

Leading Mathematics Instruction

Marian Small

January 2017

Effective math instruction depends on

- teacher mindset

- It is important for teachers to reflect on their beliefs.
- By reflecting, they might consider choices and then make better decisions.

- What do your teachers focus on more?

- Covering curriculum
 - OR
 - Student engagement
-
- Getting things done
 - OR
 - Deep thinking

- I am going to introduce the “lingo” of View 1 and View 2 teachers.
- View 1 teachers get it done.
- View 2 teachers analyze what’s really important and focus on that.

- Are your teachers View 1 teachers or View 2 teachers?

- Let's consider an expectation.

- Demonstrate an understanding of place value in whole numbers and decimal numbers from 0.01 to 10 000 using a variety of tools and strategies

View 1

- Make sure that when you present a number to a student, they can tell you which digit is in which place (and vice versa)
- OR

View 2

- A number has two fives in it and maybe other digits too.
- One five is worth 100 times as much as another.
- What could the number be?
- (maybe 505 OR 5052 OR 0.525)

A different expectation

- Translate between equivalent forms of a number (i.e. decimals, fractions, percent)

View 1

- Given one form of a number, the student can give the other forms.
- OR

View 2

- Can give examples of situations where using a decimal makes life easiest,
- where using a fraction makes life easiest,
- where using a percent makes life easiest.

Another expectation

- Factor trinomials of the form $ax^2 + bx + c$ where $a = 1$

View 1

- Just factor $x^2 + 5x + 6$
- OR

View 2

- Explain why $x^2 + 4x + 1$ is not factorable.

- The View 1 and View 2 teacher bring out different ideas to their students.
- Their students get a different “feel” for what math is or what is important in math.

What really matters in the math classroom

- It's hard to choose, but I will focus on some things you might or might not be thinking about now.

- The teacher has a learning goal that fits the nuts and bolts of the curriculum but reaches beyond skills toward critical thinking or at least thinking! (i.e. View 2)

For example

- The goal is not just about multiplying fractions, but is about helping kids see how you can predict whether the value of a number will increase or decrease a lot or a little by the fraction you multiply by.

Is INTENTIONAL

- The teacher can tell you why s/he is doing what s/he is doing throughout the pieces of the lesson.
- Can tell you why s/he is NOT doing what s/he is NOT doing

Varies format

- There is no one perfect lesson format to fit all children and all content every single day.

Focuses on student learning

- Not teacher lecturing, but...
- The teacher still plays a HUGE role in bringing to light the important ideas in the lesson

Engages students

- With interesting problems that pique curiosity either about real-life phenomena or math itself

Real life

- How long is long hair?
- How many sheets of paper does the office printer print in a year?

More mathematical

I might ask kids:

- You add two numbers and the sum of the two numbers is 10 more than the difference.
- I'll give you one answer--- 12 and 5.
- What do you notice about all of our answers?

OR

I might ask kids:

- Is it true that the graph of the line $y = 20x - 1$ has to be steep?
- And they explore that conjecture.

The consolidation

- There needs to be a meaningful consolidation.
- Its focus is NOT just to share work.
- Its focus is to evoke the important ideas of the lesson using the children's work and thinking.
- (I'll be more specific about this in the breakouts.)

Focuses on big ideas

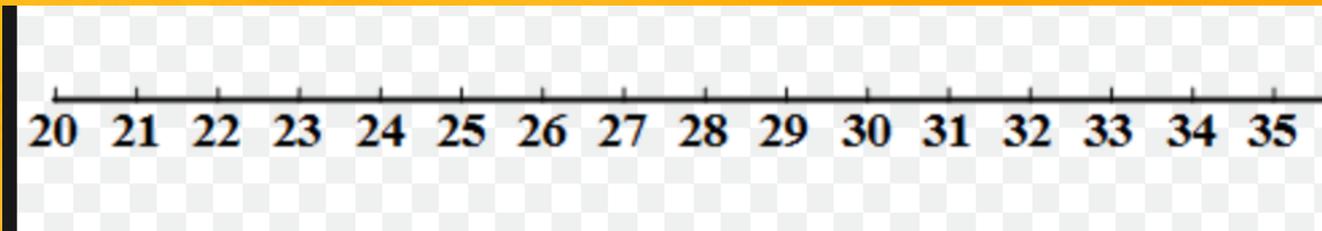
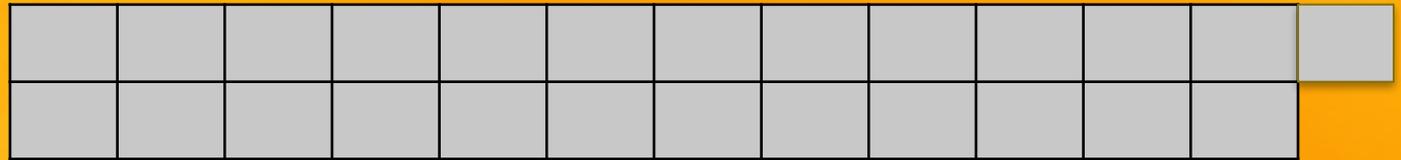
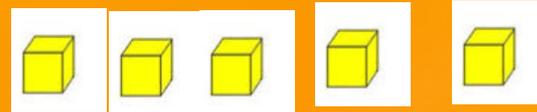
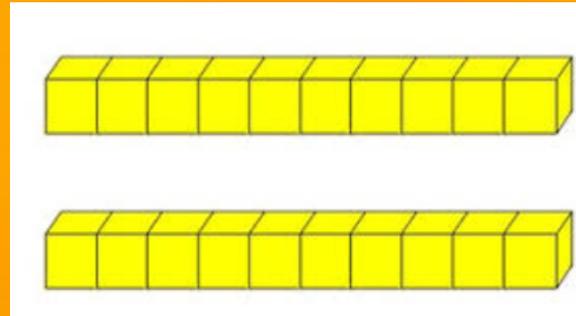
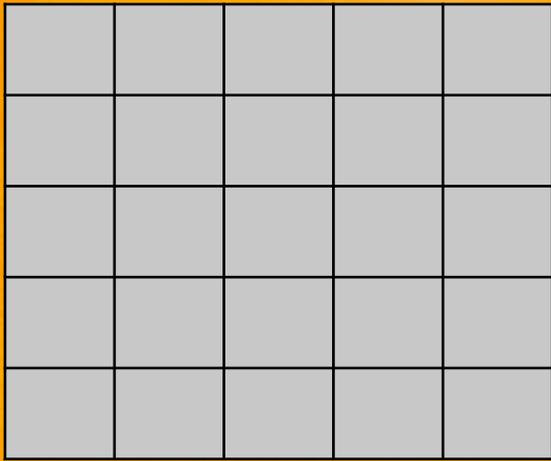
- Each teacher should be thinking about clustering the expectations they teach to focus on Big Ideas.
- It is the Big Ideas that empower students mathematically and out of which learning goals should be drawn.

For example...

- Different representations of numbers tell me different things about them.

Show

$.25$ in lots of ways.



Did any of your ways

make it easy to see:

- that it's 5×5 ?
- that it's more than 20?
- that it's an odd number?

Big Ideas

- Big ideas are not the same as overall expectations.
- They are different (in many cases, but not all) from one strand to the next.

PEDAGOGICAL FOCUS

Desirable pedagogy

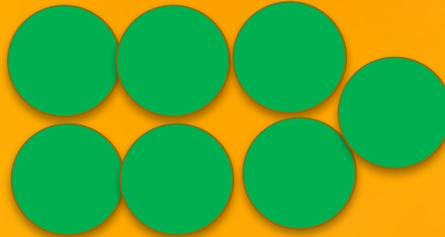
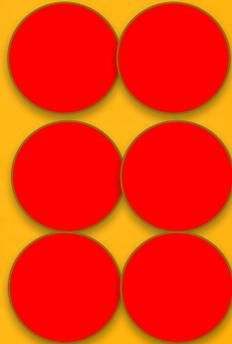
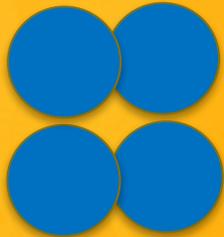
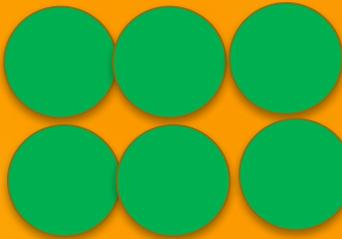
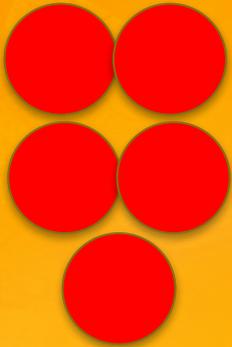
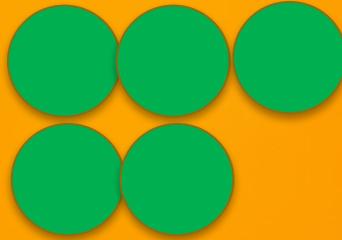
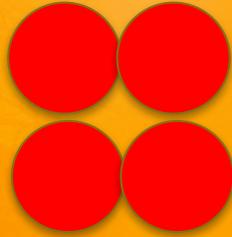
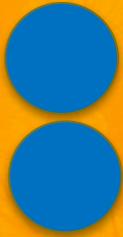
- Students learning collaboratively.

Desirable pedagogy

- Using manipulatives in purposeful ways, not just to do it because you should and not to be another thing for kids to memorize.

For example

- You have three piles of counters.
- There are some blue counters.
- There are 2 more reds than blues.
- There are 3 more greens than blues.
- How many counters might you have? How many of each colour?



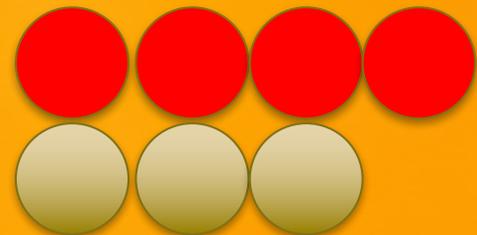
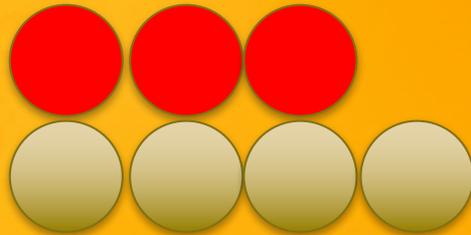
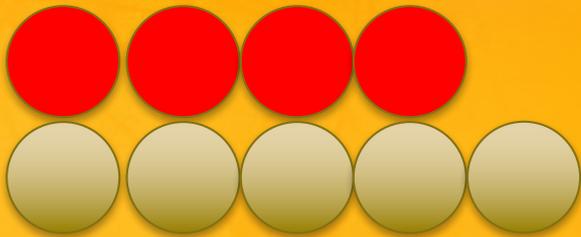
My intention

- If $r = b + 2$
- If $g = b + 3$

- That b can be anything and r and g are more.
- That g must be $r + 1$.
- That the total can only be 8, 11, 14, ... and why.
- More broadly, how knowing some information gives you other information.

For example

- You have a bunch of counters.
- Almost half are red.
- What could you have?



Desirable pedagogy

- A focus on encouraging personal strategies (e.g. How might you solve 24×8 ?)
- This may be number talks, but should happen in most other situations, too.

Eliciting thinking

- What is $42 + 19$?

vs.

- You add two numbers. The answer is close to triple one of them. What could the numbers be?
- [NOTICE: You must have added a number to its double or close to that.]

Eliciting divergence

- What is 38×7 ?

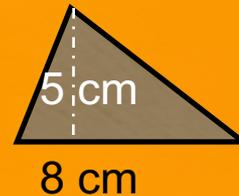
vs.

- Which is easier for you to calculate: 38×5 or 38×6 ? Why? OR
- Pick a two-digit number to multiply by a 1-digit number. The ones digit of the product needs to be 6. What is your product?

Eliciting divergence

- Find the area of this triangle.

VS



- A parallelogram has half the area of this triangle. What could its dimensions be?

Differentiating instruction

- Teaching with a focus on big ideas allows teachers to meet the needs of diverse students at the same time.
- This is as true at the secondary level as the elementary one.

Open questions

- One strategy I have been sharing is the use of open questions.
- These can be addressed effectively by students at many different readiness levels.

An example

- The answer is 50.
- What might be the question?

Some possibilities

- What is half of 100?
- What is double 25?
- What's a number toward the middle of a hundred chart?
- What might be the number of kids in two classes?
- What is a number you say when you count by 10s?

Do you notice?

- Do you notice how inclusive the last question is?
- Can you see how open questions might support building a culture of high expectations?

Parallel tasks

- We have also been using two or more tasks founded on the same big idea but meant for students with different readiness levels.

For example...

◆ Name two
fractions between
 $\frac{1}{2}$ and 1.

◆ Name two
fractions between
2 and 3.

Common questions

- Which was greater- the numerator or denominator?
- Could the numerator and denominator have been 2 apart?
- What do you know, for sure, about how the numerator and denominator are related?

Notice

- All students, at whatever level, are still focusing on problem solving and communicating in math.
- They are building their confidence.
- The strugglers are not relegated to tedious exercises.

EFFECTIVE ASSESSMENT

Assessment of Learning

- Teachers will be gathering substantial data using conversations and observations and not just products, particularly not just written products.
- Teachers will be using rubrics in appropriate circumstances.

Assessment of Learning

- Will be measuring performance on big ideas and not just on “repeating” what was shared
- All four (five?) categories of knowledge and comprehension, application, thinking and communication are measured in appropriate proportions.

By the way

- Knowledge and understanding are different.

E.g.

- What is $8 + 5$? vs.
- Why does $8 + 5$ have to be more than $6 + 5$? How much more?

They will...

- focus as much, if not more, on assessing concepts as procedures.

They will...

- allow students to show their knowledge in a variety of ways

Differentiating..

- Teachers will provide alternative forms for assessing student learning as needed
- Teachers will ensure at least some questions are open enough to allow students to show as much as they can about their knowledge on the relevant topic, perhaps using open or parallel tasks.

Your challenges

- One real challenge is that elementary teachers are insecure about what math to teach and their own ability to teach it
- Secondary teachers are less insecure but their comfort is often with procedures and not with a deeper understanding of math

Your Role

- Your role is to expect teachers to improve their teaching and to support and coach teachers trying to do that.
- Your role is also to build a coherent staff moving in the same direction in terms of math pedagogy, bringing along the stragglers.

You ..

- need to get your hands dirty.

That includes:

- learning the math with your teachers
- planning lessons with your teachers
- observing lessons and analyzing what happens, discussing it with teachers
- asking the hard, but critical, questions

We need to acknowledge

- That looking at math deeply takes a lot of learning. We can't expect teachers to do it instantly independently.
- They need support/modelling, etc.

You might

- set up PLCs for math in the school
- sponsor participation in appropriate professional learning opportunities
- set up common planning times and make sure the focus is on broadening, and not narrowing, instructional approaches

You should be able...

- to ask a teacher, in passing, what new idea s/he is trying and s/he should have an answer

You might look for...

- how often teachers are changing instructional plans based on prior assessment
- how often teachers change instructional plans based on comments students make
- how often teachers ask questions that really expose student thinking

Acting as an advocate

- Ultimately, you are the advocate for your students, and, often for their teachers.
- You have to work at getting the resources needed to do the best job, but often it is not money– it is just a commitment.

Your role is...

- To expect, but to help
- To advocate, but for what's best for your students
- To encourage some consistency in the school, but individuality too.

Greatest Needs

- After a good classroom environment, which is fundamental, but not enough....

Greatest Needs

- Unpacking expectations to develop appropriate learning goals
- Building tasks with purpose toward getting directly to those learning goals
- Getting tighter in instruction and not wasting incredible amounts of time

Greatest Needs

- Asking understanding questions more than knowledge questions
- Encouraging student use of more visual representations
- In general, eliciting deep thinking and real understanding

Download

- www.onetwoinfinity.ca
- HWK