



Teaching to Big Ideas from Dr. Marian Small

Over the past several years, mathematics and teaching approaches have become more sophisticated. Our job as teachers is to imbue our students with the confidence they need to understand the new ideas

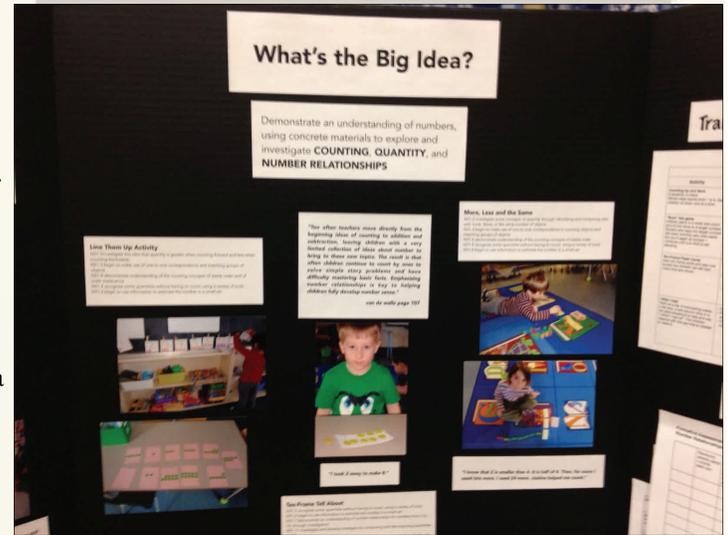
with which they are dealing. Many of us are gaining comfort and confidence with those ideas at the same time. For that reason some educators may feel uncertain because they are being asked to teach in a way that they may not have been taught.



Across the province, a number of educators have approached the curriculum as a checklist of discrete outcomes/expectations to “be covered”. Combine the time factor, the number of specific expectations within each of the five strands, multi-grades and other curriculum subject areas and this can seem like an overwhelming task. This ‘checklist of specific expectations approach’ is in stark contrast to what we know from research about how much more effective it is for students to learn when connections are explicitly made between new knowledge and ideas that students already know. Big ideas help teachers and students make those connections.

Some curriculum expectations are broader and more encompassing than others, but it is not obvious when you look at the curriculum. A focus on the big ideas also helps the teacher understand what some of the broader outcomes/expectations mean. Another way that big ideas can help is to ensure that teachers and students understand the overriding purpose behind the lesson or task. Teaching through big ideas is about teachers looking critically at a task or lesson, asking themselves why they are teaching the lesson or task, and then making sure that the purpose becomes clear to students so that the task or lesson can be more effective. Just as one does not generally teach the curriculum in its order of presentation, one does not teach big ideas in any specific order. Despite increasing abstraction as students move up the grades and shifts in focus from grade to grade, big ideas remain fundamentally the same from kindergarten to Grade 12. What is most important is that the big ideas be made explicit through the task, the questioning, the prompting and the talk. In planning assessment, appropriate tasks should be planned around relevant big ideas always keeping an eye on the big picture.

To help support our understanding of a relevant big idea, the ministry has provided materials to support our understanding of “Proportional Reasoning”. (*Big Ideas from Dr. Small, K-3, 4-8, 9-12*)



Reflective Question:

How might using Big Ideas impact how I plan?

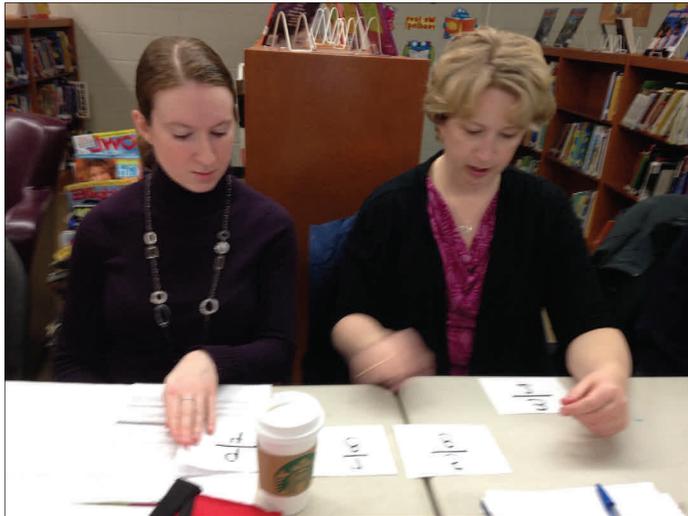


Scan here to view ‘Big Ideas from Dr. Small’



What is Proportional Reasoning and Why is it Important?

Proportional reasoning is the ability to compare an object or set of objects by making multiplicative comparisons. Students use proportional reasoning in early math learning, for example, when they think of 8 as two fours rather than thinking of it as one more than seven.



The essence of proportional reasoning is the consideration of numbers in relative terms, rather than absolute terms.

Students are using proportional reasoning when they decide that a group of 3 children growing to 9 children is a more significant change than a group of 100 children growing to 150, since the first number tripled in the first case; but only grew by 50%, not even doubling, in the second case. Another example of this would be: One dog grew from 5 to 8 kg. A second dog grew from 3 to 6 kg. Which dog grew the most? Since both dogs grew by 3 kg., one answer to this could be they both grew the same. When someone is using

proportional reasoning they will say that the second dog grew the most because he doubled his weight. For the first dog to double his weight he would have had to grow to 10 kg. Students express proportional reasoning informally by using phrases such as “twice as big as, half the size of, a third the size of,” etc.

Students begin to develop the ability to reason proportionally through informal activities.

Reflective Question:

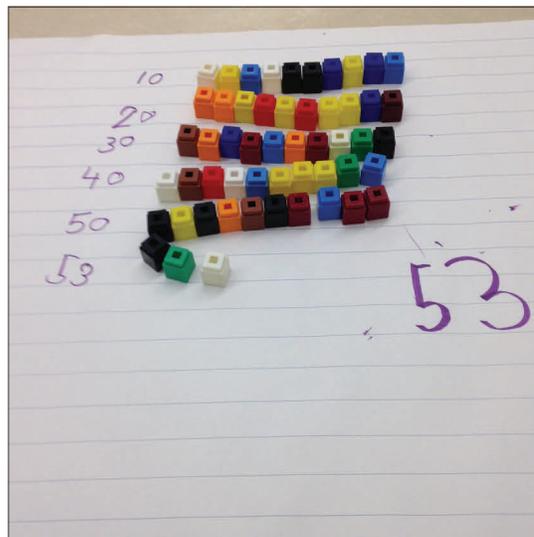
How might we as educators help students see things from a proportional reasoning perspective?



Comparing an object or set of objects helps students make sense of, organize, and describe their world. Younger children begin by making qualitative comparisons (e.g., bigger, smaller). Through experience, students learn to make additive comparisons (e.g., 2 more than, 50 less than) and eventually progress to making multiplicative comparisons (e.g., three times as long as, half as much). A focus on proportional reasoning impacts students’ flexibility with numbers and their competence with basic facts.

Although proportional reasoning is not mentioned in the Full Day Early Learning Kindergarten document, a focus on the big ideas within each of the strands will have an impact on student flexibility of thinking. It is this understanding of what quantity relationships, operational sense, measurement relationships, patterns and relationships etc. means on the part of educators that will allow us to mathematize the thinking that students bring to school with them and guide our decisions about the open ended materials we might choose to provoke such thinking.

(Paying Attention to Proportional Reasoning, K-12)



www.alcdsb.on.ca

Scan here to view
*‘Paying Attention to
Proportional
Reasoning’*



Effective Use of Manipulatives to Develop Proportional Reasoning

The Ontario Mathematics Curriculum K-12 states that students should be encouraged to select and use concrete learning tools to make models of mathematical ideas. Students need to understand that making their own models is a powerful means of building understanding and explaining their thinking to others.

Using manipulatives to construct representations helps students to:

- see patterns and relationships;
- make connections between the concrete and the abstract;
- test, revise, and confirm their reasoning;
- remember how they solved a problem;
- communicate their reasoning to others

Mathematical Manipulatives

Algetiles	3-D solids	base 10 materials/base 10 blocks	calculators
calendars	colour tiles	clocks (analog and digital)	tangrams
counters	geoboards	connecting cubes, centimeter cubes	hundreds chart
folding nets	money	relational rods (Cuisenaire rods)	isometric dot paper
number lines	mirrors (Miras)	five frames and ten frames	number cubes, dice
polydrons	pattern blocks	fraction circles and fraction strips	place value mats
protractors	Rek en Rek	grid paper, centimeter grid paper	power polygons
rulers	volume containers	thermometers	tracing paper
spinners			



Sample Proportional Reasoning Tasks Using Manipulatives

Task #1: Pattern Blocks

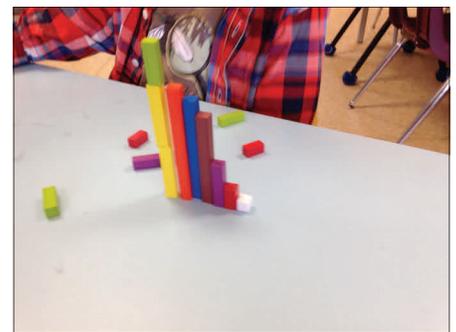
- Make pattern block designs for each situation.
- Tell how many blocks and what colour you used.
- Are there other possibilities?
How do you know you are right?

Rules:

The design is $\frac{1}{2}$ yellow.

The design is $\frac{2}{3}$ red and $\frac{1}{3}$ green.

The design is $\frac{1}{5}$ blue and $\frac{1}{2}$ green.



Task #2: Cuisenaire Rods (Note: numbers can be changed to differentiate instruction)

Choose one of these:

If the yellow rod is worth 5, what are the other rods worth?

If a light green rod is worth 15, what are the other rods worth?

If an orange rod is worth 15, what are the other rods worth?

Assign a value to the purple rod. What are the other rods worth?

Task #3: Colour Tiles

- Make a rectangle. Figure out its perimeter.
- Then make a rectangle with half the area.
- Figure out the perimeter.
- What fraction of the big perimeter is the smaller one?
- Try more times.
- What fractions are possible and which are not?

Reflective Questions:

Do you have a full range of manipulatives appropriate to grade level curriculum in your classroom?

Do your students have access to these manipulatives for every math lesson?

How do these manipulatives facilitate optimal mathematics learning for your students?



IN THE 21st CENTURY CLASSROOM K-12



Resources to Support Big Ideas, Proportional Reasoning and Manipulatives

All of the following resources can be found at:

<http://ishare.alcddb.on.ca/curriculum/numeracyK12.aspx>

Paying Attention to Proportional Reasoning, K-12

www.edu.gov.on.ca/eng/teachers/studentsuccess/ProportionReason.pdf



Video Clips: Developing Proportional Reasoning with Dr. Small at Algonquin and Lakeshore Catholic District School Board

<http://ishare.alcddb.on.ca/curriculum/Lists/DrSmall/Homepage.aspx>

Targeted Implementation and Planning Supports for Revised Mathematics (TIPS4RM)

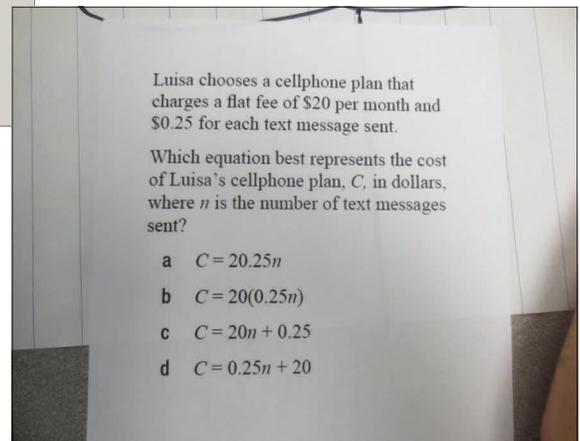
www.edu.gov.on.ca

Big Ideas and Questioning K-12

www.edugains.ca/.../BigIdeasQuestioning_Proportional_Reasoning.pdf

Dr. Marian Small Resources – www.onetwoinfinity.ca/

- * Making Math Meaningful to Canadian Students K-8
- * Big Ideas from Dr. Small K-3, 4-8, 9-12
- * Good Questions: Great Ways to Differentiate Mathematics Instruction (K-8)
- * More Good Questions: Great Ways to Differentiate Secondary Mathematics Instruction (9-12)
- * Eyes on Math: A Visual Approach to Teaching Math Concepts (K-8)
- * Uncomplicating Fractions



Ministry Webcasts for Educators—Student Achievement Division

- * Linking Today's Understanding to Tomorrow's Learning: Proportional Reasoning
- * Planning for Mathematical Understanding: Fractions Across the Junior Grades

www.edugains.ca

The Super Source

www.hand2mind.com/aboutus/brands/thesupersource

EQAO Educator Resources - www.eqao.com

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