

# What... I Can't Use a Calculator?

Presented by:

Becky Unker, Education Specialist

Utah State Office of Education

“Can you do addition?” the White Queen asked. “What’s one and one?”

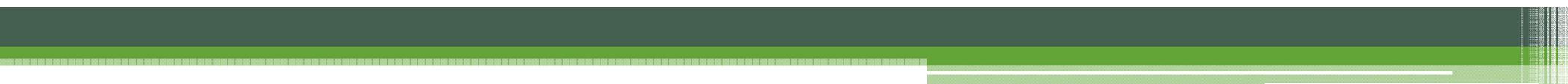
“I don’t know,” said Alice. “I lost count”.

-Lewis Carroll  
Through the Looking Glass



## Calculator and SAGE Assessment Decision:

- In order to better measure a student's actual proficiency as it relates to the Utah Core Standards, the determination has been made that calculators will not be permitted on certain parts of the grades 3-6 SAGE Mathematics Assessment.
- This decision was made by the math content and special education experts at the Utah State Office of Education, additional content experts and teachers currently working in the public schools.
- The decision was made based on the Utah Core Standards and how students should be instructed on and learn the core curriculum .

- 
- The assessment items match the expectations outlined by the core curriculum.
  - If a test item is measuring a student's ability to fluently multiply or divide numbers and the students are allowed the use of a calculator, the construct of the test item has been violated.
  - If a student is allowed to use a calculation device on those portions of the assessment where the device is not allowed, it would invalidate the assessment and the test would be counted as a "modified assessment". A modified assessment receives a proficiency level of 1.

- 
- This decision does not, and should not, deter teachers from using calculation devices during instruction, if using them would help the students become more confident in solving those problems.
  - Students who have an IEP or 504 plan can use “visual representations” (e.g., manipulatives) throughout the mathematics assessments as long as it is written into their IEP or 504 plan.
  - This strategy should also be used during instruction so the students can become familiar with how to use those manipulatives during the summative assessment.

## The Research:

- The research focuses on evidence-based practices for teaching students with difficulties in mathematics.
- Most of the summary of the research is based on two recently conducted meta-analysis (Baker, Gersten, and Lee 2002; Gersten et al. 2006), as well as complementary work by Kroesbergen and van Luit (2003).

## Effect Sizes for Instructional Variables for Students with Disabilities and Other Low-Achieving Students:

Instructional Strategy	Effect Size for SWD	Effect Size for Low-Achieving Students
Visual and graphic depictions of problems	0.50 Moderate	NA
Systematic and explicit instruction	1.19 Large	0.58 Moderate to Large
Student think-alouds	0.98 Large	NA
Use of structured peer-assisted learning activities involving heterogeneous ability groupings	0.42 Moderate	0.62 Large
Formative assessment data provided to teachers	0.32 Small to Moderate	0.51 Moderate
Formative assessment data provided directly to students	0.33 Small to Moderate	0.57 Moderate to Large

# Visual and Graphic Depictions of Problems

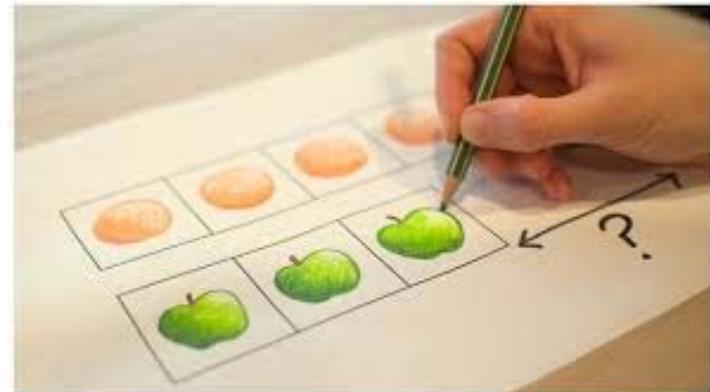
- Graphic representations of mathematical concepts are crucial of programs used in nations that perform well on international comparisons, such as Singapore, Korea, or the Netherlands.
- An interesting finding for the use of graphics and visual organizers was that *the specificity of the visual representation determined the effectiveness of the intervention.*
- When teachers presented graphic depictions of problem-solving sets with multiple examples and had students practice using their own graphic organizers with specific guidance by the teacher on which visuals to select and why, the effects were much larger than when students did not have this practice or guidance.

# Middle School & High School

- Two recent studies of middle and high school students learning algebra and fractions add another dimension to the use of visuals with this population.
- The researchers in these studies developed an approach they call: *concrete-representational-abstract* to teach successfully concepts and operations involving fractions (Butler et al. 2003) and basic algebra (Witzel, Mercer, and Miller 2003).
- Note that the manipulatives are not used to skirt the teaching of the abstraction necessary to understand mathematics. Rather, they are used for a day or two so that students really understand the visual organizers and representations.
- The benefit of this approach may be that its intensity and concreteness help students maintain a framework in their working memory for solving problems of this type.

# Model Drawing:

- Model Drawing is just what the name implies: drawing simple visual models to represent word problems.
- The drawings help students to see—literally—what word problems are all about.
- This is pretty amazing stuff.
- And it really works!



## Let's Do Some Math!

- “At lunch recess Karen passed out 3 times as many cookies as Vito did. If Vito passed out 35 cookies, how many cookies did they pass out altogether?”



## Information that we know:



The question: How many cookies did they pass out altogether?

Karen's Cookies



Vito's Cookies



?

This symbol means altogether

Karen's Cookies



Vito's Cookies



$$4 \times 35 = 140$$

OR

$$35 + 35 = 70$$

$$70 \times 2 = 140$$

OR

$$35 + 35 + 35 + 35 = 140$$

Karen and Vito passed out 140 cookies altogether during lunch recess.

## Paper Folding:

- Use paper-folding to find the product of two fractions.

- $\frac{2}{3} \times \frac{1}{2}$

- **THINK:  $\frac{2}{3}$  OF  $\frac{1}{2}$**



## Step 1:

- Since we are looking for a fraction of ***one half***, we need to begin with  $\frac{1}{2}$ .  
Fold a full sheet of paper in half.

## Step 2:

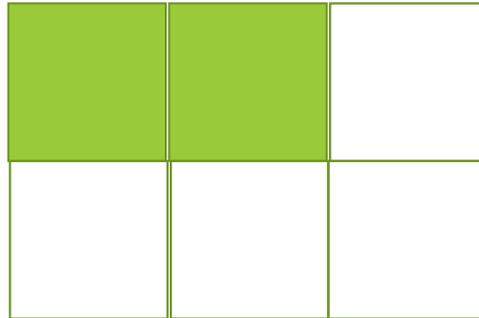
- We need to find ***two thirds*** of  $\frac{1}{2}$ , so fold the folded sheet from Step 1 into ***thirds***. Keep the paper folded.

## Step 3:

- Since only one third is showing, unfold the paper to show two of the three parts you folded in Step 2.
- Shade those two parts. Be sure to shade just on surface of the paper.

## Step 4:

- Unfold the entire paper.
- Two of the six equal parts of the whole are shaded.
- So,  $2/3 \times 1/2 = \frac{\square}{6}$ .



# Systematic and Explicit Instruction

- Consistently strong effects were found for systematic, explicit instruction.
- The studies conducted define explicit instruction as instruction that involves a teacher demonstrating a specific plan (strategy) for solving the problem types and students using this plan to think their way through a solution.
- In most studies, the emphasis was placed on providing highly explicit models of steps and procedures or questions to ask in solving problems.
- The majority of these studies dealt with procedural knowledge.
- The mean effect of these studies was large for students with disabilities.

## Student Think-Alouds

- Studies showed that when faced with multistep problems, students frequently attempted to solve problems by randomly combining numbers instead of implementing a solution strategy step-by-step.
- The process of encouraging students to verbalize their thinking—by talking, writing, or drawing the steps they used in solving a problem—was consistently effective.
- Results of these studies were quite impressive, with an average effect size of 0.98.
- The verbalization appeared to help anchor the students both behaviorally and mathematically.

## Research Conclusion

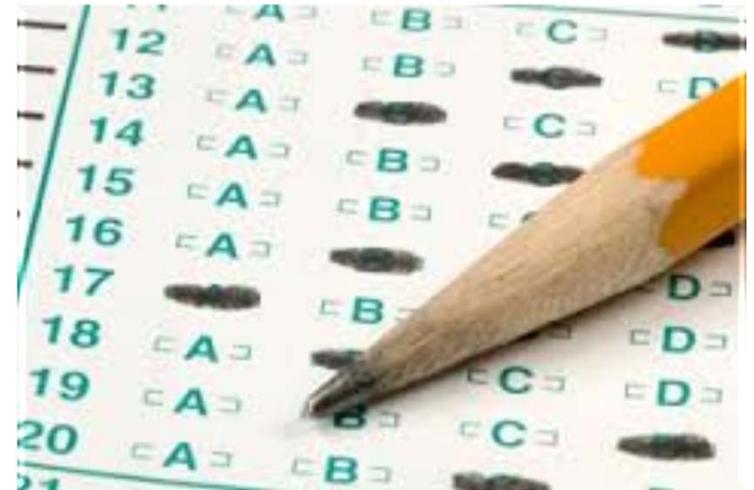
- In summary, the body of instructional research suggests several important teaching practices for students with disabilities.
- **Explicit, Systematic Instruction** that involves extensive use of visual representations is crucial.
- In many situations with students with disabilities, it is often advantageous for students to be encouraged to think aloud while they work, perhaps by sharing their thinking with a peer.
- These approaches also seem to inhibit those students who try too quickly to solve problems without devoting adequate attention to thinking about what mathematical concepts and principles are required for the solution.

# Mathematical Practice Standards:

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

## Utah's Math Data for Students with Disabilities

- Proficiency rate of Grades 3-8: 47.11%
- Proficiency rate of Grade 10: 22.96%



## Table Discussion:

- Why is there such a drop between grades 3-8 and 10<sup>th</sup> ? What technical assistance is needed for your LEA and the State to address this?
- At your table discuss what you think has caused the drop in scores between grades 3-8 and 10.
- Be ready to share your thoughts....



## Something to Ponder:

- *“I know that many kids get to middle school without knowing procedures for fraction computation. If we show them what to do, they can get the right answer. But this doesn’t mean that they learned it. My goal isn’t to get them to be able to get the right answer for twenty problems. My goal is for them to learn mathematics.”*

*-Kathy Oker*

*sixth to eighth-grade teacher*

*Wingra School; Madison, Wisconsin*

( excerpt taken from: *Extending Children’s Mathematics Fraction and Decimals*; Empson & Levi; 2011 pg. 188)