117 ÷ 3
As a first-year out teacher (in 1971) I had given the task 117 ÷ 3 to the Year 9 class ... along with a number of other tasks. I watched – transfixed – as a student made 117 strokes on the page ... and circled them 3 at a time ... and got the correct answer of 39 What can we make of this?
The World of Mathematics

In the 1960’s, James Newman’s set of four books, The World of Mathematics, was issued to school libraries. A wonderful anthology of writing about mathematics. A letter from a librarian arrived ...

Reading (about) mathematics

What mathematics book are you reading at present? (Textbooks don’t count!) What mathematics books are in your school’s library? (Textbooks don’t count!) Who ordered them? What about your local Council library?

A few possibilities ...

Where are the books about mathematics?

Bookshops, Port Macquarie, Perth Bookshops, Melbourne Internet Council libraries AAMT shop AAMT-List

Reading maths on the Internet

If everyone is to get a laptop, what will they use it for? Reading interesting materials is one possibility Some examples via my website*: • Plus magazine • MAA columns (Keith Devlin, Ivars Petersen, …) • Ron Knott’s Fibonacci site

(*Website address at end of presentation. Go to Internet PD links on home page)

Where do we learn English?

At home At school At work Via the mailbox On television On the Internet In the street On a bus At the movies or theatres ... everywhere in Australia!
Where do people learn history and geography?
At home
At school
In books, incidentally
In a museum
On holidays
Travelling
At the movies
On television
On the Internet

School of Education

Where do people learn mathematics?
At school.
Perhaps.

School of Education

Making the Invisible Visible

"Much of our present world is the product of mathematics. And yet, today, knowledge of mathematics is not generally regarded as important; a person can be largely ignorant of mathematics and still be regarded as educated." (p.206)

"Mathematics provides us with a way to make the invisible visible." (p.207)

"The message is clear: Today's world is in large part a world of mathematics. Mathematics is a product--a discovery--of the human mind. It enables us to see the incredible, simple, elegant, beautiful, ordered structure that lies beneath the universe we live in. It is one of the greatest creations of mankind--if it is not indeed the greatest." (p.209)

Keith Devlin, Life By The Numbers

Product Numbers

Supermarkets these days rely on scanning, using product numbers shown as bar codes.
The parts of a number all mean something.
The last digit is a check digit to reduce errors.
Most errors are detected and don't scan properly.
ISBNs are another example.

School of Education

Coffee jar

This Moccona coffee jar has a bar code and an associated number.

School of Education

Mathematics of coffee

The Australian Product Number (APN) is 8711000055380.
Sum of odd digits + 3 x sum of even digits must end in zero.
8711000055380 has an odd sum of 17.
8711000055380 has an even sum of 21.
17 + 3 x 21 = 17 + 63 = 80.
It checks!
An invisible process? How many shoppers see the mathematics being used?

School of Education
What is a mathematician?

"A device for turning coffee into theorems"

Paul Erdős, mathematician

( Photo from MacTutor history archive)

The man who loved only numbers

"A mathematical genius of the first order, Paul Erdős was totally obsessed with his subject — he thought and wrote mathematics for nineteen hours a day until he died. He travelled constantly, living out of a plastic bag, and had no interest in food, sex, companionship, art — all that is usually indispensable to a human life"


Media

The main purpose of the commercial media, print and electronic, is to sell advertising

Profit is maximised by maximising sales, bad news and divisive issues

• "Never let the truth get in the road of a good story"
• League Tables a fertile source
• National testing offers new goldmines
• Positive education stories waste space

Mathematical pictures

Some mathematics pictures stick in the mind more than others; here are a few:

• Gapminder (at http://www.gapminder.org/world/)
• Crash statistics and the road toll
• Symmetry and Chaos
• Peter’s Map
• Criminology

Australian road fatalities

Fatalities per 10 000 registered vehicles
The road toll per 100,000 population was shown in The West Australian in 1996:
- On Boxing Day
- On page 42
Clearly, not very newsworthy!

Symmetry and chaos

It seems paradoxical that symmetry and chaos can be considered at the same time.
Yet, Mike Field and Martin Golubitsky in Symmetry In Chaos (OUP) provide many stunning examples:
- One of our goals for this book is to present the pictures of symmetric chaos—in part because we find them beautiful and in part because we have enjoyed showing them to our friends and think that they may appeal to others.
See examples at Mike Field’s homepage: http://nothung.math.uh.edu/~mike/

The Peters map

The Peters Projection World Map is one of the most stimulating, and controversial, images of the world. When this map was first introduced by historian and cartographer Dr. Arno Peters at a Press Conference in Germany in 1974 it generated a firestorm of debate.
See http://www.petersmap.com/

Mercator’s projection

India and Scandinavia appear to be about the same size.
So do Europe and South America.
In fact, India is three times the size of Scandinavia.
South America is almost twice the size of Europe.
China is large and Africa is enormous.
England fits in Victoria!

Criminology

Possibly contradicting claims that things are getting much worse.

Metric conversion

We converted to the metric system for lengths before I started teaching.
So why was I instructed to teach students how to convert between imperial and metric measures?
...and is this worth the time it takes?
Curriculum change

The Achievement Certificate
Leaving and Matriculation
Maths IV
The Arithmetic Review
JIM
The New Primary Syllabus (1978!)
The Unit Curriculum
The new upper school courses (1990!)
National Statement/National Profiles
Curriculum Framework
NCCO
Courses of Study ...

... is inevitable!

Societal changes
Demographic changes
Technology changes
School structural changes
State/National changes ...

Change happens everywhere, not only in schools
We have no choice but to be adaptable and contribute to improving changes

Why change Year 11-12?

Inadequate treatment of statistics
• Especially for strong students
• Absence of inferential thinking
Technology
Miscellaneous hotchpotch: no big picture
‘Discrete’?
‘Applicable’?
Spatial work??
Audiences staying at school

Teacher education

Watching a student teacher in
Chicago, IL, 1986
A geometry lesson
A lesson in cultural difference

Who is mathematics for?

Where are the new mathematics teachers?
First, they need mathematics: it is too hard to teach well what you do not know

How many students opt for a university maths major at the end of year 12?
For example, in October 2005 at Murdoch:
• about 0.4% (rounding up!) of TISC preferences were for Mathematics and Statistics
• Only six TISC 1st preferences out of 2239 (0.3%) were for Mathematics and Statistics

Very few students leave year 12 keen to study mathematics

Attractions to mathematics

Maths is rarely taken as an undergraduate elective for interest, here or elsewhere.
• It is mostly taken because it is ‘required’.
• A ‘service subject’
• The ‘serf of the curriculum’?

What would we put into a mathematics course if we knew that it was students’ last?
Why did you study mathematics?
What should be included?
Four Faces of Mathematics

Keith Devlin has suggested that mathematics presents four faces to the world:
• Computation, formal reasoning and problem solving
• A way of knowing
• A creative medium
• Applications
Do we reflect all of these in our courses?

Fundamental Mathematics


“School tradition has it that arithmetic, measurement, algebra and a smattering of geometry represent the fundamentals of mathematics. But there is much more to the root system of mathematics – deep ideas that nourish the growing branches of mathematics. One can think of ...

... mathematical structures

Numbers
Algorithms
Ratios
Shapes
Functions
Data

... or attributes

Linear
Periodic
Symmetric
Continuous
Random
Maximum
Approximate
Smooth

... or actions

Represent
Control
Prove
Discover
Apply
Model
Experiment
Classify
Visualize
Compute

... or abstractions

Symbols
Infinity
Optimization
Logic
Equivalence
Change
Similarity
Recursion
... or attitudes

Wonder
Meaning
Beauty
Reality

... or behaviors

Motion
Chaos
Resonance
Iteration
Stability
Convergence
Bifurcation
Oscillation

... or dichotomies

Discrete versus continuous
Finite versus infinite
Algorithmic versus existential
Stochastic versus deterministic
Exact versus approximate

Traditional school mathematics

"... picks very few strands (eg arithmetic, algebra, geometry) and arranges them horizontally to form the curriculum. ... this layer-cake approach to mathematics education effectively prevents informal development of intuition along the multiple roots of mathematics. Moreover it reinforces the tendency to design each course primarily to meet the prerequisites of the next course, making the study of mathematics essentially an exercise in delayed gratification." (p.5)

When are we gonna use this?

... a common question in maths
But what about other subjects:
• English?
• Arts?
• History?
• Music?
• Dance?
Why is this question the main one asked?

Why learn maths?

Should we learn mathematics only when it is 'useful'?
• What if it's interesting, but not obviously 'useful'?
• What if it's important for other reasons?
Is education only for getting a job?
• Or only to go to the next educational step?
Are we really interested only in "skills"?
• Or are these just easier to test or practise?
In my opinion, the answer is NO to all these.
Avoiding Math Avoidance

"In reality, so much that goes into the traditional mathematical curriculum, especially at the elementary level, is deplorable – it is not good mathematics, it is pointless and it is dull. … It is an ironical reflection on this whole problem [of mathematics avoidance] that children get turned off mathematics without ever having met mathematics – as the mathematician understands it."
Peter Hilton, 1981, in Mathematics Tomorrow.

Technology for learning

- Scientific calculator
- Graphics calculator
- ClassPad 330
- Excel
- Internet Maths
- Java Maths
- Wolfram Demonstrations
- Hot Maths
- Mathletics

Educational change?

"For more than a hundred years, much complaint has been made of the unmethodical ways in which schools are conducted. But it is only within the last thirty that any serious attempt has been made to find a remedy for this state of things. And with what results? Schools remain exactly as they were."
- John Amos Comenius, 1632

It is easier to move a graveyard

... than it is to change the mathematics curriculum

Change is hard

... and real change is real hard

Hofstadter’s Law:
It always takes longer than you think
... even when you take Hofstadter’s Law into account
It is unreasonable to ask a professional to change more than 10% per year
... but unprofessional to change less than 10% per year
(Leinwand)

Paul Halmos

“I thought, I taught, I wrote and I talked mathematics for fifty years,
and I am glad I did. I wanted to be a mathematician. I still do.”

Springer-Verlag, New York. (p 402)

Barry Kissane

“I thought, I taught, I wrote and I talked mathematics teaching for thirty eight years, and I am glad I did. I wanted to be a mathematics teacher. I still do.”

Thank you!
For being here
For listening
http://wwwstaff.murdoch.edu.au/~kissane