9 steps to improve math instruction in Ontario

Marian Small

Thames Valley
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- What are measures of our success?

- EQAO is one piece.
- But enough enjoyment of math to pursue it later and to succeed when it’s less procedural is what we need.

- That is more likely to happen with a focus on thinking and understanding instead of primarily application and knowledge.

- Step 1: Focus on thinking and understanding, embedding knowledge and application.

- For example:

- Knowledge: What is 2/3 – 1/5?

- Or instead:
- Understanding: If the answer to a subtraction is 7/15, what might have been the denominators of the fractions you subtracted?

- For example
- Knowledge: What is the area of a circle with diameter 10 cm?

- Or instead
- Understanding: Draw a picture to show why the area of a circle with diameter 10 cm has to be about ¾ of $100cm^2$.

- For example
- Knowledge: What is the slope of the line $y = 3x - 2$?

- Or instead
- Understanding:A line has a slope of 3. If it goes through (1,1), what are some other points it has to go through?

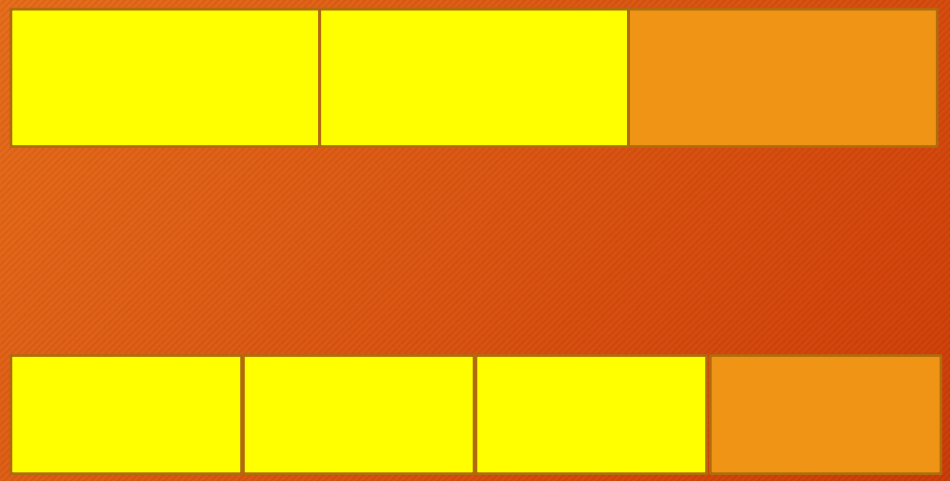
- For example
- Knowledge: Simplify:
- $2^3 \times 4^5$.

- Or instead
- Understanding: You simplified an expression and the result was 2^{13}. What could the expression have been?

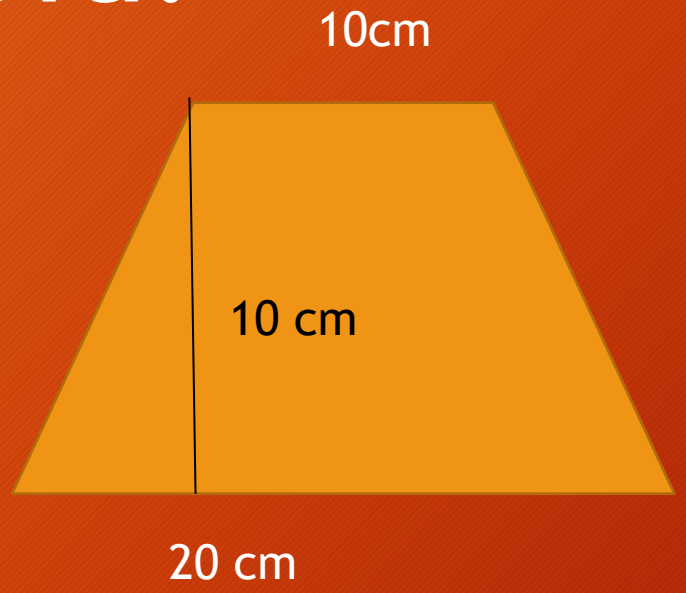
- You try:
- How could you change this to understanding?

- What is $2/3 \div 3/4$?

- One idea:
- Draw a picture to show why $2/3 \div 3/4$ is close to 1, but not quite.



- What is the area of this trapezoid?



- One idea:
- What two pieces of information about a trapezoid would tell you its area?

- Or
- A trapezoid that is not that tall has an area of 150 cm^2. What could its dimensions be?

- Step 2: Less use of problems that are “stand-alone”, and more use of problems that have options and that focus on ideas.

•Stand-alone

There are 14 students in the orchestra and twice that number in the band. There are 35 boys and 34 girls in the choir. If each student only participates in one group, how many students total are there in the orchestra, the band, and the choir?

students

- Richer example
- There are kids in a band, an orchestra and a choir.
- One number is twice another.
- One number is three times another.
- What could the total number of participants be?

•Another stand-alone

18. A basketball team won 48 out of the 80 games they played over the season.

a) What percent of the games did they win?

b) If they lost 30% of their games, what percent of the games did they tie?

- Or richer:
- A team won 60% of its games in a season.
- What are some amounts of games they could NOT have won?

•Here is another problem

Example: A bus leaves the terminal and averages 40 km/hr. One hour late, a second bus leaves the same terminal and averages 50 km.hr. In how many hours will the second bus overtake the first?

To make it richer

- Describe a scenario where one vehicle starts later than another but passes it about 2 hours.
- Tell when it passes.

Now you try to enrich a couple of problems

Olin has $0.85 in nickels and dimes. If there are 2 more nickels than dimes, , how many nickels does he have?

- e.g. Write a problem about money that could be solved by solving two linear equations simultaneously.

Now you try to enrich a couple of problems

The length of a rectangle is four times the width. If the area is $100m^2$, what is the length of the rectangle?

- e.g. What is true about the perimeter of EVERY rectangle where the length is 4 times the width?

- Even computations could require more thought.

- For example, instead of: What is 4/5 x 8/3, I might be asking:

- When you multiply a proper fraction by an improper fraction, is the result usually proper or improper?

- Step 3: Use data about your students to alter your plans for them.

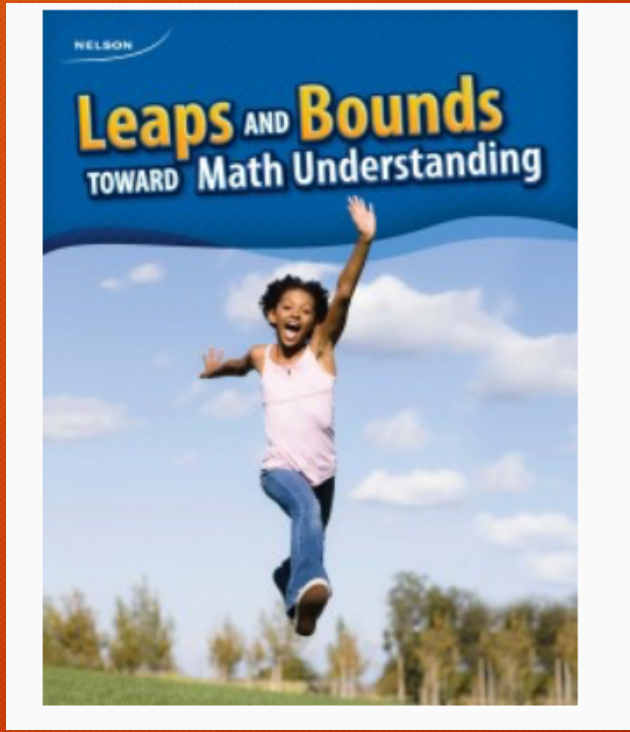
- It might be a diagnostic that is a short task or interview.

- For example, before work on area of a trapezoid, you might set a task like this:

- 1. What would make it easier to figure out the area of this shape?

- 2. How much and what information do you need to figure out the area of any triangle?

- It might be a diagnostic like from Leaps and Bounds.



- Step 4: Differentiate more, not just in practice, but in problems to be solved and maybe even assessment.

- That means using, e.g. parallel tasks and parallel assessments.

- An example task with a parallel

Choice 1: Describe what 10 colored cubes you would put in a bag so that the probability of selecting a red one is high but not certain.

Choice 2: Describe what 10 colored cubes you would put in a bag so that the probability of selecting a red one is $\frac{2}{5}$.

Choice 1: Show that the product of two numbers can sometimes be greater than the quotient and sometimes less.

Choice 2: Choose two numbers to make each statement true:

quotient < difference < sum < product

sum < difference < product < quotient

Find the equation of the line that completes the shape:

Option 1:

A **parallelogram**

$y = 8$

$y = -3x + 12$

$y = 2$

Option 2:

A right triangle

$y = -2x + 8$

$y = \frac{1}{3}x$

- Parallel assessments can focus on the same skills and concepts but with simpler examples.

- Step 5: It is critical to spend time deconstructing expectations and making thoughtful decisions about what really matters .

- For example: what matters here?
- Generate multiples and factors, using a variety of tools and strategies

- Maybe:
- A factor is never greater than the number and a multiple is never less.

- Every multiple of a number has the number as a factor.

- A factor means you can divide the original amount into that many equal groups.

- A factor means you can decompose the original amount into groups that are the size of the factor.

- You can find factors by building rectangles with the area of the number and figuring out side lengths.

- Factors come in pairs.
- If you know one in the pair, you can get the other by dividing the number by the known factor.

- If you know one factor of a number, it automatically tells you other factors.

- Or consider this one- what matters?
- Solve problems involving the estimation and calculation of the circumference and area of a circle

- Maybe:
- You only need one linear measurement of a circle to find all other linear and area measurements.

- Maybe:
- That the circumference of a circle gets bigger when the radius does, but maybe not the area

- Maybe:the circumference number is usually less than the area number, but not always.

- Perhaps another way to say the same thing- a focus on essential understandings

- For example, here are a few

- Every number can be represented in many ways. Each way may highlight something different about the number.

- We use percent as a way to standardize comparisons.

- Measurement formulas allow us to use measurements that are simpler to get to calculate others that are harder to get directly.

- .Any equation can describe many different situations.

- Step 6: Intentionality

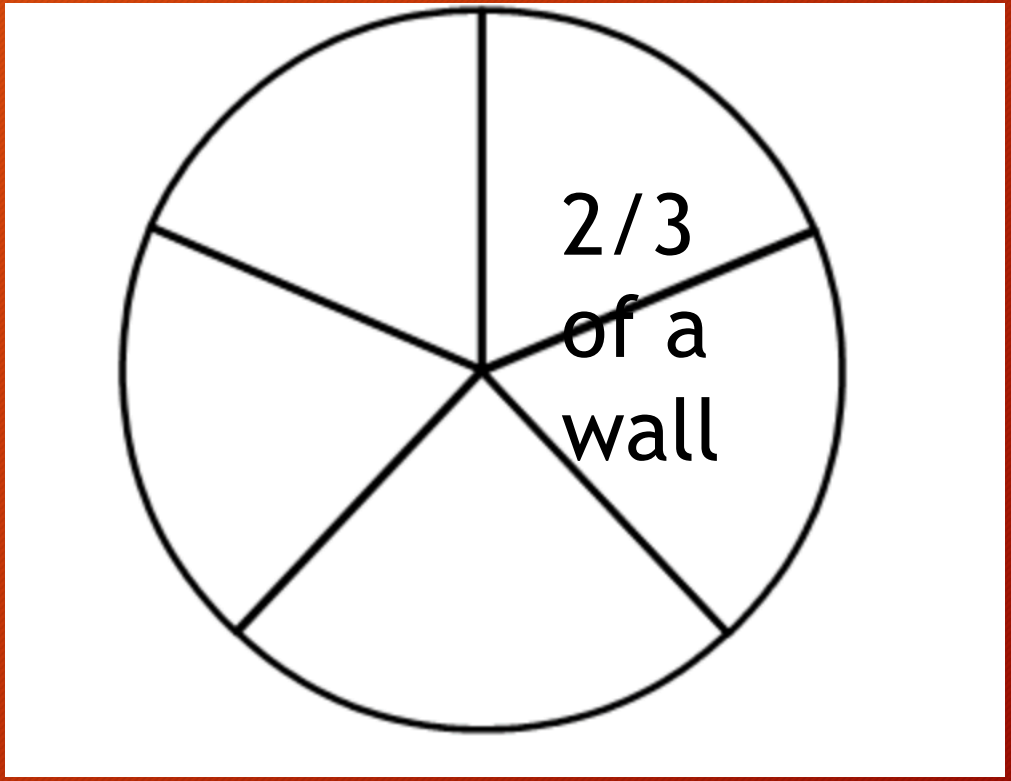
- You need purpose in your tasks. Choose them not just because they look nice or are the right topic.

- For example:
- Why might this be a good task if you want to focus on the meaning of division of fractions?

- Put fractions in the blanks:
- You can paint _____ of a wall in _____ of an hour.

- How much wall can you paint in one hour?

- E.g. 2/3 of a wall in 2/5 of an hour



- For example:
- Why might this be a good task if you want to see how shapes with the same perimeter vary in terms of their area?

Imagine a rectangle where the length is four times the width and another where the length is double the width.

The perimeters are the same. Which has more area?

- 12

3

10

5

- Using backwards design to plan lessons.
- Start with a meaningful learning goal and plan the kinds of questions kids should be able to answer.

- Also be intentional with manipulatives.
- They are not just for getting answers. They are for exploring ideas.

- For example:
- You combine a bunch of +1 counters with four times as many –1 counters. What can the totals be?

- For example:
- You use 15 algebra tiles to model a multiplication. What multiplication could it be?

- Step 7: Changing, BIG TIME, the way you consolidate lessons.

- Same day most of the time.
- Pre-planned (for the most part) most of the time.
- A focus on the math, not how the solution is achieved.

- Include more kids in consolidation by using turn and talks or asking them why one student did whatever he/she says he/she did.

- For example, you asked kids to figure out when Plan A is better and when plan B is better.

- Plan A: $30/month + 10¢ per text
- Plan B: $80/month + unlimited texts

- Instead of just asking for answers, you might ask:

- Why might someone assume the first plan is always better?

- Why might someone assume the second plan is always better?

- When is it super obvious that the first plan is good?

- When is it super obvious that the second plan is good?

- Could you use a graph to help solve the problem? How?

- Could you use a table of values to help solve the problem? How?

- Could you use equations to help solve the problem? How?

- Step 8: Not viewing skill practice and problem solving as divorced, i.e. using problems as a vehicle for practice.

- You might ask, for example:
- You graphed a lot of lines of the form $y = mx + m$.

- What do you notice?

- Or you multiply some pairs of fractions.
- Each time, the product was only a little bit more than both factors.
- What could they have been?

- Step 9: Scaffold less and only when needed.

- In the end, kids need to care.

- And that’s all about your relationship with them.

- And all about whether you pique their curiosity.

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