

Signalling the value of studying mathematics post-16: time for a concerted and sustained boost

Background

There is a strong case for increasing the mathematical and quantitative skills of young people, not only to satisfy the employment demands of an increasingly technological economy, but more generally to enable them to make sound decisions in life and benefit society¹.

However, England remains unusual among technologically progressive countries in that the study of mathematics is not universal for all students beyond age 16². Significantly, the Government's Industrial Strategy recognises there is a substantial unmet, and still growing, demand for mathematically and quantitatively skilled people in the labour market³.

In his 2017 Review of post-16 mathematics, Sir Adrian Smith FRS recommended that young people should be incentivised to continue to study mathematics post-16, and the UK Government has established several funding initiatives designed to achieve this end⁴.

Sir Adrian's review also called for a collaborative effort "to encourage universities to better signal and recognise the value of level 3 mathematics qualifications for entry to undergraduate courses with a significant quantitative element"⁵.

In response, the Royal Society's Advisory Committee on Mathematics Education commissioned the Careers Research & Advisory Centre (CRAC) to investigate how UK universities are currently communicating the importance of quantitative skills to young people, and whether and how this 'signalling' could be enhanced and made more effective in future.

CRAC's report, *Signalling the value of studying level 3 mathematics to those considering quantitative subjects at university*, is accessible at royalsociety.org/signalling

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1. It has been argued that numerical skills are a necessary element of citizenship, to understand public debate and potentially challenge arguments, which are based on quantitative evidence. Mason, G, Nathan, M & Rosso, A 2015 *State of the nation: a review of evidence on the supply and demand of quantitative skills*. London: British Academy and NIESR. See <https://www.thebritishacademy.ac.uk/sites/default/files/BA-NIESR%20State%20of%20the%20Nation%20-%20A%20review%20of%20evidence%20on%20the%20supply%20and%20demand%20of%20QS.pdf> (accessed 27 May 2020).
 2. Royal Society 2019 *Jobs are changing, so should education*. London: Royal Society. See <https://royalsociety.org/topics-policy/publications/2019/jobs-are-changing-so-should-education/> (accessed 27 May 2020).
 3. HM Government 2017 *Industrial strategy. Building a Britain fit for the future*. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf (accessed 4 February 2020).
 4. These initiatives include the Advanced Maths Premium, the Large Programme Uplift and the High Value Course Premium.
 5. The difficulty of qualifications is described by their 'level'. Level 3 qualifications include AS, A levels and Core Maths, among others. For a complete list, see <https://www.gov.uk/what-different-qualification-levels-mean/list-of-qualification-levels> (accessed 28 May 2020).

Key research findings

Signalling by universities

- Most universities currently make only limited attempts to engage directly with mainstream pre-16 students or their parents/carers to signal directly the value of studying mathematics post-16.
- By contrast, universities focus considerable effort on engaging and providing information to post-16 students (i.e. once they become prospective applicants), which could be accessed by pre-16 students and their parents/carers.
- Few universities expressly demand level 3 mathematics qualifications for entry to courses that include a significant quantitative element (e.g. biological sciences, geography, psychology and business studies).
- Many universities have indicated their support for Core Maths as a post-16 programme, but generally cite it as an acceptable alternative qualification to GCSE Mathematics rather than as a route to studying subjects that require the use of mathematics at a higher level. Few universities mention Core Maths in their admissions requirements.

Many universities' course and admissions information published for prospective applicants to subjects such as biological sciences, psychology or business does not signal strongly the need for quantitative skills in these programmes, nor that there would be value for prospective students having undertaken level 3 study of mathematics.

While universities may not include mathematics in their entry requirements, so as not to deter applicants, students nevertheless have level 3 mathematics qualifications that will be of great use to them. It is in the best interests of universities and students that universities signal honestly the level 3 mathematics qualifications they really require.

Signalling via schools and colleges

- Level 3 mathematics options may not be available in schools, and many schools may not be able to offer any post-16 mathematics options besides A level.
- Rarely do universities attend post-16 provider open evenings to assist students to determine their subject choices post-16.
- Universities more frequently engage with pre-16 students through widening participation or other outreach programmes, although there are few examples of such activities being sustained over time.

BOX 1

Examples of good signalling practice

The universities of Bath, Sheffield and York have all altered their admissions policies in order to clearly communicate the importance they place on mathematics as a foundational subject across a wide range of disciplines. These universities explicitly recognise the value of level 3 mathematics qualifications (such as Core Maths) through alternative offers, reducing by one the grade required for entry to a range of their undergraduate courses, subject to a candidate gaining a specific grade in the mathematics qualification they are taking.

Commentary

Increasing participation in mathematics post-16 is hugely important to the future productivity of the UK. Arguably, this is even more imperative as the UK shapes a new future for itself outside the European Union. Moreover, post-16 students with level 3 mathematics qualifications will benefit from the quantitative, analytical and problem-solving skills mathematics qualifications develop. These skills will complement and support attainment in other A level choices, particularly those with a significant quantitative component, and be of value to them whatever further study, training or employment they progress to.

Universities and university departments need to signal better to pre-16 students the importance of level 3 mathematics qualifications through their subject entry requirements. Improved signalling would help students make informed decisions about their post-16 studies, raise participation in level 3 mathematics and increase their understanding of the relevance of mathematics and data within a range of subjects including those that are, perhaps, not normally perceived as being especially quantitative (e.g. geography, business studies). It would also help ensure the Government, its agencies, other employers and policy bodies have a clear understanding of the importance of level 3 mathematics qualifications to the students' overall knowledge and skills portfolios.

Universities are operating in a competitive environment and the demand for courses varies. Since the cap on student numbers was lifted in 2015/16, many universities have sought to maximise the number of applicants by adopting broad eligibility criteria, including for subjects for which A level Mathematics, for example, would really be desired. Some have adapted their course content and offer less mathematically challenging versions of courses, which raises a worrying question about the exchange and use value of courses that have low versus high mathematical content⁶. While universities may be concerned that more stringent entry criteria could reduce the attractiveness of certain courses, they are paying a heavy price through teaching 'remedial maths' to undergraduates who lack the mathematical skills required to handle the quantitative demands of their courses. Further, with the numbers of pupils in secondary schools set to increase 14.7% between 2018 and 2027⁷, universities would benefit from setting entry criteria that ensure they can attract the students with the appropriate preparation in mathematics.

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6. Professor Mark Smith, Vice-Chancellor, Lancaster University. In Royal Society Advisory Committee on Mathematics Education 2018 *Working together: mathematics in a changing landscape*. London: Royal Society. See <https://royalsociety.org/-/media/policy/topics/education-skills/Maths/2018-Conference-Report.pdf?la=en-GB&hash=D589F685A2B4AE30E6512E7021A9E79B>, p. 12 (accessed 27 May 2020).
 7. Department for Education 2019 *National pupil projections – future trends in pupil numbers: July 2018 (2019 update)*. London: DfE. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/815634/National_pupil_projections__future_trends_in_pupil_numbers_July_2019_update.pdf (accessed 28 May 2020).

Recommendations

Recommendation 1

All universities should signal the importance of level 3 mathematics qualifications across a wide range of subjects.

They should:

- provide improved advice about subject choices directly to pre-16 students, to their parents/carers and others who influence post-16 study choices.
- communicate more clearly and consistently the need for mathematical and quantitative skills and their benefits for thriving in subsequent careers, employment and everyday life.
- state clearly through admissions information, and via third-party information providers such as UCAS and Unistats, that they value level 3 mathematics qualifications as preparation for Higher Education courses.
- introduce admissions requirements that expressly recognise the value of level 3 mathematics qualifications (including Core Maths)⁸.

Recommendation 2

University departments whose undergraduate degree courses do not require level 3 mathematics qualifications should promote the value of Core Maths as a complement to a student's level 3 choices.

- This would help to ensure a quantitatively skilled population that is equipped for employment and everyday life.

Recommendation 3

All universities should include signalling the value of level 3 mathematics qualifications within their existing widening participation programmes, activities and accompanying resources.

- This support would promote to pre-16 students the value of studying level 3 mathematics and support post-16 students to make well-informed subject choices so they will be able to thrive in their chosen subject at university and beyond.

This support would:

- assist schools in satisfying their statutory requirements to provide careers guidance, in particular Gatsby Benchmark 7 ('Encounters with Further and Higher Education')⁹;
- help schools ensure their students are, as Ofsted has put it, "ready for the next stage of their education, employment or training [and] gain qualifications that allow them to go on to destinations that meet their interests, aspirations and the intention of their course of study"¹⁰; and
- complement the efforts of the Advanced Mathematics Support Programme in raising participation in level 3 mathematics qualifications¹¹.

All universities should:

- seek to build and sustain more frequent engagement with greater numbers of schools and colleges to help students make informed choices for post-16 study, embedding signals about the value of level 3 mathematics qualifications.

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8. Core Maths is an umbrella term applied to a type of level 3 mathematics qualification that is equivalent to an AS level in size (and in UCAS points). Core Maths is intended for those students who have passed GCSE Mathematics with a grade 4 or above and chosen not to study AS or A level Mathematics courses. See <https://www.gov.uk/government/publications/core-maths-qualifications-technical-guidance> (accessed 27 May 2020).

9. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/748474/181008_schools_statutory_guidance_final.pdf (accessed 28 May 2020).

10. Ofsted 2019 *The education inspection framework*, p. 10. London: Ofsted. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/801429/Education_inspection_framework.pdf (accessed 27 May 2020).

11. See <https://amsp.org.uk/> (accessed 27 May 2020).