Neuf mesures pour améliorer l'enseignement des mathématiques de 7^e à la 12^e année en Ontario

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- What are measures of our success?

- OQRE is one piece.
- But enough enjoyment of math to pursue it later and to succeed when it’s less procedural is what we are looking for.

- 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.

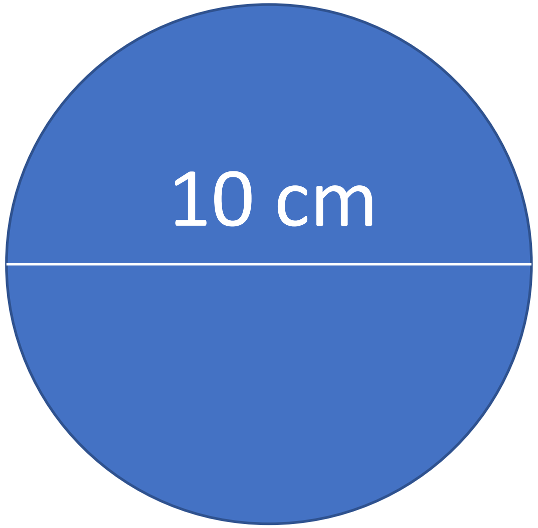
- For example:

- Knowledge:

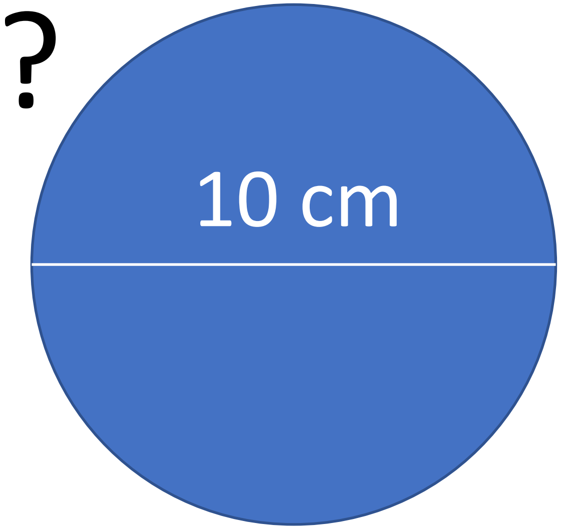
What is $2/3 - 1/5$?

- Or instead:
- Understanding:
- []/? – {}/?? = 7/15.
- What might ? and ?? be?

- For example
- Knowledge: What is the area ?



- Or instead
- Understanding: Why is the area 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.
- It goes through (1,1).
- Name other points on it.

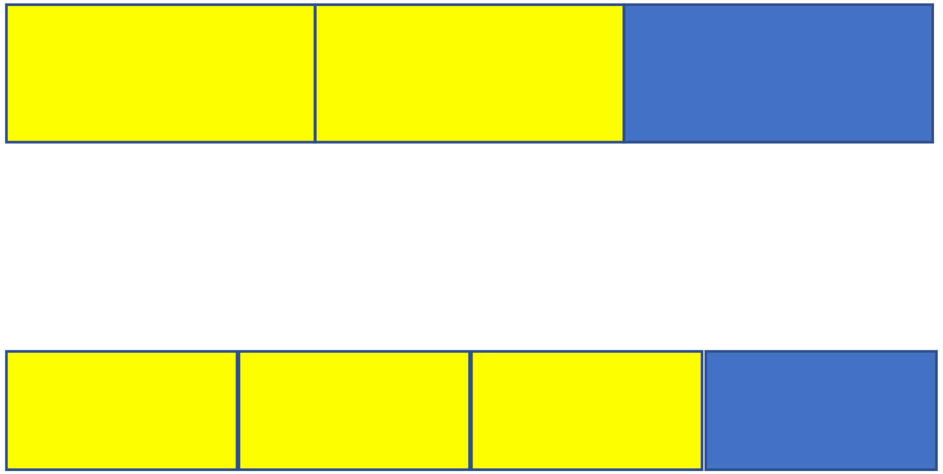
- For example
- Knowledge:
- Simplify:
- $2^3 \times 4^{-5}$?

- Or instead
- Understanding:
- You simplified.
- The result was 2^{-7}.
- What could it have been?

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

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

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



- What is the equation of a parabola with a vertex at (1,5) that goes through (2,8)?

- A parabola with vertex (1,5) is graphed.
- What quadrants could the graph go through?
- Are there options?

- Step 2: Fewer”stand-alone” problems.
- More focus on ideas.

- Stand-alone example:

- A pan was marked up 25% from the original price of $30. If you pay the 13% HST, how much do you pay now?

- Richer example
- A jacket is marked down 20%.
- It costs the same as shoes marked down 40%.
- What was the relationship between the original prices?

- 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.

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 surface area of a cone, you might set a task like this:

- 1.What would the net of a cone look like?

- 2. What measurements on that net are related?

- 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?
  - découvrir expérimentalement la formule de calcul de l'aire d'un cercle, à l'aide de matériel concret ou illustré.
  - estimer et calculer l'aire de cercles.

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

- Maybe:
- That if the circumference of a circle doubles, the area does not.

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

- Or maybe this one:
  - démontrer des identités trigonométriques simples en utilisant l'identité de Pythagore $\sin^2 x + \cos^2 x = 1$, l'identité quotient $\tan x = \dfrac{\sin x}{\cos x}$ et les identités des rapports trigonométriques inverses : $\operatorname{cosec} x = \dfrac{1}{\sin x}$, $\sec x = \dfrac{1}{\cos x}$ et $\operatorname{cotan} x = \dfrac{1}{\tan x}$.

- Maybe:
- There are some statements involving trig ratios true for NO angles, some true for ALL angles and some true for SOME angles.

- Maybe:
- This is just like algebra, e.g.
- $x + 1 = x + 2$ vs
- $x + x = 2x$ vs
- $x + 3 = 9$

- Maybe:
- That all the trig identities derive from knowing $\sin^2 + \cos^2 = 1$ and definitions of the ratios

- 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

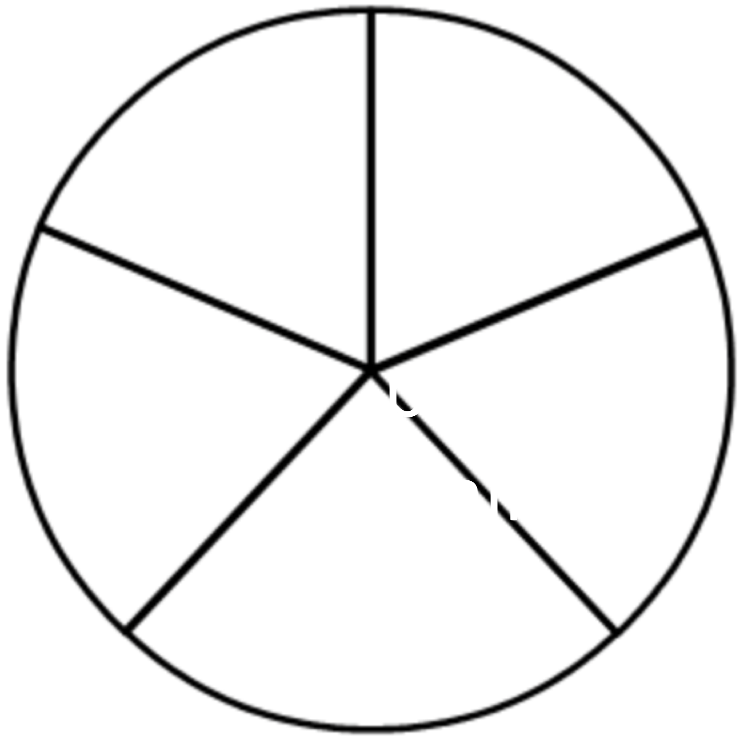
- You need purpose in your tasks. Choose them not just because they look nice or are the right topic.

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

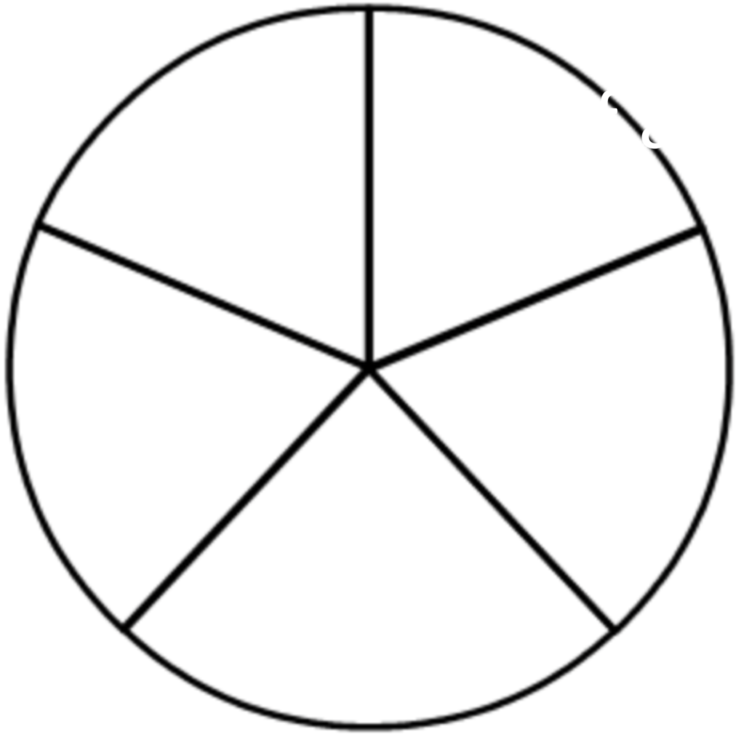
- Put fractions in the blanks:
- You can paint _____ of a wall in _____ of an hour.

- How much wall can you paint in one hour?

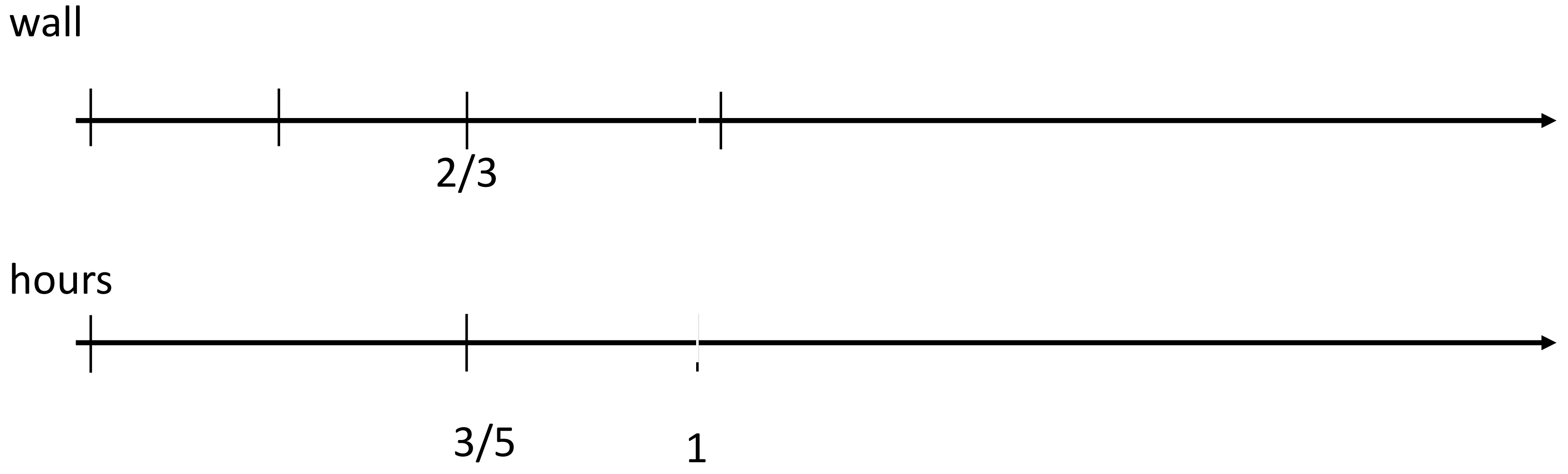
- Maybe:



- Maybe:



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



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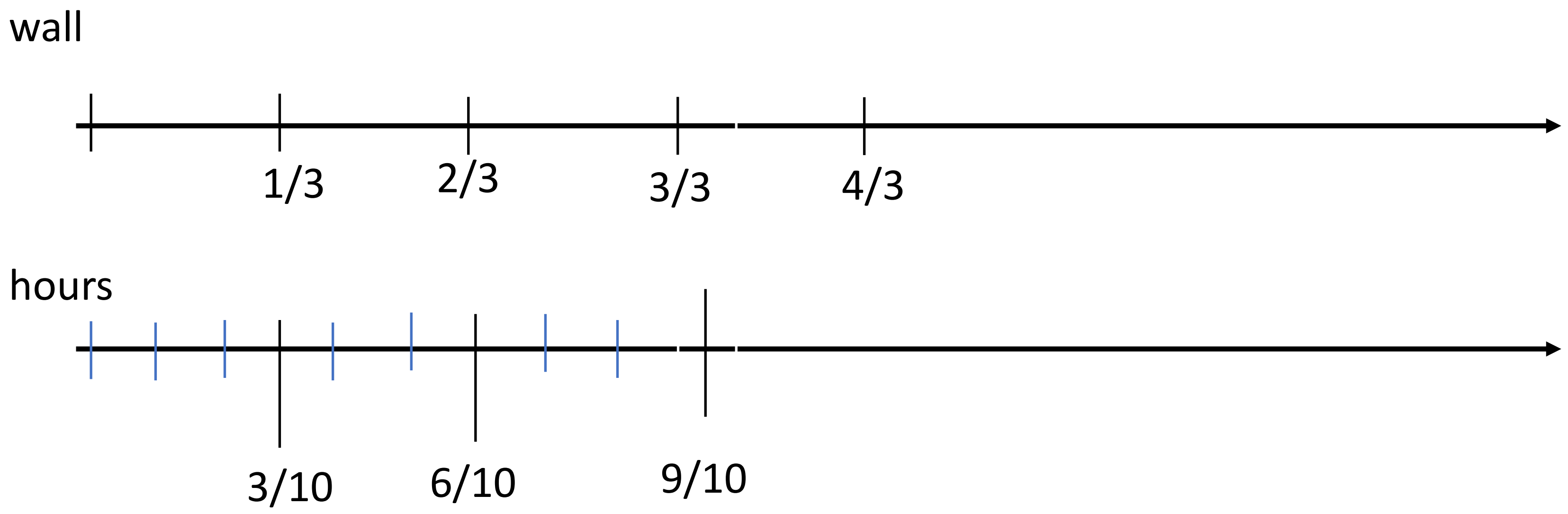

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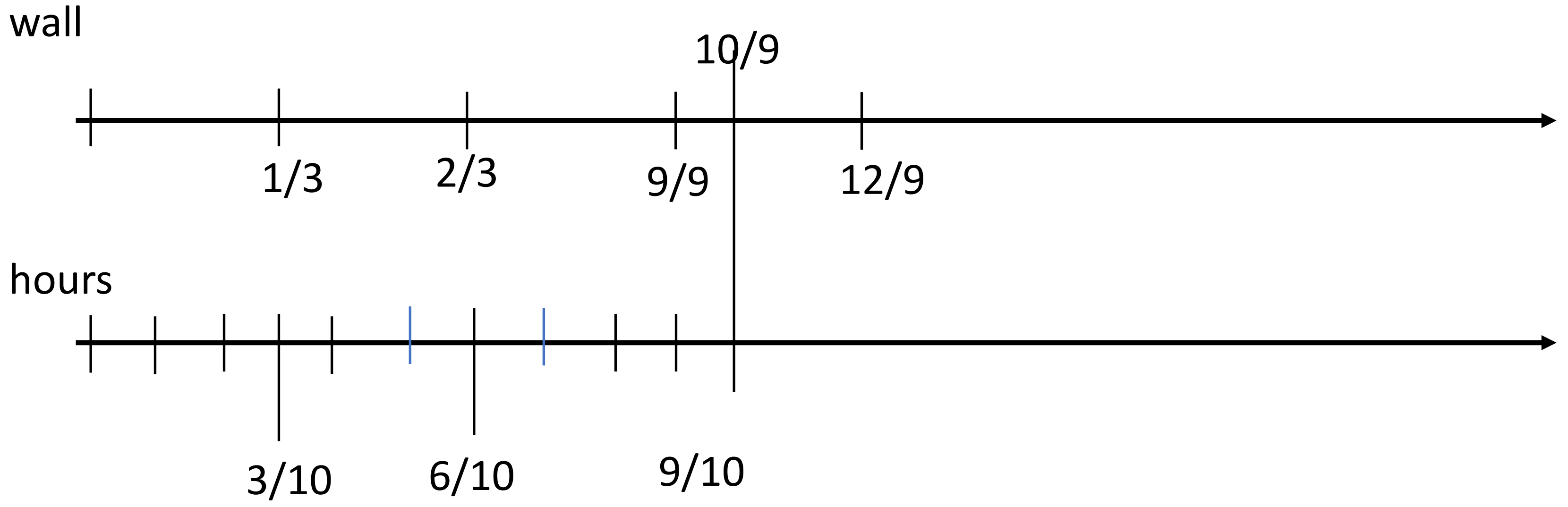
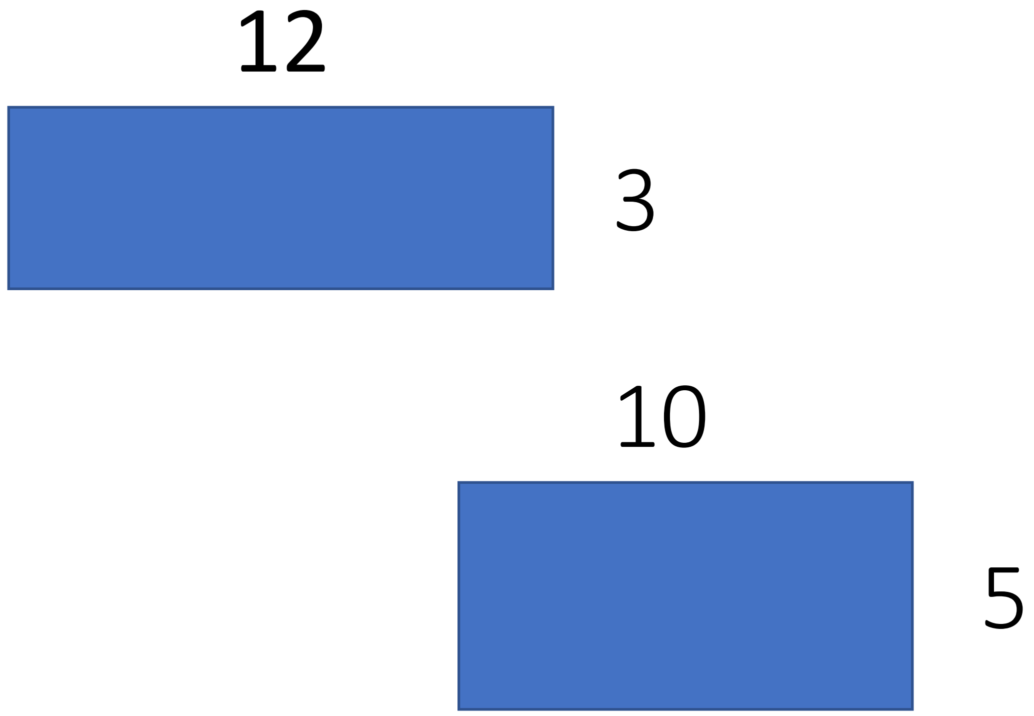


- For example:
- Why might this be a good task if you want to see how shapes with the same perimeter vary in terms of their area?

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 we 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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