

MATHEMATICS, NUMBERS AND DATA IN DAILY LIFE: A HIDDEN CRISIS AT THE BASE OF THE PYRAMID



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The government has recently announced welcome additional funding to support world-leading mathematics research here in the UK. Readers of *Science in Parliament* will understand the huge contribution that such research makes. You may be less familiar with the work of the independent charity National Numeracy (I joined as a Trustee last year) in support of its mission to enable everyone in the UK to become confident and competent with numbers and data so that they can make good decisions in their daily life.

I am no doubt preaching to the converted in making the case for the importance of having a familiarity with numbers and basic mathematical concepts for good decision making. It's hard to imagine making financial decisions or weighing up the risks of different healthcare options without these skills. Those who have the confidence and skill to use mathematics and understand data, whether at home or at work, are at a significant advantage.

However, given the shared acknowledgement of the importance of mathematical confidence and skills, it may be of interest to you to gain a deeper understanding of the current level of everyday maths skills among the UK population. The most efficient way to do this is to include a sample of the questions from the National Numeracy Challenge online tool that was used in an Ipsos MORI poll for research conducted by King's College London's Policy

Institute to support National Numeracy Day last year:

Before reading on, I would ask you to estimate the percentage of those 2,000 or so adults surveyed who managed to get all 5 questions right (answer given at the end of the article).

Although these questions are straightforward (but not trivial) and absolutely situated in daily life, National Numeracy chose not to lead on the percentage of respondents who achieved 5/5;

Appendix

For the final part of the survey we'd like to ask a few questions. Please take as long as you like and feel free to use a calculator or pen and paper to help your work out the answers.

Q13. If a scarf costs £11.70 after a 10% reduction, what was the original price? (L1)

- £12.50
- £13.25
- £13.99
- **£13.00**
- I don't know

Q14. Mike's lunch contains 640 calories of energy. What percentage is this of his target daily intake of 2000 calories? (L1)

- 45%
- 62%
- 65%
- **32%**
- I don't know

Q15. Rail tickets increased by 2% in year 1, and 5% in year 2. What was the overall increase over the two years? (L2)

- 7%
- **7.1%**
- 10.0%
- 10.7%
- I don't know

Q16. These are three offers on the same ketchup. Which is the best value for money? (L2)

- 275g for £1.05
- 454g for £1.99
- **650g for £2.20**
- 425g: buy two for £3.10
- I don't know

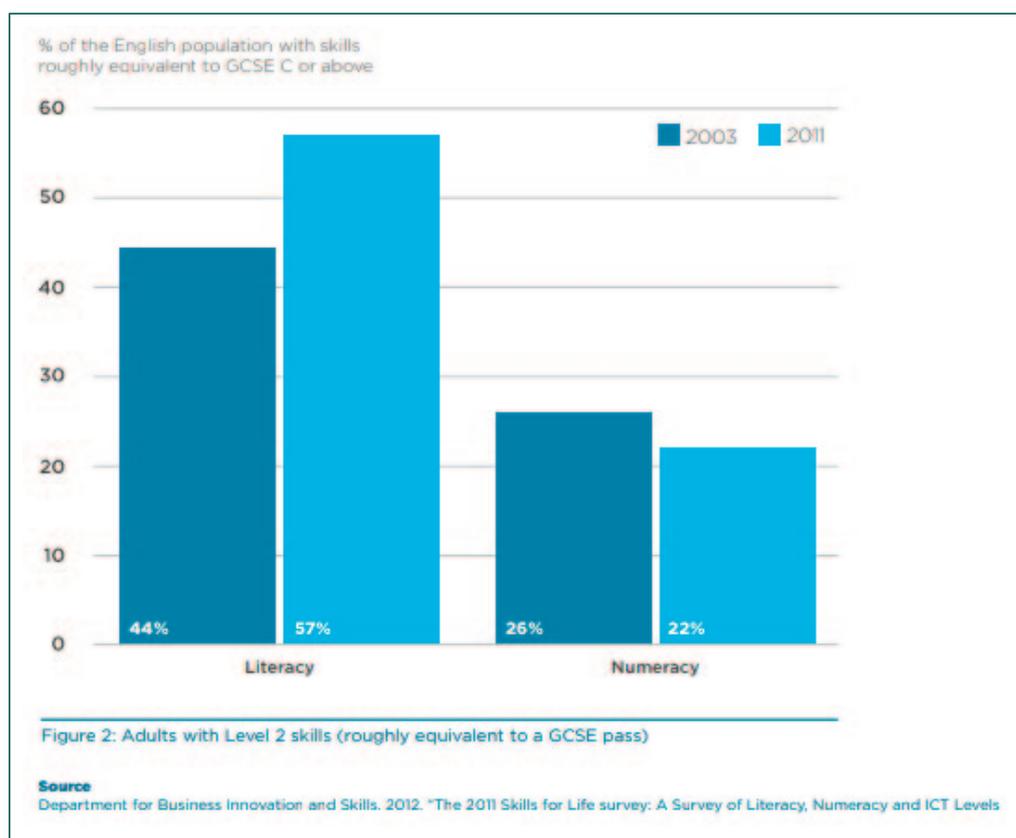
Q17. You buy a laptop that costs £899, including VAT at 20%. How much of the purchase price is VAT? (L2)

- £179.80
- £89.80
- £125.00
- **None of these**
- I don't know

their main effort is geared towards a position in which most adults in the UK get most of these kinds of questions right, so they used a threshold of 4 out of 5 as indicative of a reasonable, workable level of numeracy. Even at that lower threshold, only 20% of those surveyed achieved either 4 or 5. The majority, 56%, scored either 0, 1 or 2.

There are flaws with surveying in this way, but these statistics match remarkably closely the data from the 280,000 adults who have engaged with the National Numeracy Challenge. They also match remarkably closely the government-commissioned research shown here that spurred Lord Claus Moser to instigate the work that led to National Numeracy launching as an independent charity in 2012. As former Chief Statistician, he despaired at the results of the Skills for Life Survey, particularly given the effort that had gone into adult literacy and numeracy following his government-commissioned *A Fresh Start* report, which called for the levels of functional illiteracy and innumeracy to be halved within a decade. As you can see, through the skills-based adult education initiatives in the following years strong progress was made on literacy, but adult numeracy levels worsened.

It is worth highlighting the extent to which false assumptions about the everyday mathematical skills of the population are built in to almost all areas of life. Within the education and skills system, the new T-Levels, apprenticeships and most undergraduate courses assume a level equivalent to 5/5 in the questions above – but National Numeracy data from a Nuffield-funded pilot study shows that three quarters of social science undergraduates across ten



universities did not have the 'Essentials of Numeracy'. At work, most employers would expect their employees to be able to correctly answer the questions above – but National Numeracy data from the NHS and elsewhere shows that most cannot. Finally, when at home, the tax and pensions system has assumptions about quantitative literacy built in that far exceed where the majority of the population is. Perhaps the starkest example is Universal Credit; a programme that will not work in its current form as too many of the intended recipients cannot engage at the appropriate quantitative level.

A report commissioned by National Numeracy and produced by Pro Bono Economics suggests that the cost to the UK economy of low levels of adult numeracy is enormous. In 2014 it was estimated at around £20 billion per year, roughly 1.3% of GDP.

What is National Numeracy doing about the problem? Since

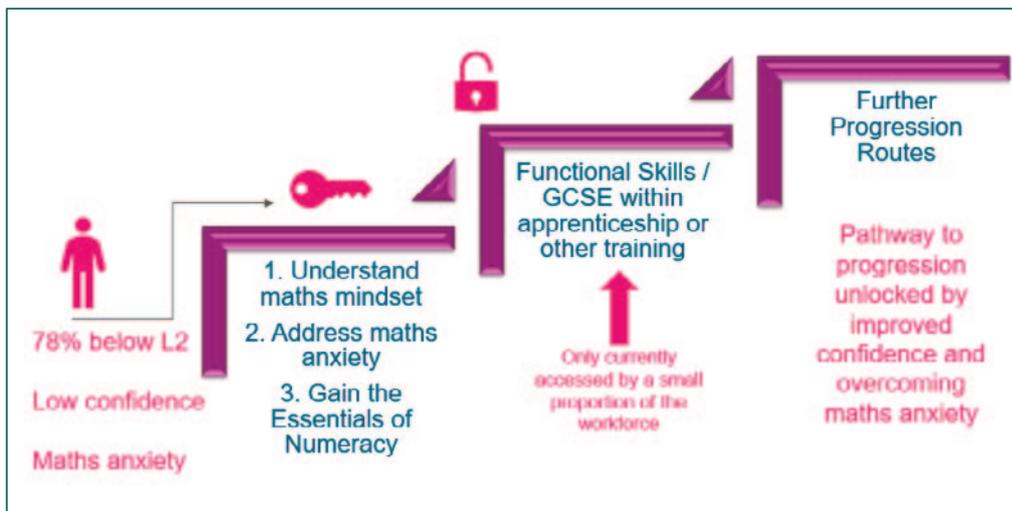
2012, the charity has sought to bring an unrelenting spotlight onto the issue, including challenging the social acceptability of 'I can't do maths'. They have found that this cultural and attitudinal barrier is huge – yet to date has largely been ignored. Their recent report, *Building a numerate nation: confidence belief and skills*, outlines why addressing maths anxiety and building confidence alongside competence is at the heart of their work. Given the scale of the issue, providing digital tools is also central; there are simply not enough teachers and tutors to address the situation.

National Numeracy has recently completed a DfE-funded Flexible Learning Fund project, under the auspices of the National Retraining Scheme, which has shown promising results. By working with partner organisations and by targeting adults directly and digitally, they have shown that it is possible to persuade significant numbers of adults (20,000 within the

project), who had not planned to improve their everyday maths, to engage with doing so by utilising an approach that focuses on building confidence alongside skills.

Partner organisations, in both the private and public sectors, have identified 'broken rungs in the ladder' to apprenticeships and qualification-based provision for adults – and that the low take-up of both is evidence of this gap. The team at National Numeracy has worked with them to attempt to fill this gap by enabling adults to build the confidence and competence to be prepared to engage with the current education and skills system:

This work draws upon evidence both within adult education and from other domains (e.g. combatting obesity through campaigns such as 'This Girl Can') that show that taking the first engagement step is crucial. What National Numeracy is trying to do could be seen as equivalent to the NHS Couch to



5K running plan and within that analogy, current qualifications-based provision is equivalent to a marathon and way out of reach.

There would appear to be an excellent opportunity to address both high-end mathematics and 'entry level quant skills'. National Numeracy's work on the latter is

world leading. They have found that for many people a fear of maths is the biggest thing that is holding them back – and just as a basic level of physical fitness is increasingly recognised to be within everyone's grasp, good numeracy is within the grasp of anyone who is currently held back by low confidence. Put

another way, all humans who can communicate moderately effectively in the English language also have the cognitive capacity to correctly answer the questions above; this is not an underlying intelligence issue.

With the right approach, we can collectively address this crisis – making clear progress within

the term of this parliament. We need the government to recognise that helping people at the base of the pyramid engage with the world effectively will be of huge benefit to the nation, as well as to the individuals themselves. But also that this is not about more or better education, it is about helping the millions of people who have emerged from our education system with low levels of mathematical confidence and poor quantitative skills get over that first step to reengage with numbers and data. It is an enormous task and National Numeracy cannot do it alone.

In the meantime, why not try the National Numeracy Challenge yourself?

Answer: 6% of those surveyed scored 5/5

SMART ENERGY: THINKING ABOUT OUTCOMES, DIGITAL INFRASTRUCTURE, AND PEOPLE



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Energy systems around the world are changing in response to climate change. They are becoming increasingly reliant on decentralised renewable resources, experiencing new types of loads such as electric vehicles, heat pumps, and storage, and experience more active demand side participation¹⁻⁶. Aligned with this is a push toward digitisation^{7,8}, with the introduction of smart-meters, greater prevalence of "Internet of Things" devices, and increasing sophistication of automation such as artificial intelligence (AI) used to provide system services. This

"smartness" is driving exponential growth in the scale and diversity of energy system data, presenting opportunities and challenges in equal measure⁹. Understanding how energy system and digital systems are evolving and interacting is key to deliver a smart energy future. While much is happening at the grid edge, a shared vision is necessary to underpin and stimulate collective action; this is a critical opportunity for government, and the time to act is now.

HOW ARE ENERGY SYSTEMS BEING REDEFINED?

Typically, smart energy is discussed in the context of the high-minded goals that smart energy systems aim to achieve, or the technologies or processes they aim to deliver. But can an energy system be smart because it uses these smart technologies, regardless of the results? While the primary purpose of traditional energy systems is to enable energy services to be delivered to end-users of the system^{10,11}, the transition toward "smarter" energy systems may see the