The early take-up of Core Maths: emerging findings

Matt Homer, Rachel Mathieson, Indira Banner and Innocent Tasara

School of Education, University of Leeds

England is an outlier in respect of post-16 participation in mathematics. One potential policy solution to this problem is Core Maths, a new Level 3 qualification equivalent in 'size' to an AS-level, but intended to be studied over two years. Core Maths has been taught in Early Adopter institutions since 2014, with first examination in summer 2016. This paper reports on the historic development of Core Maths, and the early findings of a large-scale three-year mixed-methods project funded by the Nuffield Foundation. The research is intended to provide clear practical and policy guidance for government and other stakeholders in order to secure improved post-16 mathematics participation in England.

Keywords: post-16 mathematics; Core Maths

Defining the post-16 mathematics 'problem'

It is well-documented that England is an 'outlier' (Hodgen, Pepper, Sturman & Ruddock, 2010) when it comes to participation in post-16 mathematics – that is, once the subject ceases to be a compulsory part of the national curriculum. In recent years, only approximately 20% of students in England have gone on to study Level 3 (i.e. advanced) mathematics, the lowest rate in the developed world. Moreover, students who have taken up such a course (i.e. A-level Mathematics) tend to be those students who have achieved only the highest grades at age 16 (i.e. A or A* at GCSE). There is therefore a substantial number of students - around 250,000 per year (ACME, 2012) - who attain a good grade (C or above) at GCSE Mathematics but who inhabit "the maths gap" (DfE, 2014a, para. 9). This is the group of students between the highest-achieving at GCSE who go on to study A-level Mathematics, and those who do not pass GCSE Mathematics at grade C or above and therefore are obliged by government policy to retake the course alongside their other post-16 options. The post-16 curriculum offer in mathematics for such students, who have typically achieved a B or C GCSE grade, has arguably been inadequate, despite recent ill-fated attempts to develop alternative Level 3 mathematics provision such as the A-level Use of Mathematics. A key issue for the successful development of the post-16 mathematics curriculum is to learn from these previous experiences of attempted innovation.

The fact that so many young people cease studying mathematics by the age of 16 is of stated concern to two stakeholders in particular: the government, and higher education (HE). The shortage of mathematically literate school-leavers is widely characterised as a disadvantage to the nation in economic terms (British Academy, 2015). Government and industry have been arguing for mathematics to be more widely taught in the post-16 sector, not only because of the importance to the economy of STEM careers, but also to support other employment pathways. Strong mathematics skills are said to be vitally important to the economy and increasingly important to a range of careers (Hodgen and Marks, 2013). According to the UK government,

generating mathematically competent and confident workers is central to boosting the long-term productivity of our economy (HM Treasury, 2016). The widespread political ambition is that, by the end of this decade, the majority, if not all, students should be studying maths in some form to the age of 18 (see, for example, Michael Gove, BBC News, 2011). There is also a strong argument that a good level of mathematical and statistical literacy is increasingly important in enabling citizens to participate fully in a modern, scientifically and technologically developed democratic society (British Academy, 2012).

In addition, it has long been recognised by the HE sector that students lack the mathematical skills, knowledge and confidence necessary in order to benefit fully from the courses onto which they have enrolled (e.g. ACME, 2011). The quantitative demands of HE courses are on the increase, with statistics in particular becoming more widely taught. ACME (2011) estimates that 330,000 HE entrants annually would benefit from having had recent experience of studying some advanced (post-GCSE) mathematics, including statistics, but that fewer than 125,000 have done so.

Given the economic arguments, and concerns expressed in HE, there is clearly space in the post-16 curriculum for a new mathematics qualification. Core Maths has been developed to try and address some or all of these issues.

Core Maths – the Policy Solution?

Core Maths, a term apparently coined by Liz Truss when she was Junior Education Minister (Truss, 2013), is an umbrella term for a set of new Level 3 qualifications, designed to be studied alongside other Level 3 qualifications. Five awarding bodies have produced Core Maths specifications, each with a different name and focus: Quantitative Reasoning/Quantitative Problem Solving (two different options from OCR/MEI); Mathematical Studies (AQA); Using and Applying Mathematics (City & Guilds); Mathematics for Work and Life (Eduqas), Mathematics in Context (Edexcel).

A Core Maths qualification carries the same number of tariff points for university entry as an AS-level, and is graded in the same way using letters from A to E. Core Maths courses are intended to be taught over two years and are designed to be very different from A-level Mathematics, having a different target group and purpose. According to the Technical Guidance (DfE, 2014b), Core Maths offers progression from GCSE Mathematics, without too much extra content, rather developing further mathematical understanding and skills by applying mathematics to authentic, 'real life' problems. It aims to foster an ability to think mathematically and to apply mathematical techniques with confidence to unfamiliar situations, questions and issues. It aims to be attractive and engaging to a range of students, because it makes connections with students' wider study programme, and intends to provide a sound basis for the mathematical demands which students will face in HE, in areas such as psychology, geography, business and management. It is also valuable for students going into employment across a range of professional, creative and technical fields.

A relatively small group of schools and colleges (153 centres in total) began teaching Core Maths in September 2014, to around 3,000 students, who were entered for examination in the summer term of 2016. These centres, termed Early Adopters, worked in partnership with the Core Maths Support Programme (CMSP), an initiative run by the Educational Development Trust with funding from central government. The CMSP was set up to work directly with schools and colleges, helping them to raise the profile of the course amongst students, as well as to teach Core Maths effectively. In

September 2015, additional centres (Early Developers), invited by their regional Maths Hubs, began teaching Core Maths, with funding to assist the development of expertise and resources. By September 2016, the CMSP estimated that around 500 centres were then teaching Core Maths to over 10,000 students, though preliminary investigations suggest that a number of the institutions who informed the CMSP that they were intending to teach Core Maths from September 2016 did not actually begin teaching the course, largely for reasons relating to funding (see below). As of the end of July 2017, funding for the CMSP has discontinued, and it remains to be seen what the effect of this is on the future of Core Maths.

It is important to note that not all the advice of the expert panel (Browne et al., 2013) set up to guide the development of the new qualifications was followed. In particular, the coursework element was limited to a maximum 20% in the technical guidance, when the expert panel had recommended a more even split between this and externally marked assessments. Also, the grading system was originally advised to be pass/merit/distinction, distinct from the standard A-level grading system (A/A* to E).

Key challenges facing Core Maths

Early signs appear to reveal four main issues impacting on the uptake of Core Maths.

Funding

Due to the post-16 funding system, centres are now typically setting up provision for student programmes consisting of three two-year linear qualifications (A-levels or the equivalent). Core Maths, worth a fraction (40%) of a full Level 3 qualification, does not fit neatly into this pattern, and is generally being taken alongside three full courses, resulting in additional financial cost to the centre in providing Core Maths.

Choice versus compulsion

Noyes and Adkins (2017) claim that the 'maths for all to 18' goal will not be realised as long as mathematics is optional for this age group. They believe that a new curricular structure is necessary, such as a baccalaureate system, or incentives either for individuals or institutions. This fits with the evidence in Hodgen et al. (2013) that, in countries where post-16 uptake of mathematics is much higher, the subject is compulsory, but, crucially, is not the only compulsory subject.

Teaching capacity

There is a nationwide shortage of mathematics teachers (Worth and De Lazzari, 2017). If the policy is to increase numbers of students continuing with mathematics courses in the post-16 sector, many more mathematics teachers will be needed, and shortages will become even more problematic. There is an urgent need (Royal Statistical Society, 2016) for significant investment in teacher capacity, both in CPD for teachers already in schools, and in recruiting new mathematics teachers. The CMSP has played a crucial role in developing existing teaching capacity, but this role is ending in July 2017. Non-specialist mathematics teachers might actually have an important role to play in teaching Core Maths, given its focus on 'simple maths in complex contexts', although one might imagine opposition to this from some quarters.

The currency of a Core Maths qualification

For Core Maths to thrive, this innovative qualification must be recognised and fostered by relevant stakeholder institutions: government, schools and colleges, business and

industry, the HE sector, and mathematics/mathematics education networks, associations and learned societies. Early data seem broadly positive: there is healthy support in these domains for both the vision and the potential of Core Maths. However, a key area for research is the extent to which the rhetoric around this, particularly in HE, matches the actual or perceived exchange value given to Core Maths.

The Current Study

In March 2017, we, at the Centre for Studies in Science and Mathematics Education at the University of Leeds, began a three-year project focusing on the early take-up of Core Maths, with the dual aim of exploring the successes and challenges associated with the introduction of this new qualification, and making suggestions for how the government and other agencies can best act to ensure its long-term success. Our research questions include:

- What does the uptake of Core Maths look like across England and how is this developing over its first three years?
- How are schools/colleges acting to ensure the success of Core Maths in terms of access, participation and attainment?
- Who is teaching Core Maths, and what are their experiences in relation to the qualification itself, and the quality of support they receive?
- What are student and other stakeholders' views on Core Maths?

There are a number of separate strands to the study. One consists of an analysis of National Pupil Data with the results of the first cohort (summer 2016) currently available. The second and third cohorts will be analysed subsequently; it will also be possible to trace the first two cohorts of Core Maths students through to HE. Another key strand is a set of 12 case study centres (a mix of Further Education colleges, sixth form colleges, schools with sixth forms, studio schools and University Technical Colleges), recently recruited across England. Fieldwork will include interviews with teaching staff, students, and senior leaders with responsibility for institutional policy-making, conducted during the autumn term of 2017 and again towards the end of the course. Informal lesson observation will also take place. Other strands include a nationwide online survey of Early Adopter centres, which is currently underway, and further national online surveys. Data will also be collected in the form of artefacts such as prospectuses, web pages and other materials from centres to investigate how Core Maths is being marketed to students, and how colleges are positioning themselves and Core Maths in the post-16 qualification marketplace. Finally, there will be interviews with a variety of stakeholders (e.g. HE and employers), and with senior leaders in centres not teaching Core Maths.

Emerging national data findings

Initial and emergent analysis of the first cohort's results from the national data of summer 2016 show an 81% pass rate (at least grade E), and a median grade D with 46% achieving at least a C, although the variation by specification is large and needs further investigation. AQA is the dominant awarding body with 74% of all 2,738 entries across 240 centres, with the median number of entries per institution at 9 candidates. Entries are expected to have grown to around 5,000 when the summer 2017 data becomes available.

There is a lot of scope for increase in Core Maths provision in all institution types, but particularly in schools that teach to 18. The regional uptake of Core Maths

does not initially seem to show as large a variation as, for example, does A-level Mathematics (Department for Business, Energy and Industrial Strategy, 2017). It appears that a substantial minority (38%) of centres are teaching Core Maths over one year, and a key element of our case study research will ask to what extent the qualification still meets its aims when taught this way. Logistically, however, the benefits to the institution of teaching the qualification in one year can easily be seen.

There is a strong gender imbalance in Core Maths participation, with female students in the minority (35.1%). This is hardly a surprise, echoing the gendered patterns in A-level Mathematics participation, but given the supposedly different character of Core Maths perhaps is little disappointing. Again, qualitative research in the project will investigate student perceptions of Core Maths.

More quantitative work is planned, including estimating any boost to Level 3 attainment that Core Maths might bring, the socio-economic make-up of the Core Maths take-up, value-added analysis (KS4 to KS5), entry policies based on KS4 results, and, finally, longitudinal work on HE destinations of Core Maths students.

Other informal emergent findings

It is emerging from early data collection that teachers who have been involved with Core Maths, either as Core Maths leads or as classroom teachers, are enthusiastic about both the content and the pedagogical approach. Early signs are that students themselves value what they are learning on the Core Maths course, and the way in which it is taught. There is also a recognition of the extent to which Core Maths supports and interacts with other curriculum areas, which chimes precisely with the original intent for Core Maths. A more negative early finding is that funding is proving to be a considerable barrier to uptake in some centres which had originally intended to offer Core Maths. More formal data will be generated over the course of the project to investigate these issues methodically.

The Smith Review and the future of Core Maths

In the March 2016 Budget, Professor Sir Adrian Smith was commissioned to review the provision of post-16 mathematics, "to ensure the future workforce is skilled and competitive" (HM Treasury budget, 2016), and to look at the feasibility of introducing mathematics for all to 18 in the longer term. Originally due in December 2016, the report and a brief initial government response were finally published at the end of July 2017 (Gibb, 2017; Smith, 2017).

The Smith report speaks highly of Core Maths as a key post-16 mathematics pathway. Whilst stating that it will respond more fully in due course, the government does commit to continuing some funding of support programmes for the new qualification. However, it does not promise to fund its actual teaching, which is one of Smith's main recommendations, echoing Noyes and Adkins's (2017) suggestion that Core Maths be funded directly as a fourth option alongside three A-levels. Many in the wider mathematics education community hope that, in their full response to Smith, the government will commit money along these lines, which would likely be a crucial step in securing its long-term future. In the current climate of austerity and constrained finances for schools and colleges, funding is clearly a key issue.

Conclusion

Our research is situated at a fascinating intersection of a range of factors including policy-making (and associated rhetoric), political power, policy actors, funding, student identity, institutional positioning, and qualification use and exchange value. As policy develops, and our research into the uptake of this key addition to the post-16 mathematics curriculum continues, we look forward to reporting further findings.

References

Advisory Committee on Mathematics Education (2011). Mathematical Needs: Mathematics in the workplace and in higher education. London: ACME.

Advisory Committee on Mathematics Education (2012). *Post-16 Mathematics: A strategy for improving provision and participation.* London: ACME.

BBC News (2011). *Gove says 'vast majority' should study maths to 18*. BBC news report, accessed online on 26th March 2015 at http://www.bbc.co.uk/news/education-13958422.

British Academy (2012). *Society counts: Quantitative skills in the social sciences and humanities. A position statement*. London: British Academy.

British Academy (2015). *Count us in: Quantitative skills for a new generation*. London: British Academy.

Browne, R., Koenig, J., MacKay, N., Sheldon, N., Silcott, N., &Wake, G. (2013). *Report from the expert panel on core mathematics*. London: ACME.

Department for Business, Energy and Industrial Strategy (2017). *Building our Industrial Strategy*. London: Stationery Office.

Department for Education (2014a). *Launch of new high-quality post-16 maths qualifications*. Press release, accessed online on July 20th 2017 at https://www.gov.uk/government/news/launch-of-new-high-quality-post-16-maths-qualifications

Department for Education (2014b). *Technical Guidance on Core Maths qualifications*. London: DfE.

Gibb, N. (2017). *Letter responding to Smith review*. Retrieved from https://www.gov.uk/government/publications/smith-review-of-post-16-maths-report-and-government-response

Her Majesty's Treasury (2016). *Budget 2016*. London: HM Treasury.

Hodgen, J., & Marks, R. (2013). *The employment equation: Why our young people need more maths for today's jobs.* London: The Sutton Trust.

Hodgen, J., Pepper, D., Sturman, L., & Ruddock, G. (2010). *Is the UK an outlier?* London: Nuffield Foundation.

Noyes, A.,& Adkins, M. (2017). *Rethinking the value of advanced mathematics participation*. London: Nuffield Foundation.

Royal Statistical Society (2016). *Royal Statistical Society remarks to the independent review of post-16 mathematics led by Professor Sir Adrian Smith*. London: Royal Statistical Society.

Smith, A. (2017). *Report of Professor Sir Adrian Smith's review of post-16 mathematics*. London: Stationery Office. Retrieved from https://www.gov.uk/government/publications/smith-review-of-post-16-maths-report-and-government-response

Truss, E. (2013). *Speech given to the North of England Education Conference*. Accessed online on July 20th 2017 at

https://www.gov.uk/government/speeches/education-minister-elizabeth-truss-speaks-at-the-north-of-england-education-conference

Worth, J., & De Lazzari. G. (2017). *Teacher retention and turnover research. Research Update 1: Teacher retention by subject*. Slough: NFER.