

Leading effective math instruction

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Effective Math Instruction



Is partly

- About teacher mindset

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

- 
- You might ask:
 - What do you think most about as a teacher?



Is it...

1

Covering
curriculum?

2

Student
engagement

3

Higher test
scores?

4

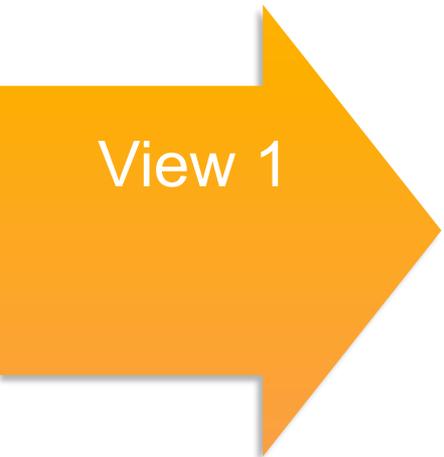
Developing
positive attitudes
toward math?

- 
- We will contrast View 1 and View 2 teachers.

- 
- Which would your teachers choose?
 - Which would you choose?

- 
- 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)



Can answer a question like:

A number has three fives in it and other digits too.



View 2



One five is worth 100 times as much as another.



View 2

One five is worth 1000 times as much as another.

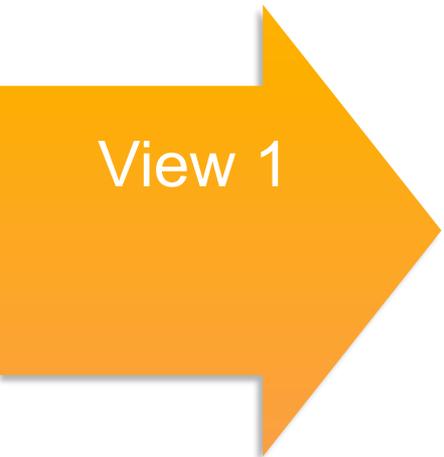
What could the number be?

By the way: e.g. 5525



Consider
this....

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.



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.



The View 1 and View 2 teacher bring out different ideas to their students.



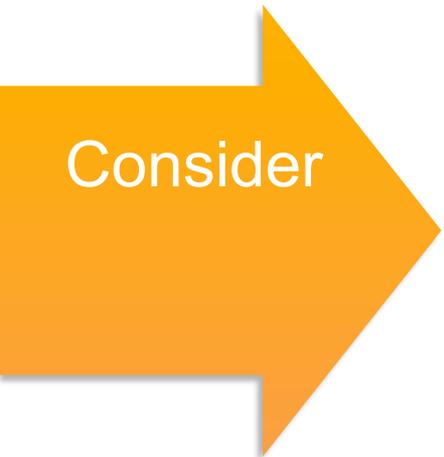
It matters

Their students get a different “feel” for what math is or what is important in math.



Assessment

Teachers can also have different mindsets about math assessment.

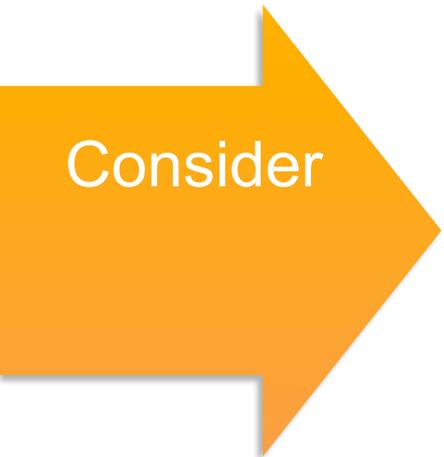


Consider

Imagine this task for a grade 4 student.



You are multiplying two numbers.



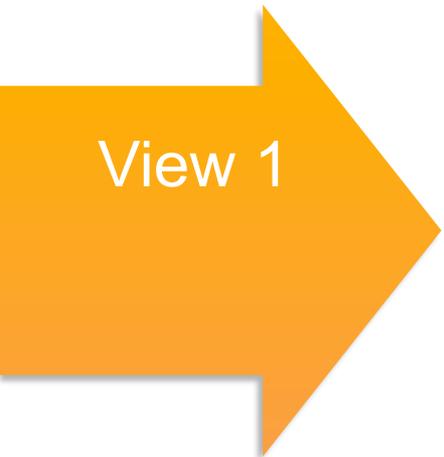
Consider

You find it **SUPER EASY**.

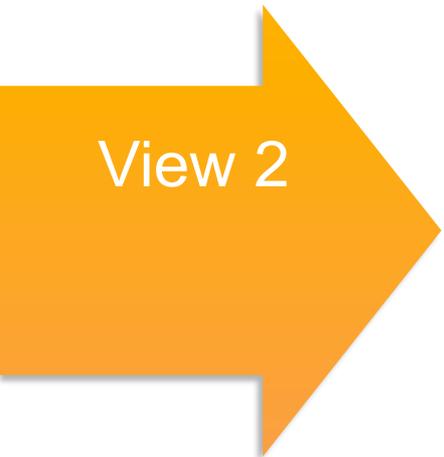
What two numbers might you be multiplying?



But how would I mark this?

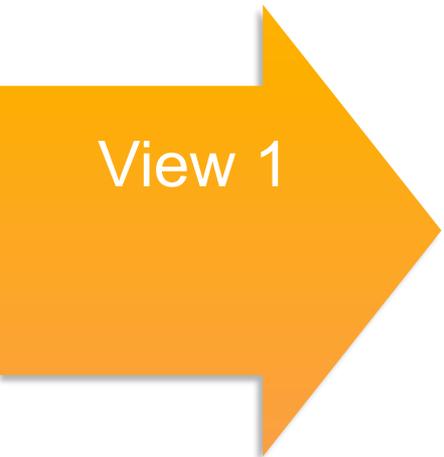


View 1



View 2

I would find out so much about what kids know.

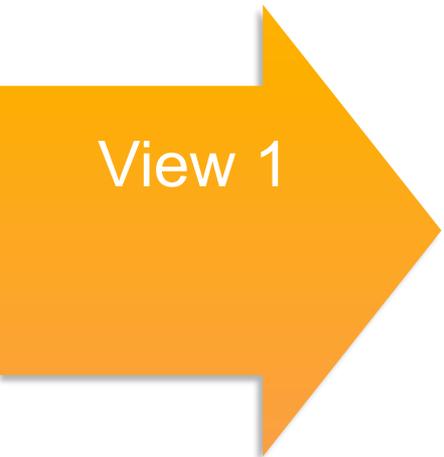


Which is more: $\frac{2}{3}$ or $\frac{3}{8}$, etc.



View 2

If one fraction has a closer together numerator and denominator than another, is it bigger?



View 1

Divide 382 by 2 and explain what you did.



View 2

How do you know that $382 \div 2$
HAS TO BE more than $182 \div 2$
without getting the answer?

How much more?



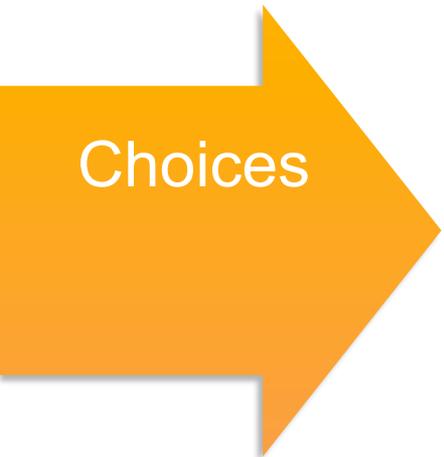
Professional Goals

Do your teachers/do you believe it is important to always keep trying new teaching strategies?



Keeping
up

Do your teachers/do you believe it
is important for you to do
professional reading?



Choices

There will be two statements.
With which would your teachers or
you most agree?



Is it...

1

If you work at your teaching, you improve and student learning improves.

2

You can only control some of what kids learn; most of it depends on the attitudes/ knowledge of your students. So do your best, but accept the inevitable.



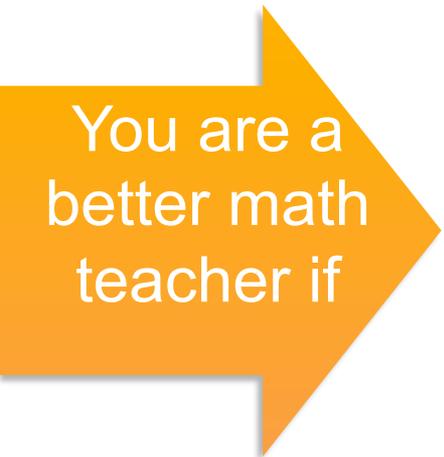
Is it...

1

Once you've taught for a while and have established some good practices, you should stick with those practices.

2

You should always be testing out new approaches.



You are a
better math
teacher if

1

you know the math you
are teaching deeply.

2

you've struggled with
math yourself so you
understand potential
student struggles better.



When you struggle with a new approach

1

You keep trying until you get it.

2

try it once or twice and if it doesn't work, you realize it won't be effective and look for others.



If a problem
seems
challenging

1

You don't use it with your students; you want them to be successful.

2

If you think it is mathematically valuable, you give it a shot anyway.



1

It is very important to spend time perfecting algorithms with larger numbers.

2

Estimating matters. Calculating with large numbers is not worth a lot of time.



All of the
previous
discussion

1

Is not about what you should or should not believe, but what you could or could not believe.

2

You have the right to decide. But perhaps it has to be a more conscious decision that it sometimes is.

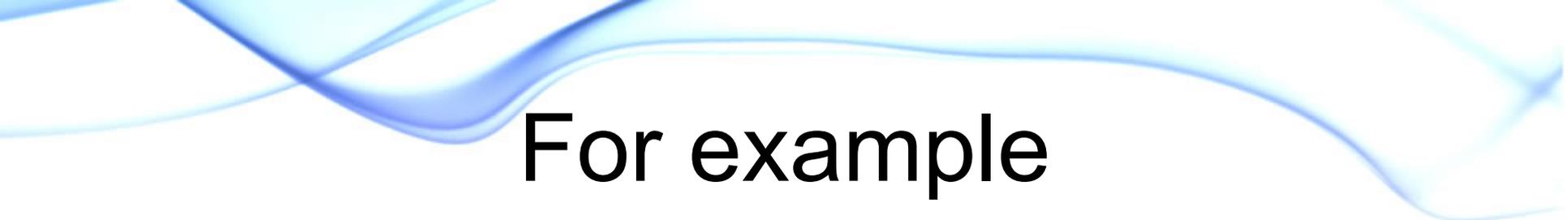


Effective instruction

- Is not only about structures and beliefs.
- It is about what we teach.

Has an appropriate goal

- 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!



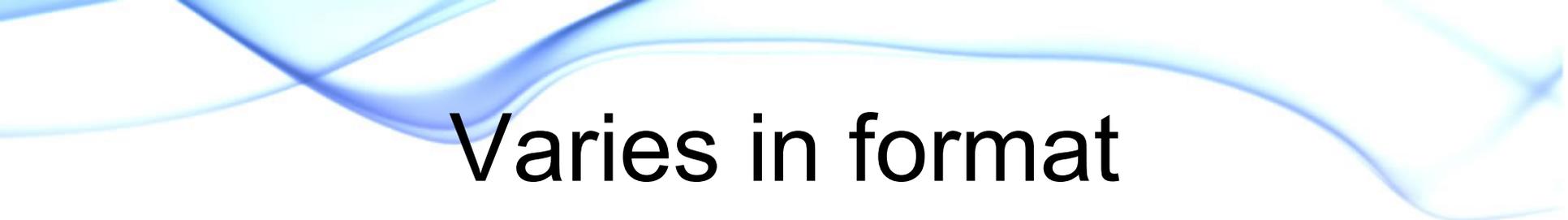
For example

- The goal is not just about multiplying 3-digit numbers by 1-digit numbers, but is about helping kids see how decomposing numbers thoughtfully helps us deal with computations.



Is thoughtful

- 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 in 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, BUT I do not believe they have to always be real-life

For example...

I might ask kids:

- You add two numbers and the sum of the two numbers is 6 more than the difference [just in the interest of time, today, one possibility is 9 and 3].
- What do you notice about all of your answers?



OR

I might ask kids:

- Is it true that whenever the numerator and denominator of a fraction are closer together, the fraction is bigger?
- 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.

Fitting in practice

- Consolidation is NOT the same as practice.
- Students need to consolidate the main teaching activity by “debriefing” prior to any practice activity.



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.



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?



Sample Big Idea

- The unit chosen for a measurement affects the numerical value of the measurement.



You could ask...

- You are using a strip 4 cm long to measure something.
- Your friend is using a strip 5 cm long.
- Who will need more strips?
- Why don't you need to know the size of the something?



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.



Big Ideas

- There are several, although not a lot, of variations on what these are, but teachers could work collaboratively on “tweaking” them to make them useful to themselves. THIS IS VALUABLE PL.



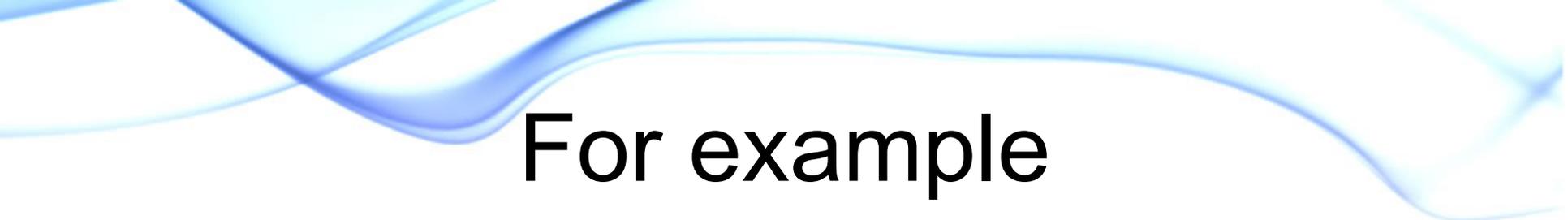
PEDAGOGICAL FOCUS

Desirable pedagogy

- Students working in pairs/groups, maybe even sharing chart paper or technology or manipulatives

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

What can I do with counters?

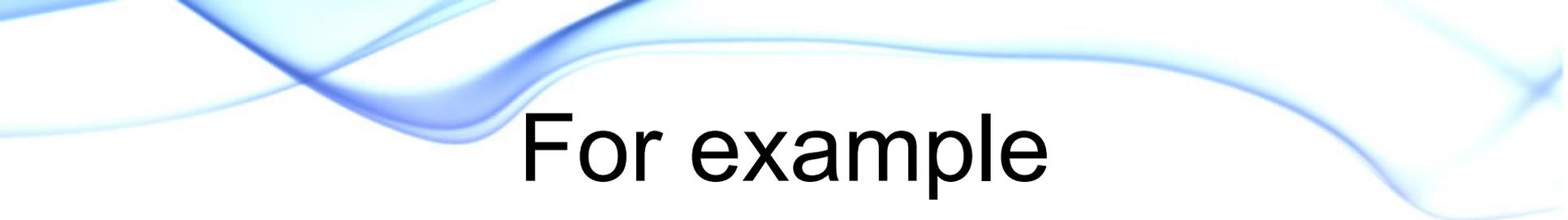
- How might you arrange 8 counters to make it **SUPER EASY** to see that there are 8?

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?

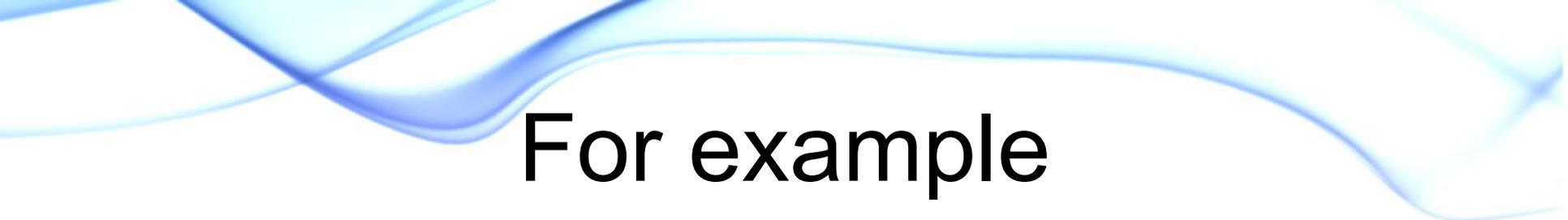
For example

- You have three piles of counters.
- There are some blue counters.
- There are twice as many reds as blues.
- There are 3 times as many greens as blues.
- How many counters might you have? How many of each colour?



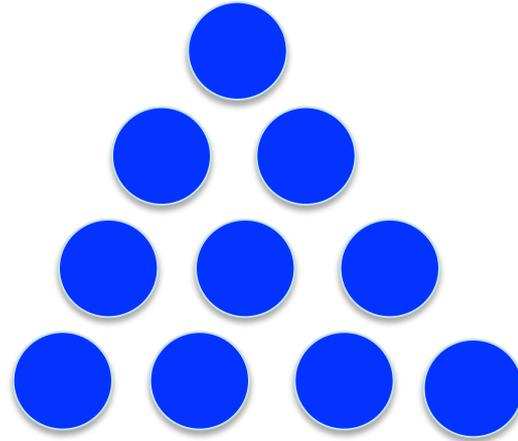
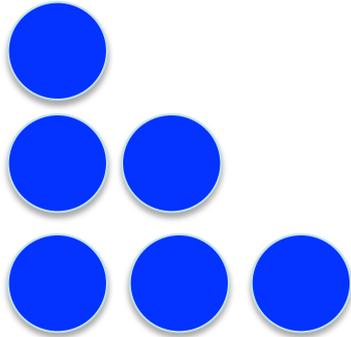
For example

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



For example

- You can show a number by putting out counters in the form of a triangle.
- What numbers can you make? Which are harder to make?



For example

- You have red, green and blue counters.
- The average number of counters for a colour is 20.
- How many of each might you have?

Desirable pedagogy

- A focus on encouraging personal strategies (e.g. How might you solve 24×8 ?)

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?

Eliciting thinking

- What is $42 - 18$?

vs.

- Why does $42 - 18$ HAVE TO have the same answer as $44 - 20$?

Eliciting divergence

- What is 38×7 ?

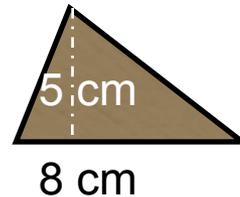
vs.

- Which is easier for you to calculate: 38×5 or 38×6 ? Why?

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



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.

Creating, not Repeating

- There is ample evidence that student involvement in the development of concepts is much more important, long-term, than their ability to recall rules. They need to learn to think mathematically, not just follow procedures.



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 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 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.



You might...

- participate in a classroom as an observer or as a co-teacher with students or work with a particular small group of students as they work through a problem



You need to think about...

- what the kids say and do--- are they risk-takers? If not, why not?

Are they willing, or even eager, to solve problems? If not, why not?



You also need to think about the teaching environment

- What is the teacher doing or not doing to bring about those behaviours?

Is s/he creating independent confident learners or insecure learners?

Teachers need to be..

- working on building their **pedagogical content knowledge**.
- This includes reading, studying or working with colleagues to learn to know what math is important, be aware of different approaches to that math, know how students might respond differently, and prepare for those responses.



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



Are teachers...

- Focusing on the important part of the mathematics?
- Thinking in terms of “big ideas” and building connections?
- Posing questions that help students focus on making sense of the math they are learning?



Are teachers...

- using ongoing assessment for gathering data to plan their instruction?



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



You might look for...

- how often teachers differentiate instruction
- whether teachers record assessment for... information

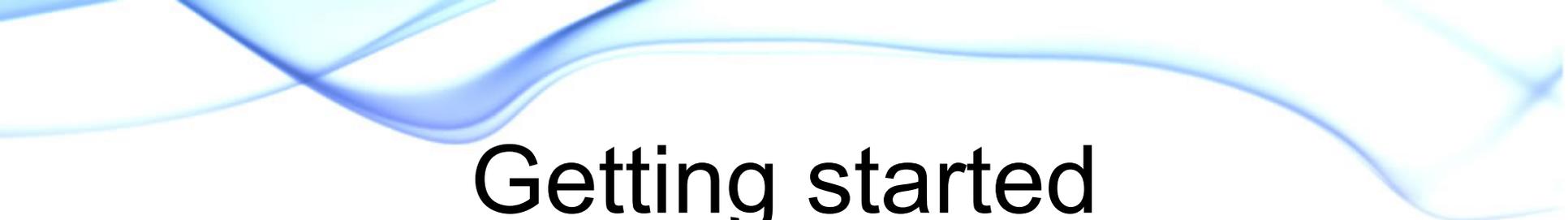


You might ask..

- How are you gathering data on your students' prior knowledge?
- How are you using that data to change your instructional plans for individual students (or groups)?

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.



Getting started

- Become aware of what's available, e.g. Gap Closing, Math for Young Children project, Ministry work on Fractions,



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.

Your role in learning teams...

- To facilitate, not necessarily to “run”
- To ask meaningful questions
- To probe more than criticize or tell
- To continue to encourage growth
- To encourage some level of consistency



Questions

- What other questions do you have?

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