



Professor Sir Adrian Smith's review of post-16 mathematics provision in England

A response from the British Academy
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INTRODUCTION

1. The British Academy welcomes the opportunity to respond to this review. The Academy has undertaken extensive work to address the deficit in quantitative skills (QS) in the UK, through its Quantitative Skills Programme (QS), a 5-year programme funded by the Department for Business, Innovation and Skills (BIS). The programme was guided by the British Academy's High Level Strategy Group for Quantitative Skills, chaired by Professor Sir Ian Diamond FBA.
2. Whilst the review relates to mathematics provision, the Academy's response draws on evidence relating to QS.¹
3. This submission will cover the following key points:
 - The ability to understand and interpret data is an essential feature of life in the 21st century: vital for the economy, for our society and for us as individuals.
 - The development of QS post-16 is essential for progression to higher education and employment, and should be compulsory for all up to 18.
 - This review should address both schools and further education colleges
 - Higher education institutes have an important role to play in signalling to schools the importance of QS.
 - A number of subjects, beyond simply mathematics and science, provide a rich context for the development of quantitative skills in schools
 - Teacher supply, initial teacher training and CPD will be crucial across a breadth of subjects
 - There is an important role for policy-makers, learned societies/subject associations and exam boards to play in curricula development and teacher supply and training
4. This response draws on the Academy's *Count Us In* report which offers a vision of how the UK can rise to the potentially transformational challenge of becoming a data-literate nation.² The findings and recommendations in *Count us in* are supported by evidence outlined in *State of the Nation: A review of evidence on the supply and demand of quantitative skills*.³

What is your view of the post-16 maths pathways/qualifications currently available to students?

5. Quantitative Skills should, ideally, be compulsory for all up to 18. But there is a need to continue to develop and promote alternative routes to studying mathematics – in addition to A-levels in England, Wales and Northern Ireland and Scottish Highers and Advanced Highers in Scotland – to open up the subject post-16 to a broader spread of the school population. Qualification development should not be seen as a zero-sum

¹ The Academy defines QS as the ability to reason using numbers. This includes an understanding and appreciation of probability, error and inference; confidence in the manipulation of numbers; an understanding of the possibilities and limits of measurement; and understanding the role of evidence in testing and modifying our understanding of social processes.

² British Academy (2015) *Count us in: quantitative skills for a new generation*:

<http://www.britac.ac.uk/sites/default/files/Count-Us-In-Full-Report.pdf>

³ *State of the Nation: a Review of Evidence on the Supply and Demand of Quantitative Skills*,

<http://www.britac.ac.uk/sites/default/files/BA-NIESR%20State%20of%20the%20Nation%20-%20A%20review%20of%20evidence%20on%20the%20supply%20and%20demand%20of%20QS.pdf>

game, where expanding one route leads to the contraction of another, but as a means of adding to the total numbers of young people taking mathematics post 16.

6. School curricula, pedagogy and methods of assessment across the UK should be subject to a process of continuous review, and CPD encouraged, so that schools and teachers can use the best methods to enable their pupils to become confident and fluent in numbers and data.
7. New Core Maths qualifications, designed to appeal to students who have gained a C grade or better at GCSE but do not currently take A-level mathematics, are a welcome first step in addressing the issue of premature specialism. The focus in the curriculum on applying maths and on data is particularly welcome. However, there is a danger that schools/colleges facing teacher shortages, funding issues, or too focused on GCSE performance league tables will be disincentivised. University admissions policies will also be crucial in incentivizing take-up.
8. Further education colleges must not be neglected. In England, colleges provide around a quarter of A-level mathematics entries and most 16–19 vocational qualifications. In Scotland, a substantial minority of students take higher education courses in colleges, so any drive to improve quantitative skills provision for young people should not overlook this route. Across England, Wales and Northern Ireland, many young people moving on to a wide range of careers in which a facility with numbers will be important – from nurses needing to calculate medical dosages to laboratory technicians preparing solutions – spend their first years post-16 in the college sector. It is therefore important to build QS into curricula across the range of courses offered at FE colleges, including vocational courses.
9. It will be important, also, to build firmer direct links between school and college education and the workplace through continued support for the apprenticeship route, further and continuing training and other schemes that allow people in work to up-skill. The apprenticeship route combines employment-based training with part-time attendance in vocational education classes or workshops related to the field of training. It is, therefore, in principle well suited to developing quantitative skills which can be applied in workplace settings.

What potential is there for different delivery teaching models in post 16 mathematics?

10. A number of subjects, including geography and economics, provide a rich context for the development of quantitative skills in schools – and not just in subjects which are formally labelled as mathematics or science, which can wrongly be seen as the only place to teach statistical and numerical understanding. Universities and learned societies could work jointly with curriculum authorities to ratchet up quantitative content of social science and humanities programmes they offer, including introducing new courses where necessary.
11. At university level, the Academy recommends that the Q-Step programme be rolled out nationally, following its successful pilot, to ensure that all social scientists have a firm grounding in quantitative skills.
12. The Academy is also considering how best to improve QS in the humanities, and will be holding discussions around this in the near future.
13. Research commissioned by the Academy found that undergraduate social science students in many universities in Europe, North America and Australasia reach much higher levels of achievement in quantitative skills than even their best UK counterparts.

This is due to more curriculum time devoted to the study of methods, greater focus on the collection, evaluation and analysis of empirical evidence and university teaching staff with more advanced quantitative skills, including post docs and postgraduates.⁴

What can be done to get more students choosing maths post-16? What about girls? What are the main challenges to increasing provision of post-16 mathematics in schools and colleges? How can these be addressed?

14. Students need to understand the importance of quantitative skills for continuation to both HE and employment. This will require better signalling from both universities and employers. This should involve not only incentivising students who are particularly strong in maths, but also those that achieve grades B-D at GCSE to continue their study.
15. Universities have the power not just to shape the content of their own courses and to improve the quality of their research, but also to send signals to schools about the importance of quantitative skills. They need to act together to encourage or require prospective students to have quantitative skills qualifications. The UK needs to move to a situation where it is normal for science, social science and humanities students to have developed significant quantitative skills in school, and for this to be thought of dynamically, so that as provision improves at secondary level, universities can then strengthen their entry requirements.
16. Policymakers should encourage co-ordinated steps by universities to ensure their student admission requirements encourage or require increasing quantitative skills engagement by students, as standards rise in schools.
17. Research by the British Academy found relatively high demand for QS amongst employers in the UK. Employers therefore also have a role to play in signalling the importance of QS for employment and the value placed on these skills at recruitment.⁵
18. Encouraging the development of quantitative skills through other science and social science programmes post-16 could positively impact the gender imbalance seen in the take-up of maths. The Q-Step programme has been used to deliver relevant 'STEM skills' within non-STEM subjects, and to students whom STEM subjects fail to attract. While only around 24% of STEM students are women, they account for 60% of students in the social sciences and biology.
19. The Government has a role to play in monitoring, and ensuring an adequate level of, QS and data literacy amongst the population, using the number of levers available to it.

What more could be done to improve mathematics teaching capacity and professional support for post 16 maths teachers?

20. Teacher supply must be addressed well beyond the need for mathematics specialist teachers. Teachers of the sciences, social sciences and the humanities also need to incorporate numerical evidence and data into their teaching. Therefore, the recruitment, retention and professional development of data-literate teachers is important. This will require a strategic approach to considering the teaching workforce, at primary,

⁴ Measuring Up, <http://www.britac.ac.uk/node/4188>

⁵ State of the Nation: a Review of Evidence on the Supply and Demand of Quantitative Skills, <http://www.britac.ac.uk/sites/default/files/BA-NIESR%20State%20of%20the%20Nation%20-%20A%20review%20of%20evidence%20on%20the%20supply%20and%20demand%20of%20QS.pdf>

secondary and college level. Schools could allow expertise to be pooled and experiences shared, especially between maths and other subjects.

21. Policymakers, including government, will need to focus on recruitment and retention numbers and also on the quality of teachers' skills. Quantitative skills education in both teachers' initial training and in their ongoing professional development will need to be improved.
22. The Learned Societies, working with exam boards, could promote data focused teacher CPD and teacher training.
23. Universities could, using the experience of Q-Step where relevant, help with maths based CPD across the school curriculum. This might be through the development of teaching and learning materials (for pupils and for teachers), provision of CPD sessions, and knowledge transfer around the advantages and pitfalls on-line learning. These are all areas where Q-Step has built up a pool of knowledge about how best to deliver these skills from a narrow teaching skills base.
24. It will also be important to signal imaginative ways to increase the number of teachers, and to incentivise graduate entry into teaching. The Academy would be happy to discuss this further.