Teaching to the Big Ideas K - 3

Marian Small
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Getting to 20

• You are on a number line. You can jump however you want as long as you always take the same size jump.

• How can you land on 20?
How Would You Use Student Responses to That Task?

- What's different about …’s way of counting than ….’s way?
- Do you have to start at 1 to get to 20?
- Anna jumped to 2, then 4, then 6,… . Ryan jumped to 4, then 8, then 12,… Who took more jumps? Why?
- Lee started at 6. Could he get to 20?
- Which way of counting to 20 was easiest?
Notice The Contrast

• What I just did is in contrast to telling students how to proceed- how to count. If I do that, it’s much harder to think about the fact that there are always different ways to count.
BIG IDEAS FOR EARLY NUMBER

1. A number tells how many are in a group. You usually count to determine the size of a group. (BIEN 1)

2. Counting is fundamental to number. Forms of counting include rote counting, counting all, counting on, skip counting, and counting back. (BIEN 2)

3. You can represent a number in a variety of ways. Each representation of a number can focus on a different aspect of the number. (BIEN 3)

4. To compare the numbers of items in two sets, you can match the items, one to one, in the two sets to see whether one set has more. Or, you can compare the position of the numbers that describe the two quantities in the number sequence. (BIEN 4)

5. Students gain a sense of the size of numbers by comparing them to meaningful benchmark numbers. (BIEN 5)
What are Big Ideas?

- These are ideas that underpin a great number of problems, concepts, or ideas that we want students to learn.

- A big idea is NOT a topic like fractions, but might be an idea like a fraction only makes sense if you know the whole of which it is a fraction.

- Some people use language like “key concepts” or “enduring understandings”.
Advantages?

• Simplifies your job of prioritizing and organizing
• Helps you assess time and attention required by an outcome
• Helps clarify what aspect of an outcome to bring into focus
• Helps you look at resources critically
• Helps you create appropriate assessments
• Helps students build essential connections
Making Big Ideas Explicit

- We cannot assume that students will see the big ideas if we do not bring them to the student’s attention.

- Many teachers, though, do not know what the big ideas in a lesson are, even if they know the lesson goal.
What Does The Teacher Do Differently?

• S/he thinks about what the big idea really is and then sets a task and asks a question to ensure it explicitly comes out, often toward the end of the lesson so that it stays with the student.
Try This

How many are in each group? How did you know?
Big Idea 1

- Numbers tell how many are in a group. You usually (but don’t always) count to determine the size of a group
Big Idea 3

- Choose one of these numbers: 5 or 8.
- Represent it as many ways as you can.
Why Does It Matter?

- Why is it useful for students to be able to represent numbers in different ways? For example, what do these four representations of 4 describe about 4?
Big Idea 4

- Work in pairs.
- Each of you thinks of a number between 1 and 20.
- Describe two different ways to show whose number is greater and why.
BIG IDEAS FOR GREATER WHOLE NUMBERS

1. A number tells how many are in a group. To count the number in a group, we often create subgroups and count the number of subgroups. (BIGWN 1)

2. The place value system we use is built on patterns to make our work with numbers more efficient. (BIGWN 2)

3. You can represent a number in a variety of ways. Each representation of a number can focus on a different aspect of the number. (BIGWN 3)

4. To compare and order numbers, we can compare them to more familiar benchmark numbers.

5. Students gain a sense of the size of numbers by comparing them to meaningful benchmark numbers. (BIGWN 5)
Big Idea 1

• Which group is easier to count? Why?

• Group 1

• Group 2
Big Idea 1

• 1. Numbers tell how many are in a group. Counting numbers beyond 10 or 20 is often based on creating subgroups and counting these.
More On BI 1

On some tables, put 32 counters into ten frames. On other tables, put 32 loose counters. Ask each group to tell how many counters are there.

Then ask…

- Why did … finish counting more quickly than …?
Your Turn

We did not yet look at the big idea:

Students gain a sense of the size of numbers by comparing them to meaningful benchmark numbers.

What could you have student do and what could you ask to bring this out?
Your Turn

One idea:

Teaching Idea 2.23

Ask students to draw a number line from 300 to 400 and place the number 323 on the line.

To focus on BIGWN 5, ask: How did you decide what other numbers to put on the number line? How do those numbers help show 323? [e.g., 325, 350, 375; It shows that 323 is almost 325, so it is one fourth of the way between 300 and 400.]
What Operation Would You Use?

• Anika had 12 cookies on a plate. If she ate them 3 at a time, how many times could she go back to get cookies?
**BIG IDEAS FOR WHOLE NUMBER OPERATIONS**

1. There are relationships between the four operations: (BIWNO 1)
   - You can represent subtraction as the opposite of addition and vice versa.
   - You can represent multiplication as repeated addition and vice versa.
   - You can represent division as repeated subtraction and vice versa.
   - You can represent division as the opposite of a multiplication and vice versa.

2. There are many situations to which an operation is applied, and there are many procedures, or algorithms, for each operation. (BIWNO 2)
3. Operation procedures should be taught meaningfully, taking into account the various meanings of the operations and the principles that apply to their use. (BIWNO 3)

4. A personal “invented” algorithm is often more meaningful and sometimes equally efficient as a conventional algorithm. (BIWNO 4)

5. There are a variety of appropriate ways to estimate sums and differences depending on the numbers involved and the context. Estimates are useful for both checking calculations and because sometimes an estimate is all that is needed. (BIWNO 5)
Create A Problem

Create a story problem for each of these number sentences.

We’ll then group them.

- $5 + 8 = 13$
- $10 – 3 = 7$
- $3 \times 5 = 15$
## Different Meanings

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<th>MEANING</th>
<th>EXAMPLE</th>
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<tr>
<td><strong>Joining</strong></td>
<td>A child has 5 marbles. His mom then brings him 3 new ones.</td>
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<td>5 marbles + 3 new marbles = 8 marbles</td>
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<td><strong>Part-part-whole</strong></td>
<td>A child has 8 marbles; 5 of them are blue and 3 are red. No action occurs, but it is still an addition situation.</td>
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<td>5 blue marbles + 3 red marbles = 8 marbles</td>
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| **Taking away** is an active separating situation. | ![Taking away](image)  
12 take away 7 leaves 5.  
12 \(-\) 7 = 5 |
| **Comparing** two quantities involves subtracting one from the other. | ![Comparing](image)  
12 is 5 more than 7.  
12 \(-\) 7 = 5 |
| **Missing addend** involves finding out how much or how many to add. | ![Missing addend](image)  
12 is 5 more than 7.  
12 \(-\) 7 = 5 or 7 + 5 = 12 |
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<td>Repeated Addition</td>
<td>The first factor, in this case 3, tells how many times to add the second factor, 4. [3 \times 4 = 4 + 4 + 4]</td>
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<tr>
<td>Equal Groups or Sets</td>
<td>[3 \times 4] is the total number of objects in 3 sets of 4. [4 + 4 + 4 = 12] [3 \times 4 = 12]</td>
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<tr>
<td>An Array</td>
<td>[3 \times 4] is the total number of items in a 3 by 4 array. [3 \times 4 = 12] An array of 3 rows with 4 counters in each has 12 counters altogether.</td>
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Danger Of “Clue” Words

• Create a subtraction question that uses the word “more”.

• Create an addition question that uses the word “less”.

Try This Computation

• Think of 3 different ways to calculate 15 – 8.
Some Possibilities

- Calculate 10 – 8 and then add 5.
- Calculate 18 – 8 and then subtract 3.
- Calculate 16 – 8 and then subtract 1.
- Add 2 to get to 10 and then 5 more.
Try This Computation

• Think of 3 different ways to calculate 200 – 134.
Some Possibilities

- Add 6 to get to 140, then 10 more, and then 50 more. The total added is 66.
- Subtract 125 and then another 9 by subtracting 10 and adding 1.
- Subtract 100, then 30, then 4.
- Add 60 to get to 194 and then 6 more.
What Do You Think Of This?

- 200
- 134

134 = 100 – 30 – 4 = 66
What Do You Think Of This?

- $200 = 199 + 1$
- $65 + 1 = 66$
What Is A Pattern?

- Write down three examples of patterns.
- What makes them patterns?
Teaching Idea 1.2

Place coloured beads in a row to make a pattern, repeating the core (e.g., blue-red) four or five times. Cover the beads with a paper tent and reveal some of the pattern as shown below. Ask students to predict what they will see next as you slide the tent over.
Making Non-Patterns

- Take 12 counters and start a pattern with them.
- Take 12 counters and make a non-pattern.
- What sorts of questions might you ask a student to focus them on the idea that a pattern has to be about regularity?
BIG IDEAS FOR PATTERNS

1. Patterns represent identified regularities. There is always an element of repetition, whether the same items repeat, or whether a “transformation,” for example, adding 1, repeats. (BIP 1)

2. The mathematical structure of a pattern can be represented in a variety of ways. (BIP 2)

3. Some ways of displaying data highlight patterns. (BIP 3)

4. Many geometric attributes (e.g., the number of corners or numbers of faces of various types of prisms), measurements, and calculations involving numbers are simplified by using patterns. (BIP 4)
Continuing A Pattern

- What comes next: 3, 5, 7,....?
- It could be 3, 5, 7, 3, 5, 7, 3, 5, 7, ...
- 3, 5, 7, 7, 3, 3, 5, 7, 7, 3, ...
- 3, 5, 7, 9, 11,...
- 3, 5, 7, 13, 15, 17, 23, 25, 27,...
## Continuing A Pattern

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What is the pattern rule?

Is there more than one way to express it?
Comparing Patterns

• In pairs, make a pattern with your linking cubes.
• Let’s compare some of the patterns we made.
• What do we mean by the structure of a pattern?
Arranging Repeating Patterns
Arranging Repeating Patterns
Find Four Patterns

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Think about a question you could ask to see if the student could “use” the pattern more generally.
Find Four Patterns

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Building Conjectures

• Think about the pattern: 1, 1, 2, 2, 2, 3, 3, 4, 4, 4, 5,…

• I “conjecture” that every 10th number is even.

• Is that true? Try to explain.

• I “conjecture” that there are more evens than odds in the first 30 numbers.

• Is that true? Try to explain.
Building Conjectures

• Choose your own pattern.

• Make two conjectures about it and then verify whether or not they are true.
What Comes Out If 10 Goes In?

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\[3 \times \text{In} + 2\]
BIG IDEAS FOR ALGEBRA

1. Algebra is a way to represent and explain mathematical relationships and to describe and analyze change.

2. Using variables is a way to efficiently and generally describe relationships that can also be described using words.
Representing Relationships

• Think about 4 and 8.

• You can think about 8 as two 4s (just like 10 is two fives).

• You can think about 8 as four more than 4 (just like 10 is four more than 6.)
Representing Relationships

• How can you represent the “doubling” relationship with a picture? The picture should be useful no matter what number you are doubling.
Representing Relationships

• How can you represent the +4 relationship with a picture? The picture has to work no matter what number you are adding 4 to.

• For example:
Representing Equality

• $8 + 4 = \cdot + 5$

• What goes in the blank and why?
Student Success With That Question

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Falkner, Levi, Carpenter
And So...

• So what do we need to do?

• We could use words: You add a number to 5 and you end up with the same amount you would if you added 8 and 4. What did you add? (Bl 2)

• We could put the “answer” on the left, e.g. \( \cdot = 3 + 4 \).

• We could use a balance metaphor for equality, viewing equality as a relationship.
Representing Equality

\[ 2 + 1 = \cdot \]
Representing Equality
Representing Equality

2 + ⋅ = 5 + 3
Representing Equality
Represent These and Solve

• $5 + \cdot = 8 + 3$
• $\cdot + \cdot = 8$

Think about how you would “verbally” say these equations to your students.
Use The Balance To Show

• That 10 is double 5.
• That 8 is one less than 9.
Modelling Subtraction

- How would you use the balance to solve $8 - 2 = \cdot$?
- How would you use the balance to solve $6 - \cdot = 3$?
- How would you use the balance to solve $\cdot - 4 = 6$?
Which Doesn’t Belong?

- Which shape below doesn’t belong?
BIG IDEAS FOR SHAPES AND THEIR PROPERTIES

1. Some attributes of shapes are quantitative, others are qualitative (e.g., the fact that a circle is round is qualitative; the fact that a triangle has three vertices is quantitative). (BISP 1)

2. Many of the properties and attributes that apply to 2-D shapes also apply to 3-D shapes. (BISP 2)

3. How a shape can be cut up (dissected) and rearranged (combined) into other shapes helps us attend to the properties of the shape (e.g., where the square corners are and whether a shape has curves or straight sides). (BISP 3)

4. Many geometric properties and attributes of shapes are related to measurement (e.g., a square is a rectangle where the width and length are equal). (BISP 4)
Big Ideas in Geometry

• Tie your yarn into a large loop. Work in groups.

• Use members of the group to hold the yarn to form each shape and be ready to tell how you arranged yourself to make it work: a triangle, a rectangle, an isosceles triangle, a hexagon, a circle.

• Why was it more challenging to make the isosceles triangle than the hexagon?
Big Ideas in Geometry

• Draw a shape like this.

• Divide the shape up into only triangles.

• Can you always cut a shape into triangles? Explain.
Big Ideas in Geometry

- Use pattern block trapezoids

- What different shapes can you make with 4 trapezoids? When trapezoids touch, whole sides have to match.

- Could you make a shape with an odd number of sides?
Big Ideas in Geometry
Big Ideas in Geometry
Your Turn

We have not yet dealt with the big idea: Many of the attributes and properties of 2-D shapes also apply to 3-D shapes.

What could you have students do and what could you ask to bring this out?
For Example

Teaching Idea 3.4

Show students a sphere and a circle.

To focus on BISP 2, ask: Suppose you are standing at the centre of the circle and the rest of the students in your class are standing around the outside of the circle. Which students are closest to you? [I'd be the same distance from all of them.] How is a sphere like the circle in that way? [If I were at the centre, I'd be the same distance from all the parts around the outside of the sphere.] Are there other ways spheres and circles are alike? [e.g., They are both round.]
Length

• Work in pairs. One of you makes a “wiggly” path with each of the two pieces of yarn you have. Don’t let your partner see which is longer and curve the paths so it’s not obvious. The partner estimates which is longer and then tests.

• How can you test to see which length is longer? Is there more than one way to test?
Big Ideas in Measurement

BIG IDEAS FOR MEASUREMENT

1. The same object can be described using different measurements. (BIM 1)

2. Any measurement can be determined in more than one way (e.g., you can use a single unit repeatedly or use many copies of the same unit). (BIM 2)

3. There is always value in estimating a measurement, sometimes because an estimate is all you need or all that is possible, and sometimes because an estimate is a useful check on the reasonableness of a measurement. (BIM 3)
Big Ideas in Measurement

4. Familiarity with known benchmark measurements can help you estimate and calculate other measurements. (BIM 4)

5. We use units to make measurement comparisons simpler. This is only effective if the same unit is used for both objects and the unit is uniform. (BIM 5)

6. The unit chosen for a measurement affects the numerical value of the measurement; if you use a bigger unit, fewer units are required. (BIM 6)

7. The use of standard measurement units simplifies communication about the size of objects. (BIM 7)
Big Ideas in Measurement
Building a Line Plot

- We are going to make a line plot to show how often people in the room have had their hair cut in the last year.
- What do you think it will look like?
- Why is a line plot a good idea for this data?
What’s The Graph About?

What could these graphs be about?
Watch The Video
Big Ideas for Displaying and Analyzing Data

1. Graphs are powerful data displays, since visual displays quickly reveal information about data. (BIDAD 1)

2. Tally charts, concrete graphs, picture graphs, pictographs, and line plots are useful for comparing the frequency of data in different categories. (BIDAD 2)

3. It is important to not only to read information from graphs but to make inferences, draw conclusions, and make predictions. (BIDAD 3)
How Do Teachers Figure Out What The Big Ideas Are?

- Professional conversations with colleagues.
Then What?

- You make sure you ask the question to bring out that big idea.
How Do You Figure Out What The Big Ideas Are?

• Some resources help you.
From a Resource

From

*Big Ideas from Dr. Small*
From a Resource

From

Math Focus K-3
In Summary

• Math really is not a set of tiny little pieces. It is a connected whole.

• It is our job to help our students see those connections.

• We have to focus in, therefore, on the big ideas, but we also have to ask open and directed questions.