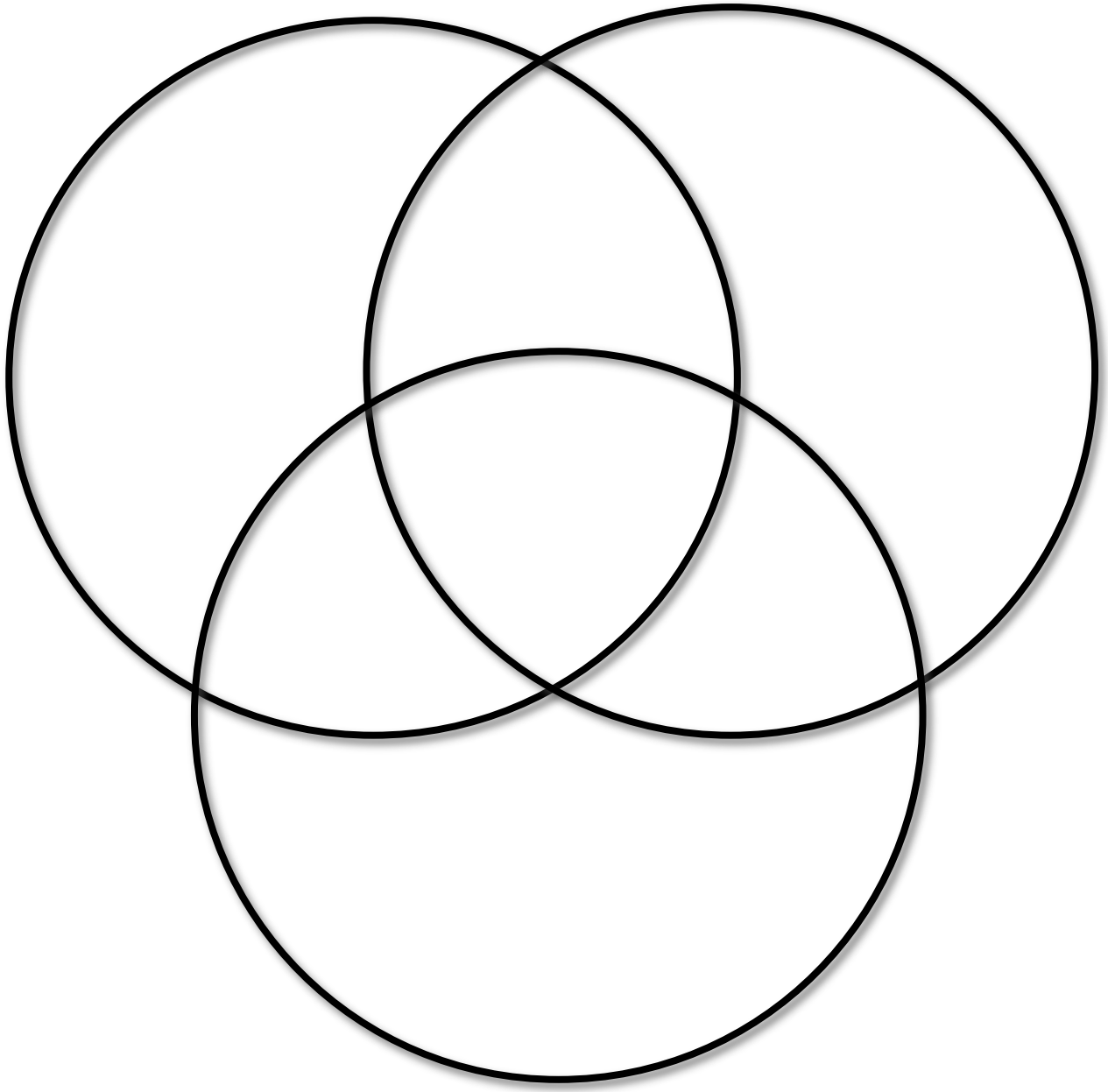
Oxford School Improvement

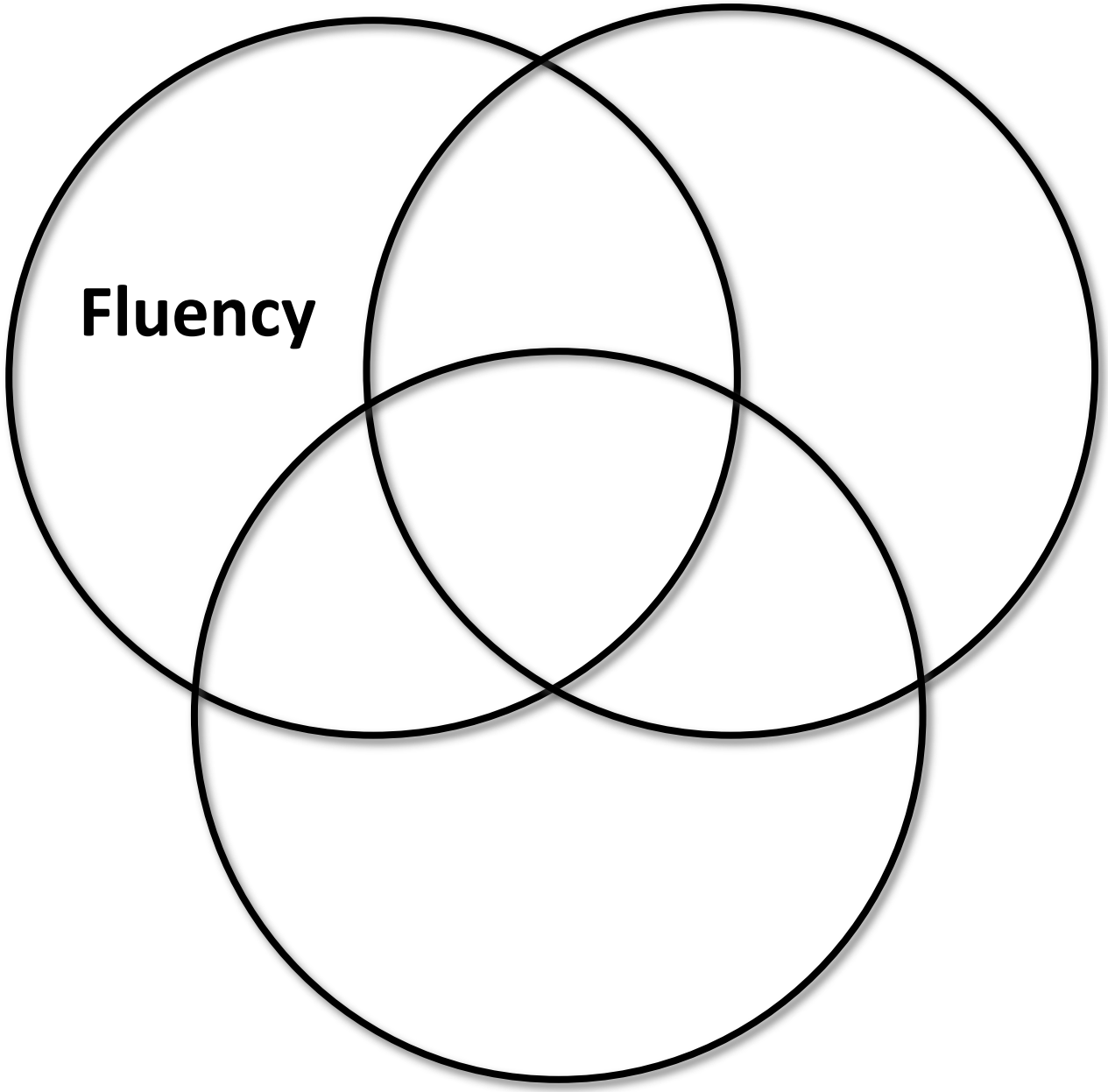
Mike Askew

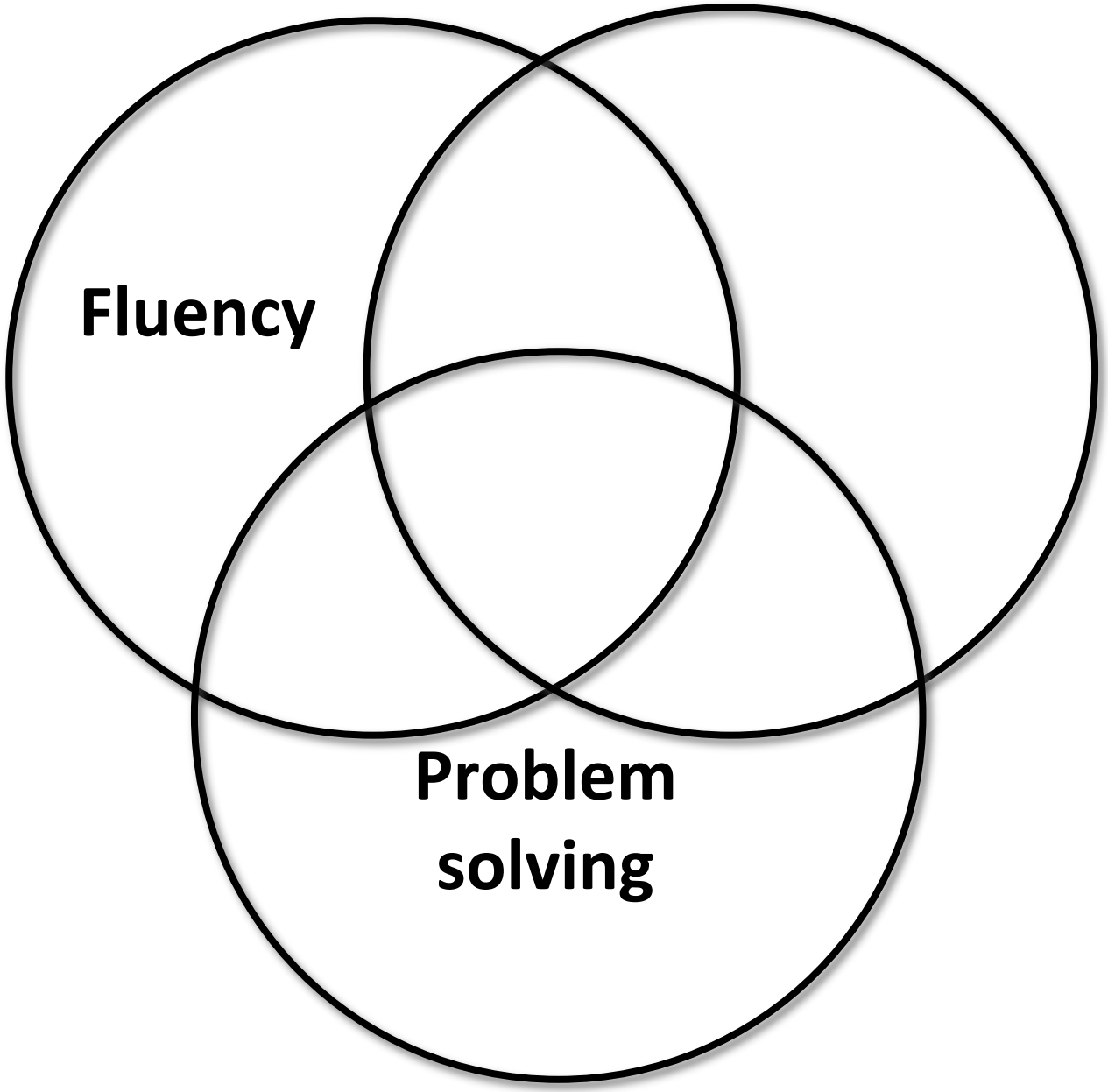
BIG IDEAS IN MATHEMATICS EDUCATION: TEACHING FOR DEEP UNDERSTANDING

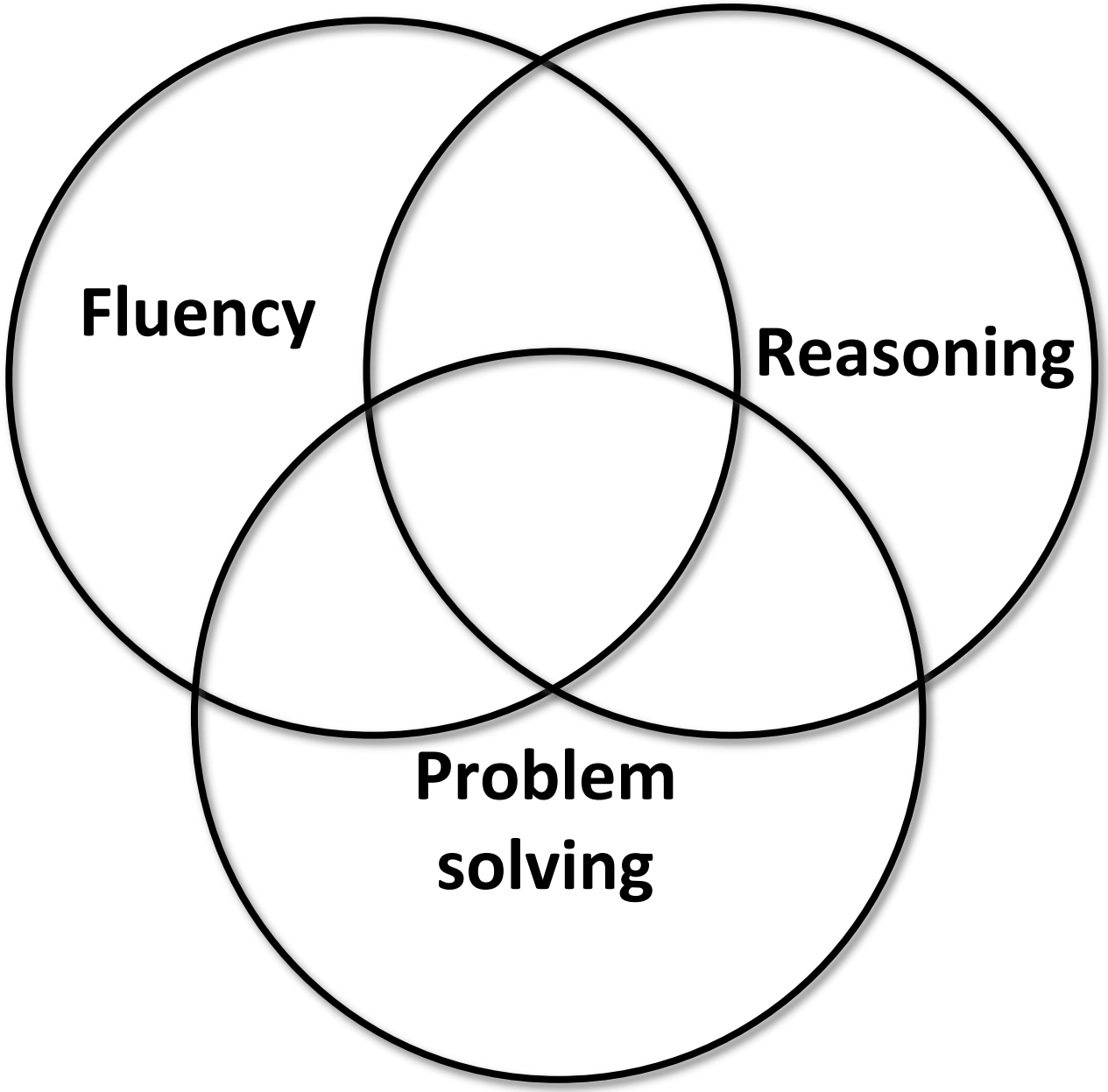
Mathematics Mastery Primary Conference
January 26 2015

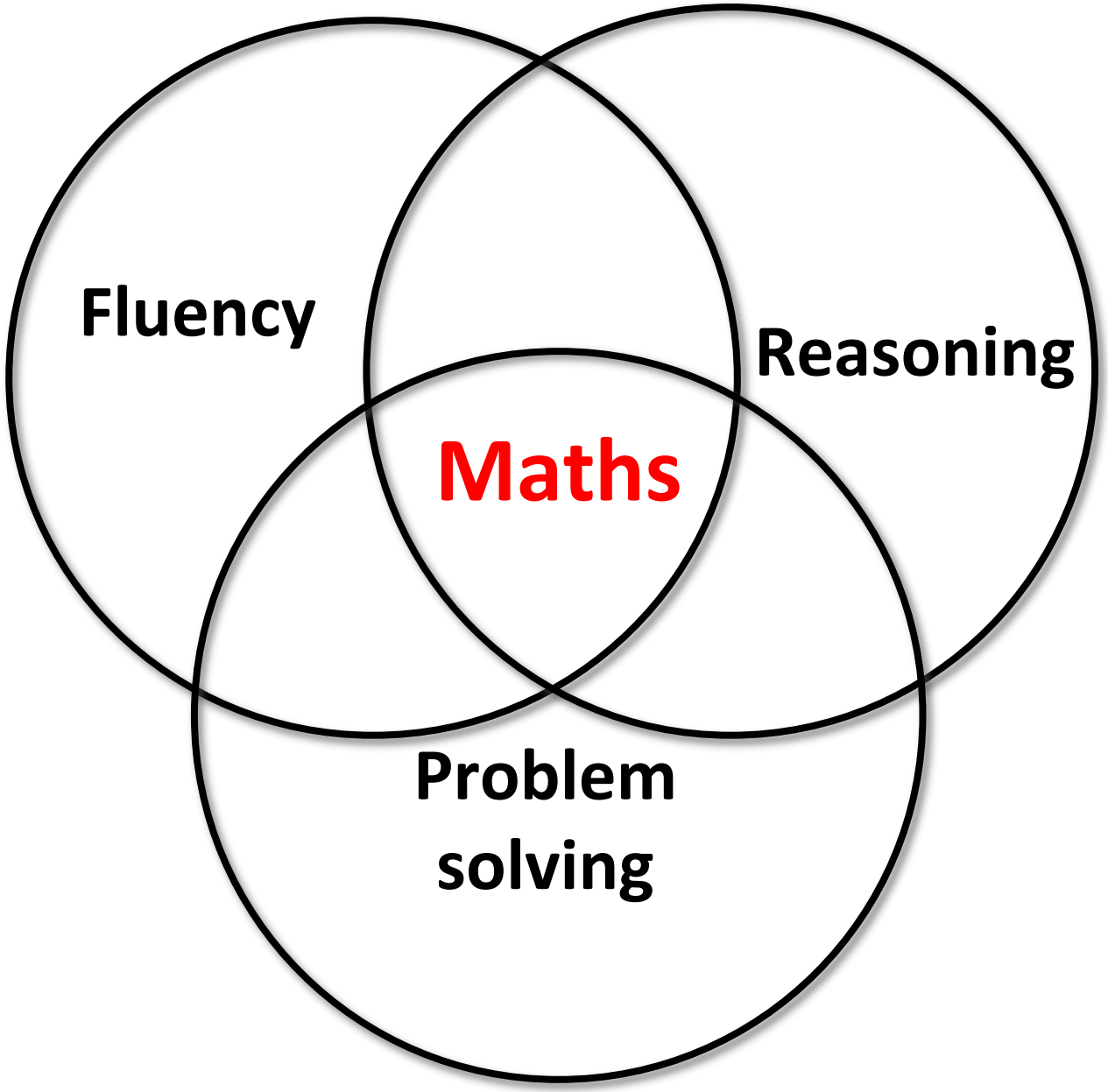
OXFORD UNIVERSITY PRESS




Fluency


Fluency
Problem solving


Fluency
Reasoning
Problem solving


Fluency
Reasoning
Maths
Problem solving

Maths is **not** a spectator sport.

Jot down ...

Inquiries

- Can you find all the multiples of 9?
- Given any 2-digit number can you predict which multiple of 9 it will produce?
- Why do you get a multiple of 9?
- What happens with three-digit numbers?

Objects of learning

Indirect

- Fluency
- Problem solving
- Reasoning (Big Ideas)

PROFICIENCIES

Direct

- Fractions
- Multiplication
- 3-D shapes

CONTENT

As teachers we need to have Big Ideas in mind in selecting tasks and when teaching.

What is a Big Idea?

Big Ideas are

- Mathematically big
- Conceptually big
- Pedagogically big

The Big Five

- Position on the number line
- Equivalence
- Arithmetical reasoning
- Classification
- Meanings and symbols

The Big Five

- Position on the number line
- Equivalence
- Arithmetical reasoning
- Classification
- Meanings and symbols

Plus

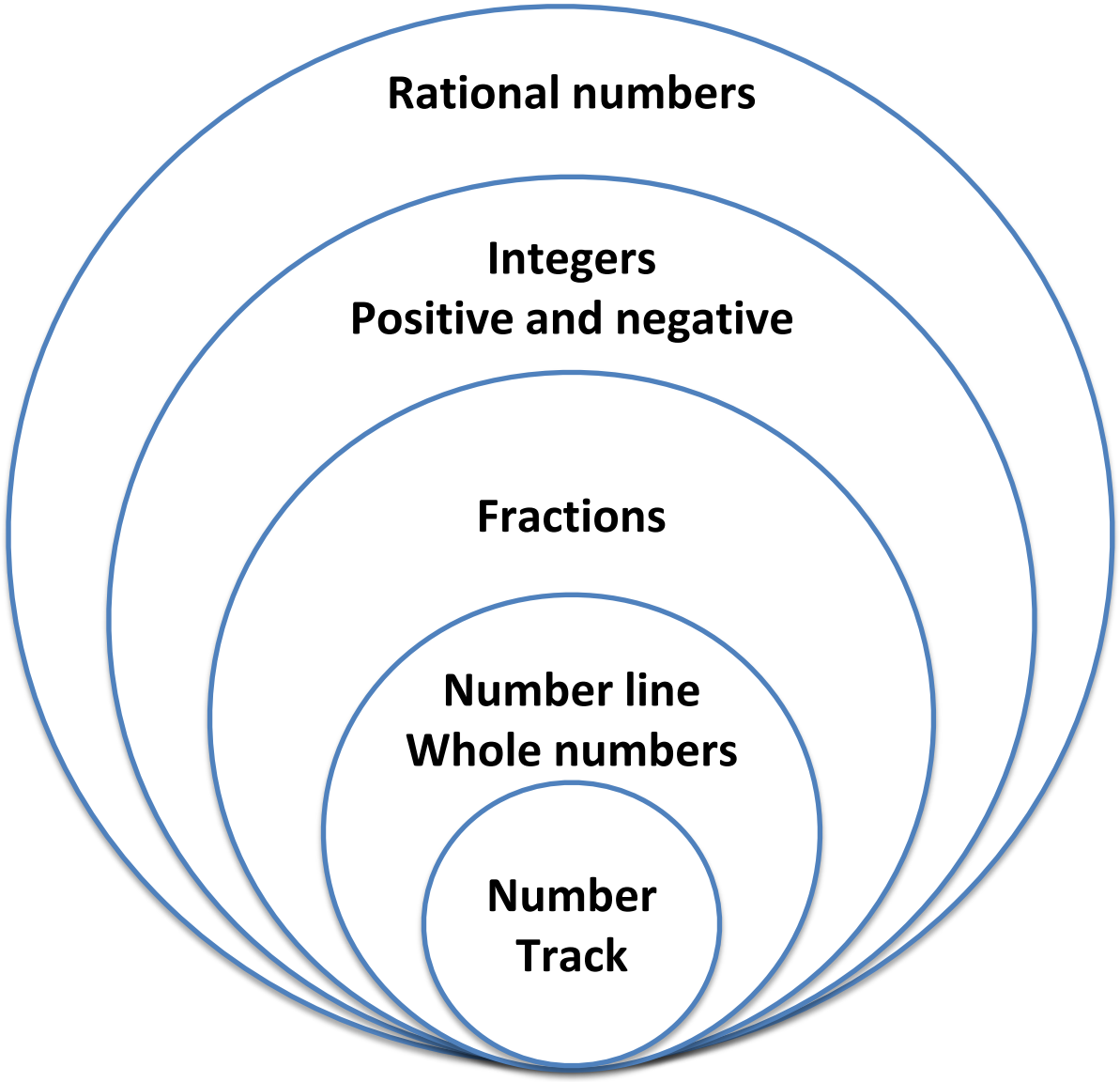
- Pattern
- Place value
- Estimation

Position on the number line

The numbers in primary maths have a unique position on the number line.

Position on the number line

- Putting numbers on a line links discrete and continuous quantities.
- Positioning numbers on the number line helps develop understanding of the number system.
- The number line helps learners connect different representations of numbers.
- Placing numbers at equal spaces on a number line is a key skill and marker of understanding.


Rational numbers
Integers
Positive and negative
Fractions
Number line
Whole numbers
Number
Track

National Curriculum

Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas.

National Curriculum

Y2

Pupils identify, represent and estimate numbers using different representations, including the number line

They check their calculations, including by adding to check subtraction and adding numbers in a different order to check addition... This establishes commutativity and associativity of addition

They use commutativity and inverse relations to develop multiplicative reasoning (for example, 4 × 5 = 20 and 20 ÷ 5 = 4).

Pupils should count in fractions up to 10, starting from any number and using the ½ and 2/4 equivalence on the number line

Big Ideas are NOT age, level or content dependent.

PIAGET

PIAGET

Working with Big Ideas is a way of dealing with classroom diversity and promoting inclusive classrooms.

Equivalence

There are infinitely many ways to represent numbers, measures and number sentences.

Jot down ...

Reasoning chains

10 x 8

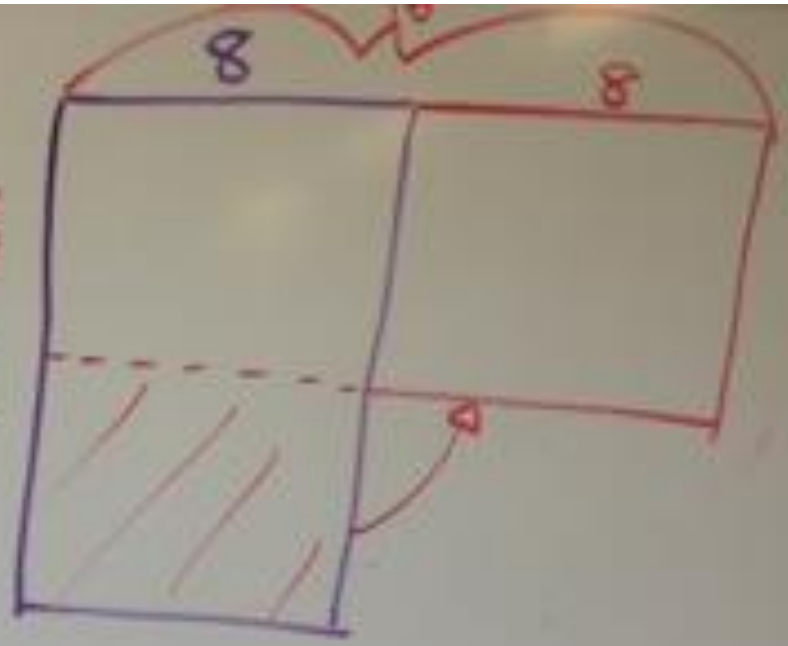
2 x 8

12 x 8

6 x 16

$12 \times 8 = 96$

$6 \times 16 = 96$



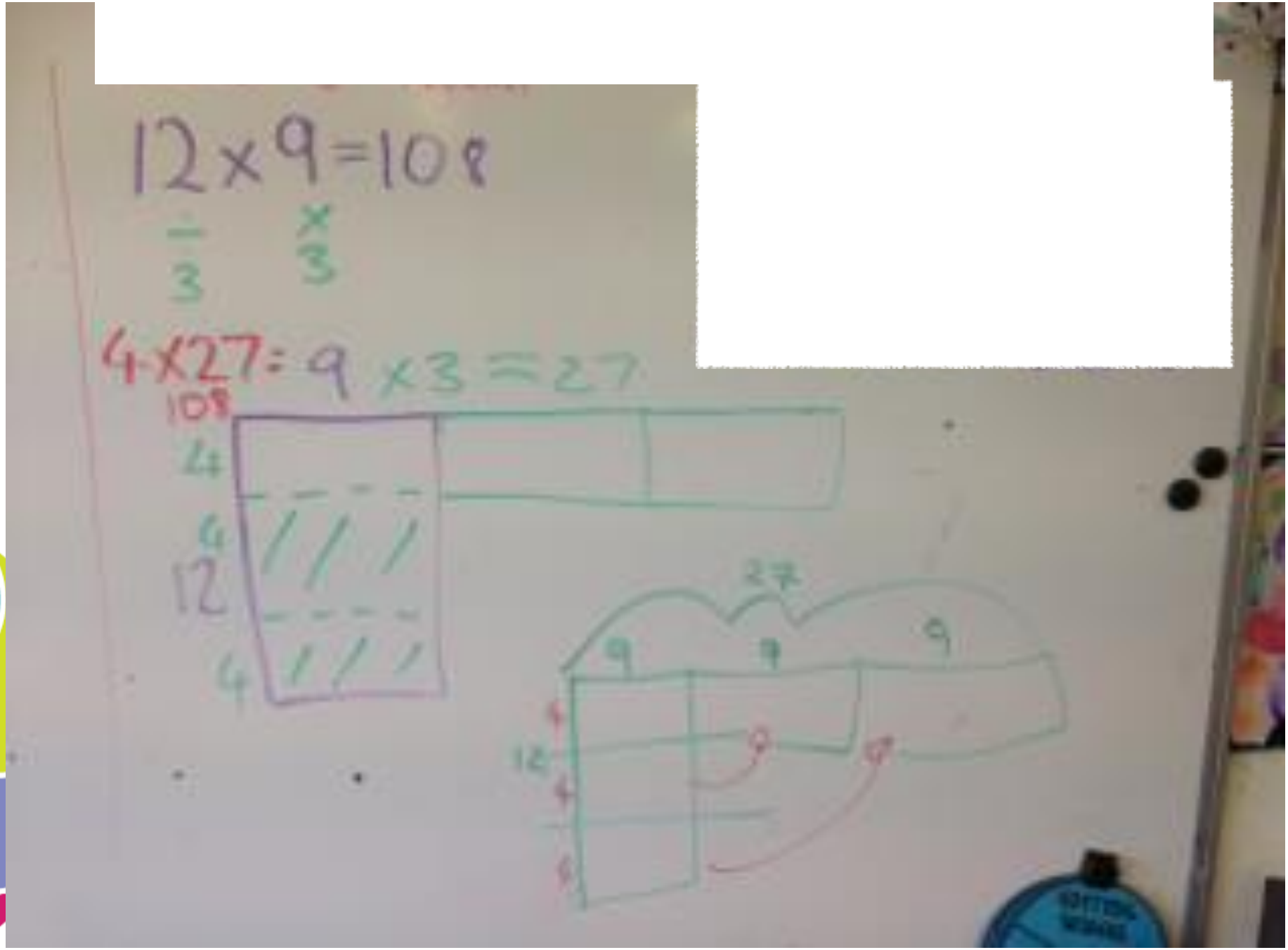
$12 \times 8 = (6 \times 2) \times 8$

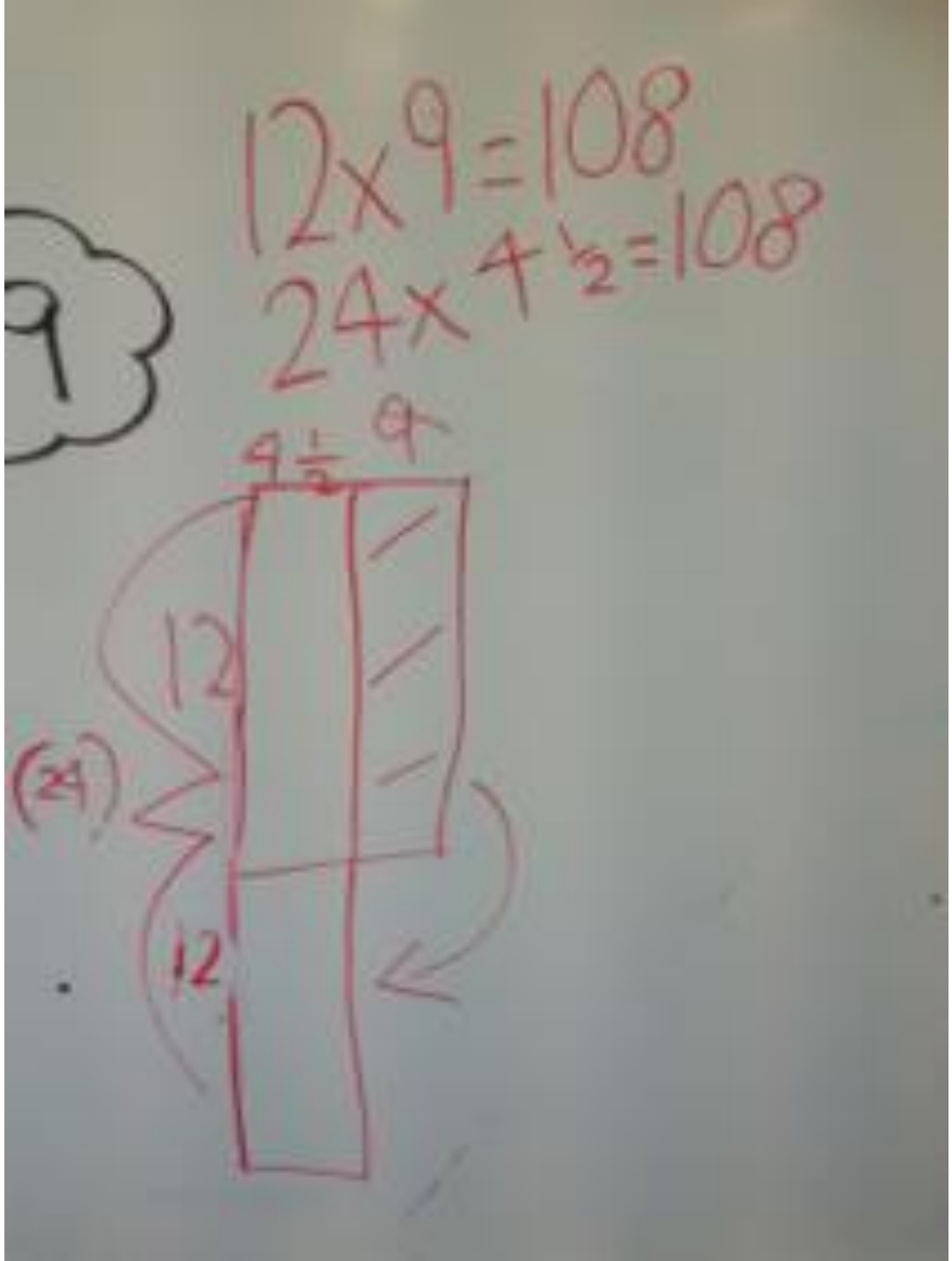
$(6 \times 2) \times 8 = 6 \times (2 \times 8)$

$(6 \times 2) \times 8 = 6 \times 16$

So $12 \times 8 = 6 \times 16$

$24 \times 4 = 96$


12 x 9 = 108
÷ 3
x 3
4 x 27 = 9 x 3 = 27
108
4
4
12
4
27
9
9
9
12
4
9
9


12x9=108
24x4½=108
9
9½
9
12
(24)
12

Structure

Freedom

Experienced teachers do two apparently contradictory things: They use more structures, and yet they improvise more. … The challenge facing every teacher and every school is to find the balance of creativity and structure that will optimise student learning.

Sawyer

Variety or Variation?

Variety

- ‘Pick and mix’
- Most practice exercises contain variety

Variation

- Careful choice of WHAT to vary
- Careful choice what the variation will draw attention to

Reasoning chains

STRUCTURE

- Variation builds and connects
- Only revealed one at a time

FREEDOM

- Pupil choice of method
- Teacher real time adjustments

Equivalence

- Representations that look different can all be linked to the same underlying mathematical idea.
- Numbers and measures can be expressed in an infinite number of ways.
- Different representations highlight different aspects of the mathematics.
- Calculating is often made easier by setting up an equivalent calculation.