IT DOESN'T ADD UP

what's wrong with maths?

CAMBRIDGE ASSESSMENT

Our big debate

ACME

Advisory Committee on Mathematics Education

www.acme-uk.org

‘Numeracy, arithmetic, maths – what age and at what stage?’

Jennie Golding, ACME vice-chair

Numeracy

- …might be seen as a quality of successful learners of mathematics (Coben, 2003), or as a proficiency which involves confidence and competence with numbers and measures, and the ability to solve number problems in a variety of contexts

- **The wages of a man for a day's work are 5s 6d, and for a woman 2s 9d. A man can do one and a half times as much work as a woman can do in the same time. Certain work has to be done which would occupy 50 men for 80 days; find the difference in the cost if 20 men and 30 women were employed to do the work instead of 50 men** *(source: Guide to employment in the Civil Service, 1911: Entrance examination, Women and girl clerks)*

Problem solving-fluency -robustness-problem solving-arithmetic-proportional reasoning

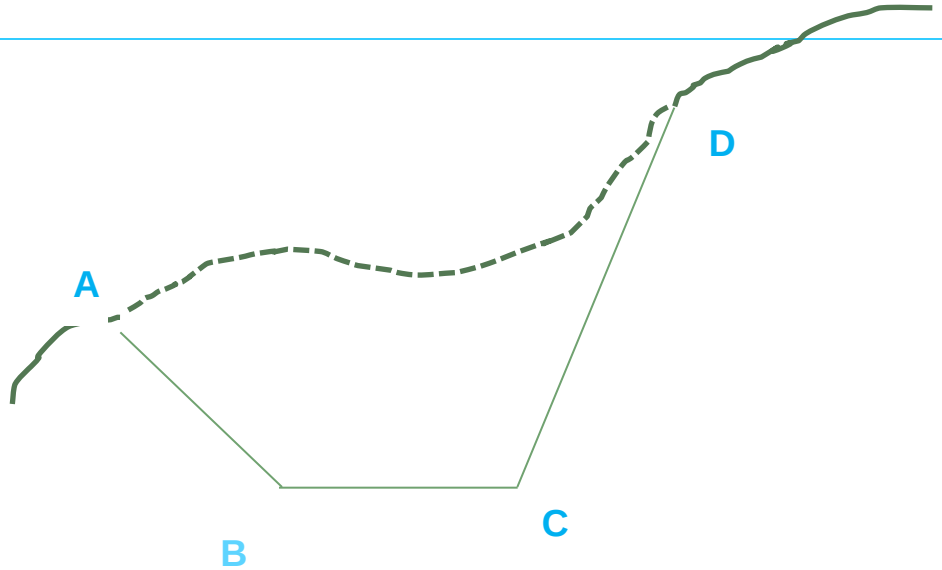
Arithmetic

‘the study of operations relating to quantity’

	£	s	d		£	s	d		£	s	d		£	s	d
	46	11	10		335	2	3		356	18	4				
	43	5	2		375	15	8		2458	4	7				
	34	16	6		956	17	10		132	15	11				
	83	19	10		246	4	7		573	14	8				
	4	12	11		24	9	4		802	7	3				
	87	16	4		753	3	9		3025	13	9				
	16	2	8		754	16	2		2617	6	2				
	24	18	4		673	12	8		459	9	10				
	28	14	2		723	18	11		728	2	8				
	89	12	8		904	11	3		256	15	3				
	27	13	10		46	8	7		287	18	5				
	9	17	35		256	13	2		153	3	7				
	13	12	0		235	19	9		893	5	10				
	48	16	3		135	13	11		460	6	3				
	40	9	8		435	5	6		247	14	8				
	31	4	4		36	15	2		2793	18	4				
	50	12	5		15	17	9		261	1	5				
	53	17	3		257	8	10		5832	9	9				
	14	17	11		133	10	9		476	12	2				
Total															

Source: Entrance paper, second division clerks

Fluency - robustness with core number procedures: to be employed efficiently and accurately, using electronic tools when appropriate



The figure shows the section of a railway cutting on the scale of 1 to 400, the dotted line being the original outline of the ground. Find the area of the cross-section ABCD, and hence find the number of tons of earth that have to be moved to make such a cutting a quarter of a mile long, taking the weight of a cubic yard of earth to be 38 cwt.

Source: Entrance paper, second division clerks

Problem-solving – modelling - reasoning - fluency

Age? I suggest…..

- Mathematics begins pre-school, in everyday and play experience and talk about pattern, shape, and a developing sense of number, that are harnessed to explore and describe the world and to begin to solve problems. All young people are curious and respond to challenge; and that extends to a curiosity about mathematics that should be nurtured and valued through multiple experiences of core mathematical concepts supported by knowledgeable and effective teachers.

ACME Mathematical Needs Reports 2011

- ***All young people are entitled to*** **education in the range of mathematics components, and building up of a range of mathematical proficiencies: that is a question of equity and of empowerment.**
- ***Employers and Higher Education need*** **young people with more robust mathematical skills (not just number) and ability to apply those reliably; and in general, more young people who know more mathematics and can use it confidently and competently. This includes a competence and confidence to model and to solve problems.**

- These are not incompatible but need creative and knowledgeable teaching at all stages (cf NC response, Raising the Bar, extant and emergent proposals for the range of mathematical needs post-16)
- Focus for a 21st century curriculum should be on ***problem solving within and beyond mathematics***, so including modelling; and supported by the development of deep conceptual understanding, robust and fluent skills and knowledge, and increasingly rigorous mathematical reasoning
- ***Technology*** affords exciting opportunities for supporting the exploration and learning of mathematics, as well as its use.
- Young people of all ages should often experience ***challenge, collaboration, excitement*** in mathematics, opportunities to ***explore and to create***, ***link-making*** across the curriculum, and expectations of ***communicating*** their mathematics in a variety of ways and with increasing rigour.

- Important ***affective characteristics*** also need to be nurtured: perseverance, resilience, the embracing of risk and challenge, an inclination to engage with mathematics and the confidence to do so…
- This can only happen with a ***whole-system consistency and coherence*** that is research-informed: assessment and accountability measures that are fully aligned with valued outcomes, and especially that value depth of pure and applied mathematical thinking rather than superficial acquaintance with material; a professional and expert teaching workforce able to enact this vision at a local level
- It should be based on ***cross-party consensus*** not on short-term initiatives, however well-intentioned, that destabilise and undermine effective T&L. Our young people's education is too important for that – for them as individuals and for national needs

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www.nationalnumeracy.org.uk

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

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Lynne McClure

Director, NRICH

Continuing Professional Development Standard

National Centre for Excellence in the Teaching of Mathematics

- Beginnings as well as ends
- Habits of mind as well as content
- Effective as well as cognitive domains

Continuing Professional Development Standard

National Centre for Excellence in the Teaching of Mathematics

Beginnings as well as ends

- The importance of the art or science of teaching - didactics – and teachers who are experts in it.
- The personal and national impact of not securing competence by the end of primary school

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- Arithmetic Proficiency is an appreciation of number and number operations, which enables mental calculations and written procedures to be performed efficiently, fluently and accurately.
- Mathematical Proficiency requires a focus on core knowledge and procedural fluency so that pupils can carry out mathematical procedures flexibly, accurately, consistently, efficiently, and appropriately. Procedures and understanding are developed in tandem. (NCETM 2013)

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Thinking about the future is risky business. Past experience tells us that today's first graders will graduate high school most likely facing problems that do not yet exist. Given the uncertain needs of the next generation of high school graduates, how do we decide what mathematics to teach? Should it be graph theory or solid geometry? Analytic geometry or fractal geometry? Modeling with algebra or modeling with spreadsheets? These are the wrong questions, and designing the new curriculum around answers to them is a bad idea. (Cuoco, Goldenberg, & Mark, 1996)

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Habits of mind

Students should be:

- Pattern sniffers
- Experimenters
- Describers
- Tinkerers
- Inventors
- Visualisers
- Conjecturers
- Guessers

(Cuoco, Goldenberg, & Mark, 1996)

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Effective as well as cognitive domain

Quiet disaffection

- Tedium
- Isolation
- Rote learning
- Elitism
- Depersonalisation

(Nardi and Steward, 2003)

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Tim Oates

15 May 2013

University of Cambridge
Local Examinations Syndicate

Arranging quicksilver

- ‘Mathematical knowledge’ is elusive to definition and description – and ‘problem-solving’ doesn’t do it
- An empirically-driven approach: inadvertently putting in place the most demanding Primary curriculum in the world
- ‘Core sequence’ or ‘audit at 11’?
- Fewer things in greater depth
- ‘Practice’

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