9 Steps to improve math instruction

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- What are measures of our success?

- Test scores 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, too.

- 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 250 – 137?

- For example:

- Understanding: Without getting an answer, how do you know that:

- 250 – 137 is just a little more than 100.

- 250 – 137 has the same answer as 253– 140?

- 250 – 137 is 3+ 10 + 100?

- 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?

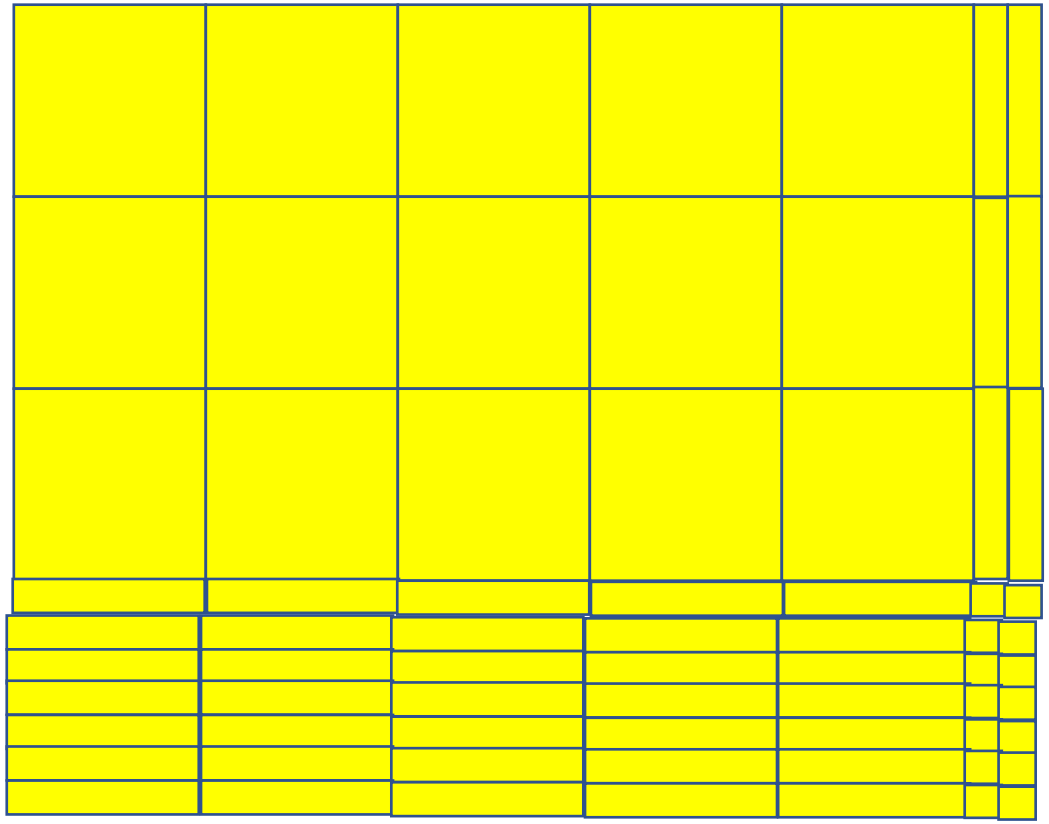
- For example
- Knowledge: What is the slope of the line $y = 3x - 2$?

- 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?

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

- What is 52 x 37?

- One idea:
- Draw a picture to show why 52 x 37 is not a lot less than 2000.



- Or:
- What story problem might lead you to calculate 52 x 37?

- 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 example:
- Jane has 3 apples. Andrea has 6. How many do they have altogether?

- Richer example
- Andrea has twice as many apples as Jane. How many could they have altogether? Are there impossible totals?

- 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 problem

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:

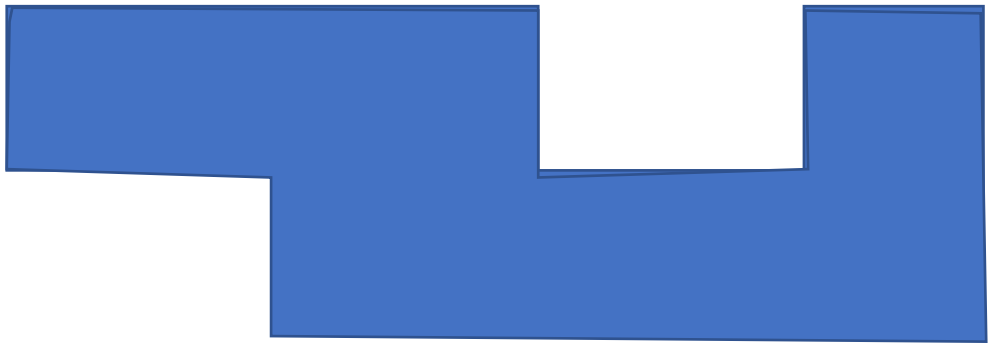
- When you multiply a proper fraction by an improper fraction, is the result usually proper or improper?

- 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?

- 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 figure 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.

- 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?

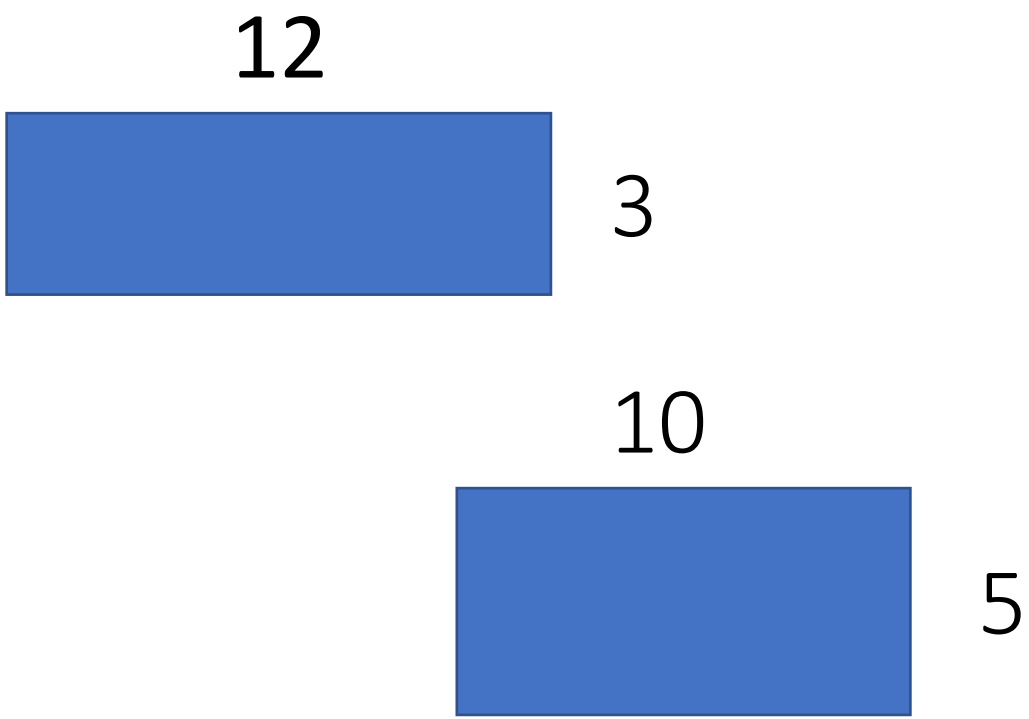
- Put numbers in the blanks:
- ____ people are sharing ____ muffins fairly.
- How many muffins will each get?

- I want students to notice:
- Which number is bigger and why.
- That different pairs can lead to the same answer.
- That you could multiply the number of people by the muffins each gets to get the total.

- 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 use pattern blocks to make a design that is ½ yellow.
- What do you notice?

- 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 multiply some pairs of fractions.
- Each time, the product is 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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