Let's **Count On** Math™

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A Counting-Based Instructional Framework

Main ideas:

1. Mathematics is a language of quantities.
2. Before operating on numbers, students need to know what those numbers are quantities of.
3. Reveal analogous structures to reduce cognitive load and create coherence, continuity, and articulation across grades.

Three Instructional Framing Questions (for planning and teaching):

1. ***What are we counting?*** (things, $, time, angle, length, area, volume, tenths, etc.)
   a. Already the same type of thing? Count right away.
   b. Not the same type of thing? Make change if possible, then count.

2. ***How are we counting it?*** (what operation, algorithm, or formula; *make change*?)

3. ***What previous skill or concept is this analogous to?*** (reduce cognitive load)

Grade 1	2 cats	+	3 cats	=	5 cats	
Grade 3	2 squares	+	3 squares	=	5 squares	
Grade 5	2 hundreds	+	3 hundreds	=	5 hundreds	
Grade 7	2 twelfths	+	3 twelfths	=	5 twelfths	
Grade 9	$2x^2$	+	$3x^2$	=	$5x^2$	
Grade 12	$2\log x$	+	$3\log x$	=	$5\log x$	

Same structure. Different symbols. Related meaning.

Show analogous (prior, current, and/or future) structures side-by-side.

Where is counting hidden or compressed in an algorithm?

Where else in your grade's curriculum are students combining quantities?

What could I try tomorrow? next week? next month?

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A Counting-Based Instructional Framework: Some Grade Level Examples

Primary - Count these things

cat cat cat **dog** **dog** **dog** **dog** cat cat cat ant **dog**

1 cat, 2 cats, 3 cats, 4 cats, 5 cats, 6 cats altogether (3 cats and 3 cats is 6 cats)

1 **dog**, 2 **dogs**, 3 **dogs**, 4 **dogs**, 5 **dogs** altogether (4 **dogs** and 1 **dog** is 5 **dogs**)

1 ant (it's alone)

= 6 cats + 5 **dogs** + 1 ant (later we teach that we don't need to write "1" in front of ant)

Intermediate - Adding decimal numbers

Add: 39.4 + 65.2

$$\begin{array}{r} {\scriptstyle 1} \\ 39.4 \\ +\ 65.2 \\ \hline 104.6 \end{array}$$

Instead of saying:	**Say:**
Line up the decimal points. Write down the decimal below. Start at the right, add down. 4+2, write down the 6 9 + 5 = 14, write down the 4 and carry the one 1 + 3 + 6 = 10, write down the 10	*What are we counting*? 4 tenths + 2 tenths = 6 tenths. Write 6 in tenths place 9 ones + 5 ones = 14 ones. *Make change* 14 is 10 + 4 Write the 4 in ones place. Write 1 in tens place (there is 1 "ten") 1 ten + 3 tens + 6 tens = 10 tens Write 10 (really it's 100)

Middle School - Order of Operations (BEDMAS)

Simplify: 3 + 4 x 5 + 2 x 6

Instead of saying:	**Say:**
Follow the BEDMAS rules ÷ and x from left to right 3 + 20 + 2 x 6 Second x 3 + 20 + 12 Now +/– from left to right 23 + 12 Second + = 35	*What are we counting*? 3 Ones + 4 Fives. Ones and Fives are different so we can't add *Make change* 4 Fives (4 x 5) is 20 ones 3 + 20 + 2 x 6 *Make change* 2 Sixes (2 x 6) is 12 ones 3 + 20 + 12 3 ones + 20 ones + 12 ones = 35

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Middle School - Adding fractions

Add: $\frac{1}{4} + \frac{5}{6}$

$\frac{3 \times 1}{3 \times 4} + \frac{5 \times 2}{6 \times 2}$ LCM = 12

$\rightarrow \frac{3}{12} + \frac{10}{12}$

$\rightarrow \frac{13}{12}$ or $1\frac{1}{12}$

Instead of saying:	**Say:**
To add fractions we need a common denominator.	*What are we counting*?
The LCM for 4 and 6 is 12, so LCD is 12	1 fourth and 5 sixths (fourths and sixths are different)
Rewrite the equivalent fractions with denominator 12	4 and 6 both go into 12. *Make change* L.C.D. to twelfths.
Add together the numerators.	3 twelfths + 10 twelfths = 13 twelfths (still twelfths)
The denominator stays the same.	3 ants + 10 ants = 13 ants (still ants)
	Make change into mixed fraction form if needed.

High School - Simplifying expressions

Simplify: $3x + x^2 + 5x + 1 + 4x^2 + 6$

Instead of saying:	**Say:**
We group like terms.	*What can we count together*?
Remember: add the coefficients, but the bases and exponents stay the same.	$3x + 5x = 8x$ (still x) 3cats + 5cats = 8cats (still cats)
$x^2 + 4x^2 = 5x^2$	$x^2 + 4x^2 = 5x^2$ (still x^2)
$3x + 5x = 8x$	1 + 6 = 7 "ones"
1 + 6 = 7 7 is the constant.	*Make change* isn't possible, so unlike terms remain separate. Write the terms in standard form, with powers descending.
Write the terms in standard form, with powers descending.	$= 5x^2 + 8x + 7$
$= 5x^2 + 8x + 7$	

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Lesson ideas, classroom resources, printable materials, and product information.	Short demonstrations, teaching tips, and classroom activities covering many K-12 learning outcomes.

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