Challenges facing mathematics education

Dr. Christine A. Suurtamm

Dispelling Myths

Myth 1

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Facts:

- The 2005 mathematics curriculum is a slight revision of the 1999 mathematics curriculum. Curriculum review and revision in Ontario has been an evolutionary process, not a revolutionary process.

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Myth 1a: The pendulum keeps swinging – one way and then the other

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- The curriculum is a blend of problem solving approaches and skill development.

Examination of the curriculum

- add and subtract three-digit numbers, using concrete materials, student- generated algorithms, and standard algorithms; (Grade 3 math curriculum)
- solve problems involving the addition and subtraction of four-digit numbers, using student-generated algorithms and standard algorithms (e.g.,“I added 4217 + 1914 using 5000 + 1100 + 20 + 11.”); (Grade 4 math curriculum)

Examination of the curriculum

- determine, through investigation using a variety of tools (e.g., pattern blocks, Power Polygons, dynamic geometry software, grid paper) and strategies (e.g., paper folding, cutting, and rearranging), the relationship between the area of a rectangle and the areas of parallelograms and triangles, by decomposing (e.g., cutting up a parallelogram into a rectangle and two congruent triangles) and composing (e.g., combining two congruent triangles to form a parallelogram) (Sample problem: Decompose a rectangle and rearrange the parts to compose a parallelogram with the same area. Decompose a parallelogram into two congruent triangles, and compare the area of one of the triangles with the area of the parallelogram.); (Grade 6 math curriculum)

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Myth 2

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Fact: There is value in student generated algorithms. This helps students to think flexibly and connect their own understanding to standard algorithms.

Development of number sense

- Opportunities to work with number problems in a variety of ways with a variety of materials
- Students sharing their strategies increases their repertoire of strategies and flexible thinking

Myth 3

- Only some people are capable of doing math

Myth 3

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Fact: All students are capable of doing math. So much of this depends on how they have been taught.

Challenges

Teachers are crucial in developing students' mathematics understanding

They are challenged with

- Developing students' conceptual and procedural understandings
- Developing their own mathematics knowledge for teaching
- Receiving mixed messages about what mathematics is important to know and do

Facilitating mathematical thinking is not easy

Conceptual understanding & procedural fluency

- Conceptual understanding of mathematical is developed through students exploration of mathematical ideas and consolidation of those ideas through skillful teaching
- Procedural fluency is more than merely knowing math facts. It is the ability to perform mathematical operations flexibly and see the connections between operations.

Both conceptual understanding and procedural fluency are necessary and interact in ways that deepen student understanding.

Your understanding of fractions

$$\frac{3}{4} \div \frac{1}{2}$$

Memorized algorithms

Panic!!

$$\frac{1}{2} \times \frac{1}{2}$$

aches to solving fraction problems. Solve the
y that is most comfortable for you:

Which of the following scenarios co
this fraction problem with stude

a. Carri
much

b. Ali ha
How

c. Tim l
they

$$\frac{1}{2} \times \frac{1}{2} = 1$$

2 halfs make a whole

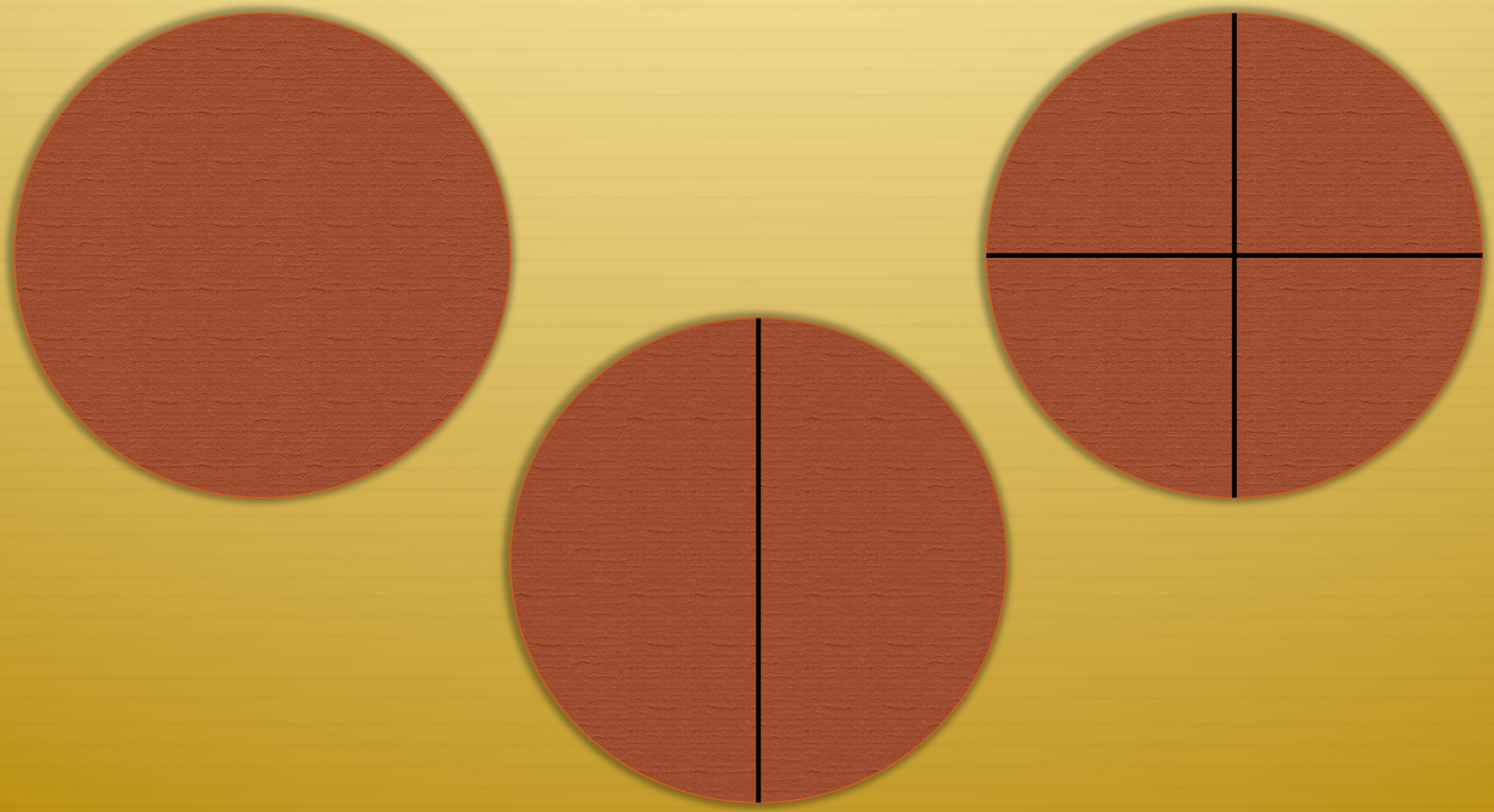
$$\frac{1}{2} \times \frac{1}{2} = \frac{2}{2} = 1$$

need a common denominator

share it with Barbara.

share it with Ed. If
eceive?

Fraction work



What is division?

- How many 5's in 30? $30 \div 5 = 6$
- How many 3's in 36? $36 \div 3 = 12$
- How many $\frac{1}{2}$'s in 1? $1 \div \frac{1}{2} = 2$
- How many $\frac{1}{4}$'s in $\frac{3}{4}$? $\frac{3}{4} \div \frac{1}{4} = 3$
- How many $\frac{1}{2}$'s in $\frac{3}{4}$?

Revisiting

How many $\frac{1}{2}$'s in $\frac{3}{4}$?

$$\frac{3}{4} \div \frac{1}{2}$$

Mathematics knowledge for teaching

- Mathematics knowledge/pedagogical content knowledge
- Understanding mathematics in ways that help students develop their own mathematical thinking.

Challenge

- Many elementary teachers do not see themselves as "math people"
- Often elementary teachers went into teaching because of their love of literature and art
- Their understanding of mathematics is often somewhat fragile rather than robust – often because of the ways that they were taught that did not build conceptual understanding

Mathematics teaching qualifications

	Grade 7/8	Grade 9/10
Intermediate mathematics	24%	77%
Senior mathematics	5%	74%
Honours Specialist (math)	1%	31%
P/J Math - Part 1	4%	1%
P/J Math - Part 2	1%	1%
P/J Math - Specialist	1%	0%
Other math qualifications	7%	4%
No specific math qualifications	69%	11%

(Suurtamm & Graves, 2007)

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(Suurtamm & Graves, 2007)

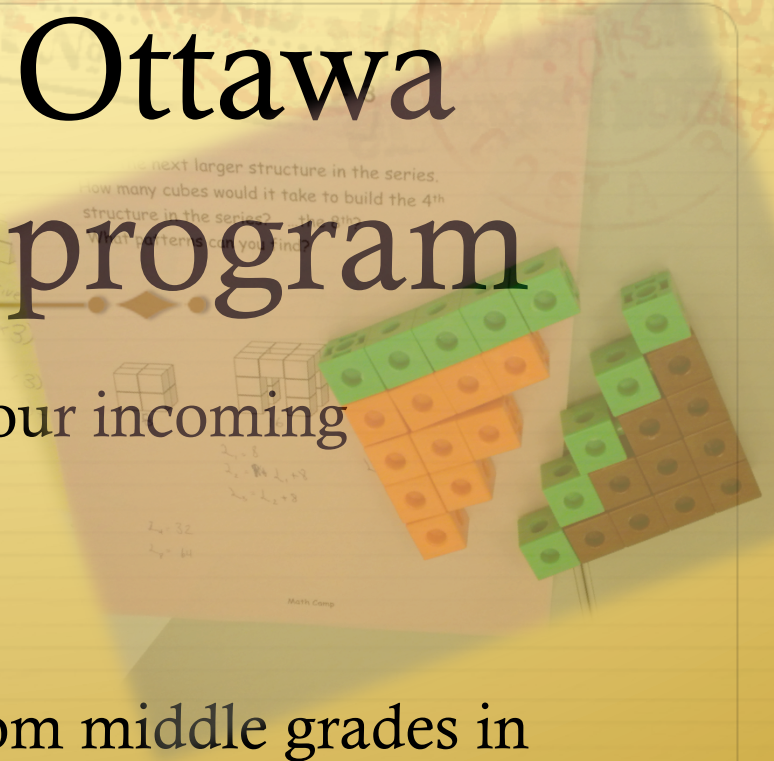
How comfortable are you with the content of the course you are teaching?

	Very
Grade 10 Academic	84%
Grade 9 Academic	80%
Grade 10 Applied	73%
Grade 9 Applied	71%
Grade 10 Essential/Locally Developed	61%
Grade 8	61%
Grade 7	57%
Grade 9 Essential/Locally Developed	55%

A variety of ways of addressing MKT

- Provide experiences to enhance teachers' conceptual knowledge and procedural fluency in the areas they are going to teach
- Support teachers in their own teaching with mathematics specialists or collaborative work with math experts on the side
- There is evidence that teachers can develop an understanding of mathematics through their own teaching.

University of Ottawa Summer math program



- Held the last week of August for our incoming prospective elementary teachers
- 7 hours a day for 5 days
- Explore mathematics concepts from middle grades in ways to enhance their
- Make connections between area, fractions, algebra
- Goal: to change perspective, increase mathematical understanding, setting the stage for continued engagement with mathematical ideas

Suggestions for further work on MKT

- Offer courses for teachers to enhance their mathematics understanding of the fundamental Work with administrators to deepen their understanding
- Develop MKT of mathematics leaders and coaches
- Mathematics support for teachers in schools
- Put math at the centre of professional development for mathematics teachers (but in a way that develops their understanding and confidence)

Another challenge

Mixed messages & impact of large scale assessment

Conflicting messages to teachers

Teacher as technician

Professional judgment

Implementing curriculum

Student needs

EQAO

External assessments

What math is important?

- Curriculum focuses on students engaging in inquiry as well as the development of skills
- Large-scale assessments have shifted to more multiple-choice questions rather than valuing students sharing their thinking
- Does the assessment focus on important mathematics?
- Test preparation?

Types of dilemmas/challenges educators face

- Conceptual dilemmas
- Pedagogical dilemmas
- Cultural dilemmas
- Political dilemmas

Thank you

Questions?