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Core Maths: Who takes it, what do they take it with, and does it improve performance in other subjects?

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Abstract:

Core Maths qualifications were introduced into the post-16 curriculum in England in 2014 to help students develop their quantitative and problem-solving skills. Taking the qualification should also give students confidence in understanding the mathematical content in other courses taken at the same time.

In this article, we explore whether Core Maths is fulfilling its aims. In particular:

- Does Core Maths provide students with a benefit (in terms of attainment) in other, quantitative, Key Stage 5 subjects (e.g., A Level Psychology, BTEC Engineering)?

We also investigate some aspects of the uptake of Core Maths:

- What are the background characteristics of Core Maths students (e.g., gender, prior attainment, ethnicity)?
- Which other qualifications (e.g., A Levels, BTECs, Cambridge Technicals) and subjects are students most likely to take alongside Core Maths?

The main finding was that students taking Core Maths had a slightly higher probability (than those not taking Core Maths) of achieving good grades in some subjects taken concurrently. Uptake of Core Maths remains relatively low, so there is certainly scope for greater numbers of students to take advantage of the potential benefits of studying the qualification.

Core Maths: Who takes it, what do they take it with, and does it improve performance in other subjects?

Tim Gill (Research Division)

Introduction

Core Maths (CM) qualifications were introduced into the post-16 curriculum in England in 2014, with first assessments in 2016. They are a suite of qualifications aimed at students who achieve a pass grade (grade 4) or higher at GCSE Maths (taken at age 16) but do not go on to take AS or A Level Maths (at age 17 or 18). This group comprised around 40 per cent of all 16-year-old students in 2013, when the qualification was proposed (DfE, 2013). The main purposes of introducing CM were to increase participation in post-16 maths, and to help develop students' mathematical knowledge and its application to a range of different areas. This means these qualifications may help students in subjects which have some mathematical content, such as psychology, business, engineering, and sciences. CM qualifications also have a focus on the application of mathematical techniques to real-world contexts.

There are several different qualifications currently within the CM suite, offered by different awarding organisations (AOs). Some AOs offer more than one CM qualification, each with a different focus. For example, OCR (Oxford, Cambridge & RSA) currently offers two CM specifications (Core Maths A and Core Maths B) and provides some guidance on its website[1] as to which specification to choose, based on the content and what other subjects are supported:

> "Core Maths A content supports all Level 3 qualifications which have a quantitative skills requirement. This includes, but is not limited to: business and economics, PE [physical education] and sport, health and social care, design and technology, engineering and all the science subjects.
>
> Core Maths B content supports subjects that require statistical skills, such as biology and environmental science, psychology, geography and sociology."

1 https://www.ocr.org.uk/qualifications/core-maths/

The qualifications are designed to be taken over two years and are equivalent to half an A Level. However, there is evidence that some schools offer it as a one-year course (Homer et al., 2020).

There is limited previous research into whether the qualifications' aims have been achieved. Homer et al. (2020) undertook a review of the qualification in its "early years" (2016 to 2019), including analysis of the characteristics of students taking CM qualifications, what other qualifications and subjects were taken alongside, and whether there was evidence that CM students performed any better than non-CM students in A Levels with some numeric content. In terms of the student characteristics, they found that the percentage of female students increased from 34 per cent in 2016 to 45 per cent in 2019, and that in 2019 CM students were, on average, more deprived than students taking A Level Maths, but less deprived than students not taking any Key Stage 5 (KS5) maths qualification. In 2018, the most common subjects taken alongside CM were mostly popular AS or A Levels with a quantitative element (e.g., Maths, Psychology, Business Studies, Chemistry) and the Extended Project Qualification (EPQ). They found no evidence that taking CM was associated with better performance in selected A Levels taken at the same time (even after accounting for other factors including prior attainment, gender, deprivation, and school type).

Homer et al. (2020) also surveyed teachers and students to elicit views of the qualification. Both groups tended to be positive about it, particularly its applications to real-world situations. They also believed that CM supported students in their other subjects with mathematical content taken concurrently, although this belief was not backed up with any empirical evidence of improved performance, as already discussed.

Uptake of CM qualifications has increased since its introduction, from 2930 in 2016 to 12 367 in 2023 (AMSP, no date). However, this is still some way below expectations. According to the Royal Society (2023), entries in 2021/22 amounted to just 7 per cent of the potential candidates (i.e., those taking A Levels, but not AS or A Level Maths). This demonstrates that one aim of the qualification (to significantly increase uptake of maths post-16) has not been achieved. Their research also found that provision of CM throughout England was "patchy", with the proportion of schools and colleges offering the subject varying greatly between different local authorities. They called for more recognition from universities, such as inclusion of the qualification in entry requirements for students. It is worth noting that some universities already recognise the benefits of CM and make alternative offers to students taking it[2].

Since the investigation of the impacts of CM in its "early years", as described in Homer et al. (2020), there has been no more recent evaluation of its possible benefits. The research presented here aimed to bring up to date some of this previous analysis. The main purpose was to investigate whether there is any evidence that taking a CM qualification is beneficial to students in terms of their performance in other qualifications taken concurrently (e.g., A Levels, BTECs,

2 See https://amsp.org.uk/universities/university-admissions/alternatives-admissions/

or Cambridge Technicals). This analysis was restricted to subjects with some quantitative element, as these were the subjects that the qualifications were meant to support and, therefore, the most likely area of benefit.

We also investigated the background characteristics of students taking CM, and which other qualifications and subjects CM was most likely to be combined with. In particular, we investigated if there have been changes in uptake since the work of Homer et al. (2020), expanded on their analysis to include more student and school characteristics, and carried out a more in-depth look at the qualifications and subjects combined with CM.

The research questions were:

1. What are the background characteristics of Core Maths students (e.g., gender, prior attainment, ethnicity)?
2. Which other qualifications (e.g., A Levels, BTECs, Cambridge Technicals) and subjects are most likely to be taken alongside Core Maths?
3. Does Core Maths provide students with a benefit (in terms of attainment) in other, quantitative, Key Stage 5 subjects (e.g., A Level Psychology, BTEC Engineering)?

Data and methods

The main source of data for this research was the National Pupil Database (NPD) Key Stage 5 (KS5) extract for 2021/22. The NPD is administered by the Department for Education (DfE) and includes examination results for all students in schools and colleges in England. It also includes student and school background characteristics such as gender, ethnicity, prior attainment, and school type. We restricted the analysis to students who took at least one qualification equivalent in size to an A Level and who were aged 17 or 18 at the start of the academic year. We requested 2021/22 data, as this was the most recent available data. We acknowledge that in 2021/22 England was still coming out of a period in which exams were cancelled and school had been disrupted by the COVID-19 pandemic. However, fundamentally the 2021/22 academic year was more “normal” than the prior two academic years so provides a reasonable comparison to the analysis of data from pre-2020 years.

For research question 1, we analysed the background characteristics of CM students and compared this with the characteristics of non-CM students. The characteristics we looked at were prior attainment, gender, deprivation, ethnicity, first language, special educational needs (SEN), school type and school gender composition.

For prior attainment, we split the KS5 cohort of students into three equally sized groups (“High”, “Medium”, “Low”) based on their average point score (APS) at Key Stage 4 (KS4). Average point score was calculated by assigning a point score to each achieved grade[3] and averaging this across all KS4 qualifications taken by the student.

3 E.g., for GCSEs the point score was the same as the grade (e.g., 9, 8, etc.). See https://www.gov.uk/government/publications/key-stage-4-qualifications-discount-codes-and-point-scores for details.

Student deprivation was measured by the Income Deprivation Affecting Children Index (IDACI), which indicates the proportion of children in the area a student lives in living in low-income families.[4] The KS5 cohort were split into three equally sized groups based on their IDACI score ("High", "Medium", "Low").

We used the ethnicity categories already recorded in the NPD to group students. These were Asian, Black, Chinese, Mixed, White, Other, and Unclassified. Chinese students were in a category of their own due to their tendency to achieve high grades compared to other Asian students. Students were also grouped by their first language (English or other).

For the students with SEN, we used the categories in the NPD. These were "SEN, no statement", and "SEN, with statement", with the second of these requiring the most support.[5]

For these last four student characteristics (IDACI score, ethnicity, language, and SEN), there was a large amount of missing data (around 50 per cent). This was because these variables were collected as part of the school census, using information provided by schools. However, independent schools and colleges were not required to provide this information, leading to large amounts of missing data from these school types. Therefore, any analysis involving these characteristics was carried out just for those students with available data.

For the analysis by school type, schools were grouped into six categories: comprehensive (including academies and secondary moderns), sixth form colleges, further education / tertiary colleges, independent schools, selective schools, and other schools.

Students were also classified by the gender composition of the school they attended. This was derived from the percentage of girls in each school. If this was greater than 95 per cent then the school was categorised as a girls' school, if it was less than 5 per cent it was categorised as a boys' school. Otherwise, it was categorised as a mixed gender school.

For research question 2, we present descriptive statistics on the qualifications and subjects most commonly combined with CM. For this analysis we considered both the most common A Level subjects and the most common non-A Level subjects.

For research question 3, we were interested in whether CM helped students' performance in other subjects with a quantitative element taken at the same time. For this analysis we removed students who took either AS or A Level Maths, as they would not be eligible to take CM. This meant we were directly comparing students taking CM with those not taking any maths in KS5.

4 For further information on IDACI calculation, including definitions of children, families, and income deprivation, see Smith et al. (2015).
5 A "statement" of special educational needs is a legal document which outlines the educational needs of the child and how they will be met by the local education authority.

We investigated performance in the eight A Level subjects with a quantitative element most commonly combined with CM. We also chose five subjects from the range of BTECs equivalent in size to one A Level, and five subjects from the range of BTECs equivalent in size to three A Levels. Again, these were all subjects with a quantitative element. This analysis consisted of a series of regression models.

Regression analysis

For each A Level or BTEC subject we investigated for research question 3, we fitted logistic regression models predicting the probability of students achieving a particular grade or higher. We chose two different grades for each subject. These grades were chosen to represent two different points across the grade distribution: firstly, a high achieving grade, only attained by a minority of students; and secondly, a grade somewhere in the middle of the distribution, which was achieved by a substantial majority of the students. For A Levels, the dependent variables were achieving at least a grade A and achieving at least a grade C. For BTECs equivalent in size to one A Level, the dependent variables were achieving grade D* and achieving at least a grade D.[6] For BTECs equivalent in size to three A Levels, the dependent variables were achieving at least a grade D*D*D and achieving at least a grade MMM.

In each model, we included a variable which indicated whether the student had taken CM or not. This was our main variable of interest. A statistically significant parameter estimate for this variable would indicate that taking CM had a significant effect on the probability of achieving a particular grade or higher.

We used multilevel regression models, as these accounted for the clustering of students within schools. For a more detailed description of multilevel logistic regressions see Goldstein (2011). The general form of the models was as follows:

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right)=\beta_0+\beta_1 x_{1ij}+\beta_2 x_{2ij}+\ldots+\beta_l x_{lij}+u_j$$

where p_{ij} is the probability of student i from school j achieving the relevant grade or higher, x_{1ij} to x_{lij} are the independent variables (including the indicator of taking CM), β_0 to β_l are the regression coefficients, and u_j is a random variable at school level.

For each regression model, other contextual variables which could have had an impact on the outcome variable were included as independent variables. These were student gender, prior attainment, deprivation, ethnic group, first language, special educational needs (SEN) status, student total qualification size, school type, school gender composition, and school mean KS5 attainment.[7]

Most of these variables were described in detail in the previous section of this

6 In BTECs, the grades (from high to low) are Distinction* (D*), Distinction (D), Merit (M), and Pass (P).

7 The base categories (or reference groups) used in the regression analyses for the categorical variables were: female; White; first language English; no SEN; comprehensive (including academies and secondary moderns); and mixed sex.

article. In addition, the student total qualification size variable indicated the total size of the KS5 qualifications taken by each student, measured in A Level equivalents. For example, a student taking three A Levels would have a value of 3. Other qualifications were already assigned a size in the NPD (e.g., BTECs were equivalent in size to either one, two or three A Levels).

For the school KS5 attainment measure (centre KS5 point score), we calculated the average KS5 point score among all students in each school. The KS5 point score for each student was available in the NPD data and (as with the KS4 point score) was calculated by assigning a point score to each achieved grade[8] and averaging this across all KS5 qualifications taken by the student.

A backwards stepwise approach was used to decide on which variables to include in the final models. This method involves starting with a model which includes all possible variables and then removing statistically non-significant variables one by one until only the statistically significant variables remain. Statistical significance was evaluated at the 5 per cent level.

To ensure confidentiality of the data, statistical disclosure controls have been applied to the results (tables and graphs). In particular, counts below 10 and percentages based on counts below 10 have either been suppressed or merged with other counts/percentages.

Results

Uptake of Core Maths by background characteristics

In the 2021/22 NPD data there were 11 522 students who took Core Maths (out of a cohort size of 442,963). Core Maths should mainly be taken by students who achieved a grade 4 or higher at GCSE Maths but did not go on to take A Level Maths. We checked whether this was the case by calculating the GCSE Mathematics grade distribution of CM students (where this data was available). We compared this with the grade distribution of those taking AS or A Level Mathematics and with those not taking any level 3 mathematics qualification. The results are shown in Table 1.

Table 1: GCSE Maths grade distribution by post-16 maths option (% of students achieving each grade)

		GCSE grade							
Level 3 maths	**N**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**<3**
Core Maths	11 034	2.6	10.2	21.5	29.6	27.0	8.6	0.7	0.1
AS / A Level	76 508	33.8	33.5	23.5	7.7	1.3	0.2	<0.1	<0.1
No maths	318 321	1.3	5.1	11.6	17.2	26.4	22.9	9.6	5.9

This shows that over 99 per cent of CM students achieved a grade 4 or higher and most (78 per cent) achieved grades 5 to 7. These are the types of students the qualification is targeted at. Students going on to take AS or A Level Maths were much higher attaining, with over 90 per cent achieving grade 7 or higher.

8 For example, a grade A* at A Level is worth 60 points, A grade is worth 50 points, down to a grade E (10 points) and a grade U (0 points).

Table 2 summarises the background characteristics of CM students and how these compare with non-CM students (including non-CM students taking AS or A Level Maths). This shows some substantial differences between the two groups in their background characteristics. For more details on the comparison between CM and non-CM students, see Gill (2024).

Table 2: Comparison of background characteristics of CM and non-CM students

Background characteristic	Summarised comparison of CM and non-CM students
Gender	CM students were relatively evenly split between females (47.9%) and males (52.1%). This compares with 53.3% female and 46.7% male for non-CM students.
Prior attainment	CM students were most likely to be in the middle attainment group (46.3%), followed by the high attainment group (32.7%). This meant they were somewhat higher attaining on average than non-CM students (33.5% low attaining, 33.0% medium attaining, 33.6% high attaining).
Deprivation	CM students were slightly more likely to be in the low deprivation group (38.2%) than in the medium (32.3%) or high (29.5%) deprivation groups. This meant they experienced less deprivation on average than non-CM students (33.0% low deprivation, 33.5% medium deprivation, 33.5% high deprivation).
Ethnicity	CM students were more likely to be white (74.4%), and less likely to be Asian (11.5%) or Black (5.3%) than non-CM students (65.8%, 15.3%, and 7.7% respectively).
First language	CM students were more likely to be first language English speakers (85.6%) than non-CM students (81.0%).
SEN status	Students with SEN made up 6.3% of CM students. This was almost identical to the proportion among non-CM students (6.4%).
School type	CM students were more likely to attend comprehensives / academy schools (51.0%), or sixth form colleges (22.6%) and less likely to attend Further Education (FE) colleges (12.9%) or independent schools (2.4%) when compared to non-CM students (36.3%, 17.2%, 29.1%, and 8.5% respectively).
School gender composition	Students taking CM were slightly more likely to attend mixed schools (94.5%) and slightly less likely to attend boys' schools (1.6%) than non-CM students (94.0% and 2.0% respectively).

Qualifications and subjects taken by Core Maths students

Table 3 presents the qualifications (and combinations of qualifications) most likely to be taken alongside CM. It shows that the highest proportion of CM students (44.4 per cent) combined it with three A Levels. The next most common qualifications combined with CM were one BTEC only, followed by two A Levels and one BTEC, and three A Levels and EPQ.

Table 3: Types and numbers of qualifications most commonly combined with Core Maths

Combination	No. of students	Per cent of CM students
3 A Levels only	5115	44.4
1 BTEC only	883	7.7
2 A Levels / 1 BTEC	713	6.2
3 A Levels / 1 EPQ	572	5.0
2 A Levels / 1 VRQ[9]	439	3.8
2 A Levels only	333	2.9
2 BTECs only	282	2.5
1 A Level / 1 BTEC	267	2.3
2 A Levels / 1 Cambridge Technical	253	2.2
1 EPQ / 1 VRQ	168	1.5

Table 4 presents the most common A Level subjects combined with CM. Eight out of the top 10 had some quantitative elements, for which CM may be useful. The third column in the table shows the percentage of CM candidates who took the subject. For example, just over 30 per cent of CM candidates also took Psychology A Level. The final column in the table shows the percentage of students taking the A Level subject who also took CM. The highest percentages were for Geography (5.1 per cent) and Biology (5.0 per cent).

Table 4: A Level subjects most commonly combined with Core Maths (students can take more than one subject)

Subject	No. of CM students	Per cent of CM students	Per cent of students taking subject
Psychology	3464	30.1	4.6
Biology	3151	27.3	5.0
Chemistry	1891	16.4	3.6
Business Studies	1845	16.0	4.8
Geography	1756	15.2	5.1
Economics	1241	10.8	3.5
Sociology	1211	10.5	2.8
History	1135	9.9	2.7
Physics	635	5.5	1.8
English Literature	610	5.3	1.9

9 VRQ = Vocationally Related Qualification. These are mainly introductions to an area of work, but do not develop a recognised competence or lead directly to employment. Examples include Applied Diploma / Certificate in Criminology (WJEC), and Diploma / Certificate in Financial Studies (London Institute of Banking & Finance).

Table 5 shows the most common non-A Level subjects taken alongside CM. The EPQ was the most popular, with 11.6 per cent of CM students. This was followed by two BTECs (Applied Sciences, and Business).

Table 5: Non-A Level subjects most commonly combined with Core Maths (students can take more than one subject)

Qualification	Subject	No. of CM students	Per cent of CM students	Per cent of students taking subject
EPQ	n/a	1 342	11.6	2.7
BTEC	Applied Sciences	861	7.5	5.5
BTEC	Business	669	5.8	2.4
VRQ	Criminology	595	5.2	3.0
BTEC	Engineering	535	4.6	8.3
BTEC	Information Technology	371	3.2	4.5
BTEC	Health Studies	323	2.8	1.5
BTEC	Sports Studies	297	2.6	2.0
Cambridge Technical	Information Technology	260	2.3	5.0
VRQ	Financial Studies	229	2.0	3.3

A further analysis explored the most common combinations of subjects taken alongside CM. The most common combination was A Levels in Biology, Chemistry, and Psychology, taken by 453 students (3.9 per cent of CM students). The second and third most common combinations were both single BTECs worth three A Levels: Engineering, taken by 271 students (2.4 per cent); and Applied Sciences, taken by 256 students (2.2 per cent). Six out of the top 10 combinations were A Levels only or A Levels with EPQ. All of these combinations included A Level Biology, four included A Level Chemistry, and four included A Level Psychology.

We also looked at the most popular combinations in a different way, by calculating the subjects with the highest percentage of students also taking CM (Table 6). This was restricted to subjects with at least 100 entries. This may give an indication of which subjects and qualifications teachers and students believed would most benefit from CM being taken alongside.

Table 6: Subjects with highest percentage of students taking Core Maths (at least 100 entries)

Qualification	Subject	No. of CM students	Per cent of students taking subject
OCR Cambridge Tech Extended Diploma	Engineering	45	30.6
OCR Cambridge Tech Diploma	Engineering	79	25.2
VRQ	Religious Education	25	17.2
BTEC National Extended Diploma	Manufacturing Engineering	22	15.6
OCR Cambridge Tech Extended Cert	Engineering	74	13.8
BTEC Level 3 National Certificate	Applied Sciences	32	13.0
BTEC Certificate	Manufacturing Engineering	16	11.1
A Level	Environmental Science	125	10.7
BTEC National Foundation Diploma	Engineering	118	10.3

The highest percentage was for the OCR Cambridge Technical Extended Diploma in Engineering, with 30.6 per cent of the students taking the subject also taking CM. Six out of these nine qualifications were in an engineering-related subject. It is surprising that the subject with the third highest percentage was a VRQ in Religious Education, as this is not a subject with any quantitative element. However, the number of candidates taking this qualification was low (145), so we should not read too much into this.

Do Core Maths students perform better in subjects which have a quantitative element than similar students not taking Core Maths?

As described earlier, for this analysis we explored performance in the most common A Level and BTEC subjects taken alongside CM which were deemed to have a quantitative element.

For each subject, we ran two sets of regression models predicting the probability of achieving:

- at least grade A and at least grade C for A Level subjects
- grade D* and at least grade D for BTECs equivalent in size to one A Level
- at least grade D*D*D and at least grade MMM for BTECs equivalent in size to three A Levels.

Within each grade we also fitted multiple models. Firstly, we fitted a model including all variables (both at student and school level) which were statistically significant ("all variables" model). Secondly, a model was fitted which excluded the census variables (IDACI, ethnicity, language, and SEN) and retained statistically significant non-census variables. This was called the "no census variables" model. As noted in the data and methods section, the census variables have large amounts of missing data. Therefore, by fitting a model excluding these we were able to include many more students and get a sense of whether this affected the results.

The key regression results are presented in Tables 7 to 9. These show, for each subject in each qualification, the parameter estimates for the variable indicating whether CM was taken or not.

The results for A Levels (Table 7) show a positive effect of taking CM for all subjects and grades apart from sociology. However, there were only a few subjects for which the effect was significantly different from 0. In terms of the models with all variables in, there were significant positive effects for biology (grades A and C), chemistry (grade C), and business studies (grade A). All these instances were also significant in the models without the census variables (and mostly only changed in value by a small amount). There were also two instances (business studies grade C, and economics grade A) where there was no significant effect of CM in the models with census variables but with a significant positive effect in the models without census variables.

There was one instance of a significant negative effect of taking CM, for sociology grade A (although in the model without the census variables this was no longer significant). This finding is examined further in the discussion section.

Table 7: Parameter estimates for Core Maths variable (A Level subjects, standard errors in parentheses)

Subject	Grade predicted	Number of students		Core Maths parameter estimate	
		All variables model	No census variables model	All variables model	No census variables model
Psychology	At least grade A	42 174	66 209	0.034 (0.065)	0.103 (0.053)
	At least grade C			0.130 (0.072)	0.105 (0.059)
Biology	At least grade A	26 091	39 409	0.232 (0.073)*	0.235 (0.059)*
	At least grade C			0.180 (0.067)*	0.132 (0.055)*
Chemistry	At least grade A	14 122	21 735	0.096 (0.092)	0.124 (0.075)
	At least grade C			0.188 (0.083)*	0.145 (0.068)*
Business Studies	At least grade A	18 208	31 529	0.250 (0.088)*	0.199 (0.072)*
	At least grade C			0.184 (0.105)	0.247 (0.084)*
Geography	At least grade A	18 186	27 391	0.166 (0.087)	0.051 (0.075)
	At least grade C			0.057 (0.099)	0.068 (0.086)
Economics	At least grade A	11 060	18 487	0.105 (0.107)	0.175 (0.088)*
	At least grade C			0.204 (0.120)	0.175 (0.097)
Sociology	At least grade A	26 205	40 812	-0.249 (0.105)*	-0.150 (0.085)
	At least grade C			0.116 (0.120)	0.052 (0.100)
Physics	At least grade A	26 091	39 409	0.345 (0.222)	0.188 (0.201)
	At least grade C			0.253 (0.138)	0.118 (0.119)

In these logistic regressions, the parameter estimates are hard to interpret as they are the log of the odds of achieving the grade or higher. However, we can convert these into probabilities for "typical" students to illustrate the size of these effects. The typical students we chose were those in the base category for each of the categorical variables and with a value of each continuous variable equal to the mean. Figure 1 compares the probabilities (for CM and non-CM students) of achieving the relevant grade (or higher) for each subject and grade with a significant CM effect (using the results of the "all variables" models). It shows that the differences in probabilities were all very small, despite being statistically significant.

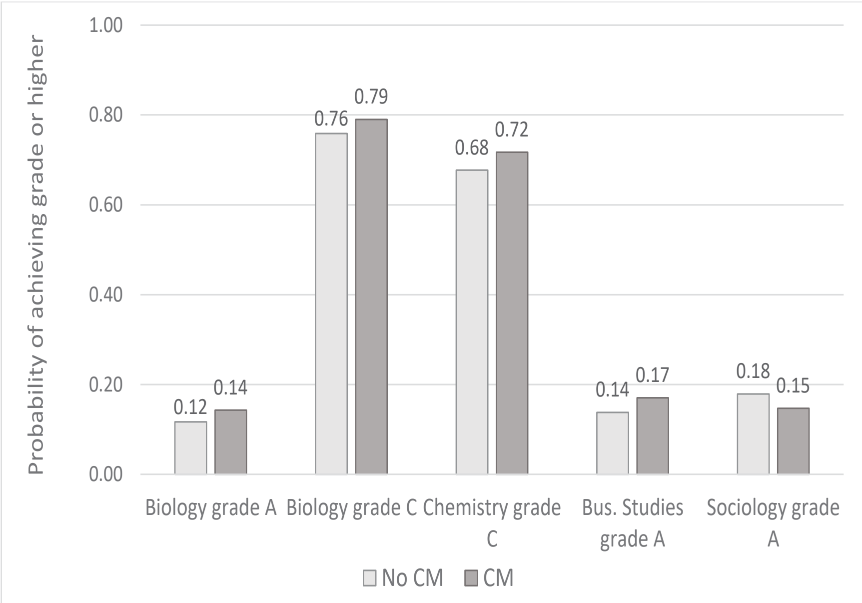

Figure 1: Probabilities of achieving a grade (or higher), for CM and non-CM students (A Levels; "all variables" models with significant CM effect)

The results for BTECs (equivalent in size to one A Level) are shown in Table 8. The "n/a" in the table means that for that particular combination of subject and grade none of the census variables had a significant effect, so there was no "all variables" model.

Table 8: Parameter estimates for Core Maths variable (BTEC subjects equivalent in size to one A Level, standard errors in parentheses)

Subject	Grade predicted	Number of students		Core Maths parameter estimate	
		All variables model	No census variables model	All variables model	No census variables model
Applied Sciences	Grade D*	3 373	4 577	0.492 (0.219)*	0.359 (0.176)*
	At least grade D			n/a	0.288 (0.144)*
Business	Grade D*	7 000	11 014	0.085 (0.214)	-0.080 (0.179)
	At least grade D			n/a	-0.005 (0.139)
Information Technology	Grade D*	3 314	5 211	n/a	-0.011 (0.203)
	At least grade D			0.165 (0.242)	0.233 (0.176)
Sport	Grade D*	3 883	5 453	n/a	-0.178 (0.230)
	At least grade D			0.060 (0.250)	-0.025 (0.216)
Health & Social Care	Grade D*	6 163	8 473	-0.058 (0.270)	-0.050 (0.211)
	At least grade D			0.183 (0.253)	-0.091 (0.209)

Only for one subject was there a significant effect of taking CM. This was applied sciences, which had significant positive effects for both grades. In terms of probabilities, "typical" CM students had a probability of achieving a grade D* in applied sciences of 0.10 compared with 0.06 for non-CM students, and a probability of achieving a grade D of 0.53 compared to 0.46 for non-CM students.

Table 9 presents the results for the BTECs equivalent in size to three A Levels. In all subjects there were no significant effects of the census variables. Therefore, the result of only one model (the "no census variables" model) is presented for each subject grade combination.

Table 9: Parameter estimates for Core Maths variable (BTEC subjects equivalent in size to three A Levels, standard errors in parentheses)

Subject	Grade predicted	Number of students	Core Maths parameter estimate
Applied Sciences	At least grade D*D*D	5 299	0.343 (0.198)
	At least grade MMM		0.614 (0.259)*
Engineering	At least grade D*D*D	2 478	0.108 (0.276)
	At least grade MMM		0.314 (0.269)
Information Technology	At least grade D*D*D	2 323	1.216 (0.407)*
	At least grade MMM		0.084 (0.349)
Business	At least grade D*D*D	7 886	-0.046 (0.316)
	At least grade MMM		0.720 (0.475)
Health & Social Care	At least grade D*D*D	7 206	-0.120 (0.508)
	At least grade MMM		-0.488 (0.493)

There were two subjects for which CM had a significant (positive) effect on performance. In applied sciences, this was for grade MMM or higher; in information technology, this was for grade D*D*D or higher. In terms of probabilities, "typical" CM students had a probability of achieving a grade MMM in applied sciences of 0.95 compared with a probability of 0.92 for non-CM students, and a probability of achieving a grade D*D*D in information technology of 0.21, compared with 0.07 for non-CM students.

Discussion

The main aims of this research were to investigate the position of the Core Maths qualifications in the KS5 curriculum, including uptake among students with different background characteristics and the qualifications and subjects it was combined with, and to see whether students taking CM performed better in their A Level or BTEC subjects taken at the same time.

The results showed that most students taking Core Maths in 2021/22 were those it was aimed at, i.e., achieving a grade 4 or higher in GCSE Maths, but not progressing to AS or A Level in the subject. Over 99 per cent of CM students achieved a grade 4 or higher in their GCSE, with most (78 per cent) achieving grades 5 to 7. On average, CM students achieved lower grades than AS/A Level students, but higher grades than those not taking any level 3 maths qualifications.

In terms of the background characteristics of CM students, we found the following:

- 52 per cent were female – this is a much more even split than in A Level Maths, which was 63 per cent male in 2021/22 (Gill, 2024). This suggests that CM could help with closing the gender gap in post-16 maths.
- CM students were less deprived than average, with 38 per cent in the "low" deprivation group (as measured by the IDACI).
- They were more likely than non-CM students to be white, first language English speakers and less likely to be Black or Asian or to have another first language.
- They were more likely to attend comprehensive schools, or sixth form colleges and less likely to attend FE colleges or independent schools when compared to all other students.

It was not within the scope of the current research to investigate the reasons for lower uptake levels in specific groups of students. Further research could investigate the reasons why particular groups of students were less likely to take CM (e.g., non-white, non-English speakers, those attending independent schools) and if anything can be done to encourage uptake among these groups of students.

However, there may also be a geographical aspect to this. Homer et al. (2020) noted that provision of CM throughout England was patchy. Many of the background characteristics we investigated (e.g., ethnicity, language, deprivation) are geographically clustered, and it may be that the areas where schools were less likely to offer CM were those with higher proportions of Black, Asian, second language English, or more deprived students. i.e., the problem is with provision of CM, not uptake.

CM students were most likely to combine the qualification with three A Levels (44 per cent of CM students). The next most common combination was with one BTEC (usually equivalent in size to three A Levels). The most common subjects combined with CM mostly had some quantitative element, such as A Level Psychology, Biology, and Chemistry, and BTEC Applied Sciences, Business Studies, and Engineering. These results suggest that CM was being taken by many students to support them in these other subjects. This confirms previous case study findings from Homer et al. (2020), who reported that several schools they surveyed required or strongly encouraged students taking particular subjects (e.g., BTEC applied sciences, A Level Psychology) to also take CM. Many students in their research also reported that they chose (or were required) to take CM because it would support them taking A Levels with a quantitative element.

The subjects with the highest proportions of students also taking CM were mostly Cambridge Technicals and BTECs. Six out of the top nine of these were engineering-related subjects. This suggests that this is a subject area where students were being particularly encouraged to take CM. This is not surprising, as engineering is a subject with a significant amount of mathematical content. It may be that students taking engineering were generally required to also take a level 3 maths qualification, either AS/A Level (for higher attainers) or CM (for lower attainers).

Although this research has shown that Core Maths is often taken alongside A Level and BTEC subjects with a quantitative component, there is still plenty of potential for increase in uptake. For example, Gill (2024) found that for some A Level subjects with high entries (e.g., Sociology, Psychology, Business Studies), there were still large percentages of students not taking any maths at all at KS5 (between 78.6 per cent and 93.2 per cent).

The current research provided some evidence that students taking CM achieved better grades than those not taking CM in some subjects with a quantitative element taken at the same time. The results of our analyses showed four occasions when CM students had a significantly higher probability of achieving a particular grade or higher in specific A Level subjects. This was for Biology grades A and C, Chemistry grade C, and Business Studies grade A. However, in each case the size of the effect was small (an increased probability of between 0.02 and 0.04).

Additional significant positive effects were identified for Business Studies grade C and Economics grade A, but only in the “no census variables” model. There was no obvious reason why these showed a significant effect while there was no such effect for the “all variables” model for these subjects and grades. One possible explanation is that the reduced sample in the “all variables” model excluded many of the students who benefitted from taking CM.

There was one significant negative effect of taking CM, for A Level Sociology. This reduced the probability of achieving at least a grade A for CM students from 0.18 to 0.15. It is not clear why taking CM was associated with worse performance in this subject, but it may reflect the relatively low levels of mathematical content in sociology. However, the size of the effect was very small.

These findings were somewhat different from those from previous research into the impact of taking CM on performance in other subjects. Homer et al. (2020) found no significant positive effects across five A Level subjects (Psychology, Biology, Business Studies, Geography, and Chemistry). Their only significant effect was a small negative one for A Level Business Studies. There are a number of possible explanations for this difference which relate to the qualification running for several more years since the last research was published, for example: the increase in uptake of CM in recent years; teachers having more experience of teaching the qualification; and schools being better at deciding which students CM is likely to help. Furthermore, the outcome variable in the previous research (point score achieved in the A Level) was different from the one in our research and their statistical model included fewer variables.

We also found evidence of an effect of taking CM on BTEC performance. For example, for BTECs equivalent in size to one A Level there were two significant positive effects on performance (applied sciences at grade D* and at grade D or above). Similarly, for BTECs equivalent in size to three A Levels, there were two significant positive effects (applied sciences at grade MMM or above; information technology at grade D*D*D or above). Two of these effects were very small, but two were substantially larger than the significant A Level effects. For applied sciences (worth one A Level), taking CM increased the probability of achieving grade D or better from 0.46 to 0.53. For information technology (worth three A Levels), taking CM increased the probability of achieving grade D*D*D or better from 0.07 to 0.21.

Overall, the positive effects of taking CM were mostly very small, but it is worth noting that several of them were in science subjects, which may have more mathematical content than the social science subjects we investigated (e.g., Sociology, Geography). It is also important to note that while the subjects we investigated had a quantitative element, for most of these the amount of mathematical content was not substantial, so it is probably unrealistic to expect to find large effects. One possible area of further research would be to look at question papers for subjects with a quantitative element and identify items requiring mathematical knowledge or skills, and then investigate if students taking CM performed significantly better on these items than non-CM students.

It should be noted that we need to be somewhat cautious with the interpretation of the results. Although, in some instances, we found a significant association between taking CM and achievement in other subjects taken concurrently, this does not mean that there was a causal link. There may be other reasons why CM students performed better. For example, it may be that students taking CM were more motivated to do well academically than non-CM students and it was this that meant they did better in their other subjects, rather than taking CM per se.

While this research suggests that CM could be having a positive impact for learners who take it, the issue of relatively low uptake amongst target learners remains, with only 11 522 entries in 2021/22 (amongst the 442 963 completing KS5 in that year). This would appear to be lower than was hoped, given that the development of these qualifications was aimed at the 200 000 students who achieved a grade C in Maths GCSE but did not go on to AS or A Level Maths (DfE, 2013). It is worth noting that in February 2024 the Education and Skills Funding Agency announced the "Core Maths premium", which is additional funding for CM students to support the planned introduction of the Advanced British Standard (ESFA, 2024). It will be interesting to see whether this has any impact on uptake levels. There is certainly scope for greater numbers of students to take advantage of the potential benefits of studying the qualification, particularly amongst groups of students where there is currently lower uptake.

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