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The early take-up of Core Maths: successes and challenges

Final report - September 2020

Executive summary

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Foreword

In a speech at the Royal Society in June 2011, the then Secretary of State for Education Michael Gove said: "We should set a new goal so that within a decade the vast majority of pupils are studying maths right through to the age of 18". This was partly motivated by Nuffield Foundation research showing that fewer than one in five students in England, Wales and Northern Ireland studied any kind of maths after GCSE, the lowest levels of participation in the 24 countries surveyed. Professor Sir Adrian Smith's 2017 review of post-16 maths education, which drew on Nuffield research, also pointed to the fundamental importance of numeracy and data skills from an economic perspective and highlighted priority areas for action.

Gove's goal was extremely ambitious, particularly in the face of constraints imposed by available maths qualifications. One policy response in train prior to the Smith Review was the development of Core Maths, a qualification aimed at those young people who have done relatively well at GCSE (at least a Grade C or Grade 4) to supplement A-levels or vocational qualifications. In a 2014 report we identified a number of challenges to be met if Core Maths was to fulfill its potential: vigorous and sustained political backing; clear and strong signalling across higher education and amongst employers that the qualification is valued; and sufficient funding and staff for schools and colleges to deliver it well.

This report gives us the first independent analysis of what early take up of Core Maths can tell us about the extent to which these challenges have (or have not) been addressed. Some of its findings are promising. Those students who have undertaken Core Maths are generally very positive about its content and value. The schools and colleges that have decided to offer Core Maths have found sensible ways to combine it with A-levels and other complementary qualifications. The focus and approach of the qualification aligns well with demands for numeracy skills from employers and higher education institutions.

However, there are many disappointing findings. Given that we are now several years in, the range of schools and colleges offering Core Maths is frustratingly limited and this is of course reflected in low student numbers. While annual entries continue to grow slowly, this conceals a certain amount of churn, with some schools dropping the award after just one cycle of engagement. There are concerns about the status of the qualification: it is not an AS level, despite having the same UCAS tariff value; and it goes against the grain of the DfE-driven shift from modular AS-A2 level courses to linear A-levels. Funding arrangements have resulted in a shift from the intended two-year model to a more compressed approach within a single school or college year. Awareness of Core Maths remains poor, perhaps the most worrying finding given that this is a necessary (but of course not sufficient) condition for employers and universities to signal to students that they value the qualification.

The introduction of a new qualification is always difficult, especially when it sits outside the well-understood framework of GCSE and A-level. Even with consolidated and sustained government backing it can take several years of development and promotion to gain recognition and value. Core Maths has all the ingredients of a valuable addition to the qualification landscape, but this report – nearly a decade on from Michael Gove's speech – suggests significant additional engagement is required from all quarters for it to fulfil its potential in addressing low participation in post-16 maths.

Josh Hillman
Director of Education, the Nuffield Foundation

Report headlines

The importance of increasing post-16 mathematics participation in England is widely recognised. Stakeholders, including government, higher education, employers, and the maths education community, have associated low post-16 maths participation with poor mathematical competence and confidence amongst school-leavers and graduates. These long-running concerns led, in 2013, to the development of Core Maths qualifications in an attempt to address this deficiency.

Our study finds that Core Maths courses are valued by teachers and students who have experienced them. However, six years on from first teaching, national take-up of Core Maths remains relatively low. The nature of Core Maths, designed to sit alongside main programmes, does not easily fit into the new per-student funding regime. Institutions struggle to find attractive and cost-effective ways of including Core Maths in their curriculum provision. In addition, the continuing lack of recognition of the qualification by higher education and employers limits its appeal to students.

New qualifications take time to gain recognition and currency. Government-funded efforts to support Core Maths uptake, including the Advanced Mathematics Premium, must be intensified, and should include consideration of direct funding. Ongoing work to encourage more higher education institutions to signal the value of Core Maths as part of entry to their programmes should also continue.

The benefits afforded by Core Maths, particularly in terms of developing the ability to apply mathematics to everyday problems, are widely recognised. The development of a two-year Core Maths course equivalent in size to an A-level, and a Core Maths-type qualification at GCSE, should be seriously considered.

1 Executive summary

1.1 A note on the impact of COVID-19 in 2020

The data gathering and the writing of this report took place prior to the onset of the COVID-19 pandemic and the national lockdown in the UK in March 2020. Publication of the report has been delayed because of the impact of the pandemic on all sectors. However, we have not adjusted any of the reporting or recommendations.

Given the crisis, and the very likely need for schools and colleges to focus on key priorities as the pandemic eases, the future of Core Maths remains uncertain. We recognise that teachers and managers in post-16 institutions may be concentrating their efforts on main programmes, while Core Maths might remain at the margins. However, we also believe that the fact that many students have missed a lengthy period of their schooling in 2020 could be a genuine opportunity for Core Maths. Most immediately, many students in Year 11, who have missed the period including the focused study for and sitting of GCSE examinations, would benefit greatly in their post-16 studies from the opportunity to study Core Maths, which would enable them to ease back into mathematical thinking. Similarly, Year 12 students with quantitative subjects in their programme would benefit from being able to practise the mathematical elements of those qualifications within Core Maths lessons. Our work indicates that any student in that transitional period of Year 11 and Year 12 would benefit from picking up Core Maths and taking mathematics through into their post-16 programme, developing the confidence to re-engage with academic study and with critical thinking, as well as with mathematics.

As the education system readjusts, over a period of months, and perhaps years, there is an opportunity for reassessment of its priorities and essential values. There is a place for the approach and accessibility of Core Maths. We are still following its fortunes keenly.

1.2 Background: Core Maths and this study

Core Maths (CM) qualifications were first taught in 2014, and first examined in 2016, as a contribution towards achieving the government's policy objective of substantially increasing post-16 mathematics participation at Level 3 in England. Participation in post-16 mathematics is known to be much lower than that in other developed countries, despite recognition that mathematical skills and confidence are important for study, life, work and society.

There have been previous initiatives designed to increase participation in post-16 maths, but sustaining and growing them has proved difficult. Additional qualifications such as Use of Mathematics A-level, whilst being appreciated by individuals who were able to benefit from them, have not contributed on a national scale to increasing the numbers of post-16 students continuing with maths. Strong and sustained political backing is essential: without it, initiatives remain vulnerable. The introduction of new Core Maths qualifications, and the embedding of mathematical and quantitative skills into other post-16 qualifications, were part of wide-ranging curriculum and assessment reforms set in train by the Conservative-Liberal Democrat coalition (2010-2015) which have had significant impact on the post-16 system. It is still not clear whether the government's ongoing aim of near universal participation in post-16 maths can be achieved.

This report provides details of a three-year (2017-2020) research project, which used a mixed-methods approach, including national data (2016-2019), a set of thirteen case study institutions (2017-2019), and an online survey (2019), to investigate the successes and challenges experienced by this new addition to the post-16 landscape over its first few years of existence. The intention is to assess the likelihood that Core Maths will successfully contribute to the desired growth in post-16 mathematics participation.

1.3 Key findings

Largely positive responses to Core Maths as a course

1. The introduction of a new course distinct from A-level Mathematics, that is designed to allow many more students to study mathematics in their post-16 career, has been broadly welcomed by school and college staff, students, and the wider mathematics education community (4.1.1). CM is well liked and highly valued by teachers and most students who have experience of it.

2. Teachers enjoy teaching CM because it is a clearly distinct qualification from A-level Mathematics (4.7). CM teachers are positive about the course, typically enjoying the greater freedom they have to allow a lesson to flow in different directions, and a lighter burden which contrasts with the pressure of hurrying through lots of content and preparing for (other) high-stakes exams (4.6.1).

3. CM is perceived by students to be less pressurised and less intense than A-level Mathematics (4.7.5). Students moving into Core Maths after experiencing GCSE Mathematics, and those moving from A-level Mathematics to Core Maths, can take a while to adjust, particularly to open-ended tasks, or where there is not one right answer.

4. The real-world, applied nature of the mathematics in CM, and the financial topics in particular, are greatly appreciated by staff and students (4.4.2). CM is perceived to be more relevant than any other maths experienced by teachers or students. CM students are generally positive about the usefulness and relevance of the mathematical skills they have developed, and the confidence they build, through taking CM.

5. The positive reception of the personal finance aspects of the course leads to a general perception that all students should be studying at least those aspects, which will help students in the future when dealing with mortgages, tax and different types of loan in their own lives, and in viewing the world with a critical eye (4.5.4).

6. Students and staff perceive that studying CM supports other subjects with a mathematical or quantitative element such as Psychology, Biology and Business Studies (4.2.4). This may be related more to the confidence and the facility with applications of mathematics which are developed, than to the specific content of a particular subject or CM specification. There is no compelling evidence from national data to suggest that studying CM enhances examination outcomes in other (A-level) subjects (4.2.6).

7. There is a perception that students who have done well at GCSE Mathematics will find CM to be an enjoyable, manageable course, even when taking it in addition to their main programme (4.4.1). Students who have taken Foundation GCSE may find it more difficult than those who have taken Higher, because they have experienced a narrower range of content. However, the accessibility of CM can bolster students' confidence in their mathematical ability, allowing students who previously struggled with mathematics at GCSE to thrive.

8. Students and teachers report that the relevance and applications of maths within CM should be made available in a corresponding pre-16 qualification at Level 2 (4.4.1).

9. According to a range of stakeholders, adult learners, on gaining their GCSE, would benefit from progressing onto CM, but currently have to fund the course themselves in order to do so (4.4.4).

Relatively weak national uptake of Core Maths

10. Growth in the number of students taking CM qualifications has been steady, with uptake rising by around 2,000 per year, from 2,930 in the first cohort (2016) to 11,791 in 2020 (Figure 1). The current number of entries represents less than 2% of the annual student cohort, however, and does not match the policy aspiration of significantly increasing the number of students studying Level 3 Mathematics, and there remains considerable scope for numbers to increase further.

11. Core Maths qualifications are nationally approved Level 3 maths qualifications counting towards the Level 3 maths measure. This is a performance measure which the Technical Guide to 16 to 18 Accountability Measures, dated July 2019, states "supports our ambition for the overwhelming majority of young people in England to study maths to age 18 by 2020" (Department for Education, 2019, p.19). This measure has not been adequately used as a lever in driving CM take-up (4.1.6).

12. National data suggest that the overall growth in CM entries also hides a considerable amount of churn, where significant numbers of institutions, particularly schools, have withdrawn or paused their CM provision (4.1.5). Local decisions about its continuation are being made within some institutions on a year-by-year basis (5.14).

13. There is no evidence to suggest that numbers enrolling on CM courses threaten A-level Mathematics numbers (4.1.8).

14. The gender balance in CM participation is more equitable than in A-level Mathematics (Table 3), and has become more so over time, growing from 33.9% female in the 2016 examinations to 45.2% in 2019 (Figure 2). However, the female participation rate varies greatly from institution to institution, and may depend upon how or whether CM is aligned with particular subjects or main programmes (Figure 3).

15. There has been an apparent shift in the most popular qualifications which CM students are also studying (4.2.5). In 2016, CM students were predominantly also studying BTEC qualifications; by 2018, the most popular companion qualifications were A-levels. A significant minority of students are pairing CM with EPQ to make up what is essentially a two-year course (4.2.1). Because CM and EPQ are unequal in terms of UCAS tariff, this combination does not quite offer the equivalent exchange value of a full two-year course.

16. Survey data suggest that there are varied opinions across England as to the likely impact of the Advanced Maths Premium (AMP) on CM uptake (4.1.7). Schools with smaller sixth forms may struggle to recruit enough students to create or maintain a CM group, even with the inducement of the AMP. Colleges, with a larger student body, may be best placed to increase their provision.

17. The deliberately sector-led approach to the rollout of CM resulted in a partial coverage of the country, with those institutions already within networks being, on the whole, the ones who engaged with CM (4.7.1). Training provided by the Maths Hubs or support programmes (CMSP/AMSP) did not necessarily reach teachers who were not part of local networks. Our data suggest that it is not unusual for teachers to have embarked on teaching CM without any training at all. Teachers report having had to fend for themselves, including making their own resources in the first couple of years, though resources are now becoming plentiful, especially thanks to online platforms and social media sharing.

Complexity of local implementation of Core Maths

18. The original two-year design of the CM course lends itself well to being offered to students who wish to maintain a breadth of study in their post-16 programme, who are comfortable with the extra work this entails, and who value the usefulness of the extra skills and confidence they develop in maths, whatever other subjects they are studying (4.2.1). However, a two-year course does not necessarily suit students who are less committed to mathematics as an extra course beyond their main programme, and this can cause a retention problem, with students withdrawing from the course (4.2.2).

19. A range of data suggests that there has been a widespread shift towards teaching CM over one year (4.2.1). Reasons for this include avoiding dropout between year 1 and year 2, moving CM examinations away from main programme examinations at the end of two years, and providing a one-year option for students withdrawing from any two-year course at the end of only one year, which leaves a gap in their study programme.

20. Systemic issues are likely to continue militating against substantial growth of CM, no matter how positively students and teachers have received the course itself (4.2). The post-16 funding structure which supports

three A-levels or the equivalent leaves little room for manoeuvre for offering extra courses. The AS-like size of CM does not fit comfortably into the new linear post-16 landscape. As a result, we have seen a range of models of implementation (Table 9), as each school or college has to work out how best to manage implementation within its own constraints and according to its needs and priorities. Some institutions choose not to engage at all with the complexities of deciding how to deliver CM, and therefore do not offer it.

21. Operational issues within institutions can constrain or prescribe the CM target group (4.3). CM may be offered primarily to students who have not achieved the access grade for A-level Mathematics, or students who need to carry on with their mathematics in order to access other subjects (e.g. Psychology, Chemistry). Linking CM with other subjects can expand numbers, but can also result in students feeling resentful about CM, and mandating them to study CM as a requirement for entry onto their main programme can lead to retention issues (4.2.1, 4.2.2). Alternatively, CM may be offered as an enrichment or extension activity into which any student can opt. This strategy tends to result in small numbers, due to low student appetite for the qualification.

22. CM tends to suffer from a relative lack of status, especially when compared with A-level Mathematics, rather than being valued in its own right (4.7.5). This can be due to a perception that CM is for students for whom A-level Mathematics is not appropriate, which in turn can be dependent on how the institution markets the course, and at whom. The status problem is exacerbated by the fact that CM is half the size of an A-level, which can lead to problems in terms of a student's package of qualifications, particularly when it comes to applying for higher education.

23. CM students are typically lower attaining at GCSE in Mathematics and English Language than are A-level Mathematics students, but are higher attaining at GCSE than other Level 3 students as a whole (Figure 9 and Table 15).

24. Although the qualification is aimed at any student who has achieved a standard pass (grade 4+) at GCSE Mathematics, it is not always the case that any grade 4+ student is offered the course (4.3). The access grade in some institutions can be a 5 or higher.

25. Awareness of CM is not necessarily strong beyond the maths department, including in institutions where CM is being taught, meaning that staff are not well enough informed to advise students about the benefits of taking CM (4.2.4). There is also confusion around the nature of the qualification, which is sometimes referred to, even by maths teachers, as an AS.

26. Schools and colleges vary in their marketing strategies and messages (4.8.2). School sixth form staff in 11-18 and 14-18 schools [i.e. carriage return before 11-18] are able to inform pre-16 students about CM and its benefits. Staff in 11-16 schools are less likely to be conversant with the options available to their students going into new institutions. Further education and sixth form colleges hold open events at which they promote their courses.

27. The marketing messages to students of the benefits of doing CM do not necessarily match with their actual and eventual experiences; for example, students told that CM will help their HE applications may find that this is not the case (4.8).

28. CM pedagogy sometimes promotes a new style of thinking and working in the classroom (4.6.1). Whilst some teachers adopt an approach which is in keeping with the exploratory and open-ended methods promoted for CM, others maintain a similar style of teaching in CM lessons as in other classes (e.g. GCSE/A-level).

29. CM is being taught predominantly by mathematics specialists (4.6.1). Care is taken over who within the maths department is allocated the CM teaching. There is a general feeling in schools and colleges that the course should indeed be taught by mathematics teachers.

Need for greater signalling of the value of Core Maths from HE and employers

30. Signalling from higher education institutions of the value of CM for studying at university remains weak (4.9.1). Whilst there are UCAS points for CM, the qualification itself, achieved at any grade, does not usually carry exchange value. This is a significant source of frustration amongst CM teachers and CM students. There are tentative signs of movement, albeit gradual and piecemeal, in the direction of more signalling of the value of CM by a number of HE institutions. The Universities of Bath, Sheffield and York are now making an alternative offer for specified courses to students attaining grade A or B in CM.

31. Retention on CM is negatively affected when students who initially believe that having a CM qualification, in addition to their main programme of three A-levels or equivalent, will enhance their university application discover that it may not (4.9.1). Retention problems can in turn cause institutions to withdraw their CM provision. Teachers say that, without the pull factor from HE, institutions and students will not take up CM in the desired numbers.

32. Higher education institutions are more likely to specify a particular GCSE grade in Maths than to recognise achievement in CM (4.9.1). This can lead to overstretching of post-16 resources, as students who have already achieved grade 4 or higher are retaking GCSE Mathematics to secure a higher grade for university entry.

33. Higher education admissions tutors are not yet, to any significant extent, cognisant of the benefits of CM to students who have taken the course (4.5.1). Employers are unlikely to have heard of CM, and therefore cannot be expected to understand the benefits it brings to students (4.5.3).

34. Employers and higher education representatives stress that they need individuals to come to them, not necessarily with advanced maths skills, but with fundamental mathematics skills and the confidence to use those skills fluently (4.5.3).

1.4 Recommendations

Based on the study's findings, and wider considerations of the pre- and post-16 mathematics curriculum landscape, we make the following set of recommendations concerning Core Maths and post-16 mathematics more generally. We recognise that some of these recommendations have funding implications, that some of them relate to long-running issues (e.g. teacher shortages, wider societal views of mathematics), and also that some, such as the development of new qualifications, might be longer-term in nature. Acting on these recommendations would begin to overcome the challenges facing CM.

Signalling the value of Core Maths

Recommendation 1

All stakeholders (schools and colleges, the Department for Education, higher education institutions, employers, awarding bodies) should recognise the need for careful signalling of the value and importance of CM. All signalling should focus on the value of studying CM in its own right in order to develop and sustain mathematical skills beyond the compulsory phase. Signalling should avoid language referring to the target group being those students not taking A-level Mathematics, since this tends to set up an unnecessary and unhelpful comparison between qualifications.

Recommendation 2

The Department for Education should ensure that the ongoing work by the Advanced Mathematics Support Programme and the Maths Hubs to increase post-16 mathematics participation be intensified. Funding for these bodies should continue in the longer term. This will help ensure, in particular, that higher education institutions continue to develop understanding of the value of CM qualifications, and begin to include them as a formal part of their admissions process.

Recommendation 3

Ofsted could play a bigger role in signalling the value of CM to schools, colleges and even parents. Ofsted has the power to influence policy at institutional level, and could demonstrate more clearly that post-16 Level 3 mathematics participation is an important part of their remit, for example, by always including this element of provision in their inspection and reporting. Greater leverage could be exerted by making more prominent reference to the Level 3 maths measure. Her Majesty's Chief Inspector could also promote the study of CM as a key part of a broad, well-balanced post-16 curriculum.

Recommendation 4

The Department for Education should ensure that all teaching staff, and those with responsibility for careers and pastoral care both pre- and post-16, as well as the new teaching school hubs, and local managers, are targeted with appropriate information about CM that they can pass on to staff and students as appropriate. This material might also include a range of shared strategies for developing student recruitment. Current efforts at informing relevant parties in schools and colleges about the importance of mathematics, post-16 mathematics, and CM specifically, focus largely on mathematics teaching staff, particularly those working in post-16 settings. However, the nature of CM, which is designed to support other subjects, future study, employment, and everyday life, implies that a wide range of staff in schools and colleges need to know about, and be able to advise on, the study of CM.

Recommendation 5

In conjunction with Ofqual, UCAS should revisit the tariff for CM, and, if possible, make it equivalent to half an A-level, in line with the Extended Project Qualification (EPQ). This will help signal CM as a qualification of equal value to the EPQ, and, when paired with the EPQ, will provide the equivalent tariff of an A-level or equivalent two-year qualification.

Supporting the teaching, funding and availability of Core Maths

Recommendation 6

The Department for Education should continue and develop its strategies for improving mathematics teacher recruitment and retention. Capacity issues are likely to inhibit the growth of CM provision, particularly if it is to be taught mainly by specialist mathematics teachers. Provision in FE colleges seems to have the potential to grow, and a specially tailored approach might be needed in contexts where technical/vocational staff may be teaching post-16 maths. The Department must act to ensure that initial mathematics teacher education and continuous professional development include support and practice in CM-appropriate approaches to teaching, such as problem solving, open-ended activities, Fermi estimation, and mathematical investigation and discussion.

Recommendation 7

The Department for Education should review the funding arrangements for CM. Currently, as an extra qualification alongside main programmes, it can be regarded by managers as an additional cost, prohibiting its uptake in some institutions. Including CM within main study programmes as a solution to the funding problem can limit a student's opportunities for progression, particularly to higher tariff HE institutions.

The Advanced Maths Premium has benefited some institutions. However, the calculation of numbers above an existing baseline is essentially unfair to those institutions who committed themselves early on to offering CM in good faith, and risks leading institutions to mandate post-16 mathematics for financial gain rather than for educational reasons. Combining financial support for CM with other Level 3 mathematics courses makes the matter even more complex. CM in school sixth forms, with naturally smaller classes, is particularly vulnerable. To ensure widespread participation, CM needs to be directly funded.

Recommendation 8

The Department for Education should fund research to investigate exactly how institutions are using the Advanced Mathematics Premium funding to support and develop their post-16 mathematics provision.

Recommendation 9

The Department for Education should make CM available to adult learners at no cost, as a natural progression from GCSE. This would help to upskill the workforce across the nation with regard to quantitative skills, in line with the objectives of the Industrial Strategy (Department for Business, Energy and Industrial Strategy, 2017).

Developing additional Core Maths-type qualifications

Recommendation 10

The Department for Education should consider developing a two-year version of Core Maths at Level 3, assessed at A-level standard. The current Core Maths qualifications certainly serve a purpose, and work particularly well in those institutions which find they can, as was intended, offer CM as a two-year enrichment course alongside a main study programme of three other courses. A two-year, A-level equivalent, version of CM would solve many of the challenges currently facing CM, including how it fits within the main programme of study, progression and study programme issues where it is offered over one year, and problems of funding CM as an extra course. We recognise the sensitivities around perceptions that such a two-year course would put it in competition with A-level Mathematics for students. A considerable degree of preparatory work would be necessary across schools, colleges and HE, to ensure that the purpose of an A-level-sized Core Maths is understood as being clearly distinct from the purpose of A-level Mathematics. A starting point for the design of such a two-year qualification could be the pre-existing compulsory and optional units of current specifications, but further development work needs to be done to consider the inclusion of content from emergent fields such as data science.

Recommendation 11

The Department for Education should consider developing a pre-16 Core Maths-type qualification at Level 2, to sit alongside the existing GCSE Mathematics. We recognise that this raises many complex and difficult issues that would need to be addressed before such a qualification could be introduced (e.g. staffing, decisions around choice/compulsion, and implications for post-16 progression). However, the longer-term benefits of a different type of GCSE Mathematics would be considerable, in terms of improving numeracy skills and mathematical confidence across the population, and in increasing post-16 mathematics uptake.

Recommendation 12

The Department for Education, and the wider government, should take steps to develop a more efficient and comprehensive system for managing the rollout of new qualifications. A wide range of actors, policies and programmes (e.g. the Smith Review, Industrial Strategy, Advanced Maths Premium, Advanced Maths Support Programme) have all been supportive of CM, and of increasing post-16 maths participation more broadly. However, this study has demonstrated that wider systemic issues can work against even well-designed and well-received qualifications, and that educational policymaking needs to be more coherent across the system.

1.5 Acknowledgment

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