

The coming 'math war'

Timothy Sibbald

Schulich School of Education, Nipissing
University



Context

- This session is informed by the preparation of a book manuscript that is under review
- The book challenged chapter authors to look at interdisciplinary math approaches, such as STEM and STEAM, in terms of how the math taught might be impacted. (Akin to asking about impact of calculators.)
- A theoretical framework for interdisciplinary studies was used by authors.

Crossing Disciplines

- STEM approaches are leading to more interdisciplinary foci
- Supported in the US by NSF and promoting K-12 interdisciplinary approaches to *go to mars*.
- Supported in the UK through colleges needing to address new materials and technologies (eg. Carbon fibre, wind turbines)

Theoretically?

- A literature search revealed one theoretical framework.
- It was published three times 1972, 1970, and originally in 1947.
- Developed with Interdisciplinary university programs in mind.
- Jantsch, E. (1947). Inter- and transdisciplinary university: A systems approach to education and innovation. *Higher Education*, 1(1), 7-37.

Intended Goal

- Wanted to know if interdisciplinary approaches change the math content that is conveyed.
- Is the theoretical framework appropriate or does it need a) updating?, and b) tailoring to K-12 or college environments?
- The extent that STEM is pursued because of funding as opposed to principled intention.

Before Continuing

- What is the fundamental purpose or purposes of education?

Knowledge (Truth?)
Growth/Development
Democracy Morality
Critical Thinking Ethics

Content Impact - Macro

- Concern that views of the purposes of education influence the interdisciplinary foci.
 - *'Education is for jobs'* means job oriented projects,
 - *'Education for learning principles/concepts'* is less pragmatic and seeks rich tasks,
 - *'Education as self-improvement'* leads to other projects such as green projects.
- Philosophical vs. political grounding of the purpose of education

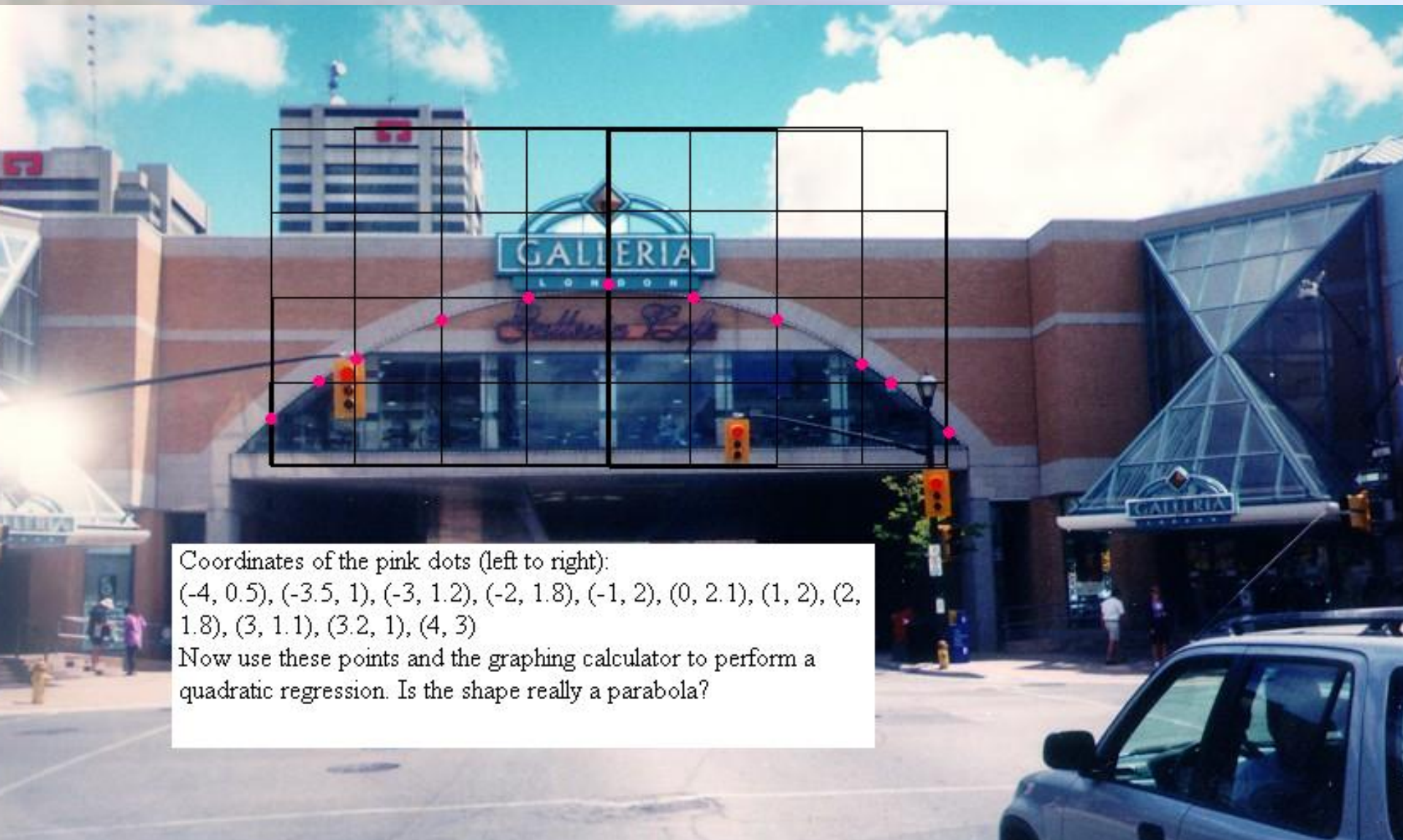
Content Impact - Meso

- Some concepts naturally cross disciplinary boundaries due to their abstraction.
- Example 1 – Spectrum of “abstract to concrete”
- Example 2 – Literacy/Communication
- Example 2 – Using a standard of measurement or establishing a coordinate system (next slide)

Where would you place the coordinate system for this quadratic?



Using symmetry? Natural features?



Coordinates of the pink dots (left to right):

$(-4, 0.5)$, $(-3.5, 1)$, $(-3, 1.2)$, $(-2, 1.8)$, $(-1, 2)$, $(0, 2.1)$, $(1, 2)$, $(2, 1.8)$, $(3, 1.1)$, $(3.2, 1)$, $(4, 3)$

Now use these points and the graphing calculator to perform a quadratic regression. Is the shape really a parabola?

Content Impact - Micro

- Issues arose with different disciplinary languages
- Use of units and variations in units
 - The (km/h)/s issue
- Views regarding idealized problems versus numerical problems
- All authors found core skills arising regardless of the disciplinary boundary they crossed.

Core skills

- These could be encapsulated as numeracy
- Somewhat elevated numeracy – km/h/s exceeds many people's day to day numeracy
- Context dependent
 - Culture such as with Sangaku
 - Euro-centricity in creative writing
- These topics are fundamental and generally not swayed by larger purpose of education

Sangaku Tangent

- Find the ratio of the radius to the side length of the square



Cut the knot points out doing this numerically with a calculator sheds no light on the geometrical relationships inherent in the shape.

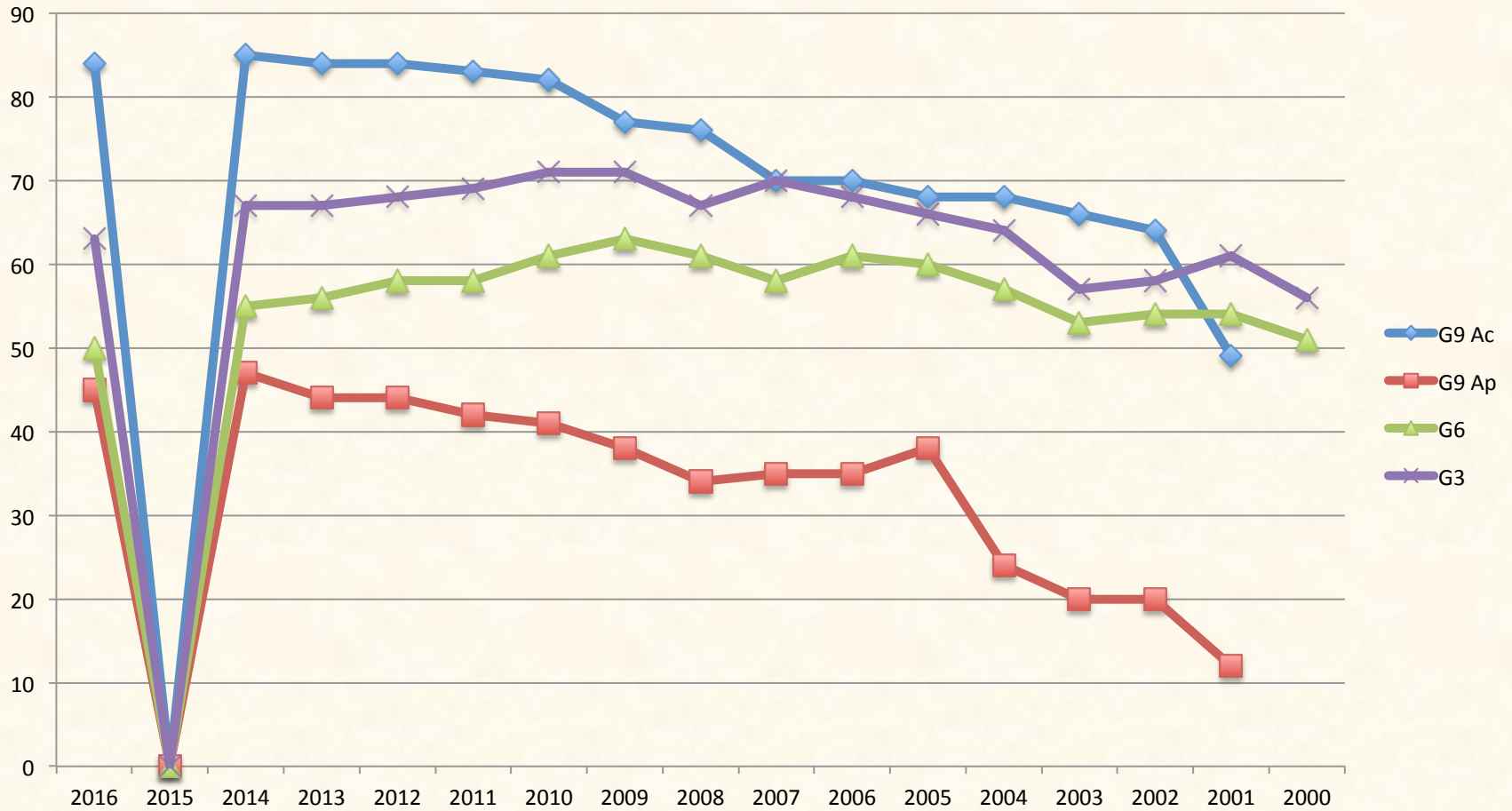
Framework Issues

- The Jantsch framework was not designed for K-12 or colleges
- It assumes that disciplines are clearly siloed as they are in departments in universities
- So why is it being applied to K-12 (or colleges)?

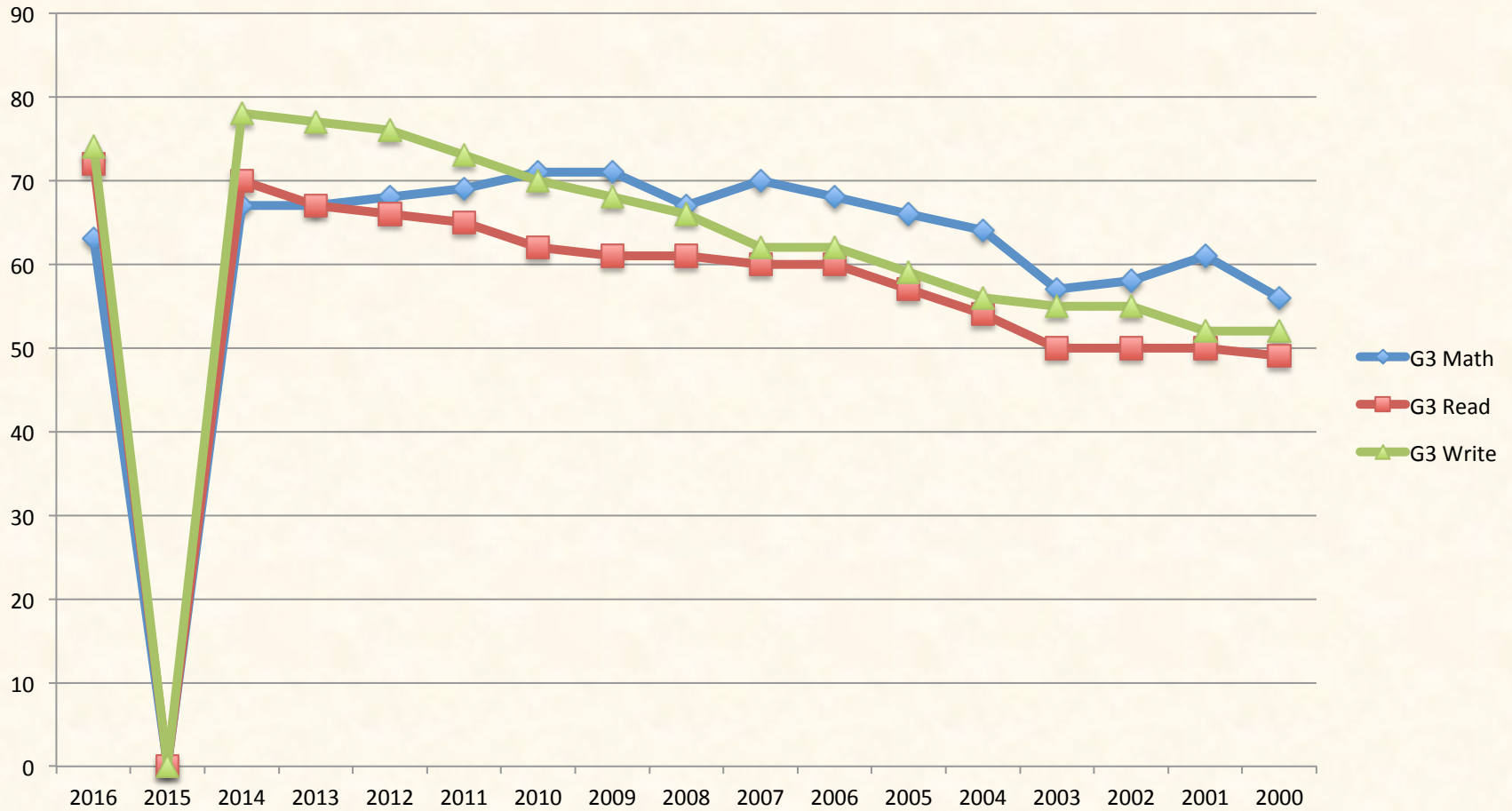
How war is arising!

- There is a strong push for STEM in the US.
- This is being copied in Ontario as US resources become available. For example, programmable robotic balls (ex. Sphero)
- The implication is that using interdisciplinary approaches will improve Ontario education

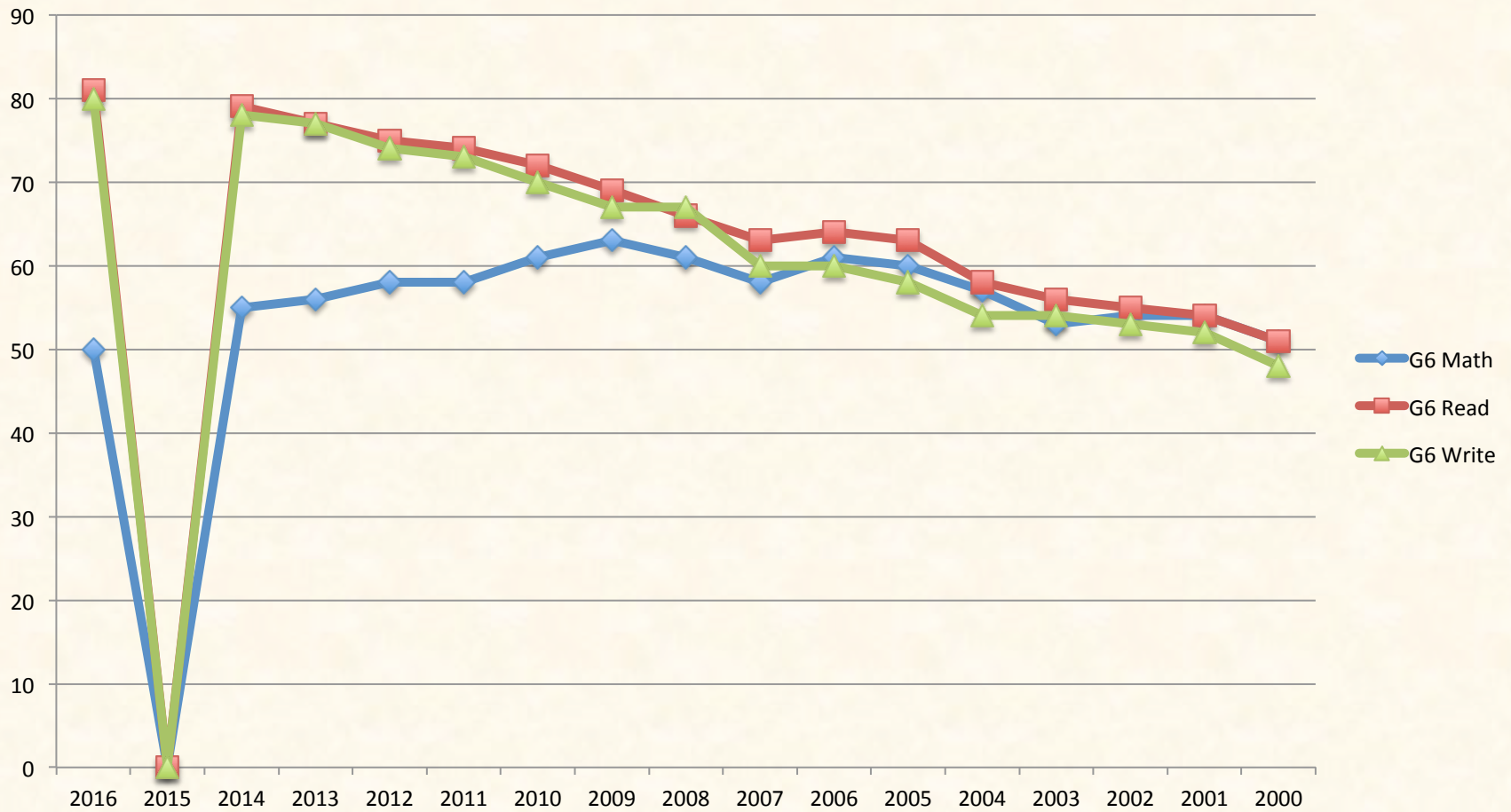
The EQAO evidence says...



Grade 3 EQAO history



Grade 6 EQAO history



Convergence of Issues

- Literacy funded to exclusion of numeracy
- STEM promoted
- Evidence is going to show STEM addresses numeracy.... Because it does.
- But, STEM creates an unclear disciplinary foundation because it is based on an out of date framework – colleges will suffer.

The war will be...

- Over support for numeracy
 - Must be distinct from literacy
- The place of numeracy
- Whether STEM or interdisciplinary approaches are as efficient as disciplinary approaches
- Whether numeracy can be embedded in the curriculum to address the issue (before back to basics can have an impact)

War Concerns

- Literacy will continue to claim numeracy is subservient to their mandate
- STEM – that only funding to provide contextual mathematics can address gaps in current system.
- ?Who? – worries about loss of coherence in education?
- Public – How will they see all this?

Thank You

To contact me:

Timothy Sibbald – timothys@nipissingu.ca

