Welcome to Erikson
Early Math iNNOVATIONS
Summer Institute Day 1!

erikson
early mathematics education

How much pizza?

Thinking about pieces, parts & wholes

Common Core State Standards for Mathematical Practice:

Unpacking what they mean.

It’s time to play games!

Mancala

21

What do we know about how children learn about numbers & operations?

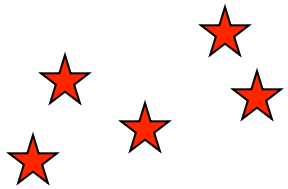
What does their *landscape of learning* look like?

Big Ideas in Number & Operations

(1 of 3)

Topic	Big Ideas	Examples
Numerosity  = 5	• Small collections can be intuitively perceived without counting (subitizing). • Quantity is an attribute of a set of objects.	• Children just "see" three objects and know it's 3. • 5 mice and 5 elephants are alike in quantity, though different in other ways.

Uses of Number
 
5th
	• Numbers are used many ways, including:
	  • to indicate amount (cardinal)
	  • to specify position in a sequence (ordinal)
	  • to provide names for members of a set (nominal)
	  • to act as shared reference points (referential)
		• *Tommy has 5 books.* (cardinal)
		• *Ava is fifth in line today.* (ordinal)
		• Numbers on basketball jerseys, home addresses, telephone numbers (nominal)
		• *Let's meet at 5 pm on December 5.* (referential)

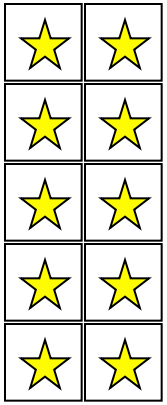
Counting
 
"1,2,3,4,5…5!"
	• Counting can be used to find out how many in a collection.
	• Counting has rules that apply to any collection.
	  • Counting words have to be said in the same order every time
	  • Each object in a set must be counted once and only once
	  • It does not matter in what order the objects within a set are counted
	  • The last number word produced is the amount of the entire set
		• *1, 2, 3, 4, 5…you have five stars!*
		• "One, four, two" doesn't give a correct answer
		• Children need strategies for keeping track, like touch-pointing or moving to another pile
		• Mixing up objects and counting again is a good exercise; the third object counted is not the only one that can "be" three
		• Being able to count is not the same as being able to answer "how many?"

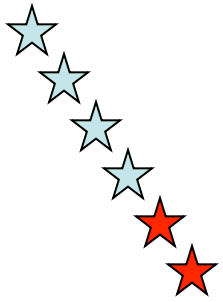
Major support for the Early Mathematics Education Project is provided by the McCormick Foundation, CME Group Foundation, the U.S. Dept. of Education Investing in Innovation Fund (i3), Motorola Foundation, Chicago Public Schools Office of Early Childhood Education, Exelon Corporation, and the Robert and Isabelle Bass Foundation

Big Ideas in Number & Operations

(2 of 3)

Topic	Big Ideas	Examples

Place Value in Base Ten 	•As numbers grow larger, we group by tens to create new units.
	  •Because we group by tens, we can represent all numbers using ten digits (0 to 9), and there are patterns to how numbers are represented.
	•The positions of digits in multi-digit numbers determine what unit they represent.
	  •The digit “0” is important as a placeholder.
	•The groups of ones, tens, hundreds (and so on) can be composed and de-composed in different ways.
		•Ten ones is one ten; ten tens is one hundred; ten hundreds is one thousand …
		•“2**0**, 2**1**, 2**2**, 2**3**…” or “**8**0, **9**0, 1**0**0, 1**1**0 …”
		•Two tens and four ones describe the 24 single eggs we bought at the store. Four tens and two ones describe the 42 children in first grade.
		•“One Hundred & One Dalmatians” is a group of a hundred and one more. It is written as 101, representing one hundred-unit, zero ten-units and one one-unit.
		•250 + 266 is simpler to compute when 256 is broken into 250 and 16. Then compute 250 + 250 (a double which many children know) and add on the extra 16 afterward.

Fractions 	•Fractions are equal parts of a whole. •A whole or unit can be divided into equal parts in many different ways. •A unit may be a single object or may be a collection of things.	•Pizzas can be cut into 6 equal wedge-shaped pieces. •6 cars can be divided equally by giving 2 cars each to 3 children. •A pizza can be divided into 4 or 6 or 8 equal slices. •6 cars can be divided equally into 2 groups of 3, 3 groups of 2, or 6 groups of 1. •One whole pizza can be divided into equal slices. •In one group of 6 cars, 1/3 are red: 2 cars are red.

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Big Ideas in Number & Operations

(3 of 3)

Topic	Big Ideas	Examples
Changing Sets 	• Sets can be *changed* by adding items (joining) or by taking some away (separating).	•*You have 2 balls and I have 3 balls. How many balls do we have altogether?* •*You had 60 cards, and you gave your friend 5. How many do you have now?*
Grouping & Partitioning 	• One can quantify a collection by grouping items into equal sets.	•*Chris has 2 boxes of crayons with 4 in each box. How many crayons does Chris have altogether?* •*There are 20 children in the 2nd grade class. Sandy brings 40 cookies so each child can have two.* •*How many hands does it take to show 20 fingers?* •*How can 3 children share 9 toy cars fairly?*
Number Composition 	•A quantity (whole) can be *decomposed* into equal or unequal parts; the parts can be *composed* to form the whole.	•*How many ways can you show 5 with fingers on both hands?* • *100 can be 50 & 50 or 70 & 30 or 90 & 10.*
Comparing Sets 	•Sets can be *compared* using the attribute of numerosity, and *ordered* by more than, less than and equal to.	•*I have a handful of raisins; Chris has a bowl-ful. Chris has more!* •*I have 1 pear and 1 peach; you have 2 apples. We have the same number of fruits.* •*Avery has 3 dirty plates, and Tracy has 4 dirty bowls. Who has fewer dishes to wash?* •*There are 6 fish and 3 snails in our aquarium. We have twice as many fish as snails.*
Solving Problems 	• The four arithmetic operations (addition, subtraction, multiplication & division) are tools for solving problems about numbers. • In order to choose which operation to use, the solver must understand what is happening in the problem situation.	•*There is usually more than one way to solve the same problem. For example, subtraction or counting up are equally valid ways to find the difference between two numbers.* •*All word problems tell a story.*

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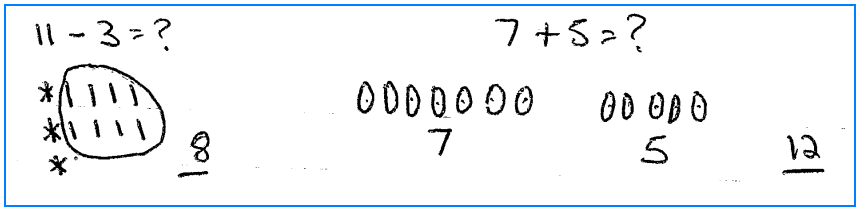
Teaching-Learning Strategies

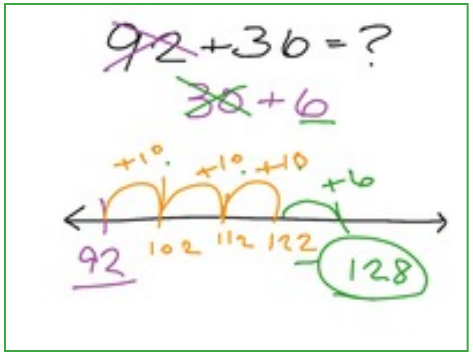
- Turn & Talk
- Learners rephrase other learners' thinking
- Sharing multiple solutions or strategies without comment
- Teachers model students’ thinking.
- Students explain or model their own thinking.

Modeling Students' Mathematical Thinking

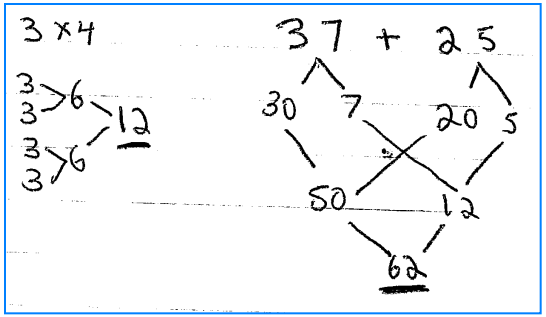
tallies or other marks



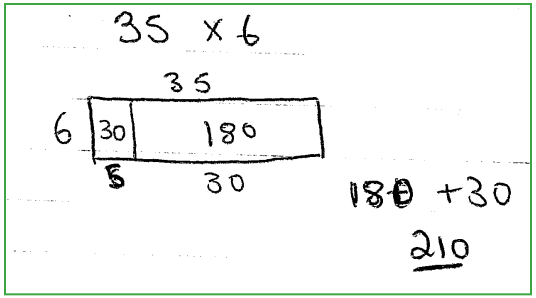
number line



number tree



rectangle or array



Exploring the
Landscape of Learning

A warm–up mental math string

92 + 39

99 + 32

139 + 94

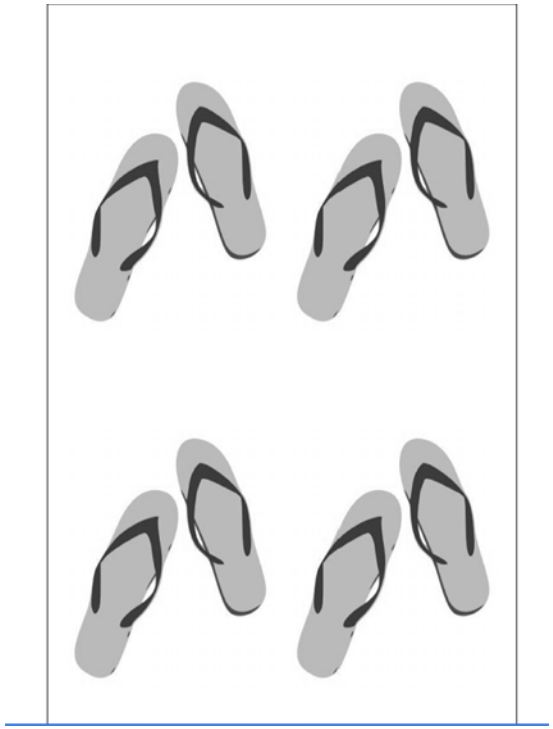
134 + 99

199 + 34

129 + 97

- What strategy does this string support?
- What big ideas underlie this strategy?

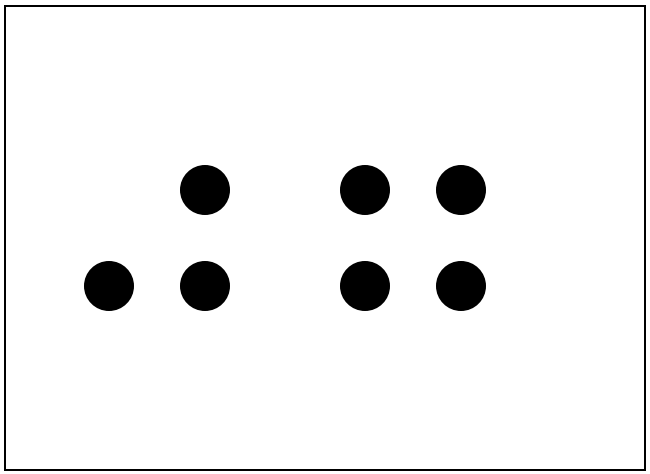
Visual Number Strings
Quick Image Billboards (K-1)



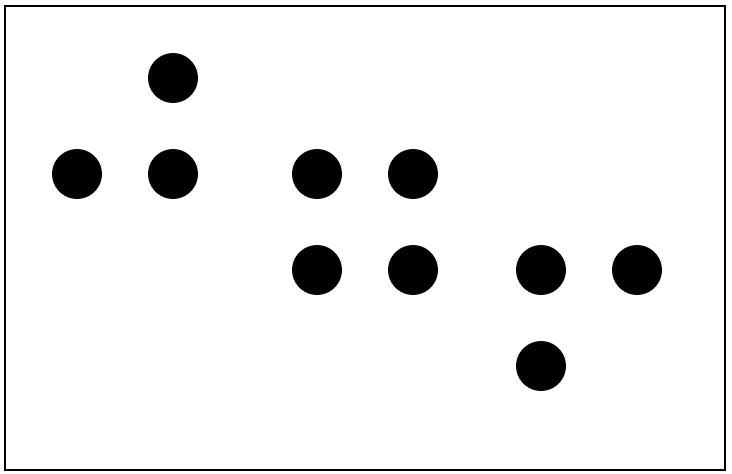
How many do you see?

Visual Number Strings
Strategies & Models

- What strategies would you expect to hear when you ask students to tell how many they see?
- How would you represent students' responses?

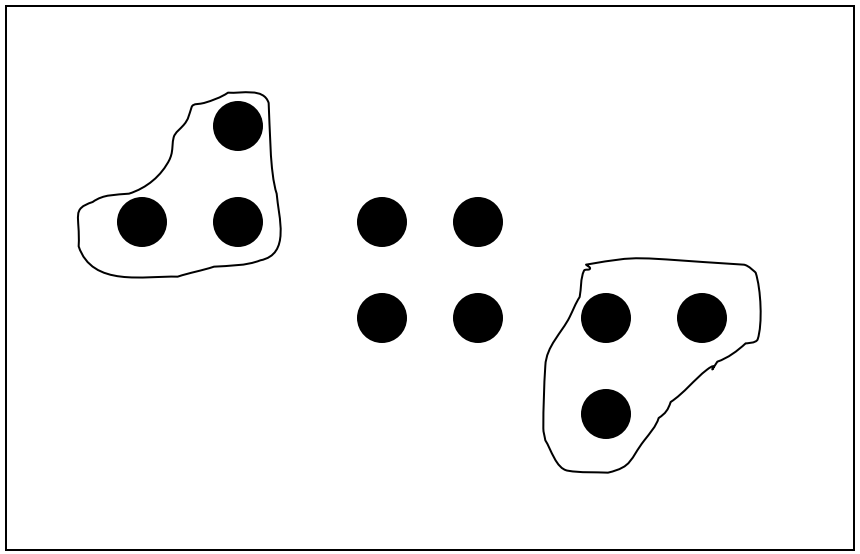


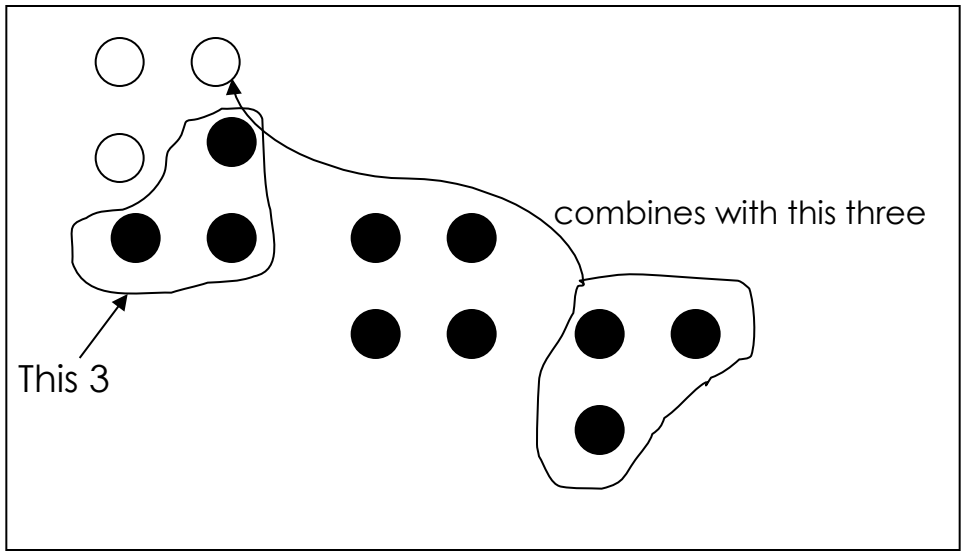
What children are looking at
in video 81.



What children are looking at
in videos 82 & 83.

Modeling students' thinking





What about the last student's explanation of "6+4=10"?

2nd Grade Number String

43 + 10

43 + 20

43 + 19

68 + 23

39 + 54

What's the focus of the string?

- compensation
- splitting
- jumps of tens and adjusting
- moving to a landmark number

Another 2nd Grade Number String

50 + 50

49 + 51

25 + 25

26 + 25

32 + 28

49 + 53

What's the focus of the string?

- compensation
- splitting
- doubles +/-
- moving to a landmark number

2nd/3rd Grade Number String

192-40

192-43

378-39

247 – 29

371 - 19

What's the focus of the string?

- constant difference
- splitting
- doubles +/-
- taking jumps of ten backwards and adjusting

Let's watch some children working on some of these problems in the classroom. (Videos 84, 85, 86)

2nd/3rd Grade Number String

192-40

192-43

378-39

247 – 29

371 - 19

- Would you continue with the 4th problem?
- Craft a string that would provide more scaffolding and help students experience the strategy.

Michael's revisions

192-40

192-43

378-40

371-19

Where have we been in the Landscape of Learning?