Why do we teach Mathematics?
Agenda

- The situation
- The needs
- The aspiration
Ratio of Subjects – OECD Average

- Language
- STEM
- Humanities
- Physical education/Vocational Ed/Other
STEM Education – OECD average

- Science
- Technology
- Math
Spending on Maths Education worldwide

~$230B* spent on Maths Education YEARLY

So... what is the Return on that Investment?

* UNESCO, OECD data
Why do we teach Mathematics?

10 minutes at URL:

Poll - why do we teach Mathematics?

Then visual summary via: http://www.wordle.net/create

And further processing (later): http://textalyser.net/
From 100+ U.S. schoolteachers
Why do we teach Mathematics?

Sources:
• Aristotle, Plato, Al-Khawarizmi, Al-Kindi, etc.
• John Allen Paulos, Temple U.
• Paul Ernest, U. of Exeter
• Eleanor Robson, U. of Oxford

- Emotional (e.g. Beauty)
- Cognitive (e.g. Logical reasoning, Creativity)
- Practical
  * Concepts (e.g. Proof)
  * Tools (e.g. Multiplication table)
How well are we doing with positive Emotions about Maths?

- Poll
Sentiment charts (1)

Source: Twitter
Sentiment charts (2)

Source: Twitter
“In 1953 you were my math teacher. You promised that algebra would come in handy someday. How much longer do I have to wait?”
Hey, Miss Lenhart! I forgot everything about algebra the moment I graduated, and in 20 years no one has needed me to solve anything for x!

I told you I'd never use it!

In your face!
How well are we doing with Cognitive development through Maths?

- Day 1 – Jon Star
How well are we doing with Practical needs for Maths?

- Day 3 – Bakker; Mayo presentations
Begging for Relevance

“Please, Ms. Sweeney, may I ask where you’re going with all this?”
“Yes, this will be useful to you later in life.”
Neuroscience Hints at...

Cortical plasticity is conditional upon relevance

Student Voice Video: Doodling in Maths class
Mindset: “Math is pure…”

Source: XKCD cartoon
Why did the Greeks teach Geometry?

a) To survey and divide fields
b) To build structures
c) To draw battle plans
d) To train abstract thinking
e) Because it is pure

A: a), b) and c)

*Relevance* first
Why did we add Trigonometry in the 1800’s?

a) Because it is pure
b) Because the times required more land surveyors and woodworkers
c) Because it was a predictor of college success

A: b) of course !
Surveyor at Stanford U.

- Me: “How do you use ArcSecant?”
- Him: “I don’t – it’s computerized”
How did we get here?

Arithmetic
Geometry
Astronomy

STEM

Algebra, Trigonometry, Calculus
Biology, Chemistry, Physics

Ancient Greece & Rome
Early Christianity & Middle Ages
Renaissance & Enlightenment
Modern Industrial Era
Today

Technology and Engineering?
How Much Historical Happenstance?

A young man, eager to impress his bride, decided to cook her a roast just like his father had always made for him. He called his father for advice, and was told to cut off the ends of the roast, and add oil and salt and pepper. The dish was a great success, but the wife asked why he cut off the ends. The young husband called his father, who said that was what he'd been taught by his own father.

So the man called his grandfather, and asked, "Why do you cut off the ends?"

"Because the pan was too small," came the answer.
**Modern industry needs different Maths**

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How do you teach Skills, Character, Metacognition?

- Via Practices

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Source: Bernie Trilling & Charles Fadel
Workplace Mathematics

- **Mathematical modeling:**
  - e.g. energy requirement of a water company; cost of sandwich; …

- **Use of Software, and coping with problems:**
  - e.g. oil extraction; dispersion of sewage; …

- **Costing (allocation, dispute management):**
  - e.g. Contract cleaning of hospital; management of railway; …

- **Performance and ratios:**
  - e.g. Insurance ratios; glycemic index; …

- **Risk:**
  - e.g. clinical governance; insurance; …

- **Quality/SPC control:**
  - E.g. Furniture; machine downtime; deviation of rails; …

Source: Royal Society – ACME 2011 “Mathematics in the workplace and higher education”
Google N-gram mentions
# Relevance is a choice

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Wisdom from a Mathematician

“One may even say, strictly speaking, that almost all our knowledge is only probable; and in the small number of things that we are able to know with certainty, the principle means of arriving at the truth -induction and analogy- are based on probabilities.”

Pierre Simon Laplace

Theorie analytique des probabilites,1825
“Numbers and probability provide the basis for statistics, which, together with Logic, constitute the foundation of the Scientific Method”

John Allen Paulos
Author, “A mathematician reads the newspaper”
Wisdom from a Corporation

“I keep saying the sexy job in the next ten years will be statisticians. People think I’m joking but who would’ve guessed that computer engineers would’ve been the sexy job of the 1990s.”

Hal Varian, Google Chief Economist
McKinsey Quarterly, Jan 2009
Our aspiration: a more Numerate society

1. Concepts AND Tools (balance)
   • Which Maths branches/subjects? (relevance)
   • Depth AND breadth (balance)
   • Application AND Formalism (balance and sequence)
   • Knowledge AND Skills AND Character AND Metacognition (balance)
   • Enabled by Technology (balance)

2. Cognitive (transfer)
   • Skills: Creativity; critical thinking; communication; collaboration
   • Character: Persistence, resilience, confidence, resourcefulness
   • Metacognition: self-reflexion on processes; learning how to learn

3. Appreciation
   • Fun, beauty
   • If not love, at least curiosity not fear!
Maths for *All Three Groups*

- **0.9% who study Maths**
- **20-40% who study S, T & E**
- **The rest of the population**
Thank You!

“What should students learn in the 21st century?”

www.curriculumredesign.org

Twitter: @CurrRedesign