

A Balanced Approach to Making **Fact Fluency** Instruction & Assessment Meaningful

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<http://bit.ly/FactFluencyNCTM2019>

SALLY FORTH by Greg Howard

HILARY'S ^{FACT FLUENCY} TEST IS TODAY, TED. CAN YOU GIVE HER ONE LAST RUN-THROUGH?

SURE.

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READY?
8 x 4

THAT'S NOT THE FIRST FACT, DAD. HOW CAN I SOLVE THEM IF YOU JUMBLE THEM UP?

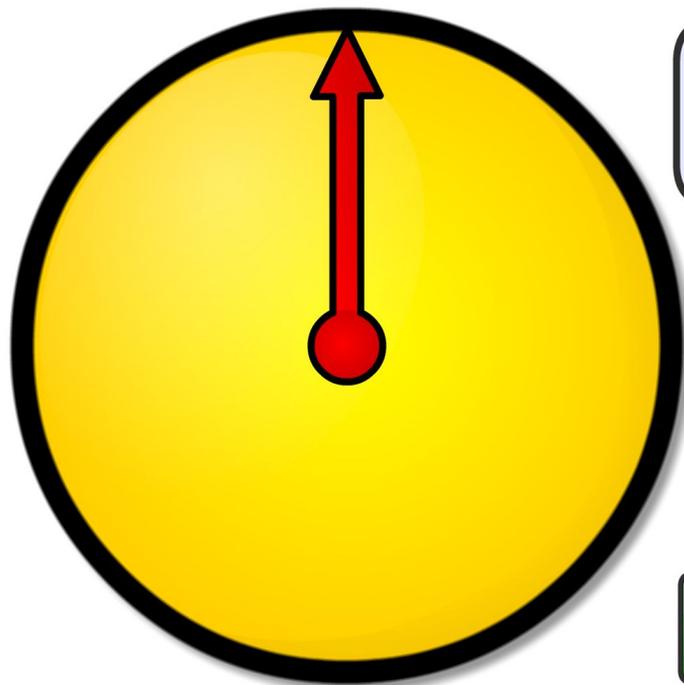


Goals

- To improve student mastery of fact fluency
- To create a meaningful approach to assessing fact fluency that will drive instruction



Test Time!



00:00:30
000

Start

Clear

Johnny's Mad Minute Fluency Assessment

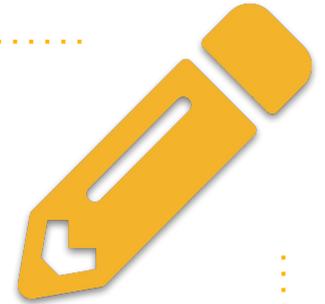
What does this assessment tell you about Johnny?

WEB MATH MINUTE ADDITION & SUBTRACTION FLUENCY

NAME: _____
SCORE: _____

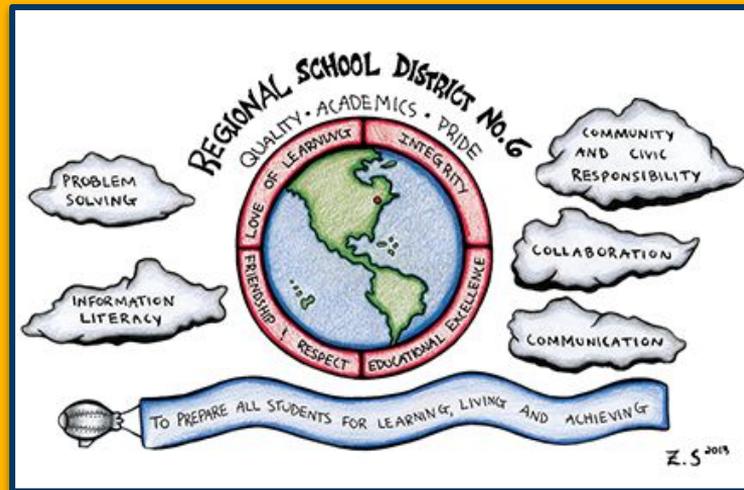
$\begin{array}{r} 3 \\ + 6 \\ \hline 9 \end{array}$	$\begin{array}{r} 3 \\ + 5 \\ \hline 8 \end{array}$	$\begin{array}{r} 8 \\ + 3 \\ \hline 11 \end{array}$	$\begin{array}{r} 6 \\ - 4 \\ \hline 2 \end{array}$	$\begin{array}{r} 10 \\ + 10 \\ \hline 20 \end{array}$	$\begin{array}{r} 10 \\ - 4 \\ \hline 6 \end{array}$	$\begin{array}{r} 6 \\ - 4 \\ \hline 2 \end{array}$	$\begin{array}{r} 3 \\ + 0 \\ \hline 3 \end{array}$	$\begin{array}{r} 7 \\ - 2 \\ \hline 5 \end{array}$	$\begin{array}{r} 9 \\ - 2 \\ \hline 7 \end{array}$
$\begin{array}{r} 8 \\ + 4 \\ \hline 12 \end{array}$	$\begin{array}{r} 5 \\ + 8 \\ \hline 13 \end{array}$	$\begin{array}{r} 10 \\ - 1 \\ \hline 9 \end{array}$	$\begin{array}{r} 7 \\ - 1 \\ \hline 6 \end{array}$	$\begin{array}{r} 3 \\ - 1 \\ \hline 4 \end{array}$	$\begin{array}{r} 1 \\ + 7 \\ \hline 8 \end{array}$	$\begin{array}{r} 6 \\ + 5 \\ \hline 11 \end{array}$	$\begin{array}{r} 3 \\ - 1 \\ \hline 2 \end{array}$	$\begin{array}{r} 9 \\ + 6 \\ \hline 3 \end{array}$	$\begin{array}{r} 5 \\ - 0 \\ \hline 5 \end{array}$
$\begin{array}{r} 9 \\ + 6 \\ \hline 15 \end{array}$	$\begin{array}{r} 8 \\ + 2 \\ \hline \end{array}$	$\begin{array}{r} 1 \\ + 6 \\ \hline \end{array}$	$\begin{array}{r} 10 \\ + 2 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ + 9 \\ \hline \end{array}$	$\begin{array}{r} 10 \\ - 5 \\ \hline \end{array}$	$\begin{array}{r} 10 \\ + 7 \\ \hline 17 \end{array}$	$\begin{array}{r} 5 \\ + 2 \\ \hline 3 \end{array}$	$\begin{array}{r} 0 \\ + 6 \\ \hline 6 \end{array}$	$\begin{array}{r} 9 \\ - 3 \\ \hline 12 \end{array}$
$\begin{array}{r} 4 \\ + 4 \\ \hline 8 \end{array}$	$\begin{array}{r} 1 \\ - 1 \\ \hline 2 \end{array}$	$\begin{array}{r} 6 \\ + 1 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ - 4 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ + 6 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ + 5 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ + 6 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ + 3 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ + 9 \\ \hline \end{array}$	$\begin{array}{r} 10 \\ + 7 \\ \hline \end{array}$
$\begin{array}{r} 5 \\ - 5 \\ \hline 10 \end{array}$	$\begin{array}{r} 3 \\ + 8 \\ \hline 11 \end{array}$	$\begin{array}{r} 7 \\ + 7 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ - 5 \\ \hline \end{array}$	$\begin{array}{r} 10 \\ - 2 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ + 0 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ - 1 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ - 1 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ - 5 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ + 2 \\ \hline \end{array}$

Reflection...



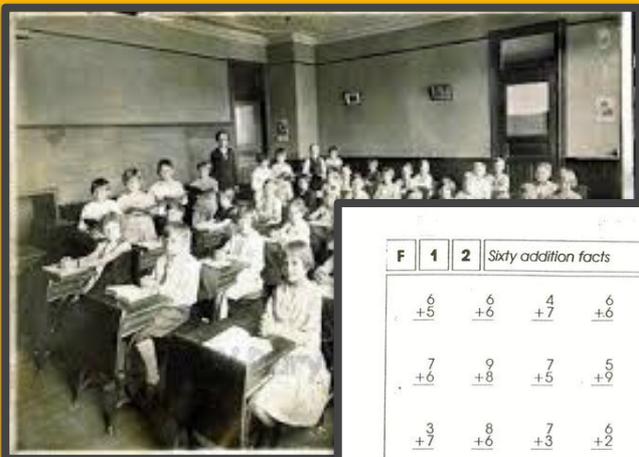
- “This test made me feel....”
- What did you learn about your students?
 - What do your students know?
 - What don't your students know?
- Based on student performance, what are your next steps instructionally?

Regional School District #6

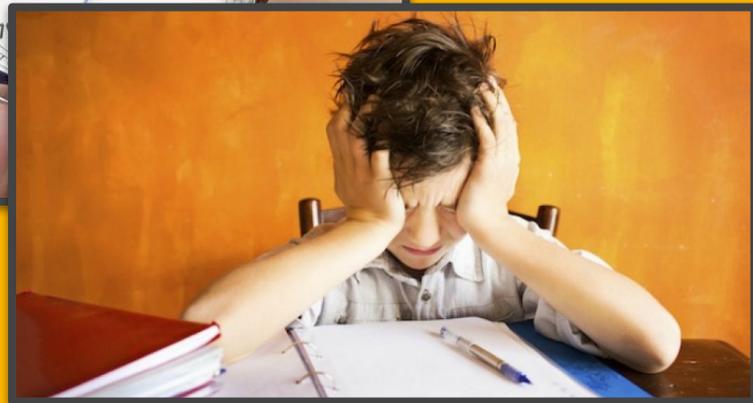


Warren	Morris	Goshen
<ul style="list-style-type: none"> ● K-6 Enrollment: 69 ● Pre-K: 9 ● Multiage Classrooms (PreK/K, 1/2, 3/4, 5/6) 	<ul style="list-style-type: none"> ● K-6 Enrollment: 107 ● Pre-K: 21 ● Single Grade Classrooms (one of each grade level) 	<ul style="list-style-type: none"> ● K-6 Enrollment: 174 ● Pre-K: 28 ● Single Grade Classrooms (two of grade K, 1, 6; one of grade 2, 3, 5)

The Way it Was...



F	1	2	Sixty addition facts																																													
	$\begin{array}{r} 6 \\ +5 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +5 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +4 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +5 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ +5 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 2 \\ +2 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +0 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +4 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +1 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +4 \\ \hline \end{array}$



Creating the Vision

- Create a sense of urgency
- Develop a fluency team
- Research, research, research
- Dialogue > agree to disagree
- Meet on common ground > create a district-wide fluency mission statement
- Create common assessments



- If you've memorized basic facts, have you learned them? Why or why not?
- Do we all agree on what fact fluency is?
- What needs to change?
- How do we change it for the better?





Could you use a pencil any way to figure it out?

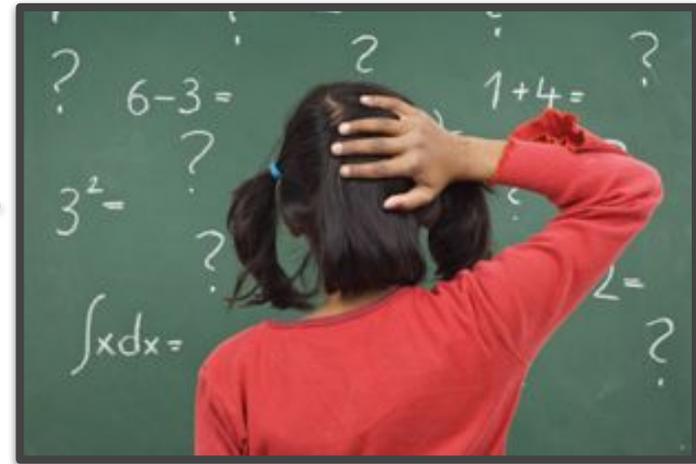
Fluency of Basic Facts

Efficient, appropriate, and flexible application of calculation skills and is an essential aspect of mathematical proficiency (Baroody, 2006).

Fluently means noticing relationships and using strategies.

Fluency is “skill in carrying out procedures flexibly, accurately, efficiently, and appropriately” (CCSSI 2010, p.6).

From memory **does not mean** “memorized”.



What is *Flexibility*, *Efficiency*, & *Accuracy*?

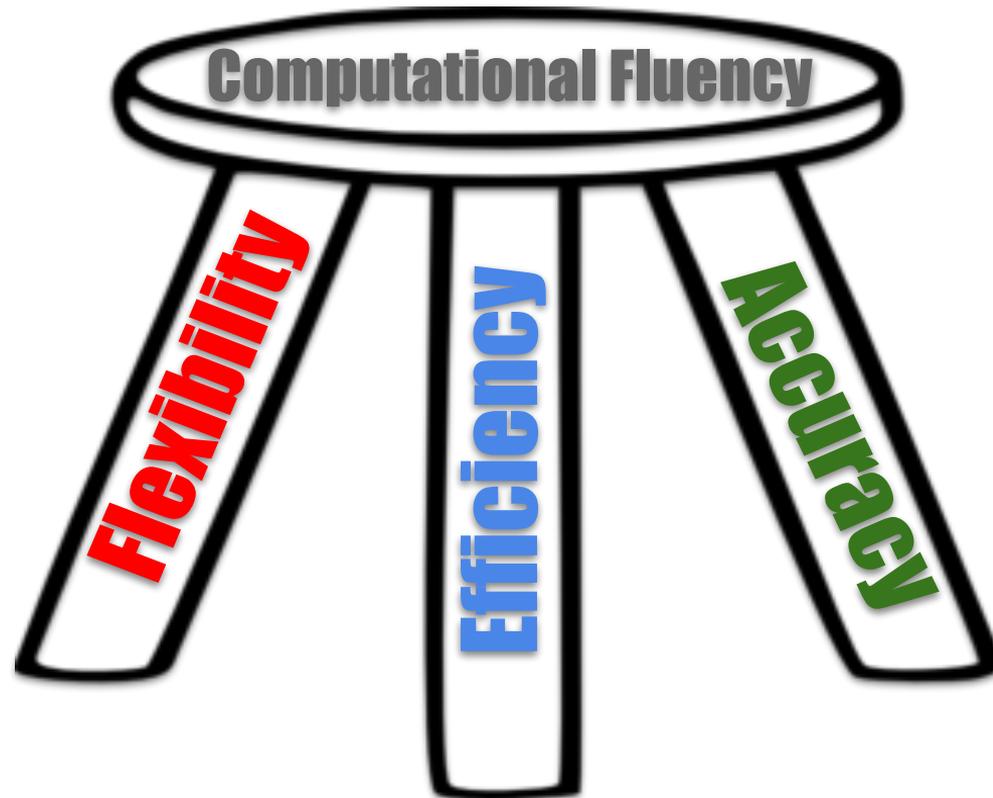
Flexibility means the ability to use number relationships with ease in computation.

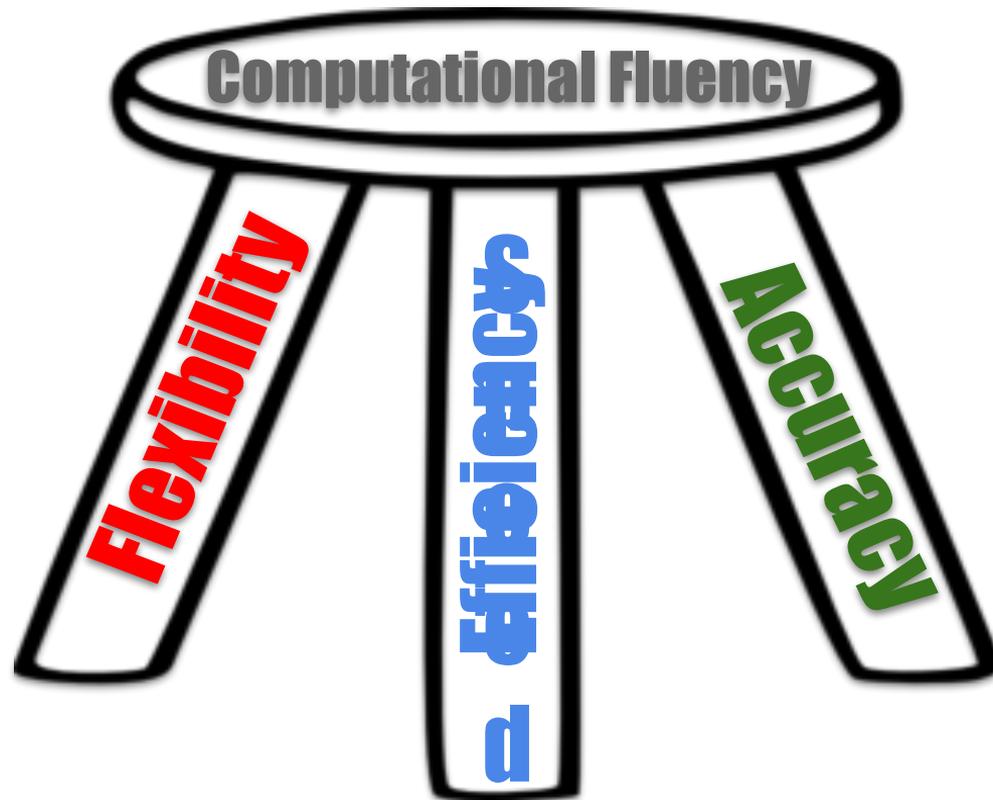
Efficiency refers to the ability to choose an appropriate, expedient strategy for a specific computation problem.

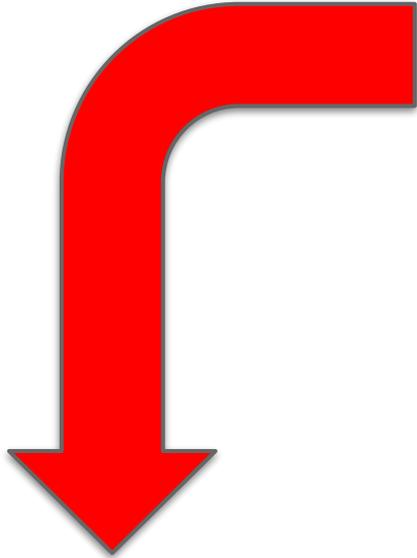
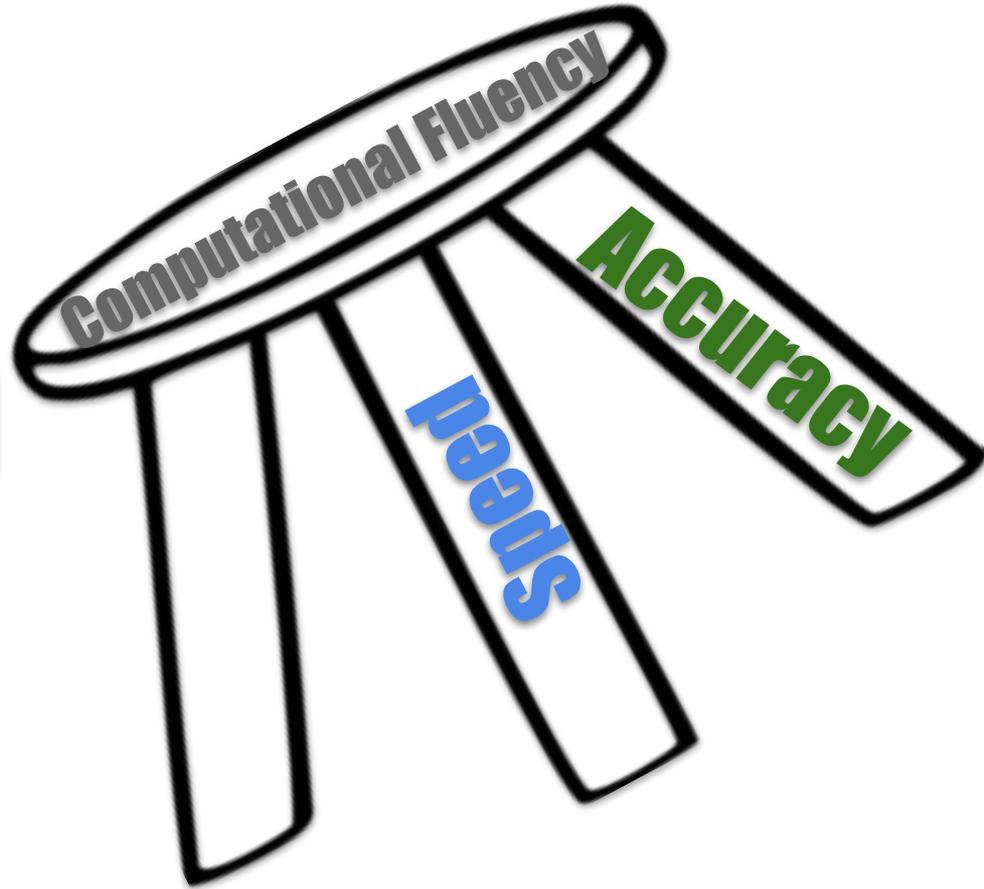
Accuracy denotes the ability to produce a correct answer.

(Parish, 2010)

Components of Fact Fluency



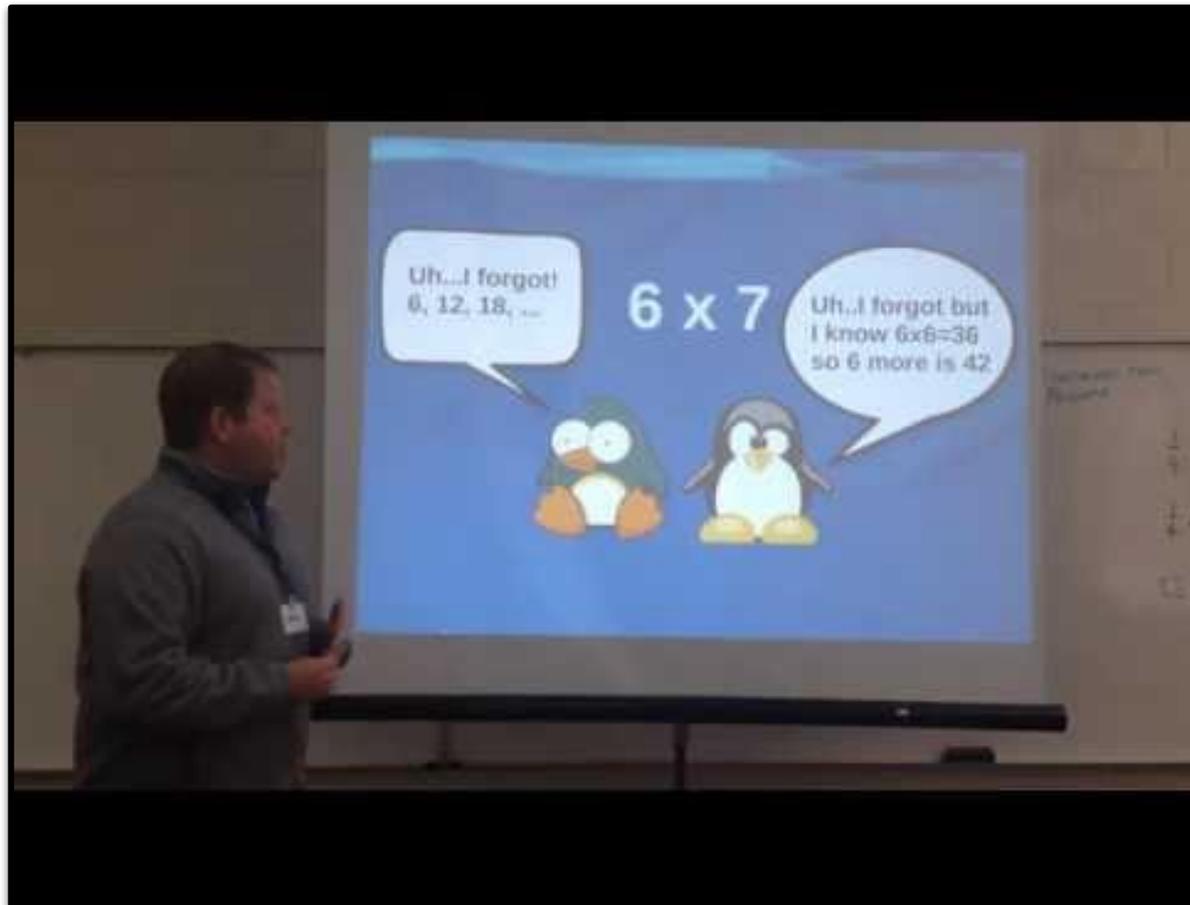




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 @MooreIntoMath



Fluency Mission Statement

The teachers of Region 6 believe that all students can develop single and multi-digit computational fluency (+, -, x, ÷ of whole number, fractions and decimals) through mathematics instruction that balances and connects ***conceptual understanding and procedural fluency*** .

To achieve computational fluency, students must integrate:

- The meaning of operations and their relationships to each other;
- Number relationships; and
- The Base-Ten Number system. (Russell, 2000, p. 154-155)

Computational fluency demands more of students than memorizing a single procedure or basic facts. It is the ability to solve single-digit and multi-digit computation with *flexibility, efficiency* and *accuracy*.

- ***Flexibility*** means the ability to use number relationships with ease in computation.
- ***Efficiency*** refers to the ability to choose an appropriate, expedient strategy for a specific computation problem.
- ***Accuracy*** denotes the ability to produce a correct answer. (Parish, 2010, p. 5)

Computationally fluent students can compute using a variety of tools including manipulatives, representations, mental math, paper and pencil, calculators or other technology, and can wisely and comfortably choose which strategy is appropriate for a given situation. Regardless of the particular method used, students should be able to explain their method.



Fluency Mission Statement cont.

Instant Recall of Basic Facts

The teachers of Region 6 believes that instant recall of basic facts, as a component of computational fluency, can be helpful as this allows students to solve complex mathematical tasks more efficiently in later grades.

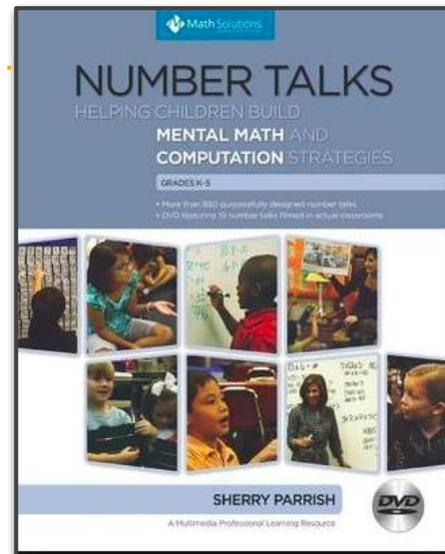
Committing facts to memory is a *process* where students begin by refining and extending their natural strategies for solving simpler problems. Embracing multiple strategies promotes deep understanding, which then connects to fact knowledge. This helps students develop methods for mental and multi-digit computation. Gradually students master more and more efficient strategies and commit more facts to memory. (Isaacs & Carroll, 1999, p 509)

By developing students' deep conceptual understanding through flexible strategies (procedural fluency) for addition, subtraction, multiplication and division, they will be able to figure out a solution. If a student rotely memorizes his or her facts without these opportunities, he or she will have no way of figuring out a solution if the fact is forgotten or unknown. In essence, the students will spend more time trying to retrieve the fact, rather than applying a known strategy to solve the fact.

Research shows that when properly instructed, the basic facts offer excellent opportunities for students to reason mathematically. (Isaacs & Carroll, 1999, p 509)

What Changed for the Better?

- All teachers “embraced” the philosophy of the new mission statement
- Number Talks pilot
 - 3rd and 4th grade teachers as pioneers
 - Growth mindset
 - Other teachers noticed, admin noticed
- Interest in progression of learning
- Transitions - fall assessed year prior



What Remained to be Changed?

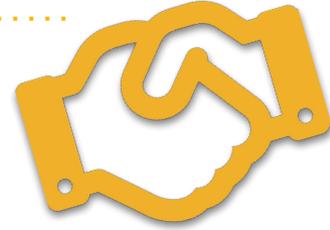


Sample Common Math Fact Fluency Scoring Rubric

(based on 45 facts in 4 minutes/5 seconds per fact)

Expectation	Number Correct	
	Addition	Subtraction
Exceeds	49-54	49-56
Meets	45-48	45-48
Near	40-44	40-44
Below	0-39	0-39

What Else Remained....

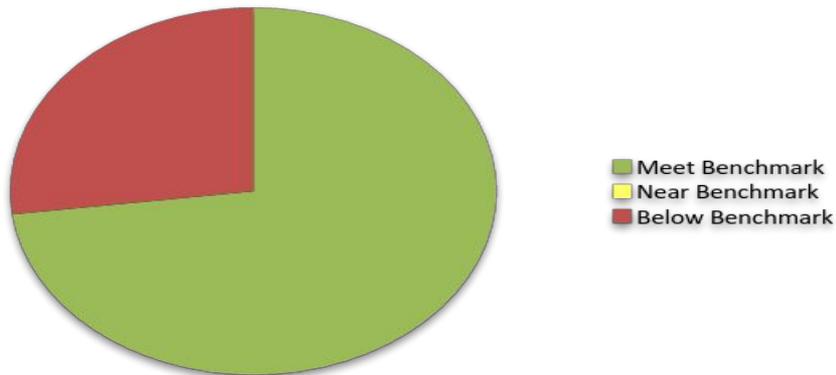


We didn't have 100% buy-in.
We didn't truly shift instruction.

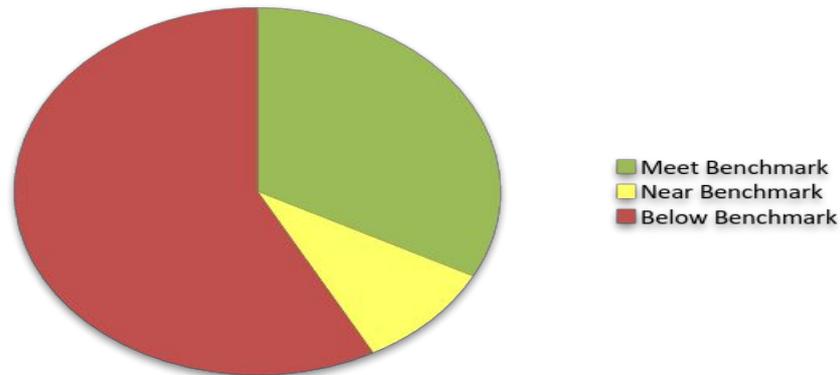


The Data-Grade 1 Results

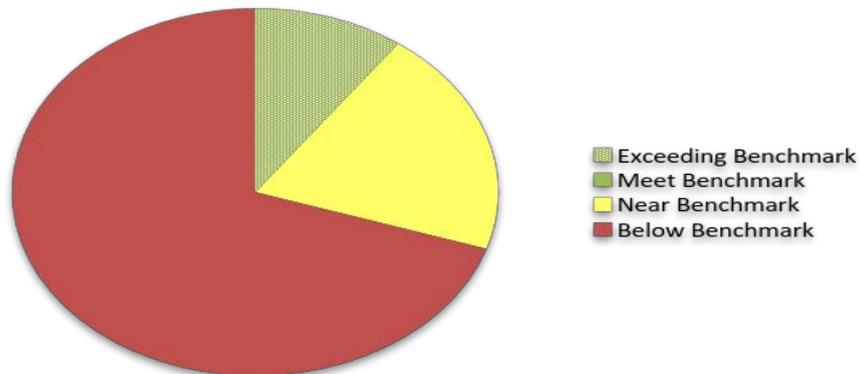
Addition to 5



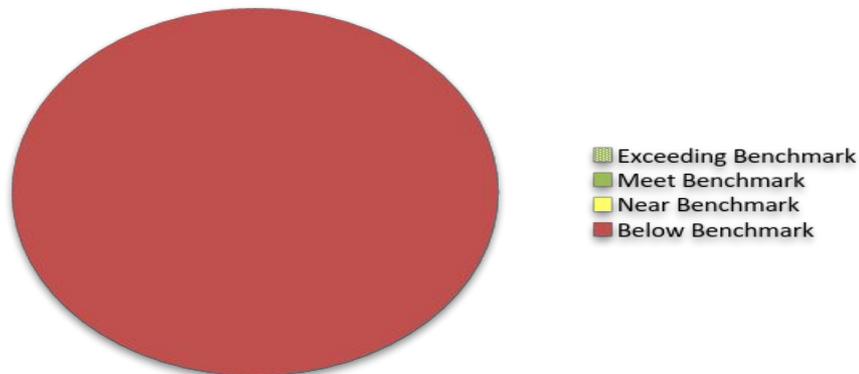
Subtraction to 5



Addition to 10

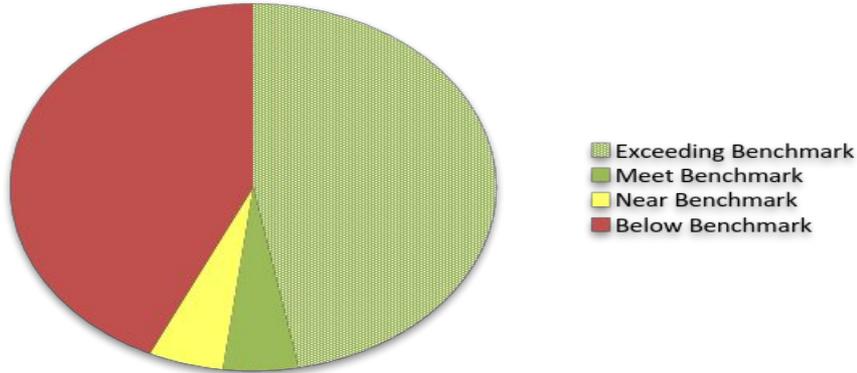


Subtraction to 10

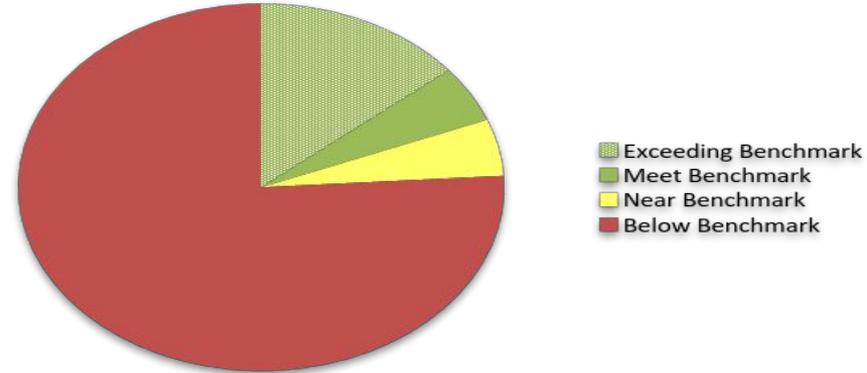


The Data-3 Grade Results

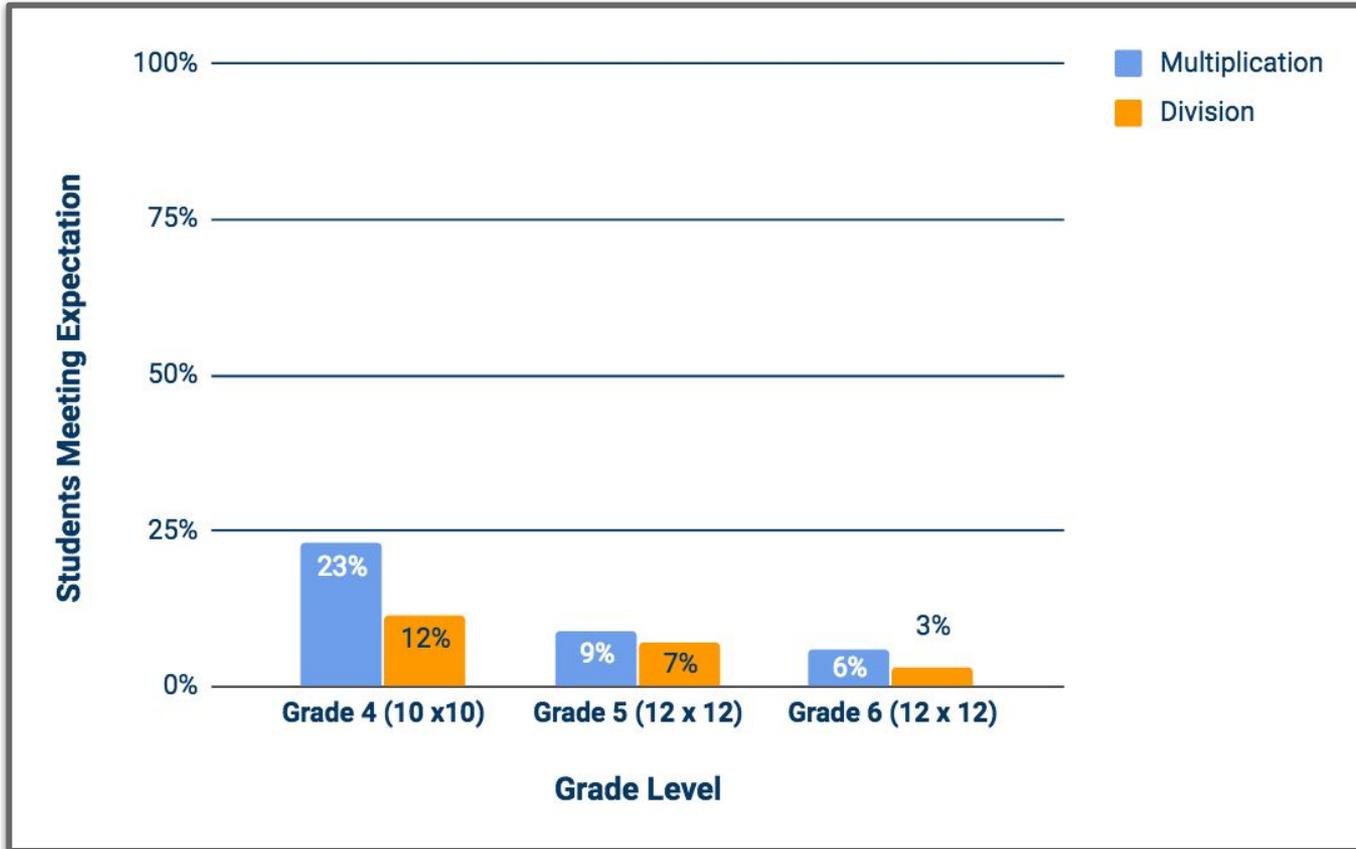
Addition to 20



Subtraction to 20



Grades 4-6 Data



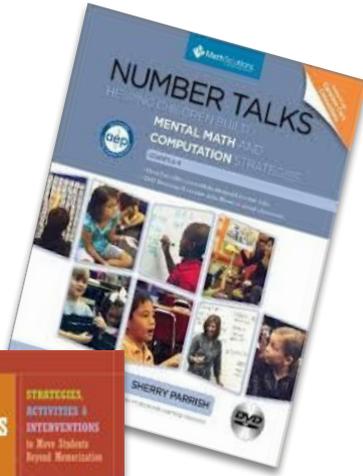
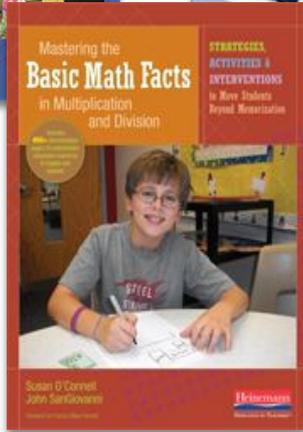
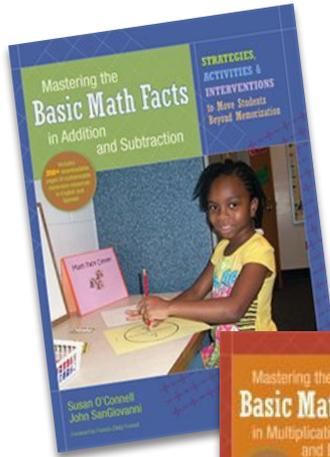
Reflection...

- What do we learn about our students from our current assessment practices?
- How does the data drive our instruction?



**How can we
“truly” show
fluency of
basic facts?**

Back to the Drawing Board...



K, Counting and
Cardinality; K-5,
Operations and Algebraic
Thinking

ACHIEVE THE CORE

teaching
children
mathematics



Phases of Basic Fact Mastery

Traditional approaches to learning facts (flashcards, drill, and timed testing) attempt to move students from **counting all** directly to mastery.

This approach is ineffective—many students do not retain what they memorized in the long term, moving to grade 4 and beyond still not knowing their facts.

Even if students remember facts, they are unlikely to be fluent as defined above, as they will not have learned to flexibly apply strategies to find the answer to a **addition and subtraction facts or more complex computation.**

(Baroody 2006)



Fluency Developmental Stages



➤ Understanding

What does $3 + 7$ mean? $7 - 3$?

➤ Modeling and/or Counting

Objects, Charts, Fingers, Drawings

➤ Mental Math Strategy

Skip Counting, Partitioning, Start with Fact

➤ Automaticity

Just knowing it.

Methods for solving single-digit addition and subtraction problems

Level
1

Direct Modeling by Counting All or Taking Away - Represent situational or numerical problem with groups of objects, a drawing, or fingers. Model the situation by composing two addend groups or decomposing a total group. Count the total or addend.

Level
2

Counting On-Embed an addend within the total (the addend is perceived simultaneously as an addend & as part of the total). Count this total but abbreviate the counting omitting the count of this addend; instead begin with the number word of this addend. Some method of keeping track (fingers objects, mentally imaged objects, body motions, other count words) is used to monitor the count.

Level
3

Convert to an Easier Problem -Decompose an addend to compose a part with another addend.

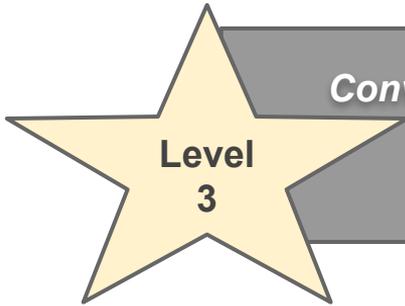
Progressions for the Common Core State Standards in Mathematics (Draft). 2011.



Counting on—Embed an addend within the total (the addend is perceived simultaneously as an addend and as part of the total). Count this total but abbreviate the counting omitting the count of this addend; instead begin with the number word of this addend. Some method of keeping track (fingers, objects, mentally imaged objects, body motions, other count words) is used to monitor the count.

Levels	$8 + 6 = 14$	$14 - 8 = 6$
Level 2: Count on	<p style="text-align: center;">Count On</p>	<p style="text-align: center;">To solve $14 - 8$ I count on $8 + ? = 14$</p>

Progressions for the Common Core State Standards in Mathematics (Draft). 2011.



Convert to an easier problem -Decompose an addend to compose a part with another addend.

Levels	$8 + 6 = 14$	$14 - 8 = 6$
<p>Level 3: Recompose Make a ten (general): one addend breaks apart to make 10 with the other addend</p> <p>Make a ten (from 5's within each addend)</p>	<p>Recompose: Make a Ten</p>	<p>$14 - 8$: I make a ten for $8 + ? = 14$</p>
Doubles $\pm n$	$6 + 8$ $= 6 + 6 + 2$ $= 12 + 2 = 14$	

Progressions for the Common Core State Standards in Mathematics (Draft). 2011.

Explicitly Teaching Strategies....



DOES NOT MEAN

- teaching a specific strategy and then asking students to use it. This approach *removes* the reasoning component and adds to what the student is being asked to *memorize*.

MEANS

- *supporting* thinking, including asking students which strategies they might use in a given situation
- helping students *see* the possibilities and letting them *choose* strategies that help them arrive at a solution.

It can take 2-4 lessons before students will internalize the reasoning strategies discussed in class. (Steinbery, 1985)

Developing Number Sense

Teachers should help students develop math facts, not by emphasizing facts for the sake of 'timed tests' but by encouraging students to use, work with, and explore numbers.

As students work on meaningful number activities they will commit math facts "to heart" at the same time as understanding numbers and math.

They will enjoy and learn important mathematics rather than memorize, dread, and fear mathematics.



Number Sense not Math Anxiety

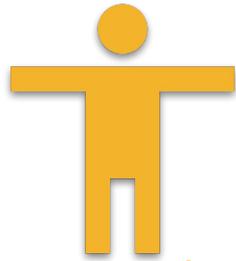
Number sense, critically important to students' mathematical

development, is inhibited by over-emphasis on the memorization of math facts in classrooms and homes. The more we emphasize memorization to students, the less willing they become to think about numbers and their relations and to use and develop number sense.

(Boaler, 2009)



Why Games?



- Develop fact fluency through “meaningful practice”
- Respect children's developmental levels
- Provide engaging and enthusiastic practice
 - Targeted practice (a general group of facts)
 - General practice (all facts for a particular operation)
- Strategic use helps move students along different phases

Games = Formative Assessment

- Monitor progress through:
 - observations
 - interviews
 - math journals (Kling and Bay-Williams, 2014)
- NCTM Assessment Principle states “*Assessment should support the learning of important mathematics and furnish useful information*”(NCTM, 2000)
- Data is more useful, as “efficiency and accuracy can be negatively influenced by timed testing” (Henry and Brown 2012), and timed testing has a negative impact on students (Boaler 2012).





Let's Look at the Assessment Process!

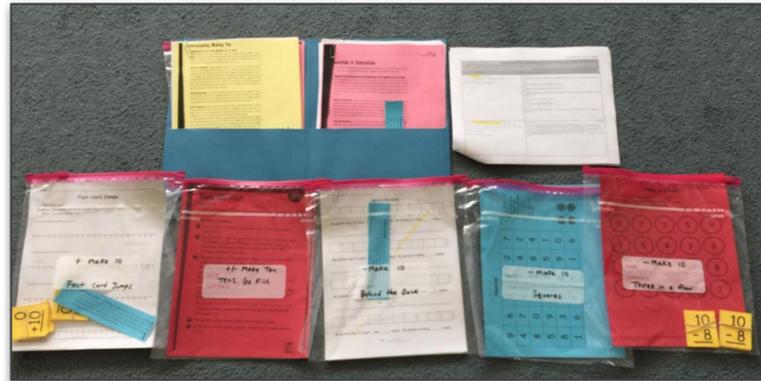
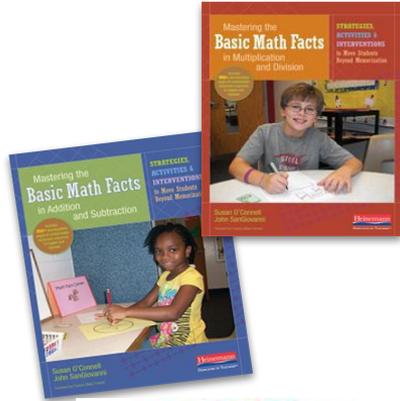
+ & - Fluency Progression

Grade Level	Skill	How It is Assessed
Kindergarten	Within 5: <ul style="list-style-type: none">• Conceptual understanding and accuracy	<ul style="list-style-type: none">• Interviews with problems in context
Grade 1	Within 10: <ul style="list-style-type: none">• Understanding, efficiency, flexibility, accuracy	<ul style="list-style-type: none">• Strategy Checklists• Interviews• End of Year Assessments (untimed)
Grade 2	Within 20: <ul style="list-style-type: none">• Understanding, efficiency, flexibility, accuracy	<ul style="list-style-type: none">• Strategy Checklists• Interviews• End of Year Assessments (untimed)
Grade 3	Within 20: <ul style="list-style-type: none">• Automaticity and accuracy	<ul style="list-style-type: none">• End of Year Assessments (timed)

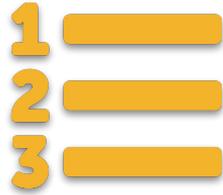
x & ÷ Fluency Progression

Grade Level	Skill	How It is Assessed
Grade 3	Within 100: <ul style="list-style-type: none">• Understanding, efficiency, flexibility, accuracy	<ul style="list-style-type: none">• Strategy Checklists• Interviews• End of Year Assessments (untimed)
Grade 4	Within 100: <ul style="list-style-type: none">• Automaticity and accuracy	<ul style="list-style-type: none">• End of Year Assessments (timed)

Fact Fluency Stations: An Interactive Organizational System



Kindergarten Interview



"Students act out addition and subtraction situations by representing quantities in the situation with objects, their fingers, and math drawings (MP 5, K.OA.1). To do this, students must mathematize a real world situations (MP 4) focusing on their quantities and their relationships rather than non-mathematical aspects of the situation."

"Students solve addition and subtraction equations for numbers within 5 ($2+1 = __$ or $3-1 = ___$) while still connecting these equations to situations verbally or with drawings. Experience with decompositions of numbers and with Add To or Take From situations enables students to begin to fluently add and subtract within 5."

From the [Progressions for the Common Core State Standards](#) (2011)

Regional School District #6 Kindergarten June Benchmark - Facts to 5 Student Sheet

1. 4 bunnies sat on the grass. 5 more bunnies hopped there. How many bunnies are there now?
(Add to-Result Unknown)

2. 10 apples were on the table. I ate 6 apples. How many apples are on the table now?
(Take From-Result Unknown)

3. There are 4 yellow pencils and 3 red pencil on the table. How many pencils are on the table?
(Put Together)

Question 1: 4 bunnies sat on the grass. 2 more bunnies hopped there. How many bunnies are there now? (Add to-Result Unknown)

What child says	What child does (check all that apply)	Rubric (check one)
	<input type="checkbox"/> role plays with the bunnies, acting out the situation. <input type="checkbox"/> just grabs 4 bunnies and 5 bunnies without role playing. <input type="checkbox"/> role plays with non-realistic items, acting out the situation. <input type="checkbox"/> just grabs 4, then 5 non-realistic items without role playing. <input type="checkbox"/> represents problem using paper and pencil to draw <input type="checkbox"/> uses numbers along with drawing of representation <input type="checkbox"/> uses symbols and equations to show along with drawing of representation <input type="checkbox"/> uses symbols and equations and no drawing <input type="checkbox"/> solves mentally <input type="checkbox"/> uses symbols <input type="checkbox"/> correct operation (adds) <input type="checkbox"/> incorrect operation (subtracts) <input type="checkbox"/> appears to guess <input type="checkbox"/> cannot solve situation	<p><u> </u> Meets End of Year Target Student solves Add To Result Unknown problem using the following strategy</p> <ul style="list-style-type: none"> • uses tools such as tiles, linking cubes, ten frame, counters. • uses paper and pencil to draw realistic or non realistic representation using shapes, etc., and counts all or counts on. • paper, pencil representation using numbers and symbols • solves mentally and can explain using number words or symbols, either verbally or with paper and pencil. <p><u> </u> Progressing Toward End of Year Target Student solves Add To Result Unknown problem using any of the following strategies</p> <ul style="list-style-type: none"> • correct operation, realistic objects and role playing <p><u> </u> Below Benchmark for End of Year Target Incorrect answer or student is not able to solve problem.</p>
	Other:	

Flexibility and Efficiency Interview

Name _____

Regional School District 6: Flexibility and Efficiency Interview-December Addition for Doubles and Near Doubles

Show the child 9 + 8	Student Response	M	D	B
<p>UNDERSTANDING Ask: Read this card to me. (If child can't read it, you can read it to the child.) What does $9 + 8$ mean? <i>*If child says $9 + 8$, ask, "What does that mean?"</i> <i>**If child says 17, point to the expression, and ask, "What does this part mean?"</i></p>		Child knows the answer 9 and 8 more, 8 and 9 more, 9 add 8 more, etc.)	Child says $9 + 8$ and cannot elaborate. Child tells story to match expression.	Child does not show understanding of what the minus sign means. He or she may give the difference, but not explain the expression.
<p>ACCURACY Ask: What is the answer to $9 + 8$?</p>		Child knows the answer or self corrects during interview.		Child does not know the answer.
<p>EFFICIENCY: Ask: How did you find the answer to $9 + 8$?</p>		Uses a strategy such as: -uses a double fact ($8+8=16$, $16+1=17$, or $9+9=18$, $18-1=17$) -Makes ten ($9+1=10$, $10+7=17$, or $8+2=10$, $10 + 7= 17$) -Counting on without using fingers (9, 10, 11, 12, 13, 14, 15, 16, 17) -Student just knows it.	Child counts on from either addend. -Counts on using fingers (9, 10, 11, 12, 13, 14, 15, 16, 17)	Uses a strategy such as: -Modelling all (shows 9 fingers, then counts 8 more on fingers again). -Child has no answer.
<p>FLEXIBILITY: Ask: If your friend was having trouble remembering this fact, what other strategy might you suggest to him or her?</p>		Child has <i>different</i> strategy (must use two bullets from list above).	Child only has one strategy from "meets benchmark."	Child has no strategy or counts all.

(M) Meets Benchmark: 4 Ms

(D) Developing: any combination of Ms and Ds

(B) Below Benchmark: 1 or more Bs

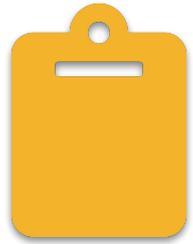


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End of Year Assessment (Achieve the Core)



Name: _____		Date: _____	
$9 + 3 = \square$	$12 - 7 = \square$	$8 + 6 = \square$	
$8 + \square = 12$	$16 - 8 = \square$	$\square - 7 = 8$	
$\square + 5 = 14$	$4 + 7 = \square$	$15 - 6 = \square$	
$8 + 3 = \square$	$14 - \square = 7$	$2 + 9 = \square$	
$13 - \square = 4$	$5 + 6 = \square$	$9 + 7 = \square$	
$18 - 9 = \square$	$6 + 6 = \square$	$13 - 5 = \square$	
$7 + 6 = \square$	$17 - \square = 8$		

- Administered 3-5x per year (dependent on grade level).
- Growth Mindset – students in grade three and four are timed up rather than back using their foundation of strategies to improve upon their automaticity.
- Application of facts, built on conceptual to procedural foundation – RIGOR
- Focuses on the relationship between the operations and their properties.

Developing Fact Fluency



Accuracy, Efficiency,
Flexibility

Automaticity



Developing Fact Fluency



Accuracy, Efficiency,
Flexibility



Number Talks

Strategy Work-Whole & Small Group

Math Games

Automaticity



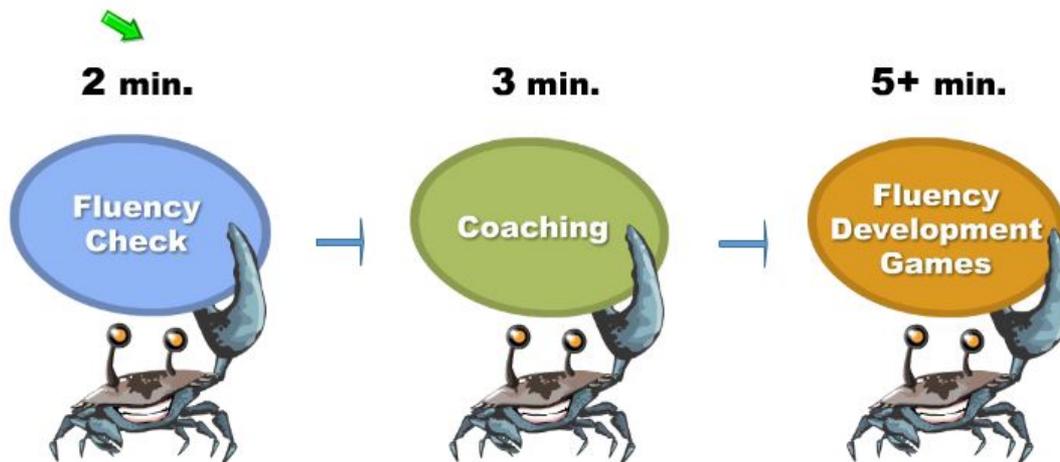
Math Games

Reflex

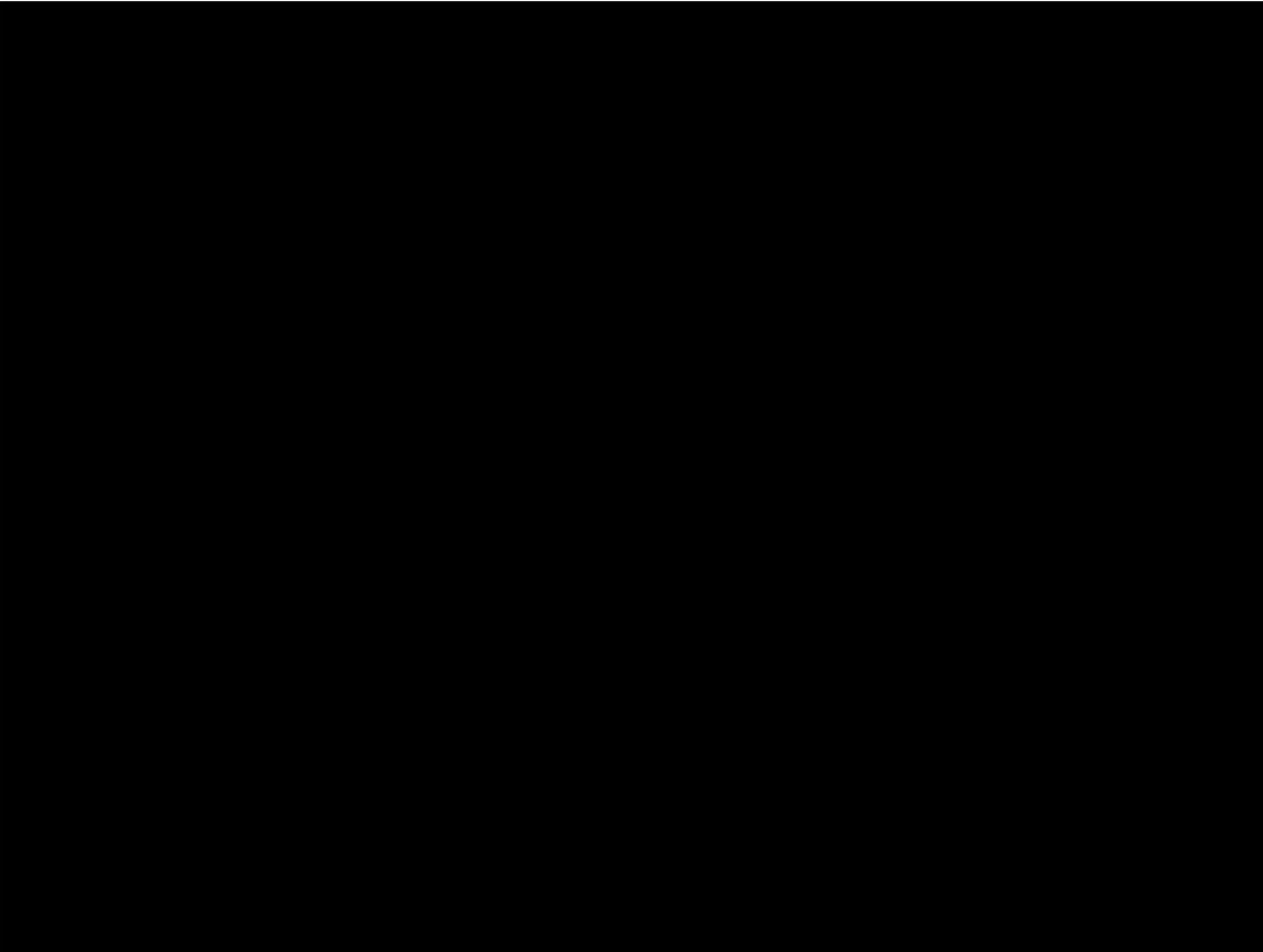




A Typical Reflex Session



Explore^{el}learning



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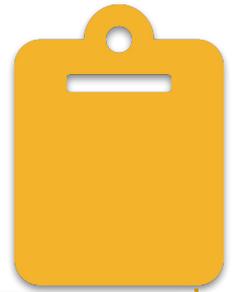


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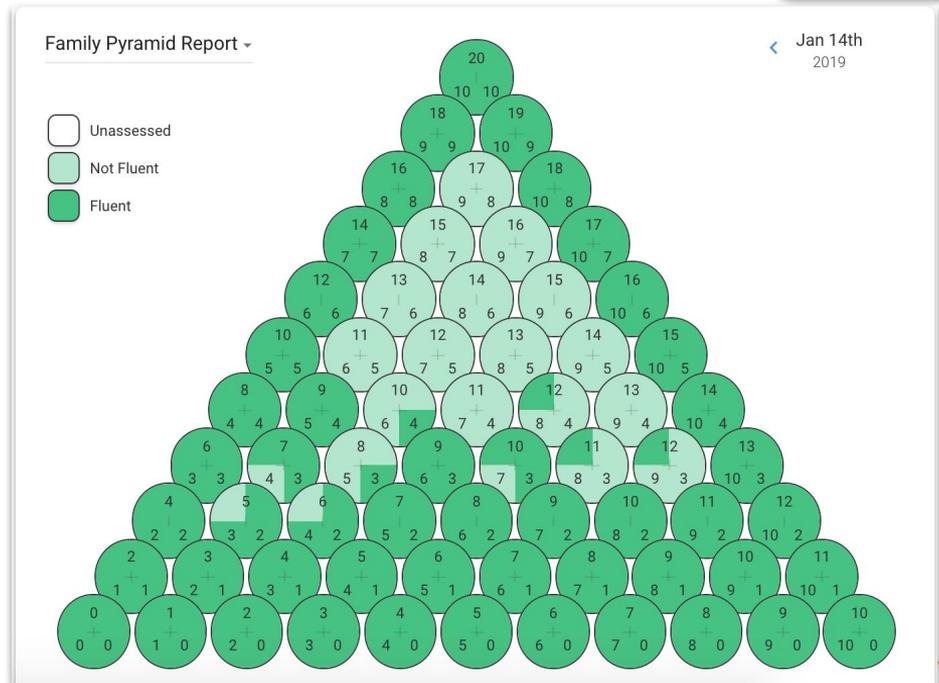


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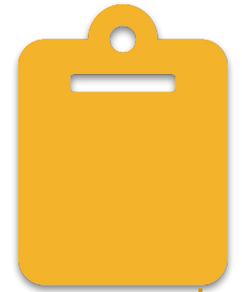
Fact Family Pyramids



- Each fact item is color-coded: fluent facts are green, not-fluent facts are beige, and unassessed facts are white.
- Use as part of your formative assessment
 - Use to drive instruction



Addition & Subtraction Reports



Addition Report

Unassessed
 Not Fluent
 Fluent

< Jan 14th 2019

0+0	1+0	2+0	3+0	4+0	5+0	6+0	7+0	8+0	9+0	10+0
0+1	1+1	2+1	3+1	4+1	5+1	6+1	7+1	8+1	9+1	10+1
0+2	1+2	2+2	3+2	4+2	5+2	6+2	7+2	8+2	9+2	10+2
0+3	1+3	2+3	3+3	4+3	5+3	6+3	7+3	8+3	9+3	10+3
0+4	1+4	2+4	3+4	4+4	5+4	6+4	7+4	8+4	9+4	10+4
0+5	1+5	2+5	3+5	4+5	5+5	6+5	7+5	8+5	9+5	10+5
0+6	1+6	2+6	3+6	4+6	5+6	6+6	7+6	8+6	9+6	10+6
0+7	1+7	2+7	3+7	4+7	5+7	6+7	7+7	8+7	9+7	10+7
0+8	1+8	2+8	3+8	4+8	5+8	6+8	7+8	8+8	9+8	10+8
0+9	1+9	2+9	3+9	4+9	5+9	6+9	7+9	8+9	9+9	10+9
0+10	1+10	2+10	3+10	4+10	5+10	6+10	7+10	8+10	9+10	10+10

Subtraction Report

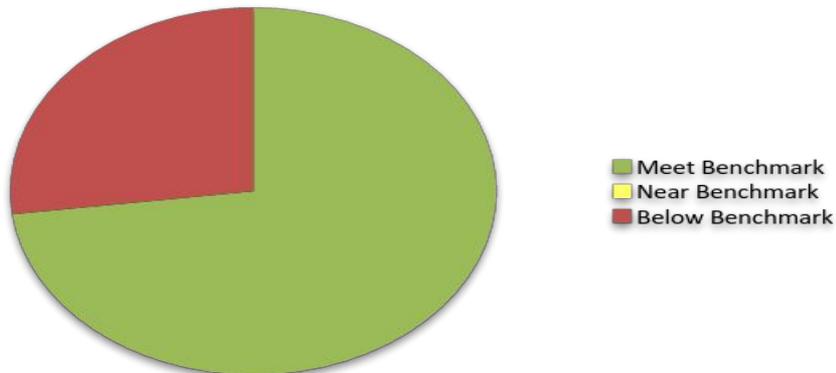
Unassessed
 Not Fluent
 Fluent

< Jan 14th 2019

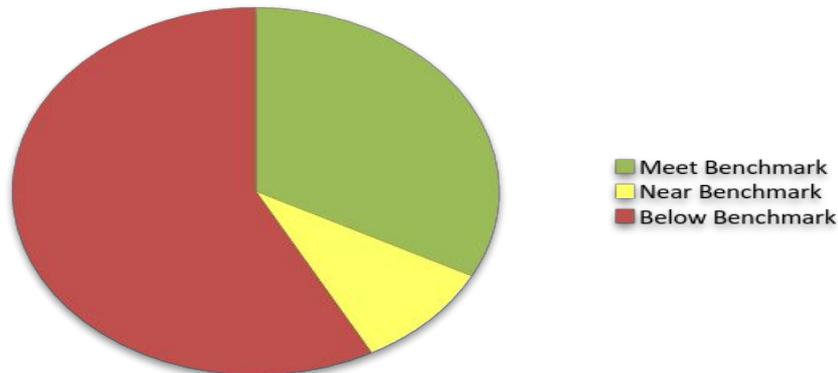
0-0	1-0	2-0	3-0	4-0	5-0	6-0	7-0	8-0	9-0	10-0
1-1	2-1	3-1	4-1	5-1	6-1	7-1	8-1	9-1	10-1	11-1
2-2	3-2	4-2	5-2	6-2	7-2	8-2	9-2	10-2	11-2	12-2
3-3	4-3	5-3	6-3	7-3	8-3	9-3	10-3	11-3	12-3	13-3
4-4	5-4	6-4	7-4	8-4	9-4	10-4	11-4	12-4	13-4	14-4
5-5	6-5	7-5	8-5	9-5	10-5	11-5	12-5	13-5	14-5	15-5
6-6	7-6	8-6	9-6	10-6	11-6	12-6	13-6	14-6	15-6	16-6
7-7	8-7	9-7	10-7	11-7	12-7	13-7	14-7	15-7	16-7	17-7
8-8	9-8	10-8	11-8	12-8	13-8	14-8	15-8	16-8	17-8	18-8
9-9	10-9	11-9	12-9	13-9	14-9	15-9	16-9	17-9	18-9	19-9
10-10	11-10	12-10	13-10	14-10	15-10	16-10	17-10	18-10	19-10	20-10

Remember The Way It Was-Grade 1 Results, 2014

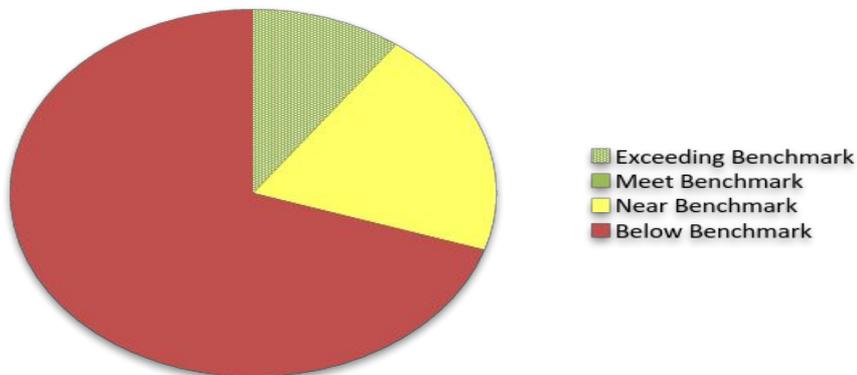
Addition to 5



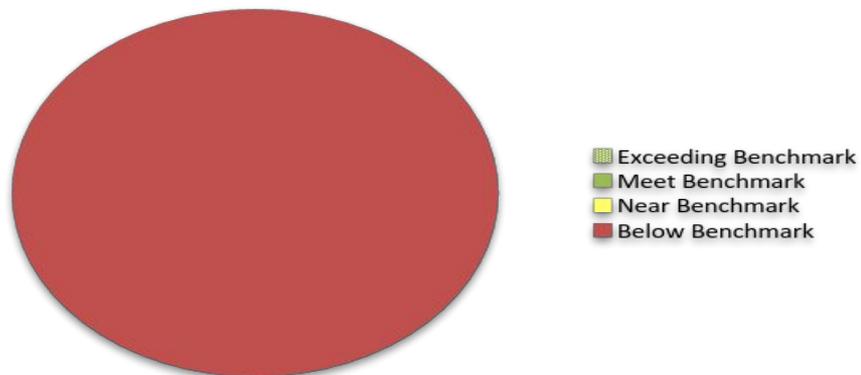
Subtraction to 5



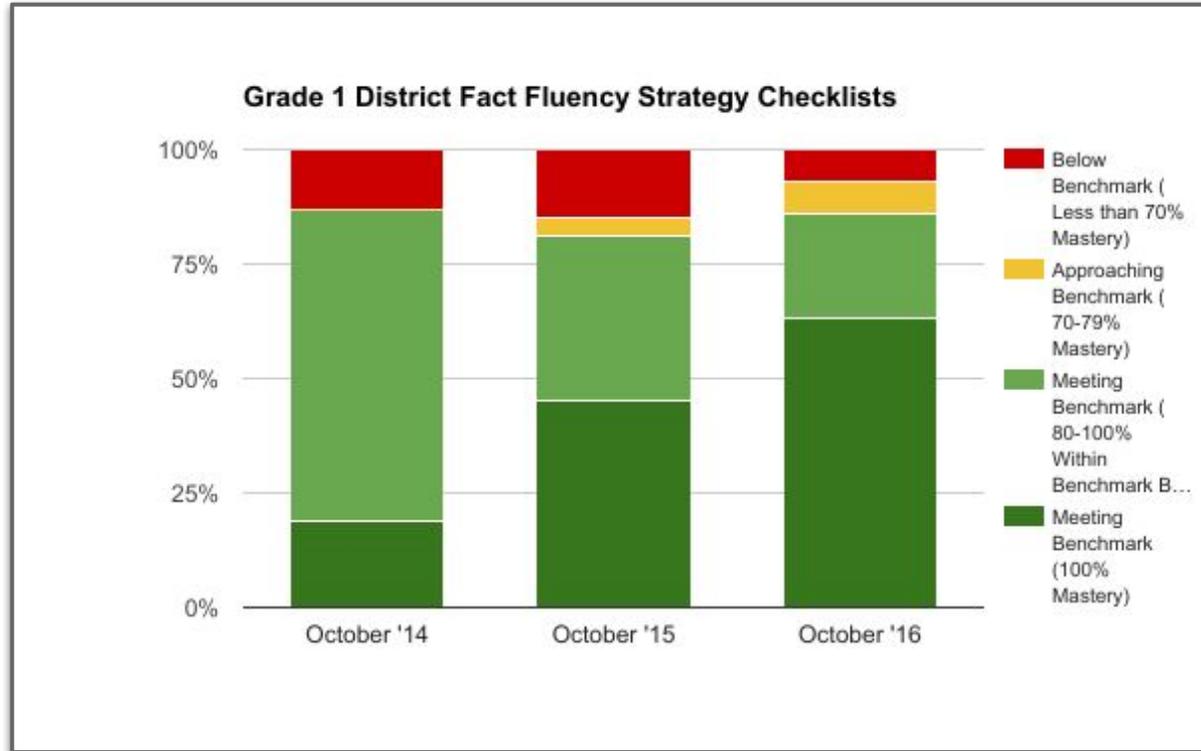
Addition to 10



Subtraction to 10

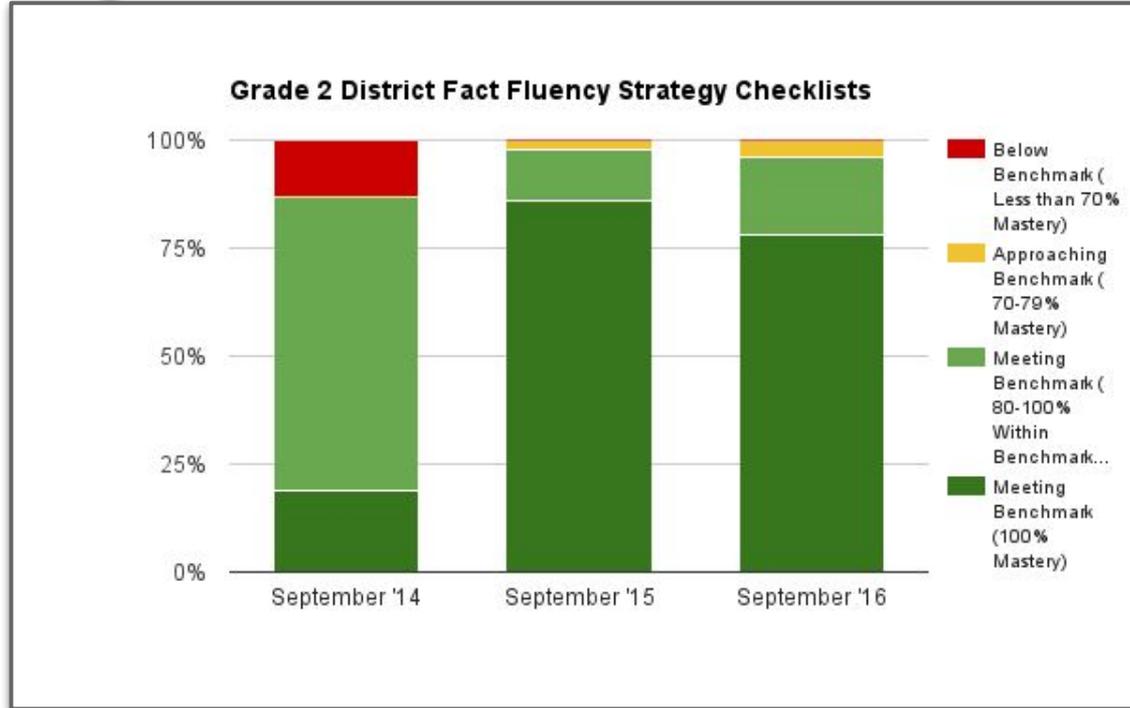


The Way It Became-Grade 1 Results



- The number of students reaching 100% mastery has greatly improved since implementation

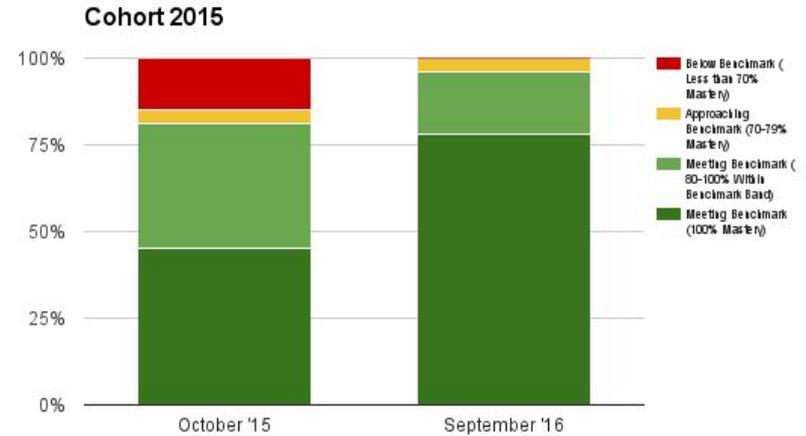
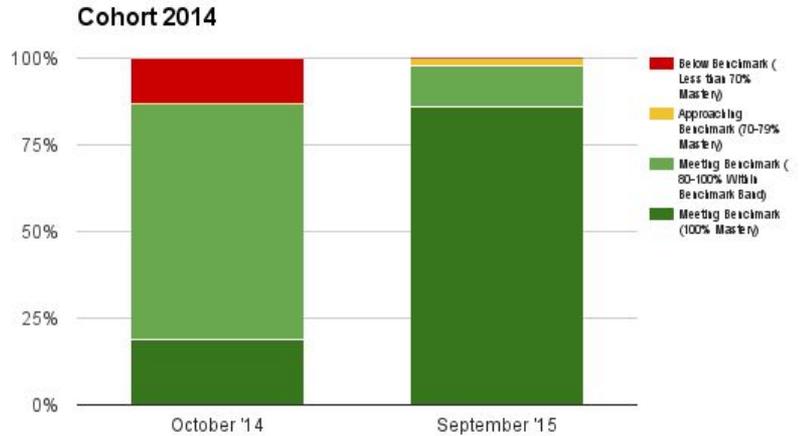
The Way It Became-Grade 2 Results



- The number of students meeting benchmark and reaching 100% mastery has greatly improved since implementation

Year to Year Growth

Grade 1 > Grade 2



- More students met benchmark in 2nd year
- No students were in need of support in 2nd year
- More students had 100% mastery in 2nd year

To Sum it all Up...

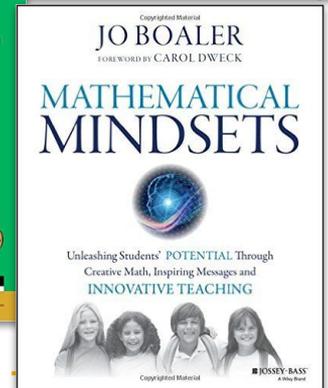
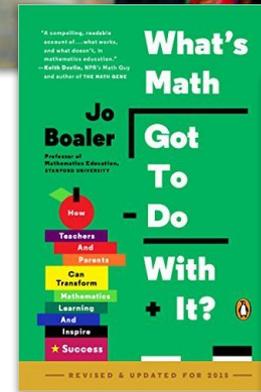
Fluency comes about when students develop number sense, when they are mathematically confident because they understand numbers.

(Boaler, 2015)



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A Call to Action...

A ACTION

C CHANGES

T THINGS



What is one new
direction you will
go in or take?





Assessment Resources



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Resources

- "Addition and Subtraction within 20 Mini-Assessment." *Achieve the Core*. Student Achievement Partners, 13 Oct. 2013. Web.
- Baroody, Arthur J. 2006. "Why children have difficulty mastering the basic number combinations and how to help them." *Teaching Children Mathematics* 13 (August): 22-31.
- Boaler, Jo. 2012. "Timed tests and the development of math anxiety." Education Week. Online July 3, 2012
- Boaler, Jo. "Fluency Without Fear: Research Evidence on the Best Ways to Learn Math Facts." <https://youcubed.org>. Online January 28, 2015. <http://tinyurl.com/piqwnjp>
- *First Steps in Mathematics: Number*
- Fletcher, Graham. "From Memory and Memorization: There Is a Difference." *G Fletchy*. N.p., 1 Dec. 2014. Web.
- Henry, Valerie J., and Richard S. Brown. 2008. "First-Grade basic facts: An investigation into teaching and learning of an accelerated, high-demand memorization standard." *Journal for Research in Mathematics Education* 39 (March):153-83



Resources

- Kling, Gina and Jennifer M. Bay-Williams. 2014. "Assessing Basic Fact Fluency." *Teaching Children Mathematics* 20 (April): 490-96.
- Kling, Gina and Jennifer M. Bay-Williams. 2014. "Enriching addition and subtraction fact mastery through games" *Teaching Children Mathematics* 21 (November: 238-47).
- National Council of Teachers of Mathematics (NCTM). 2000. *Principles and Standards for School Mathematics*. Reston, VA: NCTM.
- Parrish, Sherry (2010). *Number Talks: Helping Children Build Mental Math and Computation Strategies K-5*. Math Solutions.
- Progressions for the Common Core State Standards in Mathematics (Draft). 2011. K, Counting and Cardinality; K-5, Operations and Algebraic Thinking. The Common Core Standards Writing Team.
- Reflex-<https://www.reflexmath.com/>
- Russell, Susan Jo, Karen Economopoulos, Lucy Wittenberg, et al. 2012. *Investigations in Number, Data and Space series*. Common Core Edition. Glenview, IL: Scott Foresman.



A Balanced Approach to Making **Fact Fluency** Instruction & Assessment Meaningful

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<http://bit.ly/FactFluencyNCTM2019>