

The Ethics of Mathematics and Mathematics in Society

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How does Ethics enter into Maths?

Ethics concerned with good and human flourishing affects the following aspects of mathematics and mathematical practice at least:

1. *Professional ethics of mathematicians* -- Do mathematicians behave well (and honestly) to each other in research and towards other persons in society?
2. *Professional ethics of mathematics teachers* - Do mathematics teachers treat their students well? Do they do what is best for them? *Is the teaching of mathematics beneficial or harmful or both?*
3. *Ethics of mathematical applications* – *What are or should be the ethical limits of mathematical applications to ensure the good for society?*
4. *Ethical impact of mathematics on society* – *What further ethical impacts does the role and valuation of mathematics in society have, especially unplanned or hidden consequences?*
5. *Ethics of pure mathematics* – What ethical values does pure mathematics incorporate or embody, if any?

For some mathematicians and philosophers the claim that pure mathematics is ethics- or value-laden is problematic *ab initio*.

Is Mathematics Ethics and Value Free?

Answer depends on philosophy chosen

- **1. Objectivist position:** mathematical knowledge objective, universal, superhuman - untouched by human values or ethics.
- Although legitimate, this position has problems. Most concede:
 - *Mathematical concepts (including Natural numbers) are human inventions*
 - *Proof standards change so cannot depend on timeless fixed logical principles*
- **2. Social constructivist or humanistic position** - self evident that mathematics is value laden including ethics – because it is human product

However, can discern ethical elements in pure mathematics without resort to position 2.

Pure Mathematics and the Good

My claim - pure mathematics itself embodies aspects of the good.

1. Validity in maths requires display of means of verification (proof, calculation) publicly and openly. Thus mathematics embodies the ethical values of **openness** and **democracy**
2. Mathematics grows through pure research -- for its own sake -- based on working mathematicians' virtuosity. *Growth of knowledge and culture improves human flourishing* and is thus **intrinsically good**. Thus mathematicians' virtuosity is indeed a virtue.

Applied Ethics for Special Fields of Knowledge and Practices

- **Social responsibility of science**
 - Accepted that the Promethean power of modern science and technology warrants an extended ethic of social responsibility.
 - **Social responsibility of mathematics**
 - Mathematicians have been slow to recognise the social responsibility of mathematics, but has been suggested that there should be a Hippocratic Oath for mathematicians
 - **Medical ethics**
 - Medical ethics is a good example of applied ethics since Hippocrates. based on a set of values / principles.
 - 1. **Beneficence**. Promoting well being of others
 - 2. **Non-maleficence**. Not causing harm.
 - 3. **Respect for autonomy**. Must maintain rights to self-determination
 - 4. **Justice**. Should provide benefits equally for all, universally
- **Good basis for ethics of mathematical practices & math ed**

The Ethics of Mathematics in Society

The *ethics of mathematics in society* is problematic because of the ubiquity of mathematics in governance, science, information and communication technologies, finance and education.

GOOD IMPACTS

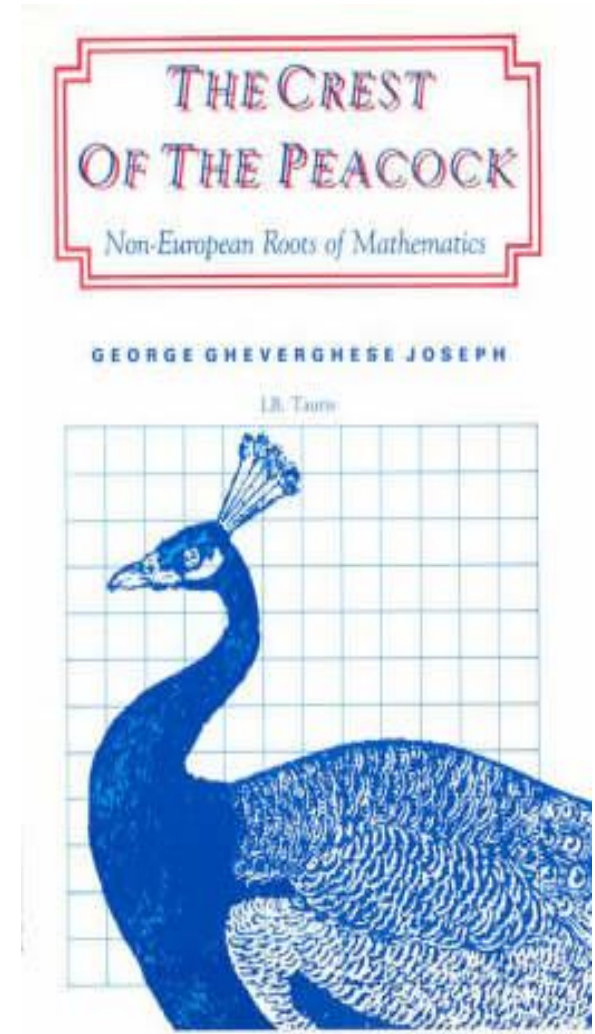
- mathematics is a great tool that enables the rich material basis for modern life. Almost all live healthier more comfortable lives because of maths and the science and technology it supports

NEGATIVE IMPACTS

- Unethical applications. Many can be cited, e.g., in the news: Cambridge Analytica privacy intrusion and data mining to influence politics and subvert democracy.
- Gross overvaluation of mathematics in modern society harmful

Mathematics is Overvalued in Society!

- *The claim that mathematics is grossly overvalued in modern society may be **shocking** for mathematicians and teachers!*
- We are **insiders** who love mathematics for its precision, power, universality, beauty, simplicity and complexity! Mathematics rightly claims to be the crowning glory of human knowledge – the **crest of the peacock** →
- But not everybody shares our love or happy experiences. Indeed we are a very small percent of the population!



How and Why is Maths Overvalued?

Ubiquity of maths in modern computerized society seen as reason everybody needs maths:

- Society depends on maths → everybody needs maths

Maths is a central feature of rationality

- Reason matters → Maths counts

The lifeblood of the modern world is money:

- Money matters → Money is an application of maths → Mathematics matters

Modern business and government depend on utility

- Utilitarianism depends on benefit (cost/profit) calculations (i.e. mathematical applications)

MATHEMATICS INSIDERS ARE A TINY MINORITY OF THE PUBLIC

> 99%

**MATHS OUTSIDERS
THE PUBLIC**



**MATHS
INSIDERS**

< 1%

gettyimages
Klaus Meinhardt

INSIDER VS. OUTSIDER VIEWS

MATHEMATICS INSIDERS

Mathematics is

- Love object, Fascinating, Beautiful, Attractive
- Meaningful, Useful, Powerful
- Avenue to personal success
- **We** are invested in it

MATHS OUTSIDERS - PUBLIC

For significant minority of public mathematics is

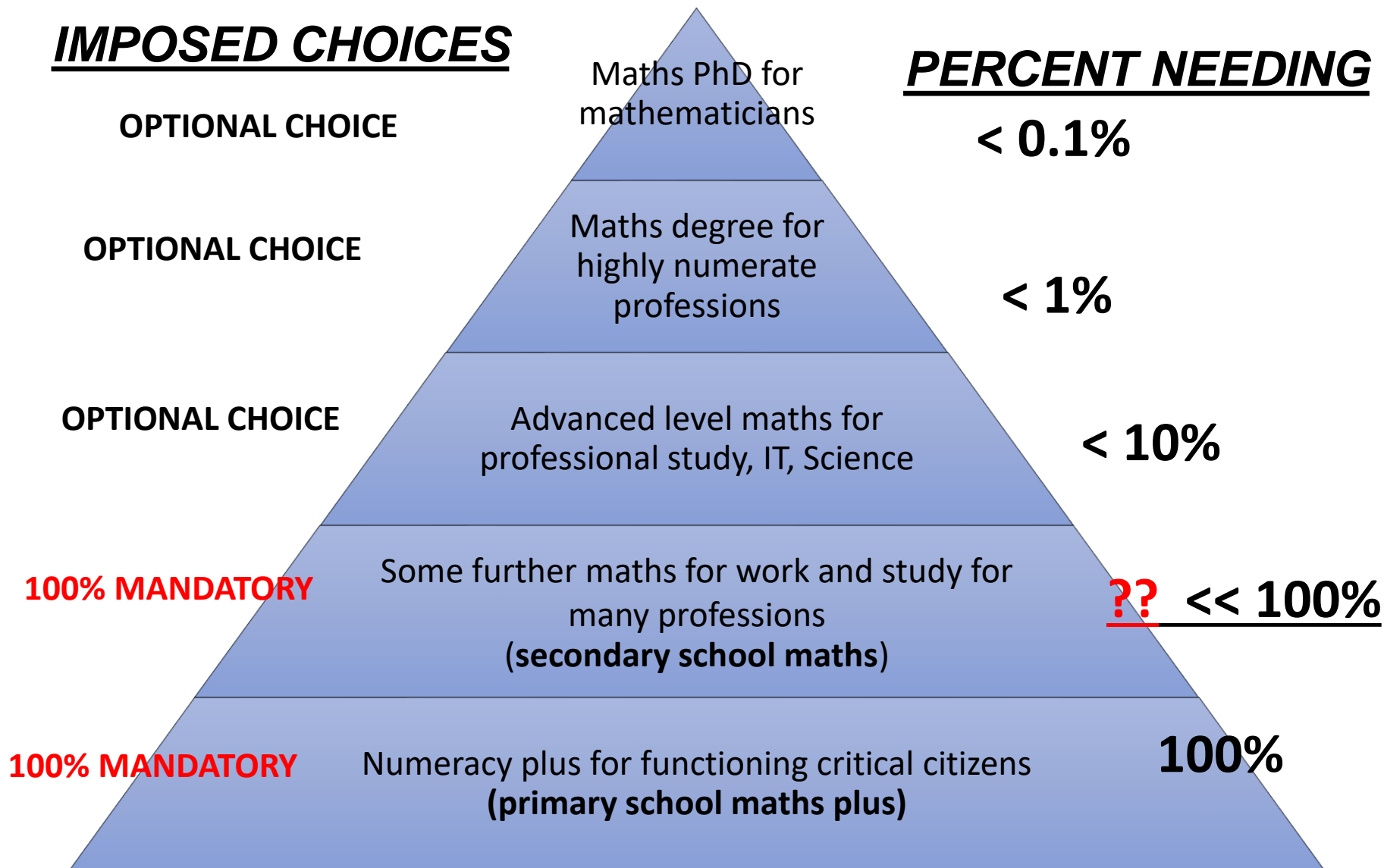
- Meaningless, Joyless, Cold, Hard, Unforgiving, Masculine, Rejecting, Frightening
- Inherited ability of **others** - not related to **our** efforts
- Obstacle to advancement
- **They** fear and avoid it

(Of course many of public also love or like maths)

Actual Mathematical Needs of Society

IMPOSED CHOICES

PERCENT NEEDING



EXCHANGE Vs USE VALUE OF MATHS

ACTUAL USE OF MATHS LIMITED (*USE VALUE*)

- All need **Numeracy plus** – to be functioning critical citizens in democracy (primary school maths **plus**)
- Society mathematized but most use algorithms in ICT, media, etc, without need of technical understanding
- Tiny minority need to understand maths algorithms

SYMBOLIC USE OF MATHS (*EXCHANGE VALUE*)

- Maths serves as a **social filtration** device. Maths certification is **critical filter** for entry to almost all higher education and professions
- Many forced to study maths involuntarily suffer loss of self confidence, negative attitudes to maths

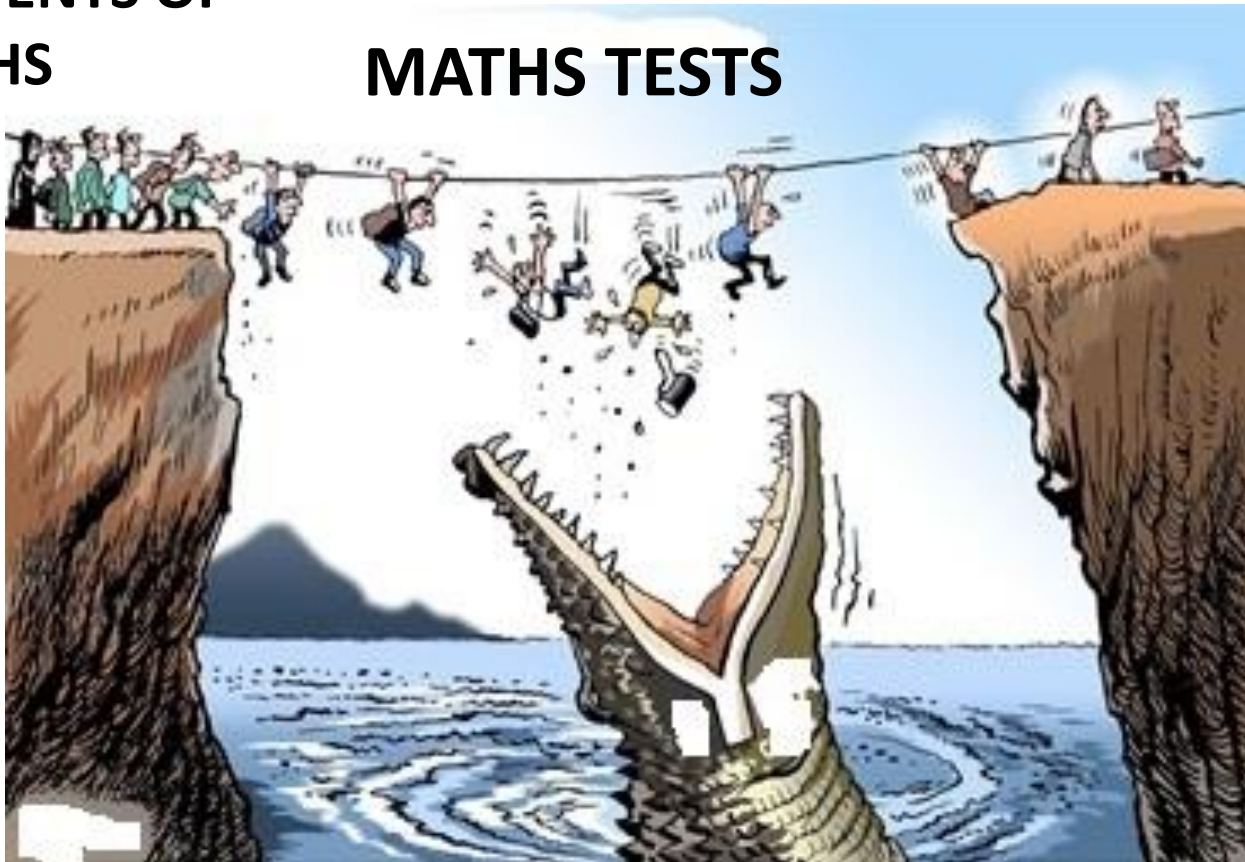
Classics: Same symbolic role as *critical filter* 16th-19thC

Maths Tests are a Critical Filter

STUDENTS OF
MATHS

SUCCESS AT MATHS

MATHS TESTS



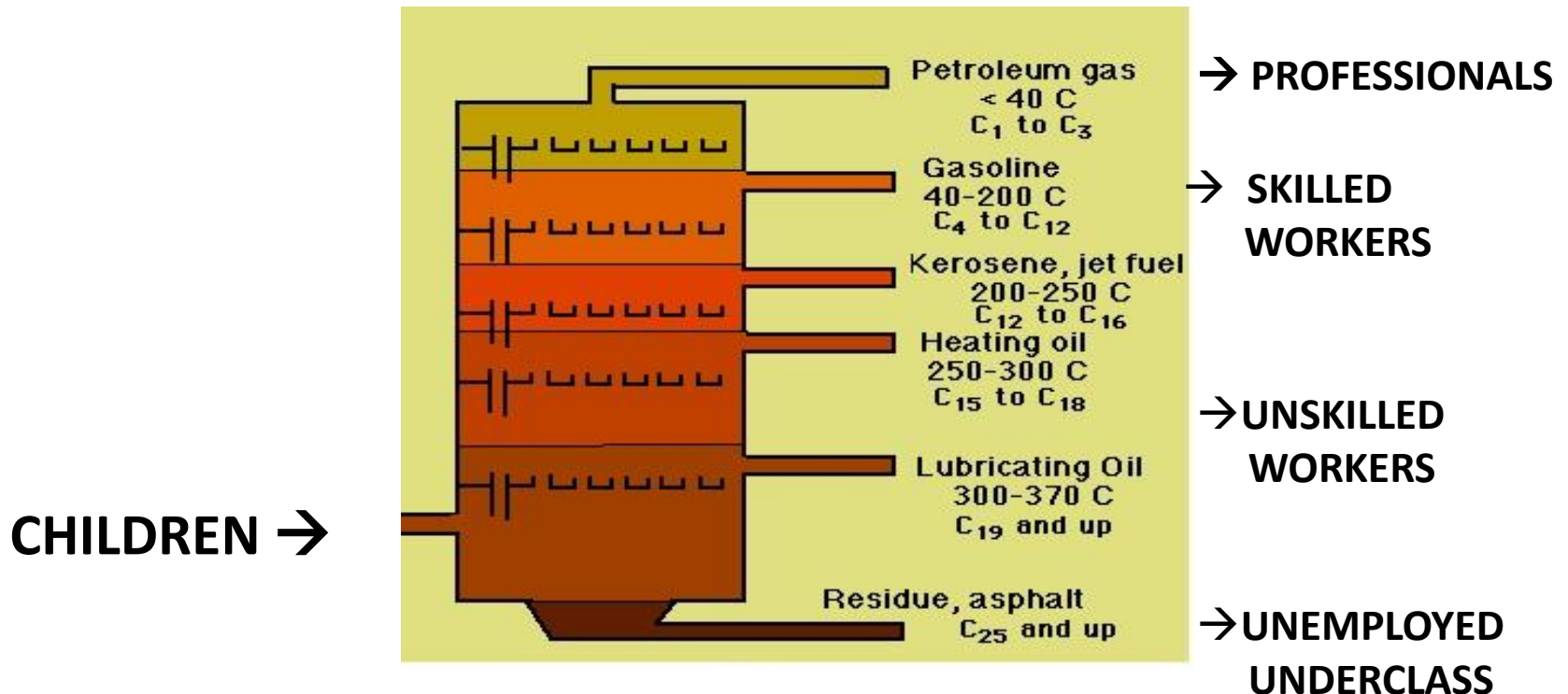
**OVERALL
SUCCESS
WITH
IMPROVED
LIFE
CHANCES**

CRITICAL FILTER

NOT JUST FAILURE BUT ALSO DAMAGE

Maths provides Fractional Distillation

MATHEMATICS ASSESSMENT SYSTEM



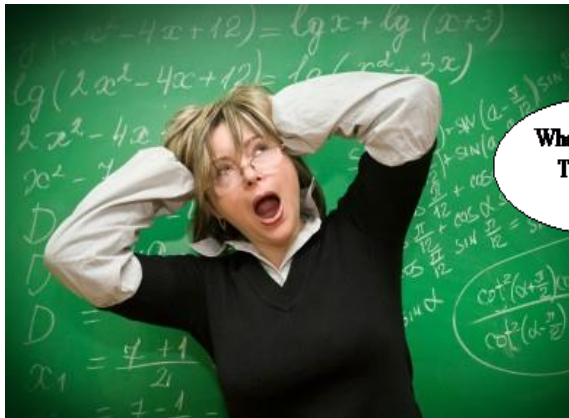
Mathematics success highly correlated with career outcomes

Success at maths should not be key arbiter of life chances

Social Cost: Negative Attitudes to Maths

Many learners and adults

- Are labelled as maths failures
- Lack confidence
- Fear mathematics
- Have reduced opportunities



When is the TEST!?!?

Recruits own up to child maths terror

By Steve Hook

TEACHING recruits need to overcome their anxiety about maths, according to a study of BED students.

Eighty per cent of the students, observed at Manchester Metropolitan University, admitted they found maths intimidating when they were at school.

The teach

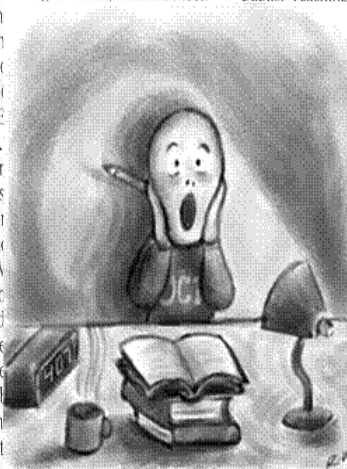
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intentions were not always realised when they reached school.

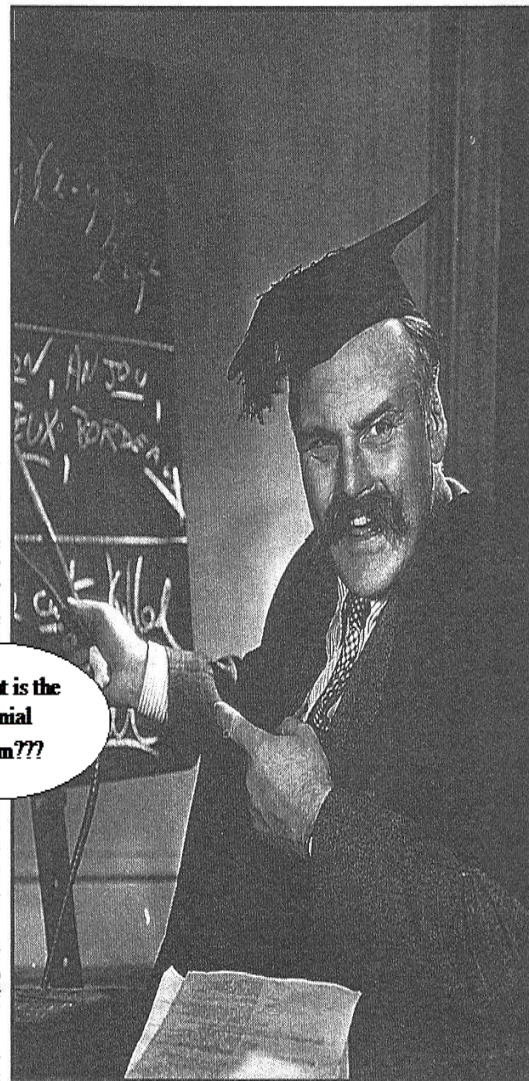
The council said the pressure of the school environment increases students' likelihood of following the patterns of teaching they so loathed when they were pupils. Teaching for the first time, they

nder p ma ai o a childr the y to trainee ery who concentrated this dominated by consw answers which pupils sure to get it right or wrong". : "We confirmed wide-ong our target group rning of maths and of ing it themselves."

ble from the Economic h Council. Telephone: (01793) 413 130.



and what is the binomial theorem???



Your number's up: Jimmy Edwards, the caricature head of Whacko!, perhaps represents the stuff of trainee maths teachers' nightmares

We are Complicit in this Over-Valuing

We gain by not questioning the over-valuing of maths in society

- *Gain more resources, prestige, dominance in schooling*

We accept uncritically argument that ubiquity in society maths means all must study abstract maths to 16 or 18

But we accept not everyone must study to 16 or 18 years

- *Arts, Literature, Drama, Psychology, Classics, Languages, Philosophy, Politics, Geography, History, Computing*

Are these not equally important for personal development and work? But we leave them optional

Is maths failure learner fault or society's fault for forcing it on everybody to 16 or 18 years?

Seeing the world mathematically

Replaces beautiful complexity of nature and the human worlds with simplified models



The Mathematical Way of Thinking

Promotes

- Detachment of meaning, precise rule following
- Reduction of complex situations to simple calculations/numerical models
- Ethics-free technical reasoning
- *Separated values*: Rules, Abstraction, Objectification, Reason, Dispassionate analysis, Impersonality (Gilligan 1982)

These valuable and intrinsic to maths. Applied across society can lead to ethical problems and abuses

- Simplistic epistemology in which things are absolutely **True** or **False**
- Training in ethics-free and value-free thinking - leads to **ethical desensitisation** & **responsibility diminishment**
- Trains instrumental reasoning in management and business with focus only on **means** and away from **ends** or **values**
- Separated values extended beyond maths imply it has no ethical or social responsibility



Dangers of instrumental reasoning

- Mathematics is *essence of instrumental reason* - focus on **means to ends** and not on **underlying values** (Frankfurt School critique)
- Instrumental reasoning underpins management, corporate and governmental thinking
- Persons, animals, environment all viewed and treated as **objects** and mere resources – not as **intrinsically valuable**
- Standardization, routinization, and dehumanization lead to **unethical** treatment of persons (Kelman 1973)



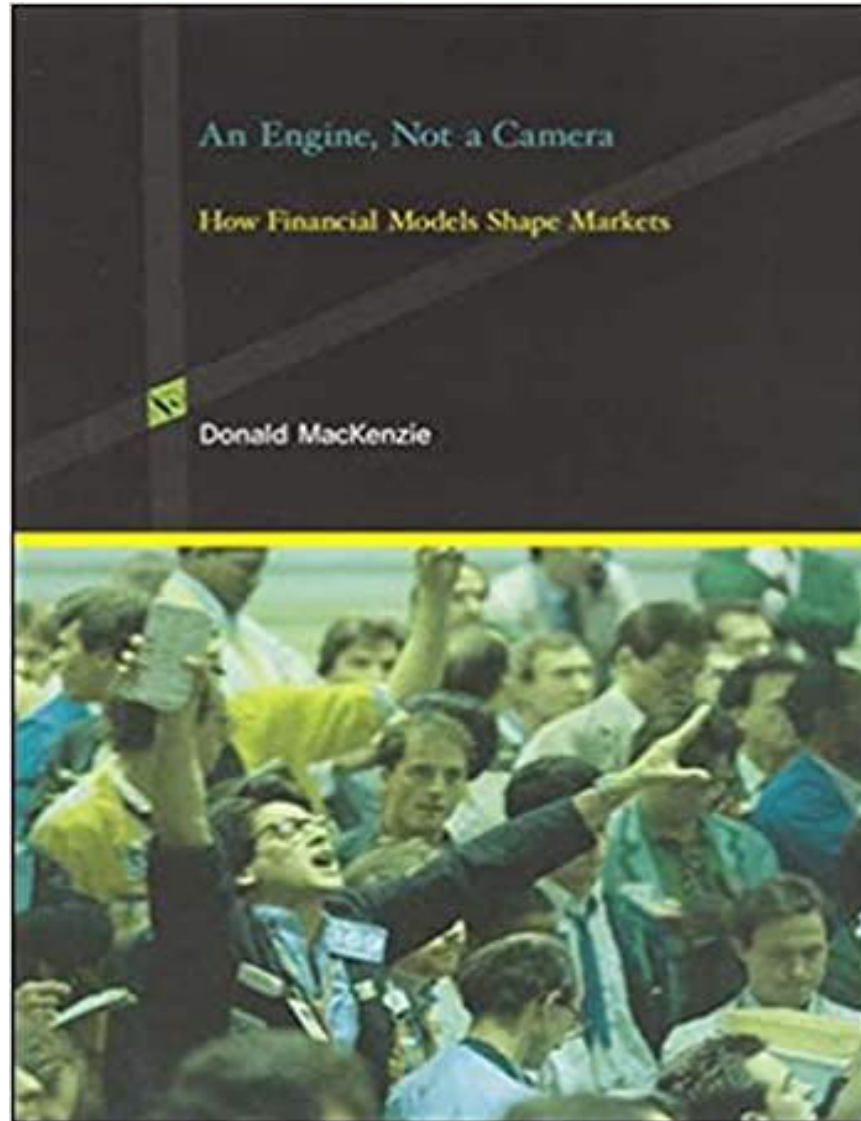
People are viewed as objects

Hidden Harm caused by Mathematics

1. Overvaluing mathematical **qualifications** blights lives of millions labeled as mathematical failures
2. Overvaluing **Quantitative outlook** supports managerialism & neoliberal performative agenda through privileging of measurement, accountability, and targets
3. Mathematical training can develop an ethics-free instrumentalist outlook that prioritises profit above any social costs -- powering exploitative corporativism and neoliberalism.

This is collateral damage – but we should acknowledge it and limit harm via our teaching

Mackenzie's book (How financial models shape markets) identifies the *performative work* of maths



Mathematics is Performative

Mathematics is an engine not a mirror – rather than merely reflect society it changes it

When you apply measures of performance – you change the activities to meeting the targets – not to meeting the original goals

- *Schooling becomes about passing exams not learning flexible and adaptable skills*

When business is all about the bottom line (profit)

- *The valuable service provided becomes secondary to profit*

When welfare or health is all about meeting targets

- *Professionals forced to compromise standards to meet targets*

Maybe not yet in Scandinavia – certainly in USA and UK

Example: Victorian *Payment by Results* in British schools

MEASURES: No. Students & Results → Determine PAY

Payment by Results SYSTEM → CHANGES EDUCATION

- Other perverse effects included inducing teachers, whose **annual salaries were now tied to the numbers of pupils in their classes and to their performance at particular exams**, to cheat. Teachers drilled their pupils mercilessly on test items (Hyndman, 1978: 34) once the inspector's visit was imminent. Some secretly trained their pupils in classroom tricks that would create a more favourable impression. Yet others falsified enrolment registers, to keep numbers artificially high. Sick children were dragged along to school to satisfy attendance requirements, upon which teachers' salaries were dependent (Hyndman, 1978: 37), while teachers now had to negotiate their salaries directly with school managers (Welch, 2007a).
- **Cramming, rather than teaching, became the means to ensure a teacher's livelihood – weakening pupils, teachers, and pedagogy.** Hence, a further product of the Revised Code was a **narrowing of the curriculum and a narrow instrumentalism with respect to educational aims**. Overall, while the scheme was justified by appeals to the principle of 'efficiency', it was in fact introduced largely as a means of curbing justifiable growth in state expenditure on education.
 - *Anthony Welch, Mammon, Markets, and Managerialism, in R. Cowen and A. M. Kazamias (eds.), International Handbook of Comparative Education, Springer 2009, p 591.*

Responsibility for Applications of Mathematics in Society

Mathematics in public communications

- It is widespread for governments and corporations to use mathematical signs or representations to lend support and an air of authority and certainty to communications and pronouncements.
- *Who keeps them honest?*

Problematic applications of mathematics

- Many examples could be cited as ethically questionable
Electronic media host and promote 'fake news', conspiracies, racism etc.
- *To whom are they accountable?*
[Gaussian copula](#) formula called "the formula that killed Wall Street" because its overextended use to price derivatives helped trigger [Global Financial Crisis](#) of 2008
- *Who is responsible?*

The performativity of mathematics

- Mathematical algorithms go beyond automating and actively modify and transform their target areas (Skovsmose and Ravn 2019).
Widespread use of algorithms to see if persons worthy of loans or credit, or likely to commit crimes. This can change lives without their knowledge or right of challenge. (O'Neill 2016)
- *Where is the ethical scrutiny in this process?*

How to correct or prevent such harm?

Overall harms comes from overvaluation and misapplication of Mathematics

How can we rectify this? (Through education)

Include **philosophy of maths** with mathematics

- Teach the limits of mathematical knowledge - its certainties do not apply to the world – there is always a margin of error
- Teach limits of mathematical thinking – true/false dichotomies do not apply to the world

Add the **ethics of mathematics** to maths courses

- Teach the limits and dangers of instrumental thinking – it dehumanization of people and institutions
- Mathematics must be applied responsibly or with awareness – it is wrong to ignore ‘incidental’ outcomes or ‘collateral damage’ in social impacts

Use **ethical examples in teaching of mathematics**

- Use real world examples – Covid, Global warming, Pollution of the environment, Health and mortality figures from around the world, statistics on gender and race inequalities to show the impact of models, measures and mathematization

Reform Mathematics Teaching

- Put less stress on examinations and testing
- Give students maths course choices 11-16/18 years
- Humanize mathematics teaching - **duty of care** for learners: *their maths attitudes and images matter*
- **Don't demonize errors** – they are inevitable steps in learning – not sins or failures
- **Teach critical thinking** – look critically at social applications and mathematics-based claims
- Add **mathematical appreciation** (<5%) to **mathematical capability** i.e. 'doing maths' (>95%)

Teach Appreciation of Maths

Maths is more than calculating, solving and proving

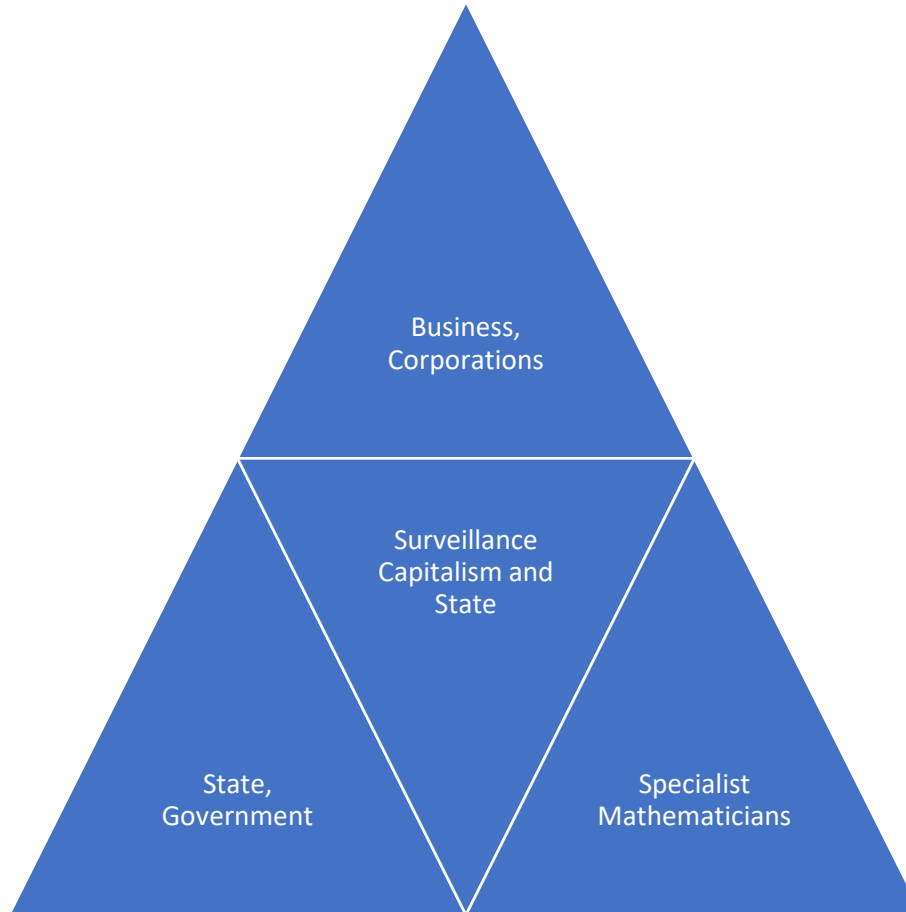
At all levels taught maths must give a broader appreciation of

- *Maths in culture, art and social life*
- *Impact of applications of maths on society and context*
- *History of mathematics and maths in history*
- *Proof and how maths knowledge validated – limits of mathematical certainty and applications*
- *Controversies in philosophy of maths*
- *Introduction of big ideas of mathematics*
pattern, modelling, symmetry, structure, equivalence, invariance, proof, paradox, recursion, randomness, chaos, infinity, etc.
- *Critical citizenship through mathematics*
- *Ethics of mathematical applications in society*

Teach critical citizenship via maths

- **Mathematics should socially and politically empower students as numerate critical citizens in society to:**
 - ✓ *Critically understand uses of mathematics in society*
 - ✓ *Use maths in social and political activity, for betterment of students and democratic society as a whole*
 - ✓ *Interpret and critique uses of maths in social, commercial and political claims in adverts, headlines, blogs, reports, etc*
 - ✓ *Understand limits of validity of uses of maths, what decisions are concealed, and reject spurious or misleading claims*
 - ✓ *Scrutinize financial sector and government systems and procedures for objectivity, correctness and hidden assumptions*
 - ✓ *Address ethical implications of maths applications to balance instrumentalism, dehumanization and separated values*
- **Every citizen needs these capabilities to defend democracy and values of humanistic and civilised society**

Mathematics Specialists only one part of *Surveillance State* and *Surveillance Capitalism* – *but an essential part*



Reaching the Other Parts of Society

- If we can teach mathematicians to see mathematics as ethical, perhaps we can also teach future
 - *Politicians and Government workers*
 - *Business leaders*
- to *see mathematics as ethical* in the long term, because they study in school too
- If we teach *all citizens* to see mathematics as an ethical issue
- **Then we may be able to CURB THE EXCESSES of the Orwellian Surveillance State, Surveillance Capitalism and Politics manipulated via Data/Apps**

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(Plus refs on social justice, race, gender, special needs, critical citizenship, empowerment and critique of objectivist and absolutist philosophies of mathematics)