MathUP and the 2020 ON Math Curriculum

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I've done a pretty deep dive!

- In order to rewrite MathUP to reflect the new curriculum, I have had to look hard at every piece of the new curriculum.
- This talk is a bit of sharing of my reaction as I did this deep dive.

The big changes (from my perspective)

- The addition of the SEL strand
- The addition of the financial literacy strand
- The addition of coding

Other Quite Visible Changes

- More deliberate attention to mathematical modelling, although it is not really a new topic

Other Quite Visible Changes

- Big changes in treatment of fractions in Grades 1 to 3
- Lots of changes in where geometry topics are addressed, e.g. Grade 3 is all 3-D and Grade 2 is all 2-D
- Work on most quadrilaterals moved up to Grade 6
- Grade 2 number to 200 instead of 100

Other Quite Visible Changes

- Delays in use of lots of probability terms in early grades
- Changes in grade levels for where many length, mass, time, area, angle and capacity units are introduced
- More requirement that pattern be specifically addressed in number situations

Other Quite Visible Changes

- Inclusion of multiple bar graphs, stacked bar graphs and the use of histograms earlier
- Lessons on infographics at many grade levels
- Earlier work on fraction operations, rate and ratio, percent, integers

Other Quite Visible Changes

- More “spread-out” work on faces and isometric views of objects
- Earlier introduction of the coordinate plane
- A somewhat later introduction of transformations, but an earlier use of coordinates to describe transformations

Other Quite Visible Changes

- Earlier work on the use of algebraic expressions
- Earlier introduction to theoretical probability
- Inclusion of the topic of divisibility tests
- Mention of repeating patterns even in higher grades

Other Quite Visible Changes

- Earlier attention to greatest common factor and least common multiple
- Work with VERY large and small numbers and measurement prefixes
- Earlier work on circle measurements
- Attention to the solution of inequalities

Other Quite Visible Changes

- Earlier attention to issues in sampling
- Earlier work on areas of special shapes
- Earlier exploration of probabilities of independent events

What Made Me Happy In the New Curriculum

- First, and foremost, the provision of teaching supports that articulate key concepts.
- Some of you have heard me talk in the past about curricula provided in Manitoba and the Atlantic provinces that are extremely detailed in those supports.

Here is a bit of what you'd see in those documents. I chose one little piece of grade 3 from Manitoba and a little piece of Grade 6 from Newfoundland and Labrador.

Specific Learning Outcome(s):	Achievement Indicators:
3.N.2 Represent and describe numbers to 1000, concretely, pictorially, and symbolically. [C, CN, V]	➛ Read a 3-digit numeral without using the word "and" (e.g., 321 is three hundred twenty-one, NOT three hundred AND twenty-one). ➛ Read a number word (0 to 1000). ➛ Represent a number as an expression (e.g., 300 – 44 for 256 or 20 + 236). ➛ Represent a number using manipulatives, such as base-10 materials. ➛ Represent a number pictorially. ➛ Write number words for multiples of ten to 90. ➛ Write number words for multiples of a hundred to 900. ➛ Determine compatible number pairs for 100.

Prior Knowledge

Students may have had experience representing and describing numbers to 100, concretely, pictorially, and symbolically. They may have represented numbers using

- concrete materials (e.g., ten frames, base-10 materials)
- coins
- tallies
- pictures
- expressions
- words
- symbols
- place value

Background Information

To develop a good sense of number, students have to develop an intuition about numbers and their relationships. Flexible intuitive thinking about numbers develops gradually as a result of exploring numbers and visualizing in a variety of contexts. Provide the use of concrete materials and models such as base-10 materials, hundred charts, number lines, place value charts, and money to help students make connections between the concrete and pictorial to the symbolic representations of the numbers.

The reading of number words such 625 should be read as "six hundred twenty-five." When reading numbers the word *and* denotes the decimal. When writing four-digit numbers symbolically, there is usually no space or comma between the thousands and hundreds place. Writing numbers that are five or more digits requires a space between the thousands and hundreds place.

When students are representing numbers in a variety of ways, they demonstrate their understanding of the use of a number (e.g., my house number is 34), how a number compares to another number (e.g., 34 is 1 less than 35), how a number can be broken into parts (e.g., 34 is 32 + 2), and place value (e.g., 34 is 30 + 4 or 20 + 14 or 10 + 24).

Assessing Prior Knowledge: Performance Task

Student Directions:

38 65 99

1. Choose one of the numbers above.
2. Represent the number in at least 6 different ways.

The student is able to represent a 2-digit number using

- ❒ concrete materials (ten frames, base-10 materials)
- ❒ tallies
- ❒ pictures
- ❒ words
- ❒ expressions/number sentences
- ❒ number line
- ❒ comparisons (greater/less than, 1 more/less, 10 more/less, etc.)
- ❒ other

Assessing Understanding: Interview

Show the following numbers. Have the student read them.

671 904 297 880 536 355

Show the following number words. Have the student read them.

- eight hundred six
- two hundred thirty-seven
- nine hundred forty-one
- six hundred fifty
- four hundred ninety-eight
- one hundred sixty-three

The student is able to

- read three-digit numerals
  - ❒ confidently
  - ❒ with hesitation
- read number words to 999
  - ❒ confidently
  - ❒ with hesitation

Rubicon

Specific Outcomes

Students will be expected to

6N1 Demonstrate an understanding of place value, including numbers that are:

- **greater than one million**
- **less than one thousandth.**

[C, CN, R, T]

Achievement Indicator:

6N1.1 Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude.

Suggestions for Teaching and Learning

In Grade 5, students represented and described whole numbers up to one million and small numbers to one thousandth. They have written a given numeral in standard from, expanded form, and in words. They have also described the meaning of each digit in a given numeral. In Grade 6, this will be extended to develop place value concepts for numbers greater than one million and numbers less than one thousandth.

Students should explore the place value chart to discover how the pattern of hundreds, tens and ones within each period makes it possible to read and write large whole numbers:

Millions			Thousands			Ones		
Hundred Millions	Ten Millions	Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones

Students should understand that:

- each position represents 10 times as much as the position to its right.
- each position represents $\frac{1}{10}$ as much as the position to its left.
- from right to left, each group of three digits is called a period.
- the three digits within each period are read as hundreds, tens and ones.

As a pre-assessment, teachers could begin by representing a number in the thousands using a place value chart.

Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones
4	5	2	1	3	7

Ask students to read this number ("four hundred fifty two thousand one hundred thirty seven"), write it in standard form (452 137) and in expanded form (400 000 + 50 000 + 2 000 + 100 + 30 + 7).

Students should extend this knowledge to read and write numbers greater than 1 000 000 by using an example such as 254 871 346.

Millions			Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
2	5	4	8	7	1	3	4	6

Ask students to read this number and write it in standard form.

Suggested Assessment Strategies

Performance

- Create cards with various number words on each as shown:

six	hundred	billion	two	four	million
thousand	eight	five			

Ask students to rearrange the cards to create as many different numbers as they can. Ask them to record the numbers they create in standard form, expanded form, in a place value chart, and in words. Challenge students to create the greatest and the least number using all the cards.

(6N1.1)

- Ask students to use the number 619 723 766 to answer the following questions:
  (i) What does the 9 represent?
  (ii) What does the 3 represent?

Resources/Notes

Authorized Resource

Math Focus 6
Lesson 1: Representing Numbers in the Millions
Teacher Resource (TR): pp. 13 – 17
Student Book (SB): pp. 36 – 39

Supplementary Resources

Making Math Meaningful to Canadian Students K-8 – Marian Small

- Support for SCO 6N1 can be found on pp.138 – 157

Teaching Student-Centered

So I am pleased that some teaching supports were added, although…

- I wish the expectations themselves reflected these key concepts a little more.

Wording of an expectation

- Now, for example, an expectation reads “represent and solve problems involving the division of two- or three-digit whole numbers by one-digit whole numbers, expressing any remainder as a fraction when appropriate, using appropriate tools, including arrays”

Some of the key ideas provided

- Groups of equal quantity, scale factors, area, combinations could all be division situations.

- This might be written into the expectation, e.g. describe contexts in which division problems are appropriate and solve those problems, even when there are remainders involved [NOT MY REPLACEMENT DID NOT MENTION DIGIT SIZE]

You need to be cautious …

- The key concepts are not always actually concepts
- E.g. contrast “situations involving division include: …
- With: And a double number line can be used to represent scaling.

Since the key concepts were not always integrated into the expectation language,…

- You will see that MathUP essential understandings and learning goals will help you with that.

I wish…

- That the number of digits involved in calculations was less of a focus. This tends not to support differentiation.

For example

Grades 3 , 4 and 5

Grade 3: B2.5 represent
and solve problems involving the addition and subtraction of whole numbers that add up to no more than 1000, using various tools and algorithms

Grade 4 up to 10 000; Grade 5 up to 100 000

So…

- MU lessons will address the number of digits suggested, but will often offer parallel tasks where the number is different.
- Even if that doesn’t happen, teachers need to feel free to tailor the work to student needs.

As well…

- That’s why parallel assessments might be important.

I was a little surprised…

- that there was no pick up from the new BC curriculum, which articulates big ideas for each grade and which focuses around competencies rather than content.

Mathematics 5

Background Information ▾ Change Grade ▾ Download ▾

Core Competencies

Communication ▾ | Thinking ▾ | Personal and Social ▾

Big Ideas

Numbers describe quantities that can be represented by equivalent fractions.

Computational fluency and flexibility with numbers extend to operations with larger (multi-digit) numbers.

Identified regularities in number patterns can be expressed in tables.

Closed shapes have area and perimeter that can be described, measured, and compared.

Data represented in graphs can be used to show many-to-one correspondence.

I wish….

- There had been provision of sample assessment questions to give a better flavour for what is really desired.

(I know that’s what I tried to do for you in MathUP, but it would be nice to see what the curriculum authors, and perhaps eventually the EQAO folks, have in mind.)

It is so convenient

- That the curriculum is in digital format.
- This certainly helps me as an author and should help you, as teachers.

Knowledge and Understanding

- The ministry has always done a good job in the context section of clarifying the difference between knowledge and understanding, but I wish this came out more clearly in how expectations are phrased and through assessment examples that might have been provided.

Knowledge and Understanding

- For example: an expectation says “understand and recall commonly used square numbers” OR
- “add and subtract fractions with like and unlike denominators, using appropriate tools, in various contexts”

- I ended up trying to clarify the difference between knowledge and understanding for teachers using MathUP.

I am good with…

- The “amalgamation” of many very small specific expectations into a single outcome, since many of the details went into the teaching supports.
- I don’t really believe there is less to teach– I think that in junior and intermediate, there might be more.

I am confused about some of the changes in measurement.

- I noticed that in Grade 1 and 2, the use of units was greatly reduced, but it remains in K.

I am good with the teaching of coding.

- Coding is a valuable tool. It does use math ideas and can, once students can use variables, allow them to create multiple examples from which to generalize very quickly, but I don’t think it teaches math ideas. We have to be sure not to overlook some of the other strategies we use to teach those ideas, e.g. ways to move on a grid or ways to use a variable.

I wonder why coding is called algebra

- There are certainly algebraic aspects to coding, but much of the coding in the primary grades is actually more spatial than algebraic.

Financial literacy

- It is obviously good to help citizens begin to understand all the financial “traps” in which they might get caught and to see how important knowledge and planning are in financial situations.

But…

- Lots of it is not math and so we are actually losing math teaching time.

- I wonder about some choices- e.g. why no dollars and cents together until Grade 5. [I know kids don’t meet hundredths until Grade 5, but that still is odd to me.]
- I find it odd to use tools to calculate compound interest in Grade 8 when students don’t really have the math skills to deal with anything more than the general notion.

And…

- I worry about talking to kids who might not have enough food to eat about balanced budgets and tax implications, etc.

SEL

- I am convinced that the learning environment matters a lot, but I am struggling to see why it’s a strand in the math curriculum, rather than background, like the processes.
- That said, it is good that examples are provided to help teachers create that environment.

SEL

- I struggled a bit with examples of what are called creative and critical thinking. I felt they were very limited compared to what we are trying to address in MathUP as creative and critical thinking.

For example…

- I would expect things like this:

For example…

- I would expect things like this:
- An angle’s measure is really easy to estimate. What might it look like?

For example…

- Which number is usually greater- the number of centimetres in the perimeter of a rectangle or the number of square centimetres in the area? Explain.

For example…

- You know that you can buy a 1.77 L container of laundry detergent for $5.95. It does 38 loads of laundry.
- Calculate each of these unit rates. Decide which you think is more useful.

For example…

- What’s your favourite number? Why?

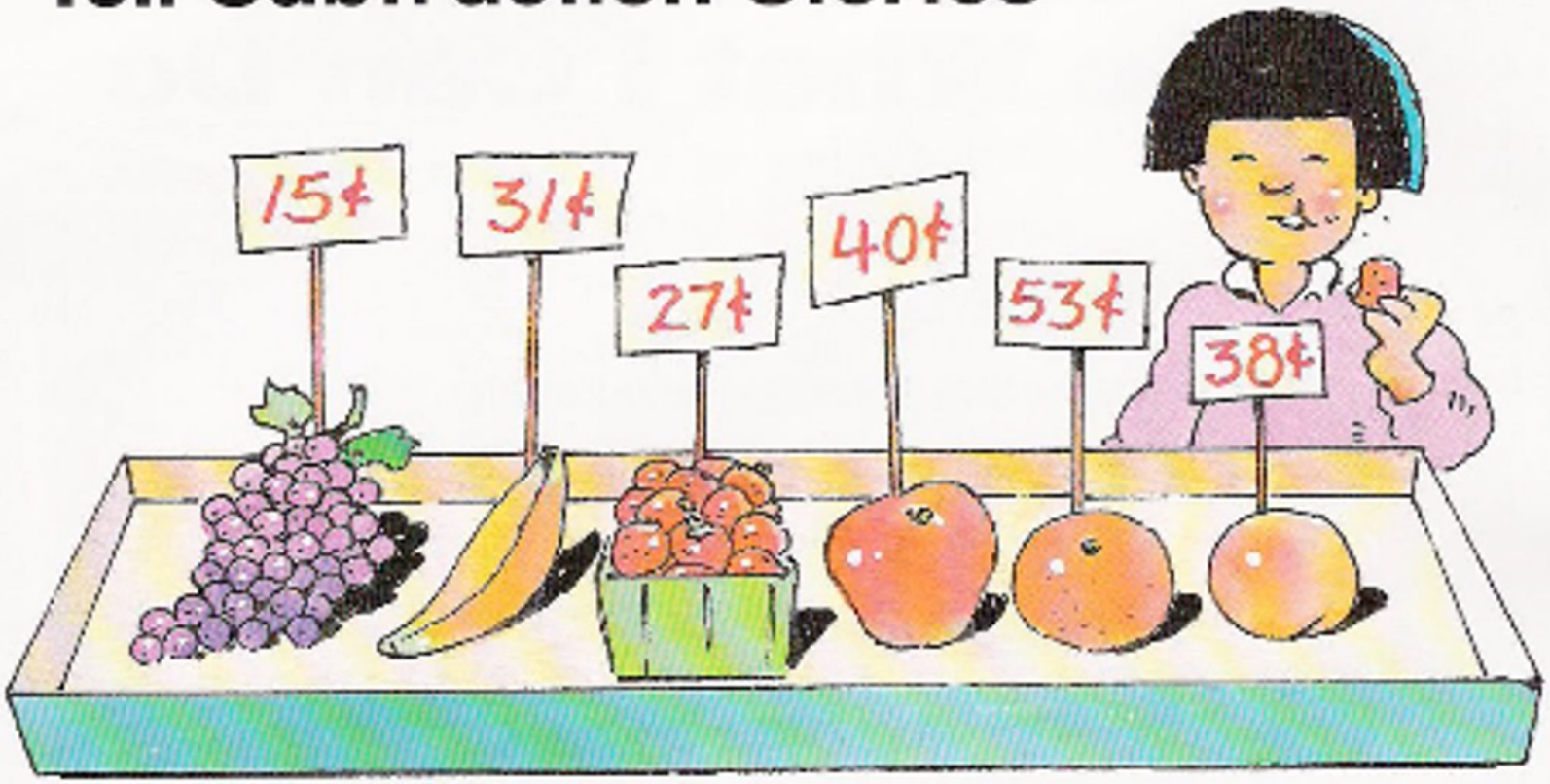
MATH UP CLASSROOM

I like nine because it's fine
and fine numbers like nine do
not waste time well your eating
a lime and that's why nine is fine

Rubicon

MATH UP

Tell Subtraction Stories



Rubicon

- Write down some of the ways 3 and 8 are alike and different.

3 and 8

Alike

They are both one digit.
5 letters in the number words
Both have E letter in the number word.
They are both under 10.
Both have T and H

Different

3 odd and 8 even. 8 More and 3 less
Don't start with the same letter.
Both don't have G or I

Professional Learning

- I mentioned earlier that part of this talk would be about the critical responsibility we all share to ensure teachers are provided with and take advantage of rich professional learning opportunities.

Professional Learning

- I don’t really want professional learning to be about– here are some great activities - just use them.
- OR I don’t want it to be about some very generic buzzwords.
- I think it needs to be “tight” and require lots of reflection.

Professional Learning

- That’s why I think the 2020 ON rewrite of MathUP provides that professional learning that is focused, but helps give insight into the new curriculum.

Mathematical Modelling

- I fully support the use of mathematical modelling but struggle to see why it is an algebra expectation and not listed in the same part of the document as the processes.

- Regardless, I tried to rewrite some of the language particularly in the Brain Benders, but in lessons as well, to help teachers see where the modelling happens.

Confusion about grade placement

- I struggle to figure out why a number of concepts were moved down a lot of grades (e.g. some fraction work, some algebra work, some percent work….), but then other things moved up (e.g. measurement and geometry work). I kind of wish that we had been told more about why these things happened. (Or maybe we were and I missed it?)

Confusion about particular pieces of content

- I realize this is political, but learning the multiplication facts for 11 and 12 does not make sense to me.
- The need to multiply 3-digit whole numbers by 2-digit whole numbers using an algorithm does not really make sense to me.
- The need to create infographics in every single grade over 5 grades seems like a lot to me.

All that said….

MathUP was rewritten to respect the decision of the Ontario curriculum writers since, clearly, a lot of thought went into the rewrite.

Any questions?