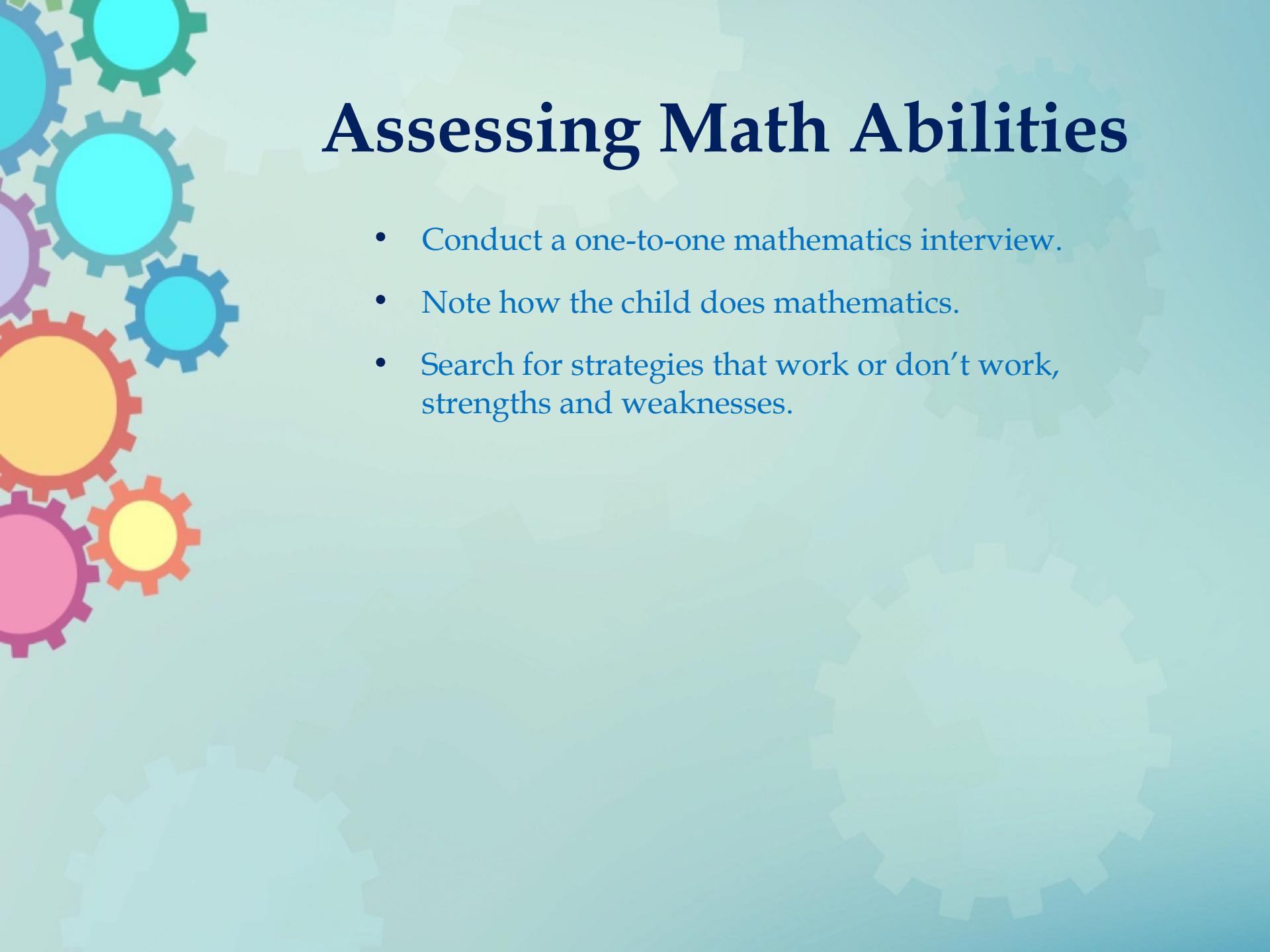
Signs of a Math Challenge

- Children with a math challenge can have one or both of two memory problems:
 1. Getting basic facts into long term memory and accessing memorized facts.
 2. Sifting through all the recalled memorized facts for the relevant information; e.g.,
 $2 + 3$ might evoke answers of 4, 5, or 6

Despite the signs of a math challenge, a learner may:

- Show normal or accelerated language acquisition: verbal, reading, writing.
- Have good visual memory for the printed word.
- Excel in other areas.
- Catch up; it may be a developmental delay and not a more fundamental deficit.





Assessing Math Abilities

- Conduct a one-to-one mathematics interview.
- Note how the child does mathematics.
- Search for strategies that work or don't work, strengths and weaknesses.

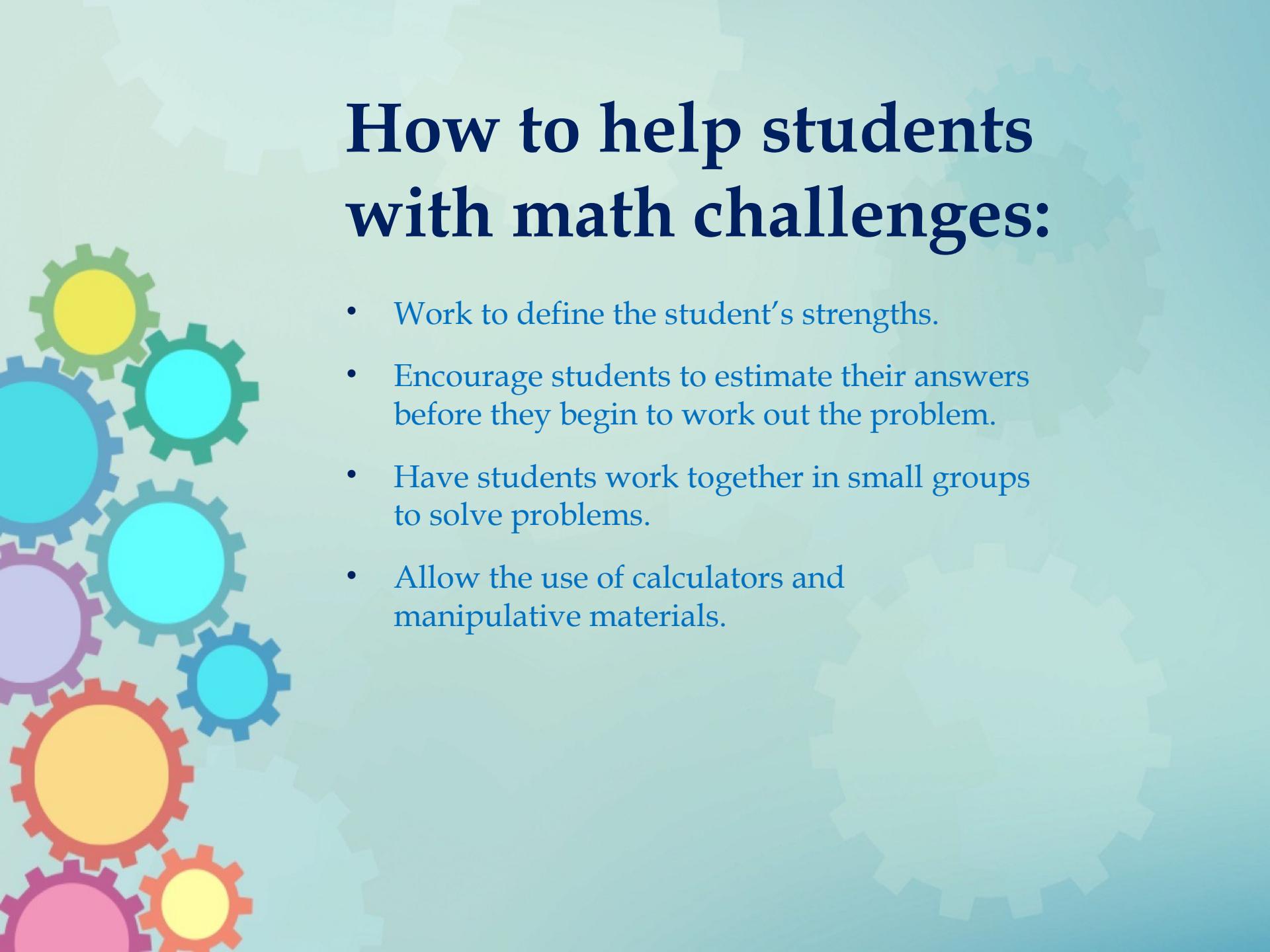
Assessing Math Abilities

- Assess the full range of areas: computation, pattern prediction, sorting, measuring, organizing space with flexibility.
- Observe and note any verbalization, drawings, asking for repeat of directions/question.
- Ask child to estimate answer before computing.



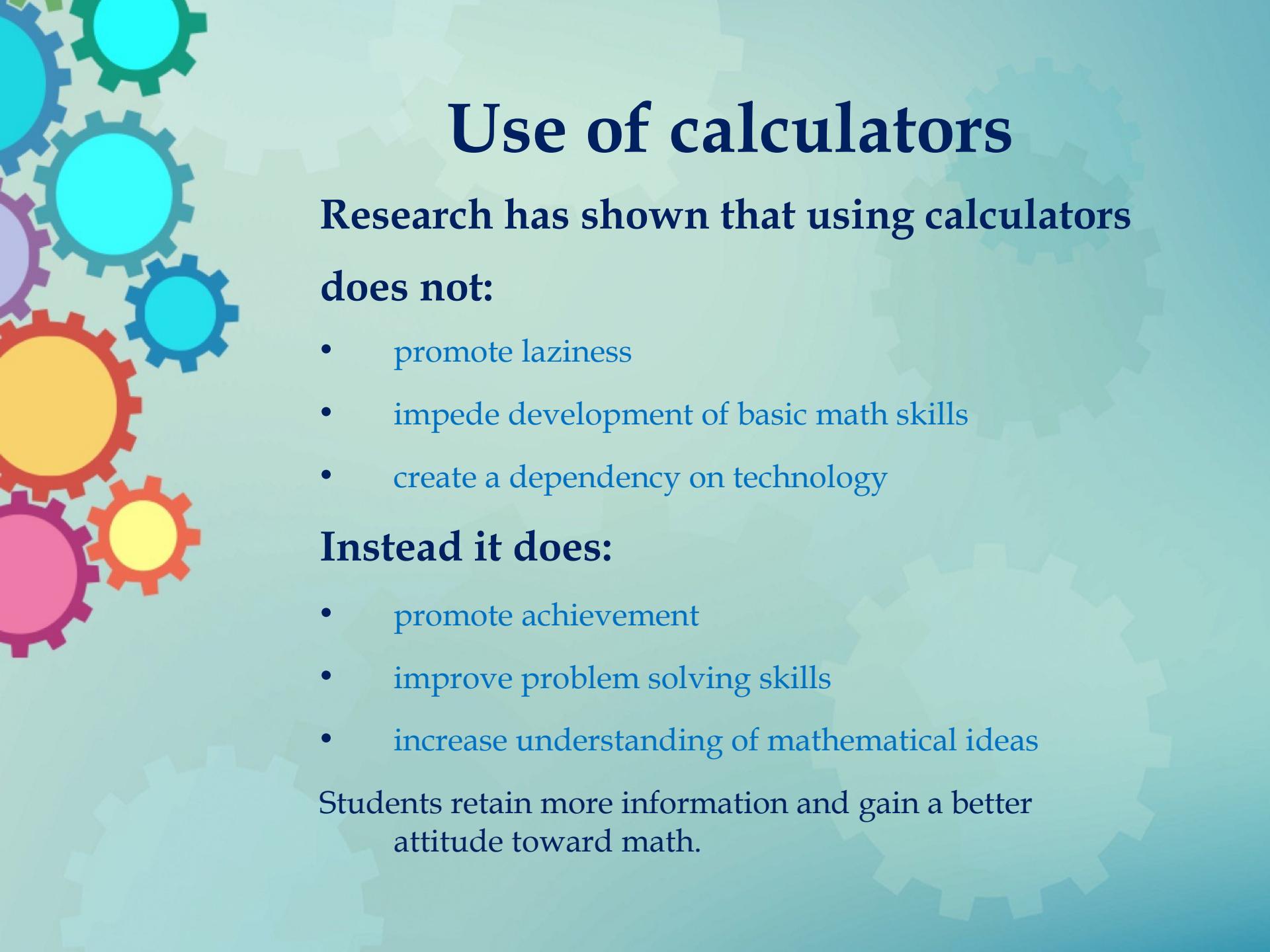
From the NCTM listserv...

"Strategically" indicates that students will select an appropriate tool based on the task. For example, given $10 \times 5 \times 2$, a student might pick up a pencil, calculator or calculate the product mentally. Providing opportunities for students to reflect on their choices in terms of efficiency and effectiveness deepens their understanding of their strategic choices. **As teachers, we can use students' tool selection to provide diagnostic information and help us prepare other learning opportunities.**



How to help students with math challenges:

- Work to define the student's strengths.
- Encourage students to estimate their answers before they begin to work out the problem.
- Have students work together in small groups to solve problems.
- Allow the use of calculators and manipulative materials.



Use of calculators

Research has shown that using calculators does not:

- promote laziness
- impede development of basic math skills
- create a dependency on technology

Instead it does:

- promote achievement
- improve problem solving skills
- increase understanding of mathematical ideas

Students retain more information and gain a better attitude toward math.

Implementation Ideas

Hands-On Activity – Money

Use the money to show your partner how much you need to buy each snack.



A woman with glasses and a blue shirt is pointing to a coin selection machine. A speech bubble says, "Find which coins you need for each snack."

SNACK-O-TRON 9000Z

Snack	Value
A	35¢
B	45¢
C	30¢
D	50¢
E	40¢
F	75¢

Coin Values

Value	Coin
50¢	Quarter
25¢	Dime
10¢	Nickel
5¢	Penny
1¢	Penny

Hands-on materials to try at this station include Hands on Money with Coin Cubes, Place Value Packaging and Talking Calculator.

Hands-on Station: “Money”

Place Value Packaging

Talking Calculator

Hands-On Money with Coin Cubes

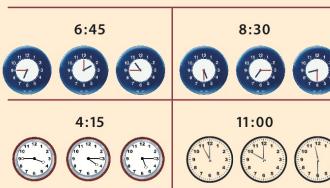
Implementation Ideas

Hands-On Activity – Time

Practice telling time using both analog and digital clocks.
Use the Day Planner to make your schedule for tomorrow.



Fun fact: We use two different kinds of clocks to tell time. A **digital clock** shows time as numbers. An **analog clock** has hands that move around a circle with numbers on it. The time is shown by the position of the hands. Both are read as "three forty-five."



Hands-on materials to try at this station include Timewheels, Day Planners and *Look at Math* Teacher's Guide and Student Book.

Hands-on Station: "Time"

TimeWheels

Day Planners

Look At Math (Teachers Guide and Students Workbook)

To be successful...

Students should work toward:

- number sense mastery
- good problem solving strategies
- automaticity (recall of facts) this allows more brainpower to go toward problem solving (not spent on computing)



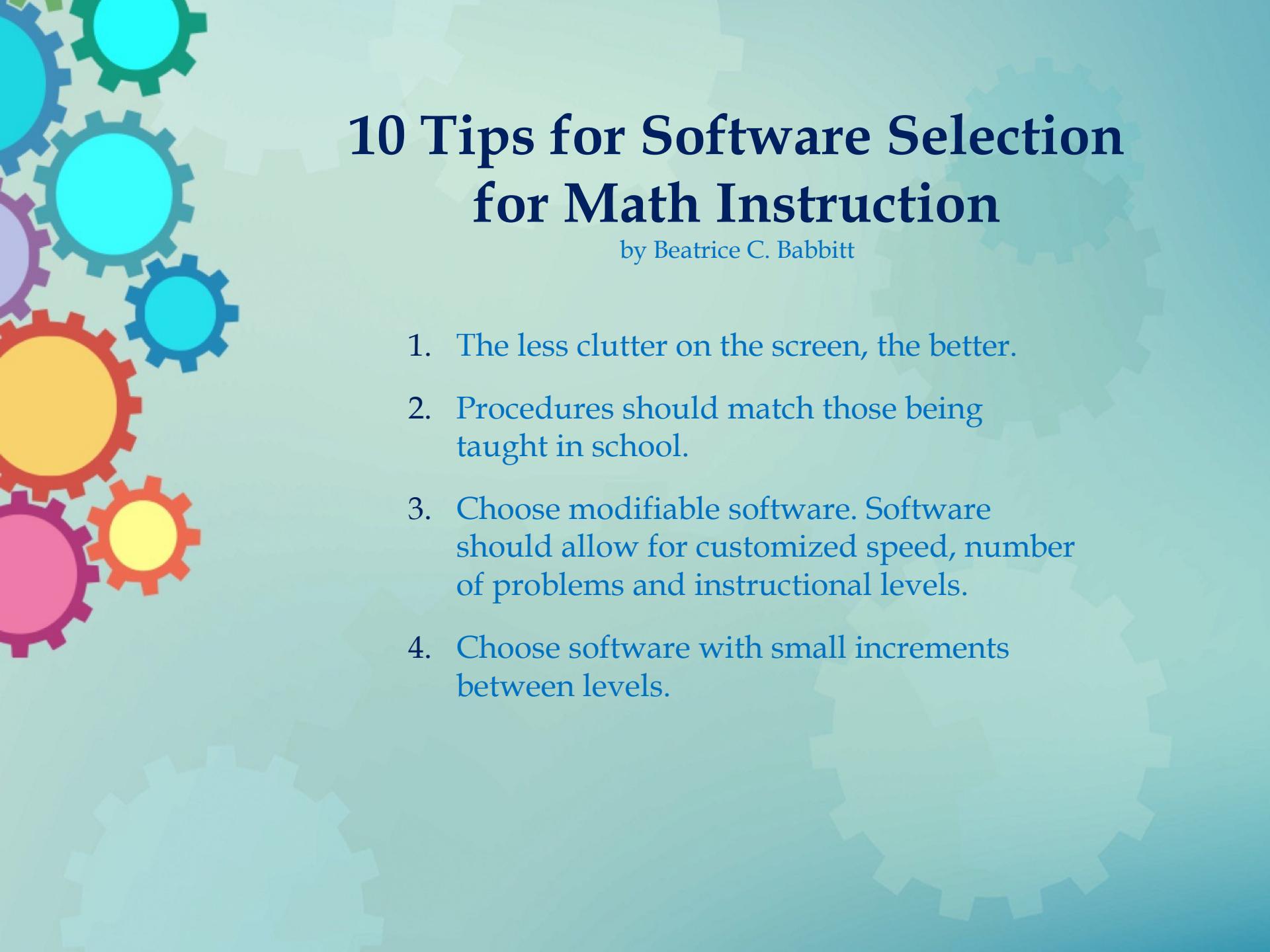
Students with number sense can:

- Count rationally past 100.
- Understand that the sequence of counting doesn't change.
- Count objects in any order.
- Know that last number named is total number.
- Count past difficult numbers (19, 29, 100).
- Count backwards, starting with any number.
- Skip count by 2s, 5s, and 10s.
- Relate basic addition and subtraction facts.
- Explain operation of multiplication.
- Explain place values through the hundreds.

A Letter to My Math Teacher:

- “I need instant answers and a chance to do the problem over once if I get it wrong the first time.”
- “Problems written too closely together on the page cause me mental confusion and distress.”
- “Please allow me more than the standard time to complete problems and please check to see that I am free of panic (tears in my eyes, mind frozen).”
- “If possible, please allow me to take the exam on a one-to-one basis in your presence.”
- “I am not lazy, and I feel really smart in everything but math. That is what frustrates me the most! Everything is easy for me to learn, but Math makes me feel stupid! Please, do be patient with me, and please do not give up on me!”

(source at end)



10 Tips for Software Selection for Math Instruction

by Beatrice C. Babbitt

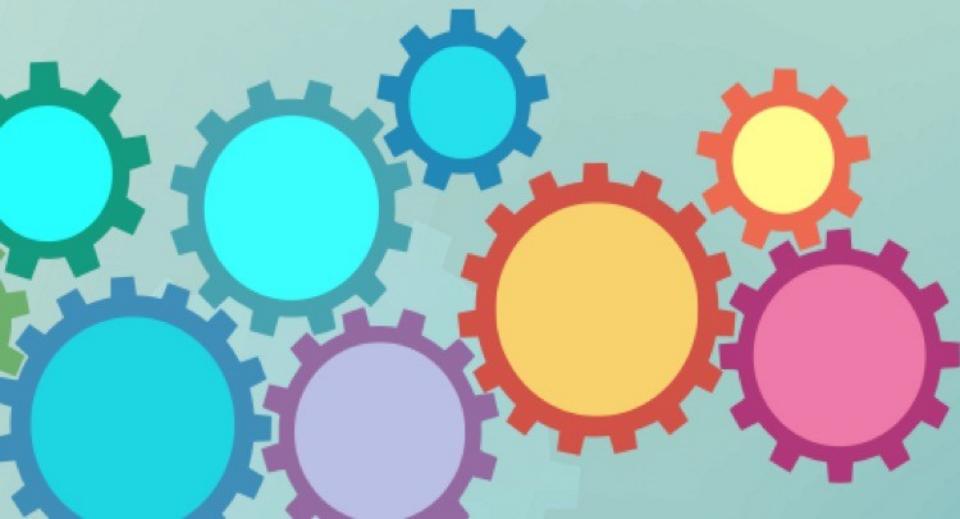
1. The less clutter on the screen, the better.
2. Procedures should match those being taught in school.
3. Choose modifiable software. Software should allow for customized speed, number of problems and instructional levels.
4. Choose software with small increments between levels.

10 Tips for Software Selection for Math Instruction

5. Choose software with helpful feedback. Provide clues to the correct answer.
6. Choose software that limits the number of wrong answers for a single problem. Limit the number of attempts, give clues to the correct answer, provide the correct answer, reintroduce that same item at a later time.
7. Choose software with good record keeping capabilities.

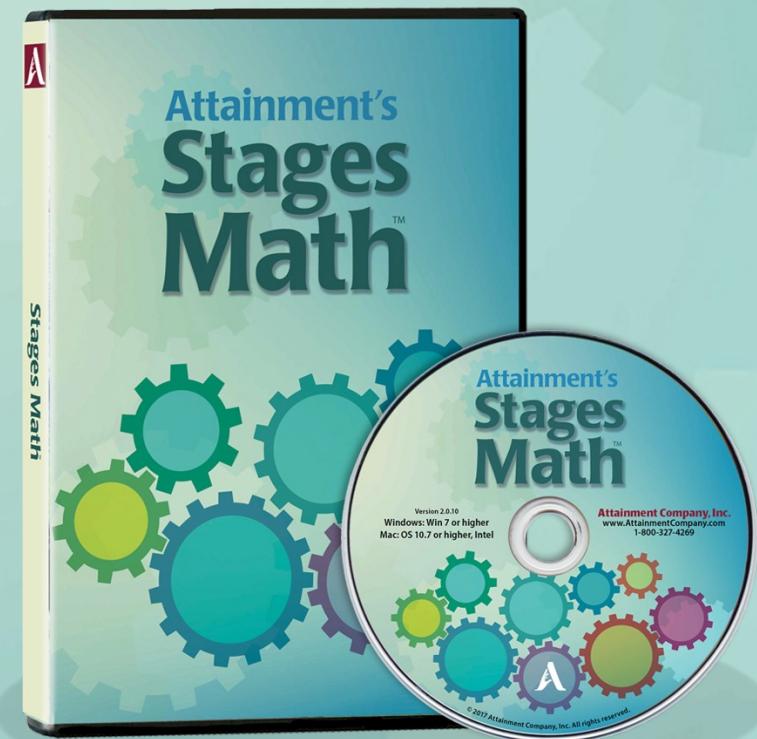
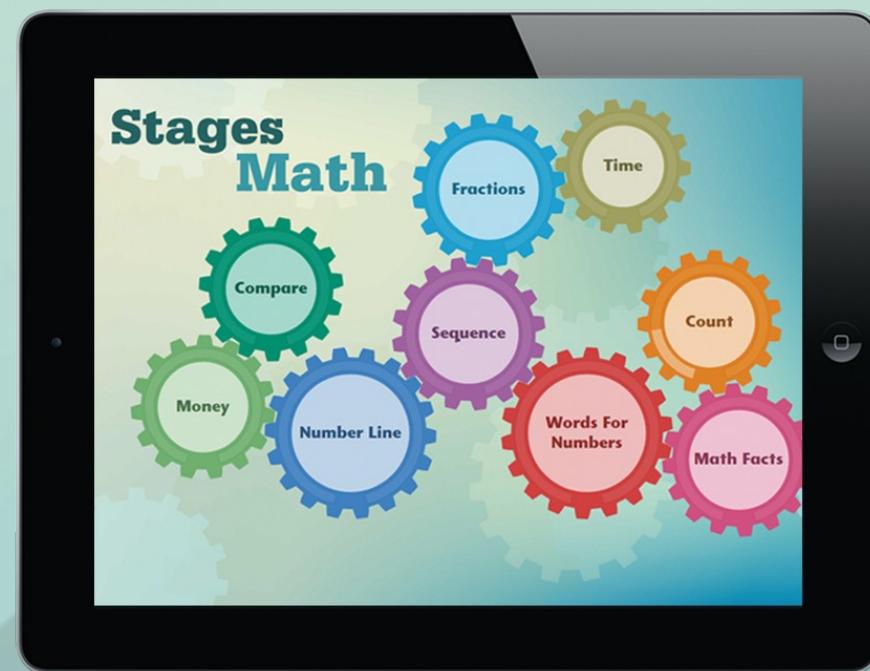
10 Tips for Software Selection for Math Instruction

8. Choose software with built in instructional aids; e.g., counters, number lines, base ten blocks, hundreds charts, or fraction strips.
9. Select software that simulates real-life solutions; e.g., multiple roads to a problem solution.
10. Remember that software is a learning tool – not the total solution!



Highlights of Stages Math: Number Sense iPad app or computer software

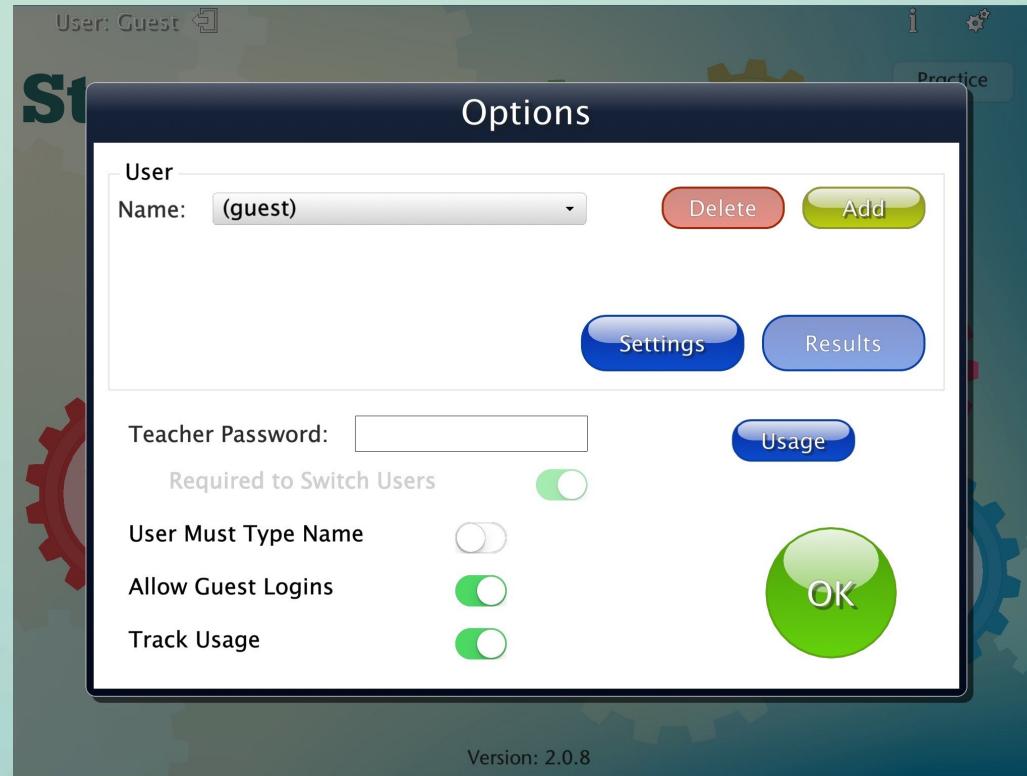
28 main activities within 9 key content areas of number sense



Highlights of Stages Math: Number Sense

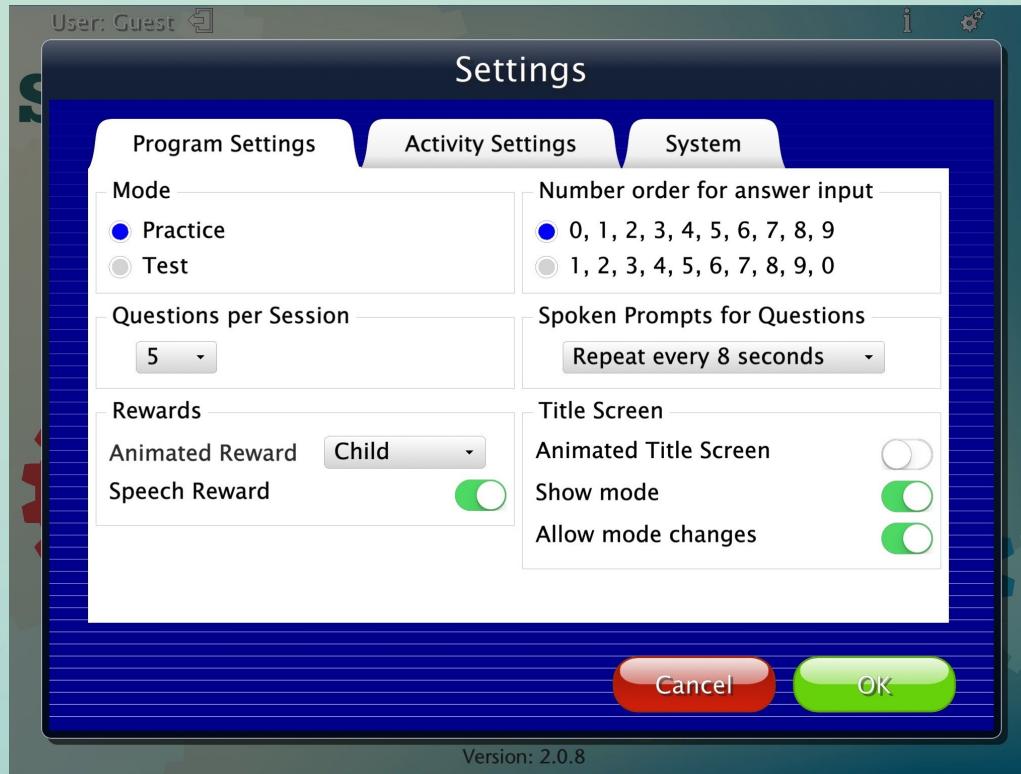
- Universal and **Accessible** design for both iPad and computer mouse, keyboard, switch, touch screen; auditory scanning, text-to-speech, pointer with dwell on computer
- **Feedback** for incorrect answers that builds learner understanding
- **Scaffolding** to support learner success
turn on or off prompting, graphical support, help buttons, etc.; talk boards for classroom inclusion
- **Adjustable** settings you can save for each learner
- **Record keeping** and certificates

Stages Math Options



Options to manage users

Stages Math Settings



General settings for mode, Rewards, Number line, Animations ...

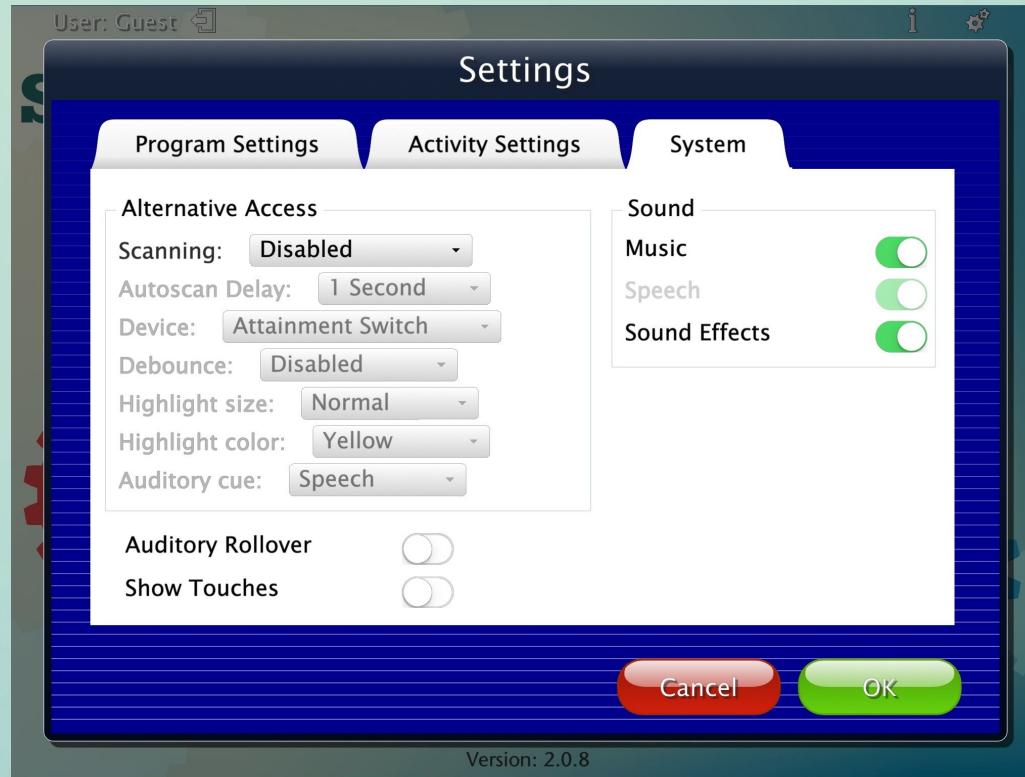
Stages Math Settings

The image displays three screenshots of the Stages Math Settings interface, version 2.0.8, illustrating the process of selecting content areas, activities, and specific skills for customization.

- Program Settings:** Shows a list of categories: Words For Numbers, Count, Compare, Sequence, Money, Time, Number Line, Math Facts, and Fractions. Each category has a checkmark and a right-pointing arrow.
- Activity Settings:** Shows a list of money activities: Count Money and Make This Amount. Both have checkmarks and right-pointing arrows.
- Make This Amount, Level 1 of 5:** A detailed dialog for the 'Make This Amount' activity. It includes:
 - Levels:** Options include Levels (Custom, Level 1, Level 2, Level 3, Level 4, Level 5), with Level 1 selected.
 - Number of Coins / Bills:** Options include 1-3, 1-6, and 1-9.
 - Include:** A list of items with checkboxes:
 - penny (checked)
 - nickel (checked)
 - dime (checked)
 - quarter (checked)
 - one dollar bill (unchecked)
 - five dollar bill (unchecked)
 - ten dollar bill (unchecked)
 - twenty dollar bill (unchecked)

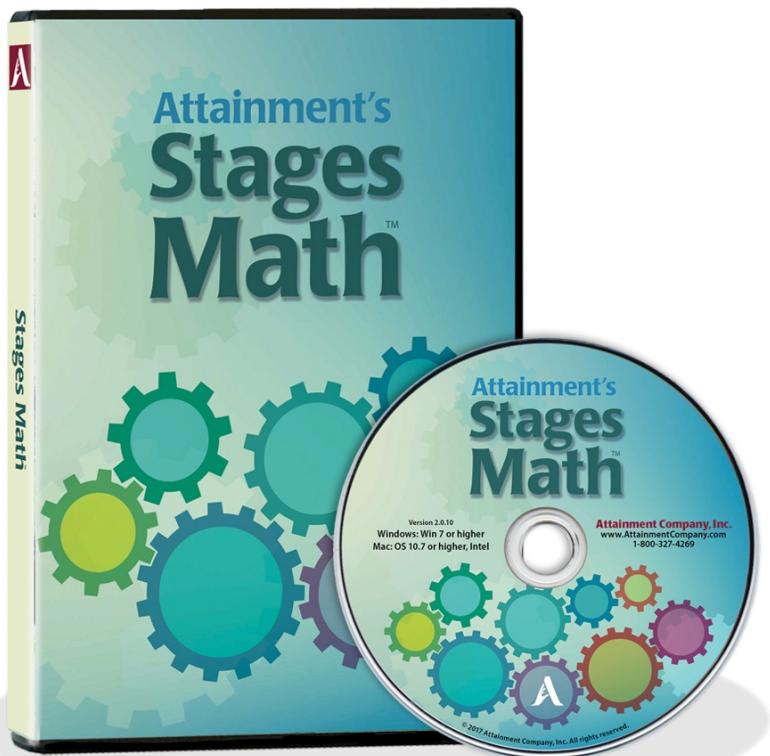
Select content area, then activity, then specific skill.
Customize for each student.

Stages Math Settings



Accessibility settings are saved separately for each student.

Let's see the software/app in action!



Case Study

Third grade Student

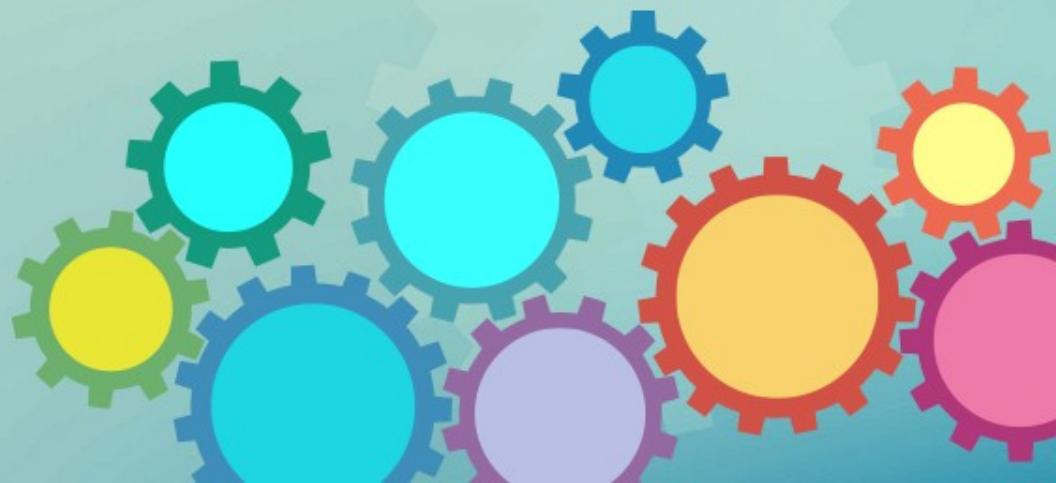
- Cognitive Disabilities
- Dependent on prompts and adults
- Significant fine motor challenges

Stages Math was recommended and implemented following an AT Assessment and school-based team meeting

Case Study

Danielle D. Special educator reflections:

- Preparation
- Implementation
- Observations
- Next Steps



"When I give Hannah (not her real name) choices, she *chooses* to use Stages Math!"

"It has given me data that guides my instruction. I can see she needs to better understand Math symbols and Math language."

"I need to use it for all my students!"

Mia - "I love that app! It's very fun! It's just the right level for me! I think I want to play this every time I get to do math games!"



Results

Name: [REDACTED]

Problems: 8

Ave Time: 13s

Stages Math

Math Facts - Practice

Score: 70%

Date: 10/6/2017

Time: 10:27 AM

Question 1 of 10

Activity: Add, Level 2 of 9 (Level Progress: 30%)

$0 + 0 = ?$

0

3.3 seconds

Question 2 of 10

Activity: Subtract, Level 2 of 9 (Level Progress: 50%)

$3 - 0 = ?$

3

5.1 seconds

Question 3 of 10

Activity: Subtract, Level 2 of 9 (Level Progress: 60%)

$10 - 3 = ?$

7

11 seconds

Question 4 of 10

Activity: Add, Level 2 of 9 (Level Progress: 40%)

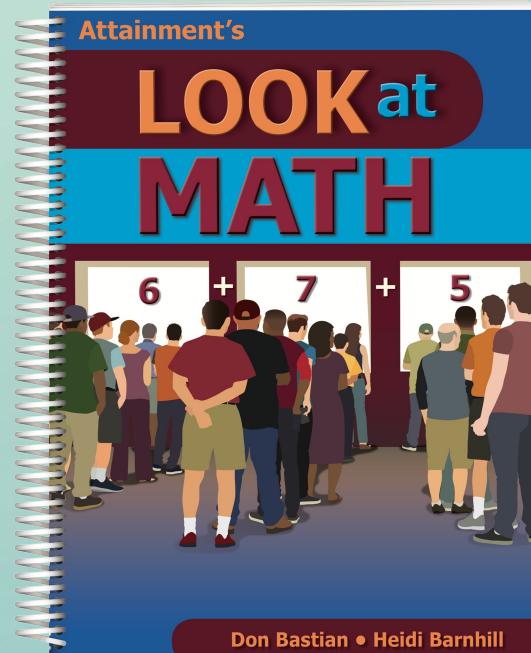
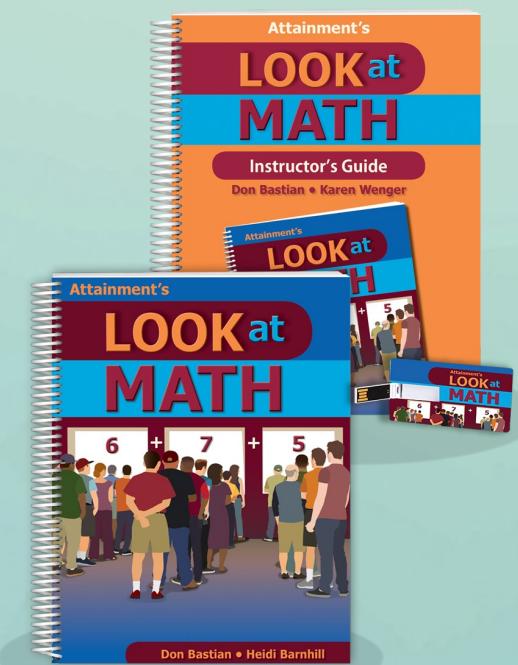
$1 + 7 = ?$

8

11.7 seconds

Highlights of Stages Math Intervention Kit

Look at Math Introductory Kit covers a wide range of concepts with a 120-lesson Instructor's Guide, a heavily illustrated Student Book, and a PDF for printouts.



Highlights of Stages Math Intervention Kit

Place Value Packaging is a hands-on activity, requiring students to use number pegs to solve place value and addition problems.



Explore YouTube...

Lots of expert/teacher/parent made exploration activities.

Place Value Introduction

Number Rock Place Value Song

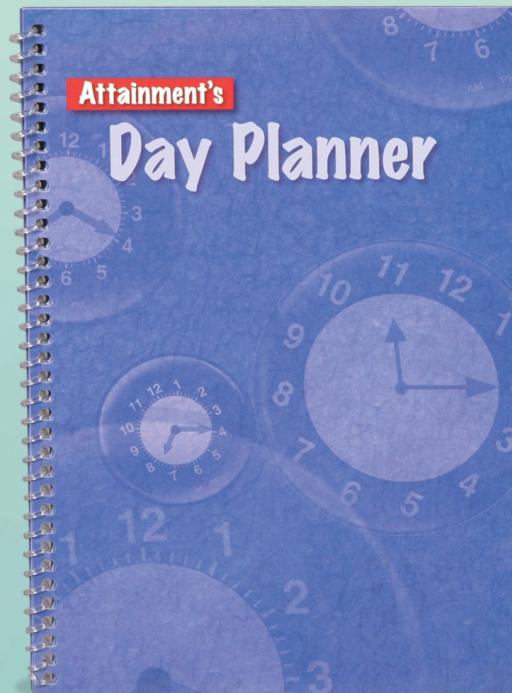
Highlights of Stages Math Intervention Kit

Talking Calculator gives students auditory feedback when solving computations.



Highlights of Stages Math Intervention Kit

Six laminated Day Planner Books simplify daytime schedules.



Highlights of Stages Math Intervention Kit



Hands-On Money provides an organized collection of realistic bills and coins and 3 coin cubes.

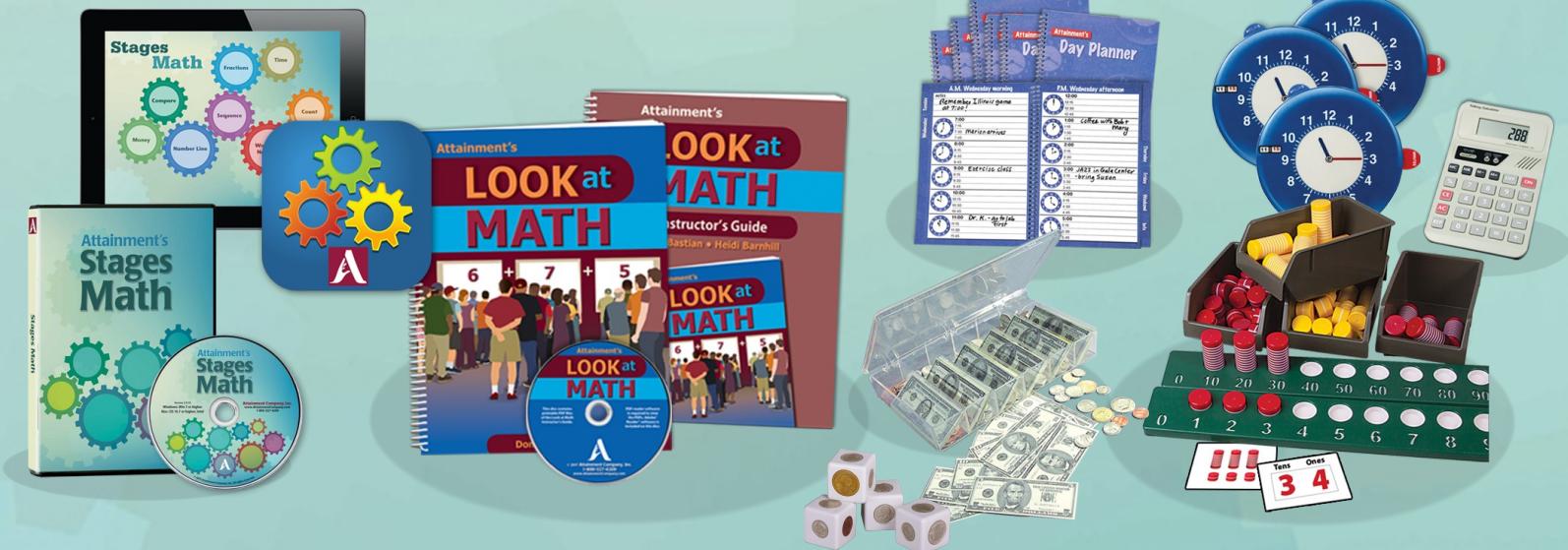
Highlights of Stages Math Intervention Kit

TimeWheel™ a realistic clock
to help learn to tell time

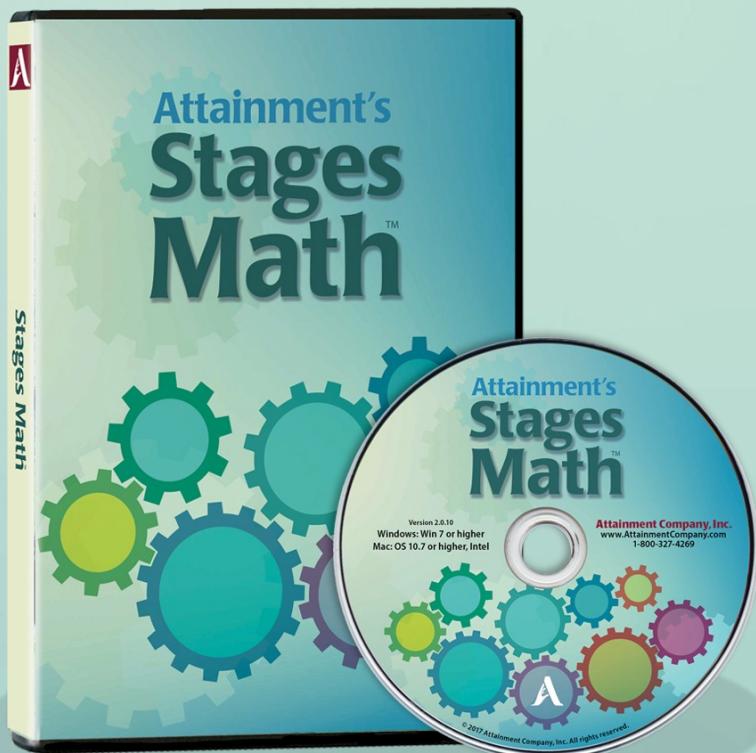


Stages Math Intervention Kit = multisensory access to math

- **Universal Design** – multiple means of representation, engagement and expression
- **Differentiate Instruction** – variety of scaffolds
- **Multisensory** – manipulative materials
- **Access** –content accessible through digital interactions



Thanks for coming!



Research References

“A Letter to My Math Teacher”, compiled by Renée M. Newman

<http://www.dyscalculia.org/teacher.html>

“Learning Disabilities in Mathematics”, by C. Christina Wright

<http://www.ldonline.org/article/5947>

“Mathematical Disabilities: What We Know and Don't Know”, by David C. Geary,

<http://www.ldonline.org/article/5881>

“Math Intervention: What Strategies Work for Struggling Learners” articles collected by Education Northwest

<http://educationnorthwest.org/resources/mathematics-interventions-what-strategies-work-struggling-learners-or-students-learning>

“Number Sense: Rethinking Arithmetic Instruction for Students with Mathematical Disabilities”, by Russell Gersten and David J. Chard

<http://www.ldonline.org/article/5838>

“Strategies for Teaching Math: What are the Facts?” by Carol H. Geller

http://www.ldworldwide.org/pdf/journal/2000/11-00_arithmetic.pdf

“Technology-Supported Math Instruction for Students with Disabilities”

by Hasselbring, Lott, and Zydny

http://209.61.229.180/library/resourcedocs/Tech-SupportedMathInstruction-FinalPaper_early.pdf

<http://www.citeducation.org/mathmatrix/>

“10 Tips for Software Selection for Math Instruction”, by Beatrice C. Babbitt <http://www.ldonline.org/article/6243>

URLs Demonstrated

Videos

“Three Ways to Use Appropriate Tools Strategically” blog by Jeff Sadlier

- <https://www.sadlier.com/school/sadlier-math-blog/three-ways-to-use-appropriate-tools-strategically-math-practice-5>

“Place Value Introduction”

- <https://www.youtube.com/watch?v=fshyCNqHlbw>

“Number Rock Place Value Song”

- <https://www.youtube.com/watch?v=a4FXl4zb3E4>

“Learning to Count to 10 Using 10 Blocks Number Line”

- https://www.youtube.com/watch?v=ji-jsPbovv0&index=5&list=PLm4gYQg22haYidp4sISJMX_h4xC7gXKQ_

“Learning to Count to 20 with Place Value Hands On Money”

- https://www.youtube.com/watch?v=45yeM-At9F4&index=4&list=PLm4gYQg22haYidp4sISJMX_h4xC7gXKQ_

Sources of Home Made Manipulatives

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Printable instructions for making and using manipulatives

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