The elusive obvious of mathematics education

… and its debut in the new Ontario grade 9 math curriculum

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Share a math story?

If you ask a student *What did you do in math today?* the typical responses will be *I don't know*, *Nothing* or the mention of a topic like *Fractions*.

In the late 1990s, working as a mathematics consultant for the Durham District School Board, I had the pleasure of offering many evening math workshops for parents. I occasionally asked, *What is your favourite math story?* The typical response was confusion.

We study school math for ten or more years. Why can't we talk about it?

What counts as math?

In 2004, we invited Apostolos Doxiadis (math prodigy, playwright, author) to a symposium funded by the Fields Institute and hosted by Western University.

Doxiadis said that mathematics education will not change unless what counts as mathematics includes the *stories of doing mathematics*.

> a view of mathematics not as something pinned like a dead moth for Euclidean purists to examine […] but mathematics as it is lived by human beings, as it is loved, as it is explored, feared, created, dreamed of... By human beings. (Doxiadis, 2003, p.6)

Why stories?

In 2003, at another Western symposium funded by the Fields Institute, Brian Boyd (University of Auckland; author of *On the origin of stories: evolution, cognition, and fiction*) spoke about the human necessity for storytelling and that telling a good story involves artistic discovery.

Anthropologist Ellen Dissanayake (author of *Homo Aestheticus: where art comes from and why*) spoke of the human biological necessity to experience, share and learn from surprising events and stories.

Bruner (1986) identified two distinct (yet complementary) modes of thought: the *narrative*, concerned with meaning-making through story telling, and the *paradigmatic*, concerned with truth through logic.

Story is not a frill, not any more than logic. Together, they make us — and math — fully human.

Story in the Ontario math curriculum?

The good news is that *story* is now in the new Ontario grade 9 math curriculum. This is a rare — wonderful — event in math curriculum writing.

For example (Ontario Ministry of Education, 2021):

- **B1.1** research a number concept to **tell a story** about its development and use in a specific culture, and describe its relevance in a current context
- **C1.1** research an algebraic concept to **tell a story** about its development and use in a specific culture, and describe its relevance in a current context

A good math story?

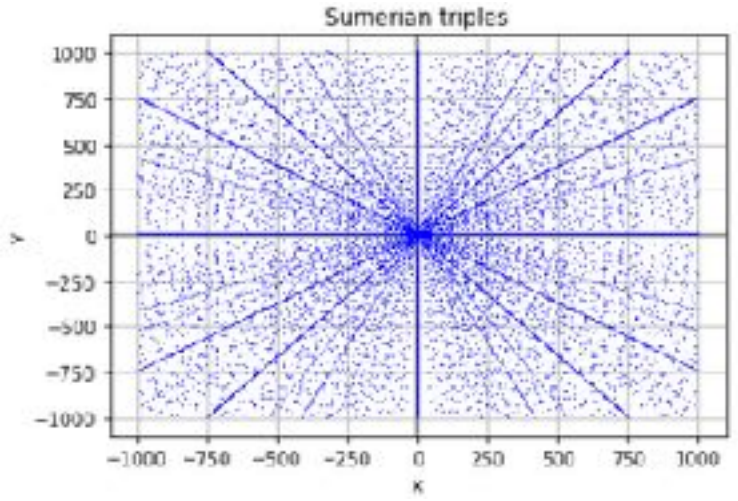
For such curriculum expectations to work — for students to learn to tell good math stories — they need to occasionally, say once each unit, live them in their classroom experiences.

A good math story includes mathematical surprise and conceptual insight (Gadanidis, 2012).

For example, in relation to expectation **B1.1** above:

- Let's look at the number concept of Pythagorean triples, like 3-4-5 and 5-12-13.
- The theorem is named after Pythagoras, but it was known before him by the Egyptians.
- Egyptian surveyors, sometimes referred to as *rope-stretchers*, carried a rope with 13 evenly spaced knots (12 equal spacings), which they stretched to form a 3-4-5 triangle to reset rectangular land boundaries when the river Nile overflowed.
- Well before the Egyptians, the ancient Sumerians etched lists of such triples — let's call them *Sumerian triples* — on clay tablets.
- How can we find Sumerian triples?
- Let's use Python to find and plot all the pairs of numbers (x, y) where x, y, and the distance from (x,y) to (0,0) are Sumerian triples.
- The math part of the code and the resulting plot are shown on the right. Run the code at bit.ly/sumerian-triples
- What patterns do you see? Do you see lines? Do you see parabolas opening to the left and to the right? What else?
- What else might you research?

```
# find Sumerian triples
for x in range (-1000,1001):
  for y in range (-1000,1001):
    hypotenuse = np.sqrt(x**2+y**2)
    if hypotenuse == int(hypotenuse):
      xList.append(x)
      yList.append(y)
```



The above starting points offer the potential for mathematical surprise and insight, and are the basis for a good math story to research, to understand, and to share.

See another example, on finding primes at learnx.ca/primes1

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