Is Core Maths fulfilling its aim? Impact on higher education outcomes

Research Report

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Executive summary

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 grade 4 (originally a grade C) or higher at GCSE Maths but do not go on to take AS or A level Maths. This group comprised around 40% of all students in 2013, when the qualification was proposed (DfE, 2013).

One of its stated main purposes was to increase participation in post-16 maths and to help 'develop students' understanding and application of maths in ways that are valuable for further study and employment across a range of areas'. This suggests that CM qualifications may help students in their future study in subjects which have some mathematical content, such as sciences, psychology, business, and engineering.

The main purpose of this research was to investigate whether there is any evidence that taking a CM qualification is beneficial to students in terms of higher education (HE) outcomes.

The research questions were:

- Are Core Maths students more likely than non-Core Maths students to progress to HE courses with a quantitative element (e.g., Biology, Psychology)?
- Are Core Maths students less likely than non-Core Maths students to drop-out of HE courses with a quantitative element?
- Is taking Core Maths associated with better degree performance in courses with a quantitative element?

Data and methods

The main source of data for this project was a dataset linking students' records in the National Pupil Database (NPD) and in the Higher Education Statistics Agency (HESA) database. We used the Key Stage 5 (KS5) extract of the NPD for 2017/18 linked to HESA data in 2018/19, 2019/20 and 2020/21.

For research question 1 we undertook two separate sets of analysis of progression. Firstly, progression to any subject classified as having a quantitative element. Secondly, progression to each subject group in turn (i.e., progression to a biological sciences subject, progression to a psychology subject etc.). The main analysis was a series of regression models predicting the probability of CM and non-CM students progressing to a subject with a quantitative element, after accounting for contextual variables.

For research questions 2 and 3 (analysis of drop-out from HE and degree class achieved) we restricted to those students in the data who were taking a course with a quantitative element. Then we identified students dropping out of these courses (in year 1 or year 2) and students who achieved a first class or upper second-class degree. The main analysis for research question 2 was regression models predicting the probability of CM and non-CM students dropping out of a subject with a quantitative element, after accounting for other contextual variables. For research question 3 we undertook regression models predicting the probability of CM and non-CM students achieving a first (or at least an upper second), after accounting for contextual variables.

For all analyses, we excluded students taking AS or A level maths. This meant we were able to directly compare students who took CM with those not taking any KS5 maths qualification.

Results

RQ1 – Progression to HE in a subject with a quantitative element

- Overall, 54% of CM students progressed to a subject with a quantitative element, compared with 43% of non-CM students.
- The results of the regression (progression to any subject with a quantitative element) showed a statistically significant positive impact of taking CM. For a typical student the probability was 0.49 for CM students and 0.39 for non-CM students.
- There was a significant interaction between taking CM and KS5 attainment, meaning that the positive effect of taking CM was slightly larger for those with a higher KS5 points score.
- The results of the regressions (progression to a specific subject group with a quantitative element) showed that for all subject groups apart from psychology, and social sciences, there was a significant positive effect of taking CM on the probability of progressing to that subject group.
- For the social sciences group there was a significant negative effect of taking CM on the probability of progressing.
- In both biological sciences, and psychology the positive effect of taking CM was only present for female students.
- For physical sciences, and business and management there was a significant interaction between taking CM and KS5 attainment, meaning that the positive effect of taking CM was larger for those with a higher KS5 points score.

RQ2 – Drop-out of HE courses with a quantitative element

- Overall, 12% of CM students dropped out of a subject with a quantitative element in year 1, compared with 13% of non-CM students.
- The results of the regression showed that students taking CM were significantly less likely to drop out than non-CM students (probabilities of 0.16 and 0.19 respectively)
- There were some statistically significant differences between subject groups. CM students had a higher probability than non-CM students of dropping out in biological sciences, geographical and environmental sciences, physical sciences, and combined. In subject groups business & management, engineering, and social sciences, CM students had a lower probability of dropping out.
- Overall, 17% of CM students dropped out of a subject with a quantitative element in either year 1 or year 2, compared with 19% of non-CM students.
- The results of the regression analysis showed that students taking CM were significantly less likely to drop out (probability = 0.18) than non-CM students (probability = 0.22).
- There was a significant interaction between taking CM and subject group. CM students had a higher probability than non-CM students of dropping out in geographical and environmental sciences. In subject groups business and management and engineering and technology, CM students had a lower probability of dropping out.

RQ3 – Achievement in courses with a quantitative element

- Overall, 33% of CM students achieved a first (and 87% at least an upper second) in a subject with a quantitative element, compared with 29% and 84% respectively of non-CM students.
- The results of the regression showed that taking CM were significantly more likely to achieve a first than non-CM students (probabilities for a typical student of 0.51 and 0.43 respectively).
- CM students were significantly more likely to achieve at least an upper second (probability for a typical student = 0.94) than non-CM students (0.92) according to a regression model.
- There were no significant interactions between taking CM and subject group in these regressions. This means there was no evidence of a differential effect of taking CM on performance in different subjects.

Conclusions

Students taking CM were significantly more likely to progress to a subject with a quantitative element. This was not surprising as many students will have taken the qualification in the expectation of studying further in a quantitative subject. This finding held across all subject groups apart from social sciences where there was a negative effect of taking CM. This lack of a positive effect for social sciences may be because some of the subjects included in this category had little or no quantitative element to them (e.g. sociology, politics, social work).

Interactions between gender and CM status for biological sciences subjects and psychology subjects showed that the effect of CM was only positive for female students. This may be because CM gave female students the mathematical confidence to progress in these subjects. Previous research has suggested that females tend to be less confident about their own mathematical ability than males (e.g., Smith, 2014).

CM students had higher probabilities than non-CM students of achieving a first or at least an upper second-class degree in a quantitative subject. Perhaps surprisingly, there was no evidence of differences in the effect of taking CM for the different subject groups. This may be related to using a high-level subject grouping. Using finer subject classifications instead might have identified significant differences between subjects in the effect of taking CM, perhaps due to their differences in mathematical content. Alternatively, the issue may be that our analysis is limited by the fairly small numbers of CM students taking each individual subject group.

Taken together, these findings suggest that taking CM may be beneficial to students taking a quantitative subject at HE. However, the usual caveat applies here: association does not mean causation. There may be other reasons why CM students were less likely to drop out and more likely to achieve a good degree that were not directly related to taking CM.

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 grade 4 (originally a grade C) or higher at GCSE Maths but do not go on to take AS or A level Maths. This group comprised around 40% of all students in 2013, when the qualification was proposed (DfE, 2013).

One of its stated main purposes was to increase participation in post-16 maths and to help 'develop students' understanding and application of maths in ways that are valuable for further study and employment across a range of areas' (page 5). This suggests that CM qualifications may help students in their future study in subjects which have some mathematical content, such as sciences, psychology, business, and engineering.

There are several different qualifications currently within the CM suite. OCR has two different specifications, AQA has three and Pearson just one. These are outlined in Table 1.

Table 1: Summary of Core Maths qualifications

Exam board	Qualification name	Summary of content
OCR	Core Maths A (MEI[1]) Level 3 Certificate	Introduction to quantitative reasoning; Critical maths. "Students use problem-solving cycles in modelling, statistics and financial mathematics in a variety of contexts, and check the outcomes of their calculations. They also use appropriate technology to work with quantitative information."
	Core Maths B (MEI) Level 3 Certificate	Introduction to quantitative reasoning; Statistical problem solving. "Starting from a problem to solve, a quantitative statement to evaluate or a question that has mathematics underlying it, students use a number of skills and processes in engaging in their reasoning. They are expected to think flexibly and use their mathematical and statistical knowledge to make logical and reasoned decisions."
AQA	Certificate in Level 3 Mathematical Studies with Statistical techniques	Analysis of data; Maths for personal finance; Estimation; Critical analysis of given data and models; The normal distribution; Probabilities and estimation; Correlation and regression
	Certificate in Level 3 Mathematical Studies with Critical path and risk analysis	Analysis of data; Maths for personal finance; Estimation; Critical analysis of given data and models; Critical path and risk analysis; Expectation; Cost benefit analysis
	Certificate in Level 3 Mathematical Studies with Graphical techniques	Analysis of data; Maths for personal finance; Estimation; Critical analysis of given data and models; Graphical methods; Rates of change; Exponential functions
Pearson	Level 3 Certificate in Mathematics in Context	Applications of Statistics; Linear Programming; Probability; Sequences and Growth

[1] Mathematics Education Innovation, a charity which advocates for improving lives through advances in mathematics education.

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 prior research into whether the qualification's aims have been achieved, particularly in relation to higher education outcomes. 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.

They also surveyed teachers and students to elicit views of the qualification. Both teachers and students 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 a mathematical content taken concurrently, although this belief was not backed up with any empirical evidence of improved performance.

Uptake of CM qualifications has increased since its introduction, from 2,930 in 2016 to 12,367 in 2023 (AMSP, no date). However, this is some way below expectations. According to the Royal Society (2023), entries in 2021-22 amounted to just 7% of the potential candidates (i.e., those taking A levels, but not 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 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 (see https://amsp.org.uk/universities/university-admissions/alternatives-admissions/).

Although uptake of CM has been low, it may still be beneficial for those that do take it. For example, Gill (2024a) found that taking CM was associated with significantly better performance in some A level and BTEC subjects taken concurrently. The main purpose of the research presented here was to investigate whether there is any evidence that taking a CM qualification is beneficial to students in terms of higher education (HE) outcomes. We restricted our analysis to HE subjects with some quantitative element, as these were the subjects where taking CM is most likely to be beneficial.

The research questions were:

- Are Core Maths students more likely than non-Core Maths students to progress to HE courses with a quantitative element (e.g., Biology, Psychology)?
- Are Core Maths students less likely than non-Core Maths students to drop-out of HE courses with a quantitative element?
- Is taking Core Maths associated with better degree performance in courses with a quantitative element?

This work is of particular interest currently, with the UK government planning to require students in England to continue to study maths until age 18 (Lewis and Maisuria, 2023). Therefore, the outcomes of this work will inform discussions about possible changes to post 16 maths. Core Maths is an important part of this mix and therefore it is essential to know whether it is fulfilling its aims of developing quantitative and problem-solving skills which support maths in other courses.

Data and methods

The main source of data for this project was a dataset linking students' records in the National Pupil Database (NPD) and in the Higher Education Statistics Agency (HESA) database. The NPD is administered by the Department for Education (DfE) and includes examination results for all students in all qualifications and subjects in schools and colleges in England, as well as student and school background characteristics such as gender, ethnicity, level of income-related deprivation and school type. The HESA data has information on the students who attend universities in the UK. It includes details of the institution attended, the course subject and level, the degree classification obtained (where applicable) and some additional background characteristics, such as socio-economic status and level of parental education.

We used the Key Stage 5 (KS5) extract of the NPD for 2017/18 linked to HESA data in 2018/19, 2019/20 and 2020/21. At the time of the data request, this was the most recent available linked data that allowed us to follow-up students at the end of KS5 through their HE journeys. This enabled us to investigate the relationship between taking CM and the probability of progression to HE courses with a quantitative element, the probability of dropping out of HE courses with a quantitative element and the probability of achieving a 'good' degree (first class or upper second class) in courses with a quantitative element.

To select the courses with a quantitative element we used the HESA subject classifications, known as the Common Aggregation Hierarchy (CAH)[2]. Using the highest level of aggregation, we chose courses from the following classifications as likely to have a quantitative element:

- Biological and sport sciences
- Psychology
- Physical sciences
- Engineering and technology
- Geography, earth and environmental sciences
- Social sciences
- Business and management

Note that subjects in the mathematical sciences group were not included because students taking these subjects would be expected to have A level Maths rather than Core Maths (or no maths at all).

Some students took combined courses where they studied for more than one subject. For these students, the following rule was applied: if more than 50% of the course was in a subject classified as having a quantitative element, then the student was counted as taking a subject with a quantitative element. Otherwise, the student was excluded.

For the analysis of progression to courses with a quantitative element we restricted the data to all students in the NPD who progressed to HE. From this data we also excluded any

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[2] See https://www.hesa.ac.uk/support/documentation/hecos/cah

students who took AS or A level Maths. This meant we were able to directly compare students who took CM with those not taking any KS5 maths qualifications. Then we identified which of these students progressed to a subject with a quantitative element. We used NPD data on students completing KS5 in 2017/18 matched to HESA data in 2018/19, 2019/20, and 2020/21. This meant we were able to include students who had one or two years of deferment before progressing to HE.

We undertook two separate sets of analysis of progression. Firstly, we analysed progression to any subject classified as having a quantitative element. Secondly, we analysed progression to each subject group in turn (i.e., progression to a biological sciences subject, progression to a psychology subject etc.).

For the second and third research questions (analysis of drop-out from HE and degree class achieved) we restricted to those students in the data who were taking a course with a quantitative element. Again, we also excluded students who took AS or A level Maths. Then we identified students dropping out of these courses (in year 1 or year 2) and students who achieved a first class or upper second-class degree.

Students who were present in the HESA data (and taking a subject with a quantitative element) in one year (e.g., 2018/19) but were not present (or were no longer taking a subject with a quantitative element) in the next year (e.g., 2019/20) were counted as having dropped out of HE. This is not a perfect measure, as some of these students may have transferred to a university in a different country or taken a year out (i.e., not dropped out), but we assumed that there will only be a very small number of such students. We undertook two separate analyses of drop-out. Firstly, students who dropped out in year 1 and secondly, students dropping out either in year 1 or in year 2. For the first of these, students who started HE in 2018/19, but were not in the data for 2019/20, or students who started in 2019/20 (i.e., those who deferred a year), but were not in the data for 2020/21 were counted as dropping out. For the second analysis, students who started HE in 2018/19, but were either not in the data for 2019/20 or were in the data for 2019/20, but not 2020/21 were counted as dropping out.

Finally, for the analysis of degree class achieved, we used the NPD data for 2017/18 matched to HESA data for 2020/21. This means that this analysis was limited to students who started HE immediately after finishing school and completed their degree in three years. This will therefore exclude any students taking four-year courses, or those who take a year out during their degree.

For each of the research questions, descriptive analyses showing patterns of progression to and achievement in HE were undertaken. Then, we carried out regression analyses to fully account for the students' backgrounds when investigating progression, drop-out and attainment for CM and non-CM students.

Regression analysis

For each of the research questions regression models were fitted.

The first of these was a set of logistic regression models predicting the probability of students who completed their KS5 studies in 2018 progressing to HE in a subject with a quantitative element within the next three years. We used a multilevel model, as this accounted for the clustering of students within schools (leading to students within schools having, on average, more similar outcomes than students in different schools). For a more detailed description of multilevel logistic regressions see Goldstein (2011). The general form of the model was as follows:

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

where p_{ij} is the probability of student i from school j progressing to HE, x_{1ij} to x_{lij} are the independent variables, β_0 to β_l are the regression coefficients and u_j is a random variable at school level. Separate models were run, predicting:

i) the probability of progressing to any quantitative subject.
ii) the probability of progressing to a subject in each quantitative subject group (seven models).

The second set of logistic regression models predicted the probability of a student taking a subject with a quantitative element dropping out of HE in either their first or second year. For these models we accounted for two separate hierarchies in the data, with students clustered in schools and in HE institutions. This was accounted for by using a cross-classified multilevel model. The general form of the model was:

$$\log\left(\frac{p_{ijk}}{1-p_{ijk}}\right) = \beta_0 + \beta_1 x_{1ijk} + \beta_2 x_{2ijk} + \cdots + \beta_l x_{lijk} + u_j + u_k$$

where p_{ijk} is the probability of student i from school j and attending HE institution k dropping out of HE, x_{1ijk} to x_{lijk} are the independent variables, β_0 to β_l are the regression coefficients, u_j is a random variable at school level and u_k is a random variable at institution level.

The final set of models predicted the probability of achieving a first-class degree in a quantitative subject (and separately the probability of achieving at least an upper second-class degree). A cross-classified multilevel model was employed here too, with students nested in schools and in HE institutions. The general form of the model was:

$$\log\left(\frac{p_{ijk}}{1-p_{ijk}}\right) = \beta_0 + \beta_1 x_{1ijk} + \beta_2 x_{2ijk} + \cdots + \beta_l x_{lijk} + u_j + u_k$$

where p_{ijk} is the probability of student i from school j and achieving a first (or, separately, at least an upper second) in HE institution k and all other terms are as in the model predicting drop-out.

The regression models were fitted using the *glmer* function in the R programming language (Bates *et al*., 2015).

In each regression model, we included contextual variables which were likely to affect the outcome variable. The variables included in all models were gender, KS5 attainment, deprivation, ethnic group, first language, special educational needs (SEN) status, total size of qualifications taken at KS5, school type, school sex composition, and school mean KS5 attainment. Other contextual variables, taken from the HESA data, were included only in the models predicting the probability of drop-out or the probability of achieving a good degree.

These were students' socioeconomic classification, their parents' level of education, and the degree subject group.

None of these characteristics were directly relevant to any of the research questions being addressed, but it was important that they were included in the models because it allows us to be more confident that any significant effect of taking CM was genuine and not down to differences in the other factors. They were all characteristics which previous research (e.g., Chowdry *et al.* 2008; Gill, 2017; Vidal Rodeiro, 2019; Gill, 2024b) found to be significant factors in determining the likelihood of progression, drop-out, and degree class achieved.

For the measure of KS5 attainment, we used the students' average KS5 points score. This variable was already in the NPD data and was generated by assigning a points score to each achieved grade[3] and averaging this across all KS5 qualifications (at least equivalent in size to an A level) taken by a student. The measure, therefore, excluded the grade achieved in CM (for those students who took it), as this is equivalent in size to an AS level.

To measure student deprivation, we used the NPD variable Income Deprivation Affecting Children Index (IDACI), which indicates the proportion of children in a very small geographical area (Lower Layer Super Output Area or LSOA) living in low-income families[4]. It varies between 0 and 1 and indicates how income deprived the area is that they live in (although it cannot tell us how income deprived the student actually is).

We grouped students by their ethnic background using the categories in the NPD: Asian, black, Chinese, mixed, white, other, and unclassified. Chinese students were in a category of their own due to a well-known tendency to perform very well 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 indicating children requiring the most support[5].

For these four student characteristics (IDACI score, ethnicity, language, and SEN), there was a large amount of missing data (around 50%). This was because these variables were collected as part of the school census, using information provided by schools, and independent schools and colleges were not required to provide this. As such, there is no information on these variables for students in these school types. Students with missing data for any of these variables were excluded from most of the analysis involving the variables (e.g., the regression models). However, we also undertook a sensitivity analysis by running regression models which excluded these variables (and therefore included the students missing in the main models) and seeing what impact this had on the results.

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 3 A

[3] For example, the scores for A level grades were A*=300, A=270, B=240, C=210, D=180, E=150, U=0.
[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.

levels would have a value of 3. Other qualifications were already assigned an equivalent size in the NPD (e.g., BTECs were equivalent in size to either 1, 2 or 3 A levels).

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.

We also categorised schools and colleges by their sex composition (i.e., boys', girls', or mixed). To do this, we first calculated the percentage of girls in each school. If this was greater than 95% then the school was categorised as a girls' school, if it was less than 5% it was categorised as a boys' school. Otherwise, it was categorised as a mixed school.

To generate the school KS5 attainment measure (centre KS5 point score), we calculated the average KS5 points score amongst all students in the school, based on achieved grades.

In the HESA data, students were classified by their socioeconomic status (SES), based on their parents' occupation if there were under 21 or their own occupation if 21 or over. The categories used are standard categories used in the UK census, which run from 1 ('Higher managerial & professional occupations') to 8 ('Never worked & long-term unemployed'), with 9 indicating 'not classified' (including students)[6].

Students were also classified according to whether at least one of their parents had a HE qualification (e.g., degree, diploma, or certificate of HE) or not.

Finally, the degree subject group was included in some models. This was based on the Common Aggregation Hierarchy (CAH) classification. For students taking combinations of subjects in different subject groups we applied the following rule: if the percentage of the course within one subject group was greater than 50%, then assign the student to that group; otherwise assign the student to an additional group called 'Combined'.

In the final regression models, variables which were not statistically significant were excluded. A backwards stepwise procedure was used to decide in which order to exclude non-significant variables.

To ensure confidentiality of the data, statistical disclosure controls have been applied to the results (tables and graphs). For example, all counts have been rounded up or down to the nearest 5 and counts below 10 and percentages based on counts below 10 have either been suppressed or merged with other counts/percentages.

Results

RQ1 – Are Core Maths students more likely to progress to HE courses with a quantitative element (e.g., Biology, Psychology)?

The first analysis looks at the number of CM and non-CM students progressing to HE courses with a quantitative element, broken down by background characteristics. We excluded students taking either AS or A level Maths. Table 2 shows the overall numbers and percentages.

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[6] For a full list of the different categories, see the HESA website.

Table 2: Students progressing to HE in a subject with a substantial quantitative element, by CM status.

Taken Core Maths?	N progressing to HE	N progressing quant	% progressing quant
No	182,085	77,505	43
Yes	3,150	1,715	54

Table 2 shows that students taking CM had a higher likelihood (54%) of progressing to a subject with a quantitative element than those not taking CM (43%). This is not surprising as many CM students will have taken the qualification in the expectation of studying further in a quantitative subject.

Table 3 shows progression to a subject with a quantitative element broken down by student and school characteristics. This table shows, for each characteristic, the number of students progressing, the percentage of these taking CM, the percentage of CM students progressing, the percentage of non-CM students progressing, and the difference between these.

Of most interest in this table is the column showing the difference in the percentage progressing between CM and non-CM students. This gives an indication of whether the increased likelihood of progressing for CM students differed by student background characteristics.

In each case the value of this variable was positive, meaning that within each group, CM students were more likely to progress than non-CM students. However, the size of the difference varied between groups. Some interesting findings were:

- The difference was larger for students of mixed (19 percentage points) or black (13pp) ethnicities and smaller for Asian (7 pp) or other (4 pp) ethnicities.
- The difference was much smaller for non-English speakers (5 pp) than for English speakers (12 pp).
- SEN students without a statement showed a bigger difference (18 pp) than non-SEN students (11 pp).
- The difference was largest amongst independent (25 pp) or selective (18 pp) school students.

Table 3: Students progressing to HE in a subject with a substantial quantitative element, by CM status and background characteristics

Characteristic		**N progressing quant**	**% taking CM**	**% CM progressing**	**% No CM progressing**	**Difference in % progressing**
Gender	Female	113,960	1	50	39	11
	Male	71,275	2	59	49	10
Prior Attainment	Low	61,065	2	56	46	10
	Medium	60,270	2	55	43	12
	High	63,155	1	51	39	12
Deprivation	Low	28,145	3	56	43	13
	Medium	28,475	2	55	43	12
	High	28,325	2	54	46	8
Ethnicity	Other	1,705	3	50	46	4
	Asian	10,195	3	56	49	7
	Black	6,255	2	64	51	13
	Chinese	320	3	SUPP	44	SUPP
	Mixed	4,300	2	64	45	19
	Unclassified	1,255	2	52	45	7
	White	61,125	2	53	42	11
Language	English	71,205	2	55	43	12
	Other	13,515	3	55	50	5
	Unknown	430	4	SUPP	49	SUPP
SEN	None	80,740	2	55	44	11
	SEN, no statement	3,940	2	59	41	18
	SEN, with statement	465	2	SUPP	30	SUPP
School type	6th Form College	37,040	1	52	42	10
	Comp/Academy	68,365	2	54	44	10
	FE College	42,115	1	54	42	12
	Independent	16,205	<1	67	42	25
	Other	12,475	3	54	44	10
	Selective	9,035	1	60	42	18
School sex	Boys	2,875	1	SUPP	43	
	Girls	9,210	2	52	38	14
	Mixed	172,425	2	54	43	11

Table 4 presents the progression to individual subject groups with quantitative elements.

Table 4: Students progressing to HE in a subject with a substantial quantitative element, by CM status and HE subject group

HE Subject group	Taken Core Maths?	N progressing to HE	N progressing in subject	% progressing in subject
Biological Sciences	No	182,085	14,415	8
	Yes	3,150	305	10
Psychology	No	182,085	10,930	6
	Yes	3,150	215	7
Physical Sciences	No	182,085	3,865	2
	Yes	3,150	135	4
Engineering & Technology	No	182,085	3,795	2
	Yes	3,150	220	7
Geog. & Env. Sciences	No	182,085	2,065	1
	Yes	3,150	50	2
Social Sciences	No	182,085	18,445	10
	Yes	3,150	245	8
Business & Management	No	182,085	21,295	12
	Yes	3,150	480	15

For all subject groups apart from social sciences, CM students were more likely to progress to a HE subject group with a substantial quantitative element than non-CM students. The biggest difference was for the engineering and technology group, with 7% of CM students progressing to this subject group, compared with just 2% of non-CM students.

The results of the regression predicting progression to a subject with a quantitative element are presented in Table 5. This shows the parameter estimates (with standard errors in brackets). Statistical significance (at the 5% level) is indicated by an asterisk. Several different models were run. Model 1 included just the student level variables, and model 2 added in any significant interaction effects between taking CM and the other predictor variables[7]. Model 3 excluded the census variables. These variables had a lot of missing data and we wanted to check whether including the students with missing data changed the results of the models in a meaningful way. Note that in model 3 there were some variables (school type, school sex composition) which were not included in models 1 or 2 because of non-significance.

The results of the regressions show a significant positive effect of taking CM on the likelihood of progressing to HE. The size of the regression coefficient was similar in all models, between 0.353 and 0.393. This shows that the exclusion of students with no record for census variables in models 1 and 2 had little effect on the outcomes.

[7] Significant interaction effects were identified using a backwards stepwise procedure

Table 5: regression parameters for a model predicting the probability of progressing to a subject with a quantitative element (Model 1=student level variables; Model 2 = interactions; Model 3 = excluding census variables, due to missing data)

Effect		**Model 1 (n=84,690)**	**Model 2 (n=84,690)**	**Model 3 (n=183,755)**
Intercept		-0.436 (0.013)*	-0.436 (0.013)*	-0.418 (0.013)*
Taken Core Maths	**No**			
	Yes	0.353 (0.048)*	0.393 (0.051)*	0.380 (0.038)*
Gender	**Female**			
	Male	0.393 (0.015)*	0.392 (0.015)*	0.407 (0.010)*
KS5 points score		-0.012 (0.001)*	-0.012 (0.001)*	-0.009 (0.000)*
Ethnic group	**White**			
	Other	-0.034 (0.054)	-0.036 (0.054)	
	Asian	0.105 (0.027)*	0.107 (0.027)*	
	Black	0.212 (0.030)*	0.213 (0.030)*	
	Chinese	-0.020 (0.118)	-0.019 (0.118)	
	Mixed	0.080 (0.033)*	0.079 (0.033)*	
	Unclassified	0.013 (0.064)	0.009 (0.064)	
Language	**English**			
	Other	0.159 (0.024)*	0.159 (0.024)*	
	Unclassified	0.144 (0.106)	0.143 (0.106)*	
SEN status	**None**			
	SEN, no statement	-0.184 (0.034)*	-0.183 (0.034)*	
	SEN, statement	-0.761 (0.103)*	-0.760 (0.103)*	
Candidate total qualification size		-0.067 (0.014)*	-0.069 (0.014)*	
School type	**Comp/Academy**			
	6th Form College			-0.058 (0.035)
	FE College			-0.223 (0.028)*
	Independent			-0.020 (0.031)
	Other			0.006 (0.031)
	Selective			0.070 (0.038)
School sex	**Mixed**			
	Boys			-0.220 (0.055)*
	Girls			-0.030 (0.034)
Taken Core Maths*KS5 point score			0.011 (0.005)*	

Interpretation of parameter estimates in logistic regression models is not straightforward, as they represent the log of the odds of progressing. However, we can make comparisons by converting the results to predicted probabilities of progressing for specific groups of students. These students will be referred to in the rest of the report as ‘typical’ students, and they are those who were in the base category for all categorical variables[8], and with a value of the continuous variables (mean KS5 points score, IDACI score, candidate total qualification size, and centre mean KS5 point score) equal to the mean amongst all students. The means for these variables are shown in Table A1 of Appendix A.

Figure 1 presents the probabilities of progressing to HE for students with different mean KS5 points scores split by whether they took CM. This is for typical students, using the results of model 1 in Table 5.

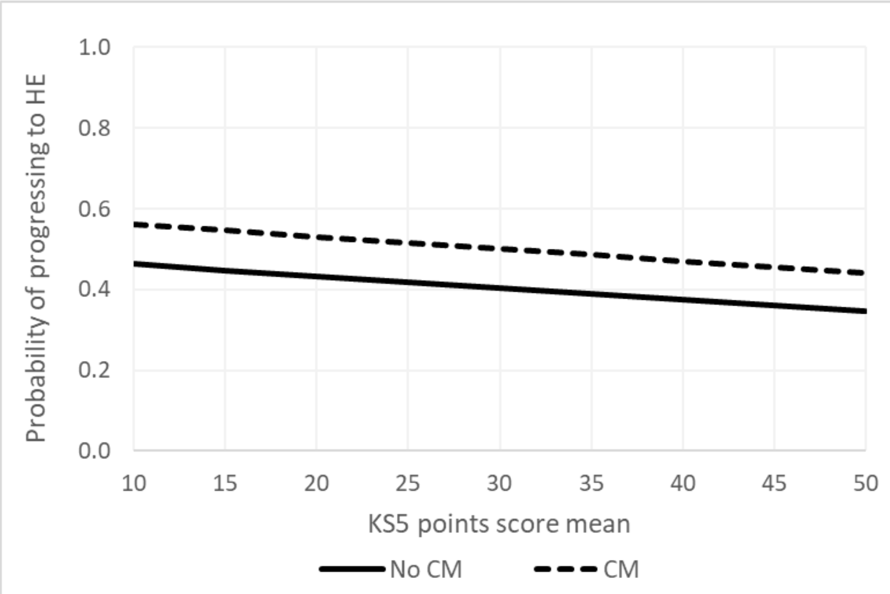

Figure 1: Predicted probabilities for typical students of progressing to HE by CM and KS5 mean points score

This illustrates the size of the difference in probability between CM and non-CM students. For example, for students with a mean KS5 points score equal to the mean amongst all students (33.9, equivalent to one B grade and two C grades at A level), the probability was 0.49 for CM students and 0.39 for non-CM students.

There was one significant interaction effect, between CM and KS5 points score. This was a very small but positive effect (0.011), meaning that the positive effect of taking CM was larger for those with a higher KS5 points score. This is illustrated in Figure 2, using the results of model 2. This shows that CM students with low KS5 points scores only had a slightly increased probability of progressing. For CM students with higher scores, the increase in probability was larger. For example, CM students with a points score of 50 (average grade A) had a probability of 0.49, compared with 0.35 for non-CM students.

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[8] Meaning a student who was female, white, English speaking, had no SEN, attended a comprehensive school, and attended a mixed sex school

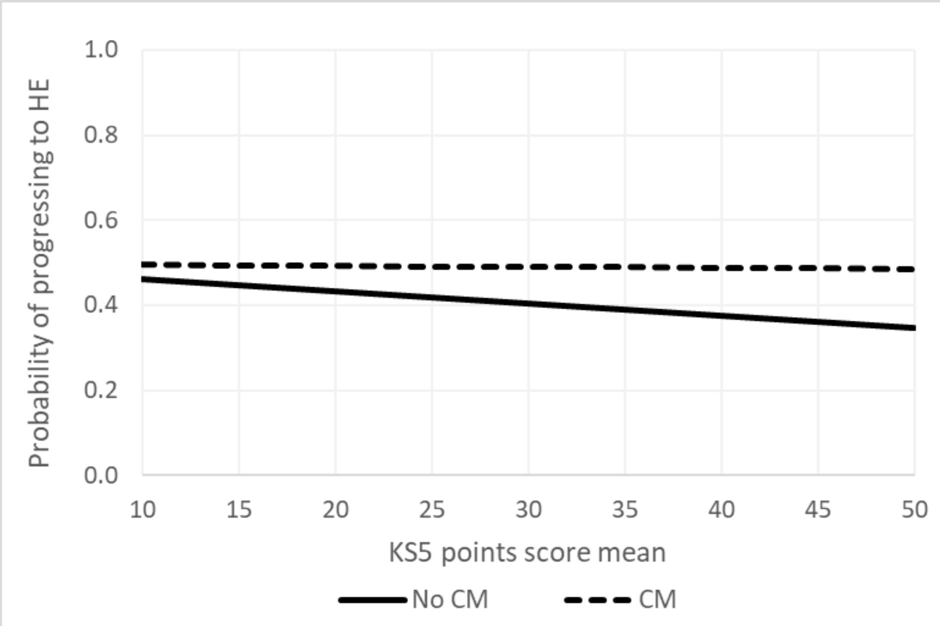

Figure 2: Predicted probabilities for typical students of progressing to HE by CM and KS5 mean points score (including interaction effect between CM and KS5 point score)

Table 6 presents a summary of the regression models predicting the probability of progressing to individual subject groups. This table only shows the parameter estimates for the CM variable. The full regression results can be found in Appendix B (Tables B1 to B7).

For each subject group we present the results of two models. The first model (the 'All variables model') included all statistically significant variables (both at student and school level) but excluded any significant interactions. The second model excluded census variables ('No census variables model'). As we explained before, these variables had a lot of missing data and we wanted to check whether including the students with missing data changed the results.

Table 6: Parameter estimates for core maths variable, by subject group (standard errors in parentheses).

	Core Maths parameter estimate	
Subject	**All variables model (no interactions)**	**No census variables model**
Biological Sciences	0.241 (0.080)*	0.162 (0.065)*
Psychology	0.143 (0.091)	0.256 (0.076)*
Physical Sciences	0.574 (0.119)*	0.682 (0.094)*
Engineering & Technology	1.142 (0.133)*	1.146 (0.087)*
Geographical & Environmental Sciences	0.499 (0.172)*	0.491 (0.152)*
Social Sciences	-0.400 (0.086)*	-0.315 (0.069)*
Business & Management	0.171 (0.067)*	0.144 (0.054)*

For all subject groups apart from social sciences, there was a positive effect of taking CM on the probability of progressing to that subject group. However, for psychology the parameter estimate in the all variables model was not statistically significant. With the exception of psychology, there was very little difference between the all variables model and the no census variables model.

To illustrate the size of the CM effect in different subjects, Figure 3 compares the probabilities (for CM and non-CM students) of typical students progressing in each subject group. Please note that the definition of 'typical' was different for each subject because it depends on which variables were included in the model used to generate these probabilities. Therefore, this figure should not be used to make comparisons between different subjects, only between CM and non-CM students within the same subject.

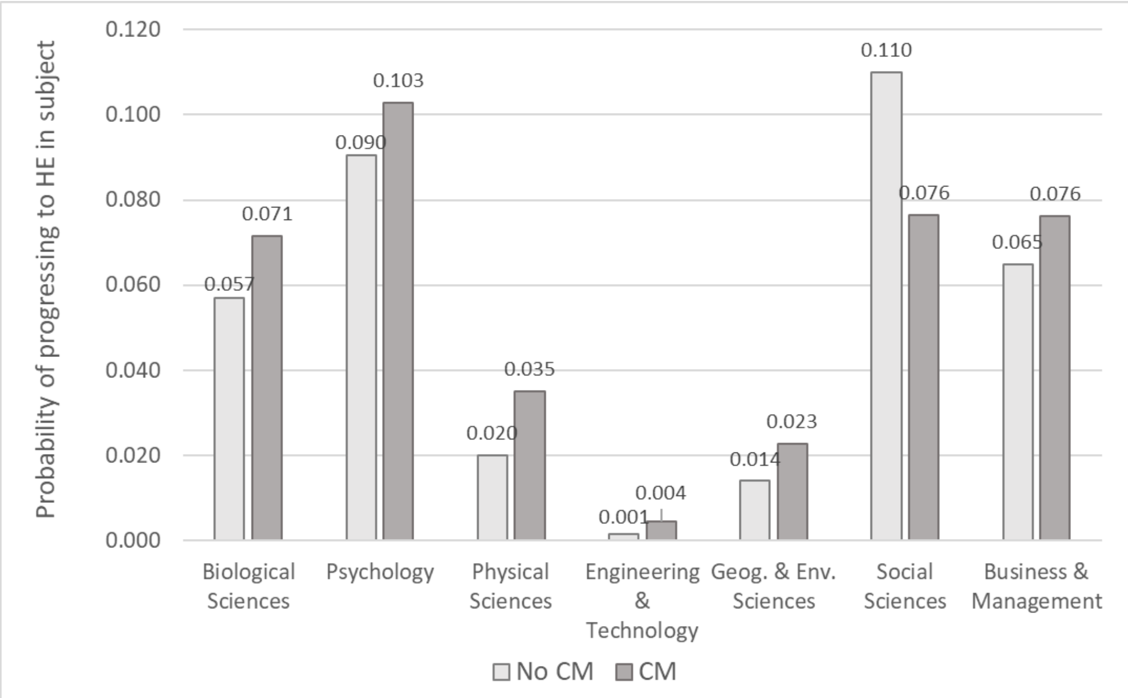

Figure 3: Probabilities of progressing to HE in the subject, for CM and non-CM students (psychology effect non-significant)

Whilst the increases in probability for CM students were not large in absolute terms, some of them were substantial in relative terms. For example, the probability of progressing to an engineering & technology degree for CM students was four times higher (0.004) than for non-CM students (0.001). Note the reduced probability in social sciences for CM students (0.076) compared to non-CM students (0.110).

There were a few significant interaction effects between taking CM and the contextual variables for some subjects (detailed in the tables in Appendix). For biological sciences there was a significant negative interaction between taking CM and gender, meaning that the effect of taking CM was lower for male students than for female students (the base category). This effect is illustrated in Figure 4, where we see that the effect of taking CM was positive for female students (increasing probability of progression to HE from 0.060 to 0.105) but not present for male students.

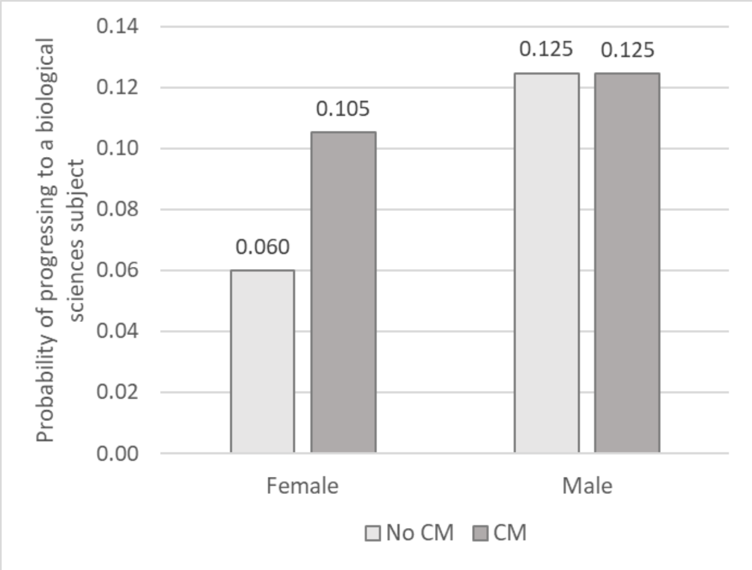

Figure 4: Predicted probabilities of progressing to a biological sciences subject, by CM and gender.

There was a similar negative interaction between taking CM and gender for the psychology subject group (see Figure 5), which led to a positive effect of taking CM for females and a small negative effect for males.

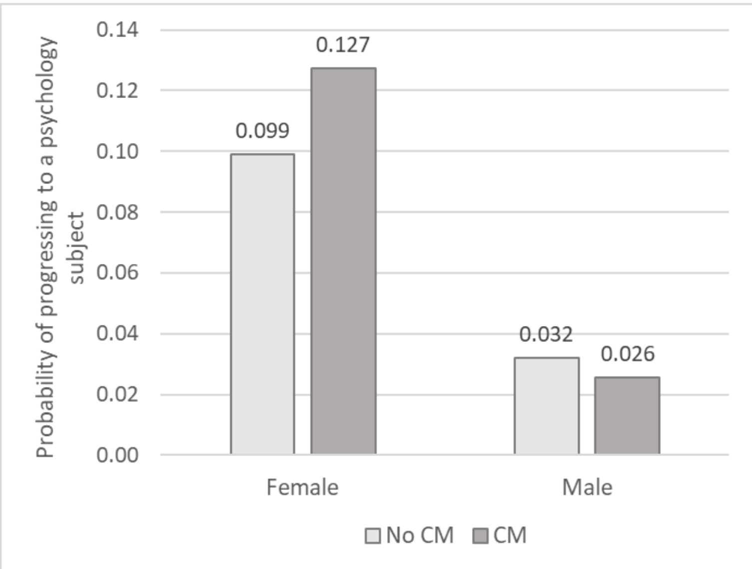

Figure 5: Predicted probabilities of progressing to a psychology subject, by CM and gender

A third interaction effect was between taking CM and KS5 points score mean for physical sciences subjects. This was a positive effect and is illustrated in Figure 6. This shows that the positive effect of taking CM increased with increasing KS5 points score mean. At very low levels of KS5 points scores there was no difference in the probability of progression. However, at a KS5 points score mean of 50 (equivalent to grade A) CM students had a higher probability (0.048) than non-CM students (0.015). At a KS5 points score equal to the mean (33.9), CM students had a probability of 0.038, compared to 0.020 for non-CM students.

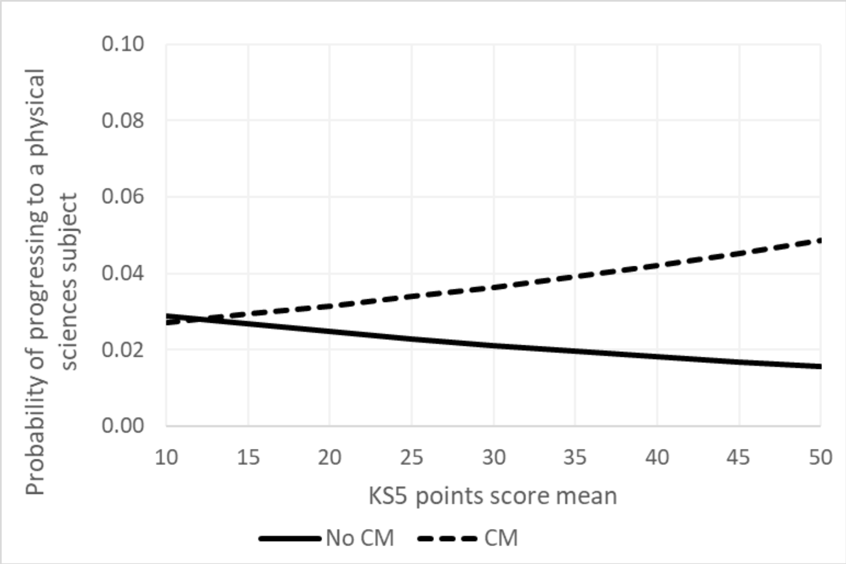

Figure 6: Predicted probabilities of progressing to a physical sciences subject, by CM and KS5 points score.

The same interaction (between CM and KS5 points score mean) was also present for engineering and technology subjects. However, this was a negative interaction, meaning that the effect of taking CM was lower for higher ability students, as illustrated in Figure 7.

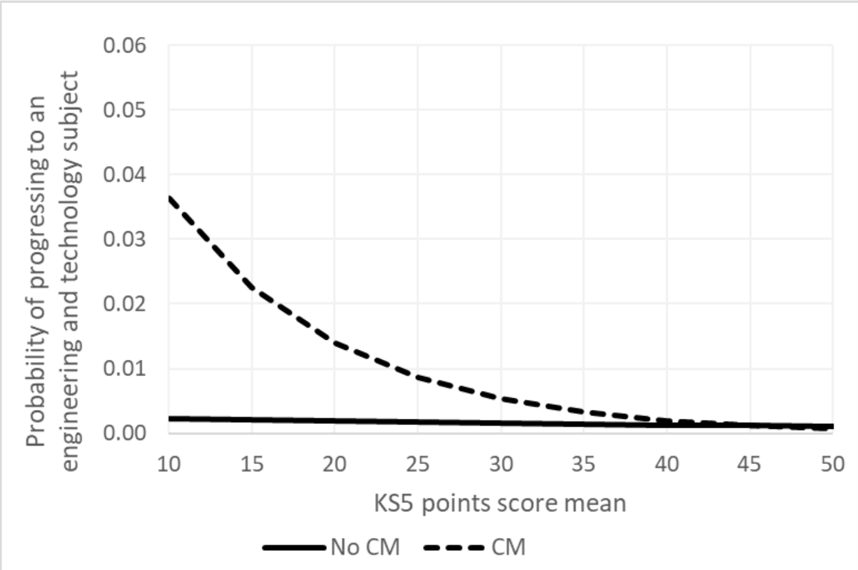

Figure 7: Predicted probabilities of progressing to a engineering and technology subject, by CM and KS5 points score

Figure 7 shows that at a KS5 points score mean of 40 and above there was almost no difference in the probability of progression. However, at low levels of KS5 points score mean, the probability was higher for CM students than for non-CM students.

The final interaction was between taking CM and KS5 point score for the business and management subject group. This was a positive interaction, so the effect of taking CM was larger for higher ability students than for students with low KS5 points score mean.

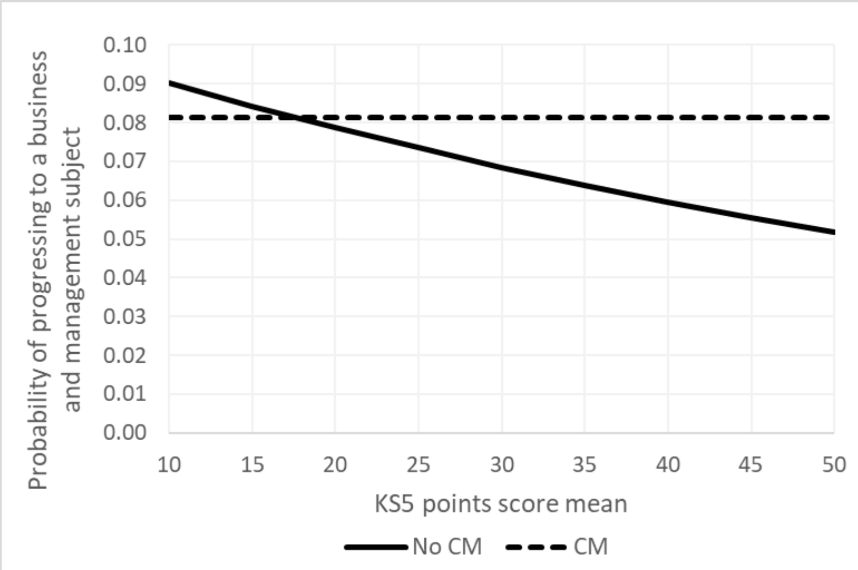

Figure 8: Predicted probabilities of progressing to a business and management subject, by CM and KS5 points score

Figure 8 shows that at a KS5 points score mean below 17, there was a slightly higher probability of progressing for non-CM students than for CM students. Above this, CM students had a higher probability of progressing. For example, at a KS5 points score mean of 50 the probability of progressing was higher for CM students (0.081) than for non-CM students (0.052).

RQ2 – Are Core Maths students less likely to drop-out of HE courses with a quantitative element?

Drop-out in year 1

The definition of drop-out used in the analysis was students who either left HE completely, or those who changed course from a subject with a quantitative element to a non-quantitative subject. Table 7 shows the number of students dropping out in year 1 according to this definition (whether or not they took CM in KS5).

Table 7: Drop out status (Y1) of students starting a quantitative subject

Drop out status	Students	% of students
No drop out	65,825	87
Drop out of HE	4,375	6
Change to a non-quantitative subject	5,280	7
All drop out	9,655	13
All students	**75,480**	**100**

Table 7 shows that around 6% of students dropped out completely in year 1, with about 7% changing to a non-quantitative subject.

Table 8 presents the numbers and percentages dropping out, by whether CM was taken. This shows that there was very little difference in percentage dropping out for CM and non-CM students.

Table 8: Drop out status (Y1) of students starting a quantitative subject by Core Maths uptake

Taken Core Maths?	N taking quant subject	N dropping out	% dropping out
No	73,830	9,460	13
Yes	1,650	195	12

Table 9 presents the percentage of students dropping out, by whether they took CM or not and each background characteristic. In this, and all subsequent analysis, we combined the 'SEN no statement' and 'SEN with statement' categories into one, because of very low numbers of students in the 'SEN with statement' category who took CM.

The differences in percentages dropping out between CM and non-CM students were mostly small. However, it is worth noting that:

- For some groups there was higher drop-out amongst CM students than non-CM students. This included students with SEN (difference of 13 percentage points), students attending a girls' school (5 pp) and students in SES class 3 (3 pp).
- The largest differences where drop-out was lower for CM students were for students attending FE colleges, and those in SES class 1 or 7 (all 4pp).

Table 10 presents the drop-out in year 1 from individual subject groups, by CM status. This shows that students taking CM were less likely than non-CM students to drop out of psychology, and physical sciences subjects, but were more likely to drop out of biological sciences subjects.

Table 9: Students dropping out of HE from a subject with a quantitative element in year 1, by CM status and background characteristics

Characteristic		N taking quant subject	% taking CM	% CM dropping out Y1	% non-CM dropping out Y1	Difference in % dropping out
Gender	Female	42,205	2	14	13	1
	Male	33,275	3	10	13	-3
Prior attainment	Low	25,065	3	13	16	-3
	Medium	24,835	2	11	12	-1
	High	25,195	2	10	10	0
Deprivation	Low	12,130	3	9	10	-1
	Medium	12,145	3	12	12	0
	High	12,170	3	14	13	1
Ethnicity	Other	755	3	SUPP	12	SUPP
	Asian	4,875	4	13	13	0
	Black	3,150	3	12	12	0
	Chinese	SUPP	SUPP	SUPP	SUPP	SUPP
	Mixed	1,875	3	SUPP	10	SUPP
	Unclassified	525	2	SUPP	12	SUPP
	White	24,490	3	11	11	0
Language	English	29,050	3	12	11	1
	Other	6,550	3	9	12	-3
	Unknown	SUPP	SUPP	SUPP	SUPP	SUPP
SEN	None	34,125	3	11	11	0
	SEN	1,675	4	25	12	13
School type	6th Form College	14,675	2	14	13	1
	Comp/Academy	28,340	3	11	12	-1
	FE College	16,035	2	13	17	-4
	Independent	6,340	1	SUPP	8	SUPP
	Other	5,220	4	13	12	1
	Selective	3,625	2	SUPP	10	SUPP
School sex	Boys	SUPP	SUPP	SUPP	SUPP	SUPP
	Girls	3,330	2	15	10	5
	Mixed	69,455	2	12	13	-1
Socioeconomic status (SES)	1	14,545	2	7	11	-4
	2	16,340	2	11	12	-1
	3	7,690	2	16	13	3
	4	5,925	2	12	14	-2
	5	3,455	2	12	14	-2
	6	8,205	2	13	14	-1
	7	5,340	2	11	15	-4
	8	SUPP	SUPP	SUPP	SUPP	SUPP
	9	10,470	2	11	13	-2
Parent educated to degree level	Yes	31,095	2	9	11	-2
	None	32,810	2	13	14	-1
	Don't know / refused	9,850	2	13	13	0

Table 10: Students dropping out of HE in year 1 from a subject with a substantial quantitative element, by CM status and HE subject group

HE Subject group	Taken Core Maths?	N taking quant subject	N dropping out	% dropping out
Biological Sciences	No	13,775	2,780	20
	Yes	295	70	24
Business & Management	No	17,625	2,020	12
	Yes	235	25	11
Engineering & Technology	No	1,955	75	4
	Yes	50	<10	SUPP
Geog. & Env. Sciences	No	3,775	435	12
	Yes	130	<10	13
Physical Sciences	No	3,475	720	21
	Yes	210	30	14
Psychology	No	20,170	2,200	11
	Yes	460	30	6
Social Sciences	No	10,490	790	8
	Yes	210	<10	SUPP
Combined	No	2,565	440	17
	Yes	60	10	17

The results of the regression predicting drop-out from a subject with a quantitative element are presented in Table 11.

For this analysis we ran three different models. In model 1, only the student level variables were included, and model 2 excluded the census variables. Finally, model 3 added in any significant interaction effects between taking CM and the other predictor variables.

Note that socioeconomic status was not significant in any of the models.

The results of the regressions show a negative effect of taking CM on the likelihood of dropping out, but this was only significant in the model without census variables. The effect is illustrated in Figure 9, which shows the probability for 'typical'[9] students with different KS5 points scores (using the results of model 2).

[9] Typical students in this case were female, attended a comprehensive school, taking a subject in the biological and sport sciences subject group, with parents educated to degree level, and with values of continuous variables equal to the mean. The means for the continuous variables are shown in Table A2 of Appendix A.

Table 11: regression parameters for a model predicting the probability of dropping out (in Y1) of a subject with significant quantitative element (Model 1=student level variables; Model 2 = excluding census variables, due to missing data; Model 3 = interactions)

Effect		**Model 1 (n=36,315)**	**Model 2 (n=74,680)**	**Model 3 (n=36,315)**
Intercept		-1.423 (0.058)*	-1.490 (0.058)*	-1.439 (0.058)*
Taken Core Maths	No			
	Yes	-0.155 (0.102)	-0.198 (0.082)*	0.293 (0.174)
Gender	Female			
	Male	-0.149 (0.037)*	-0.172 (0.025)*	-0.148 (0.037)*
KS5 points score		-0.017 (0.002)*	-0.014 (0.001)*	-0.017 (0.002)*
IDACI score		0.604 (0.134)*		0.609 (0.135)*
Candidate total qualification size		-0.082 (0.034)*	-0.038 (0.017)*	-0.083 (0.034)*
Subject group	Biological and Sport Sciences			
	Business & Management	-0.837 (0.050)*	-0.788 (0.033)*	-0.808 (0.050)*
	Engineering & Technology	0.135 (0.086)	-0.028 (0.051)	0.214 (0.088)*
	Geography & Environmental Sciences	-1.705 (0.169)*	-1.536 (0.121)*	-1.836 (0.183)*
	Physical Sciences	-0.704 (0.083)*	-0.651 (0.057)*	-0.701 (0.085)*
	Psychology	-1.341 (0.066)*	-1.166 (0.045)*	-1.316 (0.066)*
	Social Sciences	-0.722 (0.050)*	-0.673 (0.034)*	-0.708 (0.050)*
	Combined	-0.398 (0.090)*	-0.246 (0.059)*	-0.404 (0.092)*
Parent educated to degree level	Yes			
	No		0.137 (0.025)*	
	Don't know / refused		0.038 (0.037)	
School type	Comp / Academy			
	6th Form College		0.128 (0.042)*	
	FE College		0.222 (0.038)*	
	Independent		-0.048 (0.055)	
	Other		0.016 (0.052)	
	Selective		-0.021 (0.065)	
Taken Core Maths*subject group	Biological Sciences			
	Business			-1.042 (0.313)*
	Engineering			-1.213 (0.348)*
	Geography			1.646 (0.516)*
	Physical Sciences			-0.148 (0.392)
	Psychology			-0.977 (0.493)*
	Social Sciences			-0.362 (0.315)
	Combined			0.162 (0.446)

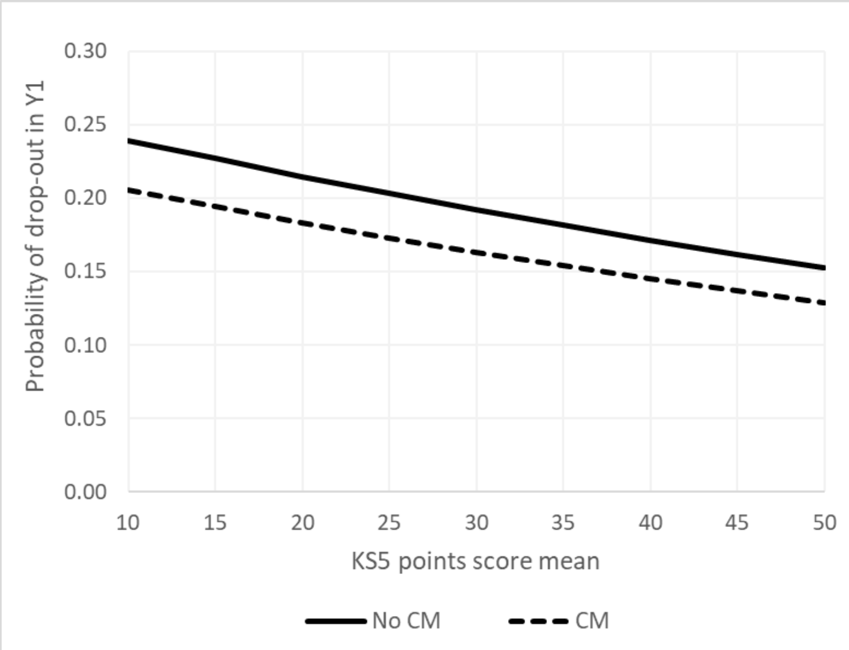

Figure 9: Predicted probabilities of drop-out in year 1 by CM and KS5 mean points score (no census variables model)

Figure 9 illustrates that the difference in probability between CM and non-CM students was not large. For example, for students with a mean KS5 points score equal to the mean amongst all students (33.2, equivalent to one B grade and two C grades at A level), the probability was 0.16 for CM students and 0.19 for non-CM students.

In the model with interactions (model 3), the parameter estimate for taking CM was positive, which contrasts with the results of models 1 and 2. This was due to the significant interaction between taking CM and subject group, meaning that the CM effect was positive (albeit not statistically significantly) for the base subject category (biological sciences), but was negative for most other subject groups. This is illustrated in Figure 10 which shows the probabilities of dropping out of the different subject groups, by CM.

This shows that CM students had a higher probability than non-CM students of dropping out in biological sciences, geography, physical sciences and combined. In subject groups business & management, engineering, psychology, and social sciences CM students had a lower probability of dropping out. However, the interaction effects for physical sciences, psychology, and combined subject groups were not significant, meaning that there was no evidence that the effect of taking CM was different for these subject groups than for biological sciences.

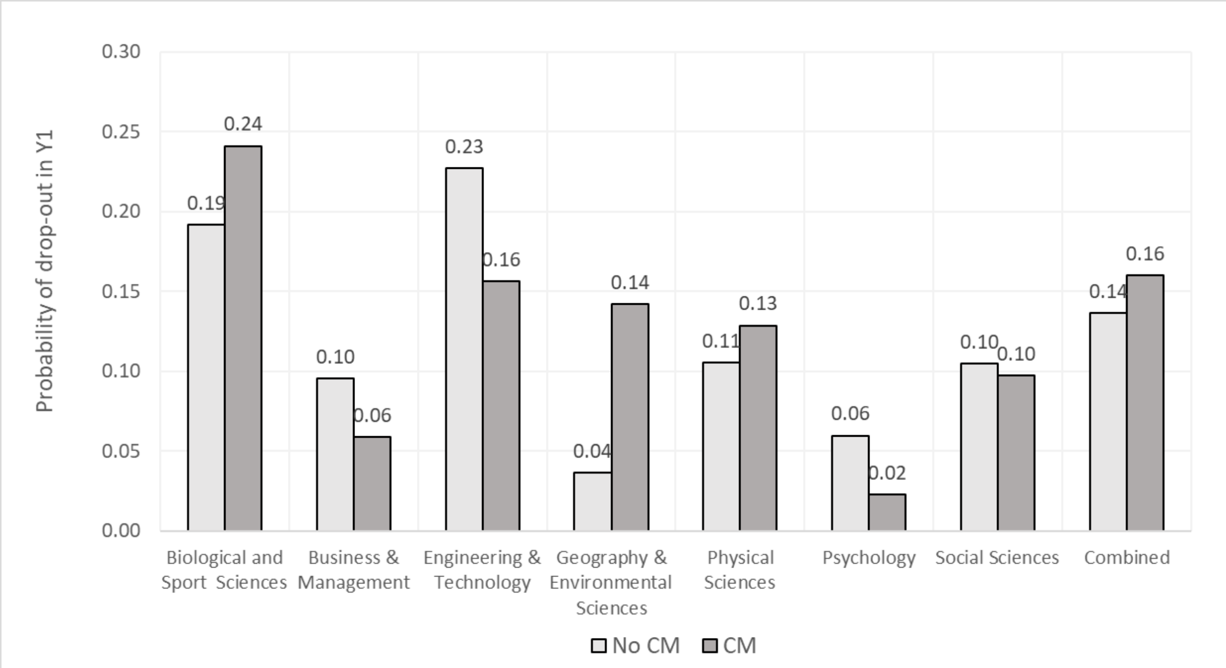

Figure 10: Predicted probabilities of drop-out in year 1 by CM and subject group

Drop-out in year 1 or year 2

Table 12 shows the number of students dropping out in year 1 or year 2 and the type of drop-out. Only students starting HE in 2019 were included in this analysis, to allow for drop-out in Y2 as well as Y1 (whether or not they took CM in KS5).

Table 12: Drop out status (Y1 or Y2) of students starting a quantitative subject

Drop out status	Students	% of students
No drop out	49,780	81
Drop out of HE	6,515	11
Change to a non-quantitative subject	4,675	8
All drop out	11,190	18
All students	**60,975**	**100**

In all, 18% of students dropped out or changed to a non-quantitative subject. Of these, 11% dropped out completely.

Table 13 presents the numbers and percentages dropping out, by whether CM was taken. This shows that CM students (17%) were slightly less likely to drop out when compared to non-CM students (19%). Table 14 presents the percentage of students dropping out, by whether they took CM or not and each background characteristic.

Table 13: Drop out status (Y1 or Y2) of students starting a quantitative subject by Core Maths uptake

Taken Core Maths?	N taking quant subject	N dropping out	% dropping out
No	59,585	11,320	19
Yes	1,390	240	17

Table 14: Students dropping out of HE from a subject with a quantitative element in year 1 or year 2, by CM status and background characteristics

Characteristic		N taking quant subject	% taking CM	% CM dropping out Y1 / Y2	% non-CM dropping out Y1 / Y2	Difference in % dropping out
Gender	Female	34,600	2	17	18	-1
	Male	26,375	3	18	21	-3
Prior attainment	Low	20,325	3	19	25	-6
	Medium	20,175	2	18	17	1
	High	20,155	2	12	15	-3
Deprivation	Low	10,290	3	14	13	1
	Medium	10,290	3	16	16	0
	High	10,280	3	21	19	2
Ethnicity	Other	670	3	SUPP	18	SUPP
	Asian	4,450	4	18	17	1
	Black	2,845	3	18	17	1
	Chinese	SUPP	SUPP	SUPP	SUPP	SUPP
	Mixed	1,570	3	21	14	7
	Unclassified	450	2	SUPP	19	SUPP
	White	20,840	3	16	16	0
Language	English	24,880	3	17	16	1
	Other	5,900	3	14	17	-3
	Unknown	SUPP	SUPP	SUPP	SUPP	SUPP
SEN	None	29,565	3	16	16	0
	SEN	1,380	4	27	18	9
School type	6th Form College	11,910	2	18	19	-1
	Comp/Academy	24,450	3	16	17	-1
	FE College	12,225	2	20	28	-8
	Independent	4,805	1	SUPP	12	SUPP
	Other	4,485	4	21	19	2
	Selective	3,105	2	SUPP	12	SUPP
School gender	Boys	SUPP	SUPP	SUPP	SUPP	SUPP
	Girls	2,900	2	15	13	2
	Mixed	56,925	2	17	19	-2
Socioeconomic status (SES)	1	12,060	2	11	15	-4
	2	13,500	2	15	17	-2
	3	6,420	2	25	19	6
	4	4,945	3	15	21	-6
	5	2,935	2	19	20	-1
	6	6,800	2	15	21	-6
	7	4,460	3	19	22	-3
	8	SUPP	SUPP	SUPP	SUPP	SUPP
	9	8,330	2	21	20	1
Parent educated to degree level	Yes	25,400	2	13	16	-3
	None	27,510	2	19	20	-1
	Don't know / refused	7,650	2	21	22	-1

There were some interesting differences in drop-out rates. In particular:

- For some groups there was higher drop-out amongst CM students than non-CM students. This included students with SEN (difference of 9 percentage points), students of mixed ethnicity (7 pp) and students in SES class 3 (6 pp).
- The largest differences where drop-out was lower for CM students were for students attending FE colleges (8 pp), low attainers, and those in SES class 4 or 6 (all 6 pp).

Table 15 presents the drop-out from individual subject groups, by CM status. For many subject groups, there were only small differences in drop-out rates between CM and non-CM students. However, there were larger differences in two subject groups, with students taking CM less likely to drop-out from business and management subjects or from engineering and technology subjects.

Table 15: Students dropping out of HE in year 1 or year 2 from a subject with a substantial quantitative element, by CM status and HE subject group

Subject group	Taken Core Maths?	N taking quant subject	N dropping out	% dropping out
Biological & sport sciences	No	11,425	3,195	28
	Yes	255	75	29
Business & management	No	16,045	2,730	17
	Yes	395	40	10
Engineering & technology	No	2,715	990	36
	Yes	175	45	26
Geographical & environmental sciences	No	1,230	70	6
	Yes	20	<10	SUPP
Physical sciences	No	2,070	545	26
	Yes	55	10	23
Psychology	No	3,385	540	16
	Yes	120	20	17
Social sciences	No	8,680	970	11
	Yes	180	15	9
Combined	No	14,030	2,285	16
	Yes	195	25	14

The results of the regression predicting drop-out in year 1 or year 2 from a subject with a quantitative element are presented in Table 16.

As before, we ran three different models. In model 1, only the student level variables were included, and model 2 excluded the census variables. Finally, model 3 added in any significant interaction effects between taking CM and the other predictor variables.

Table 16: regression parameters for a model predicting the probability of dropping out (in year 1 or year 2) of a subject with significant quantitative element (Model 1=student level variables; Model 2 = excluding census variables, due to missing data; Model 3 = interactions)

Effect		**Model 1 (n=30,355)**	**Model 2 (n=59,395)**	**Model 3 (n=30,355)**
Intercept		-1.192 (0.068)*	-1.258 (0.063)*	-1.204 (0.068)*
Taken Core Maths	No			
	Yes	-0.182 (0.098)	-0.250 (0.078)*	0.176 (0.177)
Gender	Female			
	Male		-0.068 (0.024)*	
KS5 points score		-0.024 (0.002)*	-0.020 (0.001)*	-0.024 (0.002)*
IDACI score		0.995 (0.140)*		0.997 (0.140)*
Candidate total qualification size		-0.240 (0.036)*	-0.165 (0.020)*	-0.242 (0.036)*
Ethnic group	White			
	Other	-0.133 (0.115)		-0.131 (0.115)
	Asian	-0.133 (0.055)*		-0.131 (0.055)*
	Black	-0.226 (0.064)*		-0.224 (0.064)*
	Chinese	-0.571 (0.302)		-0.562 (0.303)
	Mixed	-0.211 (0.080)*		-0.209 (0.080)*
	Unclassified	0.160 (0.132)		0.160 (0.132)
Socioeconomic classification	1			
	2	0.049 (0.053)	0.068 (0.036)	0.050 (0.053)
	3	0.077 (0.064)	0.090 (0.044)*	0.074 (0.064)
	4	0.126 (0.069)	0.136 (0.048)*	0.126 (0.069)
	5	0.063 (0.082)	0.074 (0.057)	0.063 (0.082)
	6	0.228 (0.063)*	0.162 (0.043)*	0.226 (0.063)*
	7	0.103 (0.073)	0.149 (0.049)*	0.105 (0.073)
	8	0.122 (0.225)	0.103 (0.146)	0.120 (0.226)
	9	0.116 (0.063)	0.127 (0.042)*	0.114 (0.063)
Subject group	Biological Sciences			
	Business &	-0.792 (0.049)*	-0.713 (0.033)*	-0.771 (0.049)*
	Engineering & Tech	0.330 (0.087)*	0.253 (0.051)*	0.387 (0.090)*
	Geographical sciences	-1.467 (0.164)*	-1.480 (0.129)*	-1.563 (0.174)*
	Physical Sciences	-0.687 (0.079)*	-0.648 (0.054)*	-0.678 (0.081)*
	Psychology	-1.255 (0.061)*	-1.097 (0.043)*	-1.243 (0.062)*
	Social Sciences	-0.689 (0.048)*	-0.645 (0.034)*	-0.675 (0.049)*
	Combined	-0.313 (0.088)*	-0.135 (0.059)*	-0.306 (0.089)*

Effect		Model 1 (n=30,355)	Model 2 (n=59,395)	Model 3 (n=30,355)
Parent educated to degree level	Yes			
	No		0.114 (0.026)*	
	Don't know / refused		0.127 (0.037)*	
School type	Comp / Academy			
	6th Form College		0.169 (0.041)*	
	FE College		0.406 (0.037)*	
	Independent		-0.030 (0.055)	
	Other		0.055 (0.049)	
	Selective		-0.119 (0.065)	
Taken Core Maths*subject group	Biological Sciences			
	Business &			-0.700 (0.282)*
	Engineering & Tech			-0.832 (0.325)*
	Geographical Sciences			1.654 (0.583)*
	Physical Sciences			-0.262 (0.395)
	Psychology			-0.357 (0.382)
	Social Sciences			-0.469 (0.320)
	Combined			-0.176 (0.472)

The results of the regressions (models 1 and 2) show a negative effect of taking CM on the likelihood of dropping out, but this was only significant in the model without census variables (model 2). The effect is illustrated in Figure 11, which shows the probability for typical[10] students with different KS5 points scores.

Figure 11 shows that the probability of drop-out in year 1 or year 2 for a student with a KS5 points score equal to the mean (33.4, equivalent to one B grade and two C grades at A level) was 0.18 if they took CM and 0.22 if they did not take CM.

[10] Typical students in this case were white, attended a comprehensive school, taking a course in biological sciences subject group, parents educated to degree level, in socioeconomic classification group 1, with values of continuous variables equal to the mean. The means for the continuous variables are shown in Table A3 of Appendix A

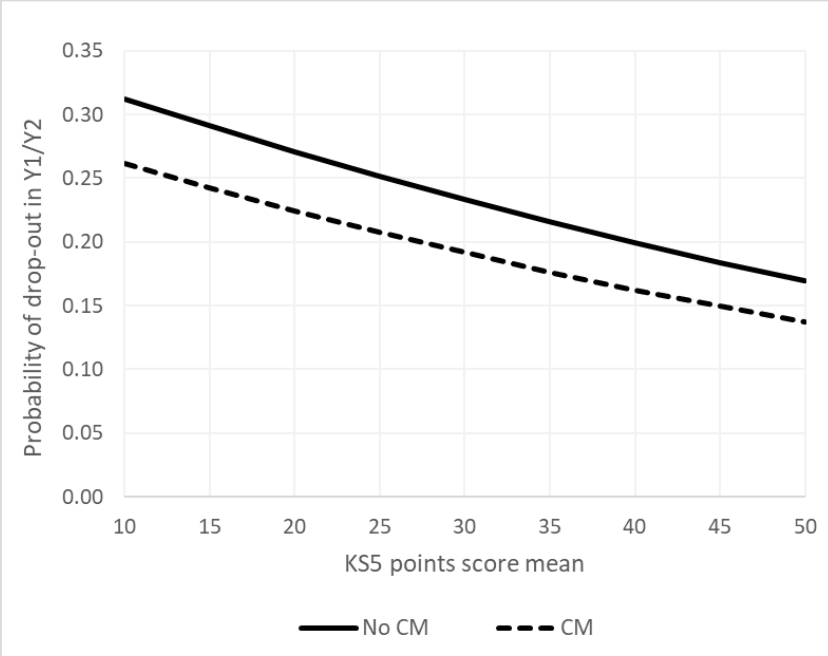

Figure 11: Predicted probabilities of drop-out in year 1 or year 2 by CM and KS5 mean points score (based on model 2).

There was one significant interaction effect, between taking CM and subject group. This is illustrated in Figure 12.

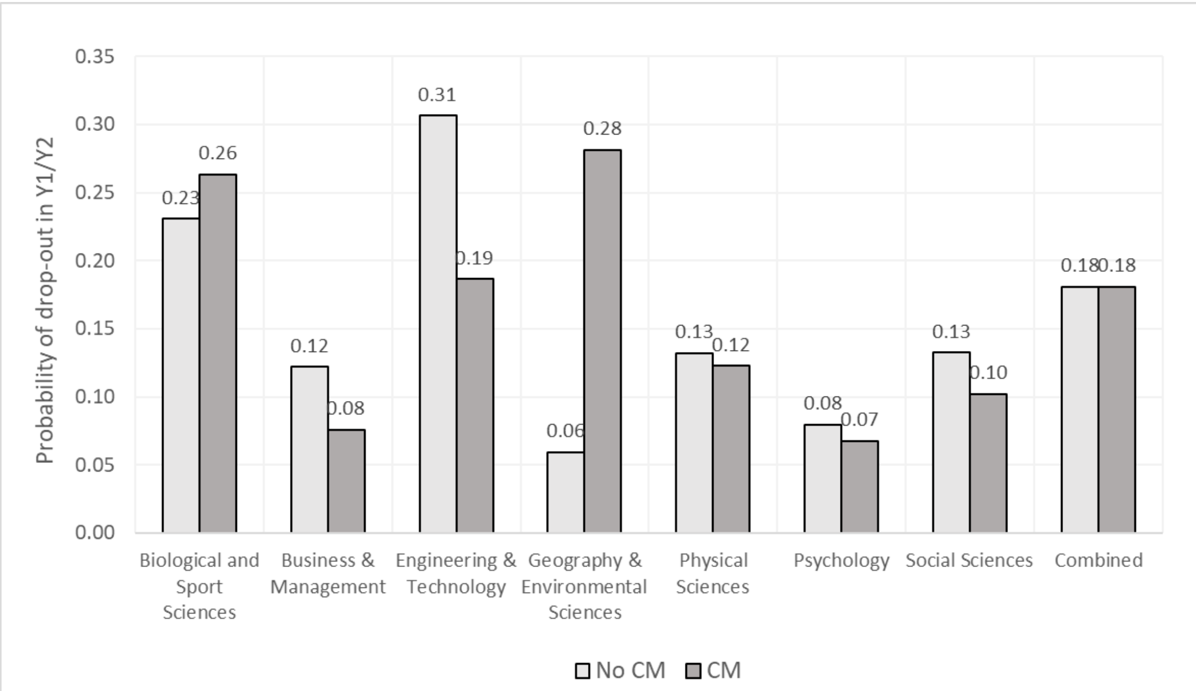

Figure 12: Predicted probabilities of drop-out in year 1 or year 2 by CM and subject group (including interaction between CM and subject group).

Compared with biological sciences, the effect of taking CM was significantly larger (i.e. led to a larger increase in the probability of dropping out) for geographical and environmental science subjects. In contrast, the effect of taking CM on the probability of dropping out was negative in business and management subjects and engineering and technology subjects.

This meant that CM students had a lower probability of dropping out in these subjects than non-CM students. Having said this, this finding is based upon a very small number of student (see Table 15) and should be treated with caution. For the other subject groups, there were no significant differences compared with biological sciences.

RQ3 – Is taking Core Maths associated with better degree performance in courses with a quantitative element?

First class degree

Table 17 shows the overall numbers and percentages of students achieving a first-class degree, by whether they took CM. This shows that CM students were slightly more likely to achieve a first (33%) than non-CM students (29%).

Table 17: First-class degree status, by Core Maths uptake

Taken Core Maths?	N achieving degree in quant subject	N achieving a first	% achieving a first
No	31,480	9,135	29
Yes	670	220	33

Table 18 presents the numbers and percentages of students achieving a first-class degree by CM and background characteristics. Some interesting findings were:

- The advantage for CM students was larger for males (6 pp) than females (3 pp). It also was larger for high attainers (8 pp) than for lower attainers (6 pp for low attainers and 4 pp middle attainers).
- There was a substantial difference amongst students in FE colleges, with 39% of CM students achieving a first, compared with 24% of non-CM students.
- For selective school students, the percentage achieving a first was higher for non-CM students (36%) than CM students (30%).
- SES categories 5 ('Lower supervisory & technical occupations') and 6 ('Semi-routine occupations') had the largest differences in favour of CM students (21 pp and 13 pp respectively).

Table 18: Students achieving a first-class degree in a subject with a substantial quantitative element, by Core Maths uptake and background characteristics.

Characteristic		N achieving degree in quant subject	% taking CM	% CM achieving first	% non-CM achieving first	Difference in % achieving first
Gender	Female	20,055	2	35	32	3
	Male	12,090	3	30	24	6
Prior attainment	Low	10,850	3	27	21	6
	Medium	9,545	2	33	29	4
	High	11,585	1	44	36	8
Deprivation	Low	5,745	3	38	35	3
	Medium	5,795	3	32	32	0
	High	5,775	2	26	25	1
Ethnicity	Other	325	3	SUPP	23	SUPP
	Asian	2,330	3	27	27	0
	Black	1,225	2	SUPP	17	SUPP
	Chinese	SUPP	SUPP	SUPP	SUPP	SUPP
	Mixed	810	2	SUPP	26	SUPP
	Unclassified	SUPP	SUPP	SUPP	SUPP	SUPP
	White	12,370	3	36	34	2
Language	English	14,270	3	35	32	3
	Other	3,020	3	25	24	1
	Unknown	SUPP	SUPP	SUPP	SUPP	SUPP
SEN	None	16,675	3	32	31	1
	SEN	685	4	SUPP	29	SUPP
School type	6th Form College	6,105	2	29	29	0
	Comp/Academy	13,565	3	33	31	2
	FE College	5,490	2	39	24	15
	Independent	2,785	1	SUPP	29	SUPP
	Other	2,355	3	33	27	6
	Selective	1,855	2	30	36	-6
School gender	Boys	SUPP	SUPP	SUPP	SUPP	SUPP
	Girls	1,765	2	39	34	5
	Mixed	29,770	2	32	29	3
Socioeconomic status (SES)	1	7,045	2	37	32	5
	2	7,565	2	30	31	-1
	3	3,485	2	25	28	-3
	4	2,540	3	30	27	3
	5	1,575	2	52	31	21
	6	3,325	2	39	26	13
	7	2,225	3	22	25	-3
	8	SUPP	SUPP	SUPP	SUPP	SUPP
	9	4,090	2	34	27	7
Parent educated to degree level	Yes	13,965	2	33	31	2
	None	14,490	2	34	28	6
	Don't know / refused	3,555	2	28	25	3

Table 19 reports on the numbers achieving a first by CM uptake and subject group. This shows that in the biological science, geographical & environmental sciences, and psychology subject groups CM students were clearly more likely to achieve a first. The differences in the other subject groups were all small.

Table 19: Drop out status (year 1 or year 2) by subject group and Core Maths uptake

Subject group	Taken Core Maths?	N achieving degree in quant subject	N achieving a first	% achieving a first
Biological and sport sciences	No	5,320	1585	30
	Yes	105	40	36
Business & management	No	7,775	2455	32
	Yes	205	65	32
Engineering & technology	No	525	185	36
	Yes	30	10	34
Geographical & environmental sciences	No	2,080	645	31
	Yes	55	20	40
Physical sciences	No	650	255	27
	Yes	15	<10	SUPP
Psychology	No	5,375	1440	39
	Yes	120	30	47
Social sciences	No	8,880	2335	27
	Yes	120	40	25
Combined	No	870	230	26
	Yes	20	<10	SUPP

The results of the regression analysis are reported in Table 20. This shows the parameter estimates (with standard errors in brackets). Statistical significance (at the 5% level) is indicated by an asterisk.

There were three different models. In model 1, only the student level variables were included, model 2 added school level variables, and model 3 excluded the census variables. There were no significant interaction effects between taking CM and other variables in the models.

The results show that there was a positive effect of taking CM on the probability of achieving a first in a quantitative subject. However, this was only statistically significant in model 3, when census variables were omitted. The size of the effect (using the results of model 3) is illustrated in Figure 13 which shows the probabilities for typical[11] CM and non-CM students at different levels of KS5 mean points score.

[11] Typical students in this case were female, attended a comprehensive school, taking a course in biological sciences subject group, parents educated to degree level, in socioeconomic classification group 1, with values of continuous variables equal to the mean. The means for the continuous variables are shown in Table A4 of Appendix A

Table 20: regression parameters for a model predicting the probability of achieving a first in a subject with significant quantitative element (Model 1=student level variables; Model 2=school level variables; Model 3 = excluding census variables, due to missing data)

Effect		**Model 1 (n=17,230)**	**Model 2 (n=17,230)**	**Model 3 (n=31,795)**
Intercept		-0.186 (0.086)*	-0.216 (0.087)*	-0.291 (0.072)*
Taken Core Maths	No			
	Yes	0.206 (0.111)	0.216 (0.111)	0.319 (0.091)*
Gender	Female			
	Male	-0.498 (0.041)*	-0.507 (0.041)*	-0.476 (0.030)*
KS5 points score		0.062 (0.002)*	0.065 (0.003)*	0.053 (0.002)*
IDACI score		-1.204 (0.173)*	-1.290 (0.175)*	
Candidate total qualification size		0.280 (0.039)*	0.264 (0.039)*	0.226 (0.024)*
Ethnic group	White			
	Other	-0.344 (0.150)*	-0.321 (0.150)*	
	Asian	-0.188 (0.070)*	-0.182 (0.069)*	
	Black	-0.760 (0.090)*	-0.735 (0.090)*	
	Chinese	-0.073 (0.284)	-0.052 (0.283)	
	Mixed	-0.318 (0.090)*	-0.299 (0.090)*	
	Unclassified	-0.221 (0.173)	-0.167 (0.172)	
Language	English			
	Other	-0.296 (0.064)*	-0.303 (0.064)*	
	Unclassified	-0.823 (0.351)*	-0.857 (0.358)*	
Socioeconomic status (SES)	1			
	2	-0.022 (0.051)	-0.028 (0.051)	-0.066 (0.038)
	3	-0.158 (0.066)*	-0.170 (0.066)*	-0.163 (0.050)*
	4	-0.250 (0.076)*	-0.255 (0.076)*	-0.217 (0.057)*
	5	-0.034 (0.085)	-0.045 (0.085)	-0.025 (0.066)
	6	-0.201 (0.072)*	-0.219 (0.072)*	-0.309 (0.053)*
	7	-0.221 (0.082)*	-0.234 (0.082)*	-0.328 (0.061)*
	8	-0.106 (0.267)	-0.108 (0.267)	-0.195 (0.199)
	9	-0.173 (0.067)*	-0.181 (0.067)*	-0.233 (0.048)*
Parents educated to degree level	Yes			
	No			-0.078 (0.031)*
	Don't know / refused			-0.246 (0.047)*
Subject group	Biological Sciences			
	Business	0.201 (0.060)*	0.216 (0.060)*	0.183 (0.043)*
	Engineering	0.237 (0.181)	0.258 (0.181)	0.316 (0.106)*
	Geography	-0.219 (0.081)*	-0.207 (0.081)*	-0.090 (0.062)

Effect		Model 1 (n=17,230)	Model 2 (n=17,230)	Model 3 (n=31,795)
	Physical Sciences	0.552 (0.138)*	0.557 (0.138)*	0.371 (0.095)*
	Psychology	-0.468 (0.063)*	-0.467 (0.063)*	-0.379 (0.048)*
	Social Sciences	-0.343 (0.058)*	-0.338 (0.058)*	-0.271 (0.043)*
	Combined	-0.348 (0.118)*	-0.348 (0.118)*	-0.231 (0.089)*
School type	Comp / Academy			
	6th Form College		0.088 (0.179)	-0.278 (0.055)*
	FE College		0.761 (0.582)	-0.673 (0.054)*
	Independent		0.036 (1.331)	-0.046 (0.067)
	Other		-0.184 (0.062)*	-0.225 (0.061)*
	Selective		0.225 (0.070)*	0.205 (0.070)*
Centre KS5 points score			-0.029 (0.005)*	-0.012 (0.004)*

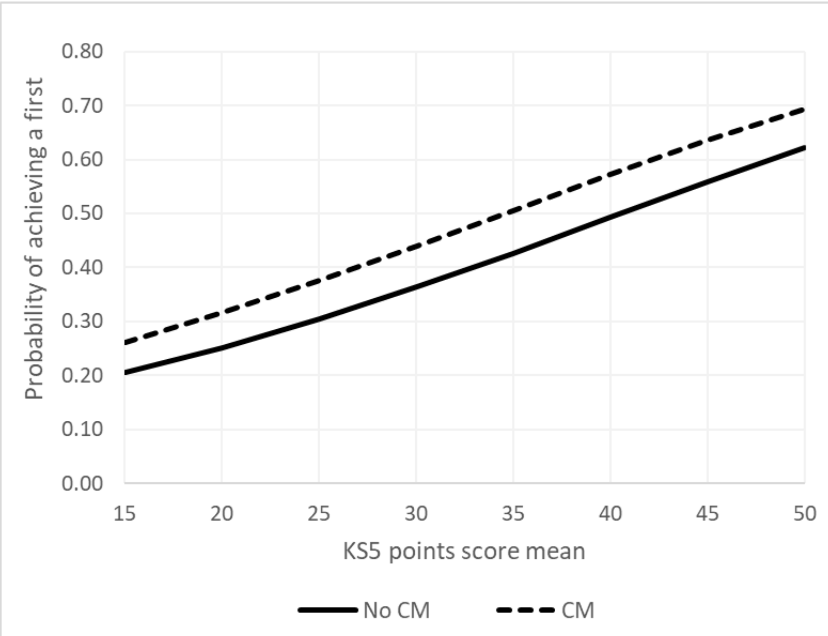

Figure 13: Predicted probabilities of achieving a first by CM uptake and KS5 mean points score (based on model 3).

At the mean value of KS5 points score mean (35.1) CM students had a probability of a first of 0.51, compared with 0.43 for non-CM students.

At least an upper second-class degree

Table 21 shows the overall numbers and percentages of students achieving an upper second-class degree or higher, by CM uptake. This shows that CM students were slightly more likely to achieve at least an upper second (87%) than non-CM students (84%).

Table 21: Upper second-class degree (or higher) status, by Core Maths uptake

Taken Core Maths?	N achieving degree in quant subject	N achieving a first	% achieving a first
No	31,480	26,490	84
Yes	670	580	87

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Table 22 presents the numbers and percentages of students achieving at least an upper second class degree by CM and background characteristics. Some interesting findings were:

- The advantage for CM students was larger for students with SEN (9 percentage points) than for students without (2 pp).
- For students attending 6th form colleges or selective schools, the percentage of students achieving at least an upper second class degree was higher for non-CM students (83% and 93% respectively) than for CM students (78% and 88%). This contrasts with students attending FE colleges where the percentage was much higher for CM students (83%) than non-CM students (75%).
- SES categories 5 ('Lower supervisory & technical occupations') and 6 ('Semi-routine occupations') had the largest differences in favour of CM students (17 pp and 8 pp respectively).
- The advantage for CM students was larger for students with parents not educated to degree level (6 pp) than those with parents with a degree (0 pp)

Table 23 shows the numbers achieving an upper second or higher by CM uptake and subject group. This shows that only in the biological science subject group were CM students clearly more likely to achieve at least an upper second than non-CM students. In contrast, students taking a subject in the geographical and environmental sciences group were more likely to get at least an upper second if they did not take CM (91% v 87%). The differences in the other subject groups were all very small.

Table 22: Students achieving at least an upper second-class degree in a subject with a substantial quantitative element, by Core Maths uptake and background characteristics

Characteristic		**N achieving degree in quant subject**	**% taking CM**	**% CM achieving 2(i) or better**	**% non-CM achieving 2(i) or better**	**Difference in % achieving 2(i) or better**
Gender	Female	20,055	2	91	87	4
	Male	12,090	3	82	80	2
Prior attainment	Low	10,850	3	82	77	5
	Medium	9,545	2	91	86	5
	High	11,585	1	91	89	2
Deprivation	Low	5,745	3	91	90	1
	Medium	5,795	3	91	88	3
	High	5,775	2	85	82	3
Ethnicity	Other	325	3	SUPP	82	SUPP
	Asian	2,330	3	87	83	4
	Black	1,225	2	SUPP	75	SUPP
	Chinese	SUPP	SUPP	SUPP	SUPP	SUPP
	Mixed	810	2	SUPP	85	SUPP
	Unclassified	SUPP	SUPP	SUPP	SUPP	SUPP
	White	12,370	3	91	89	2
Language	English	14,270	3	90	88	2
	Other	3,020	3	83	82	1
	Unknown	SUPP	SUPP	SUPP	SUPP	SUPP
SEN	None	16,675	3	89	87	2
	SEN	685	4	92	83	9
School type	6th Form College	6,105	2	78	83	-5
	Comp/Academy	13,565	3	90	86	4
	FE College	5,490	2	83	75	8
	Independent	2,785	1	SUPP	91	SUPP
	Other	2,355	3	87	83	4
	Selective	1,855	2	88	93	-5
School gender	Boys	SUPP	SUPP	SUPP	SUPP	SUPP
	Girls	1,765	2	94	92	2
	Mixed	29,770	2	86	84	2
Socioeconomic status (SES)	1	7,045	2	90	89	1
	2	7,565	2	89	86	3
	3	3,485	2	90	82	8
	4	2,540	3	88	83	5
	5	1,575	2	100	83	17
	6	3,325	2	88	80	8
	7	2,225	3	72	80	-8
	8	SUPP	SUPP	SUPP	SUPP	SUPP
	9	4,090	2	81	83	-2
Parent educated to degree level	Yes	13,965	2	86	86	0
	None	14,490	2	89	83	6
	Don’t know / refused	3,555	2	82	81	1

Table 23: Upper second-class (or higher) degree status (year 1 or year 2) by subject group and Core Maths uptake

Subject group	Taken Core Maths?	N achieving degree in quant subject	N achieving a 2(i) or better	% achieving a 2(i) or better
Biological sciences	No	5320	1585	79
	Yes	105	40	89
Business & management	No	7775	2455	85
	Yes	205	65	87
Engineering & technology	No	525	185	80
	Yes	30	10	81
Geographical & environmental sciences	No	2080	645	91
	Yes	55	20	87
Physical sciences	No	650	255	85
	Yes	15	<10	SUPP
Psychology	No	5375	1440	87
	Yes	120	30	89
Social sciences	No	8880	2335	84
	Yes	120	40	83
Combined	No	870	230	82
	Yes	20	<10	SUPP

The results of the regression models are shown in Table 24.

In model 1, only the student level variables were included, model 2 added school level variables, and model 3 excluded the census variables.

These results show a significant and positive effect of taking CM on the probability of achieving at least an upper second. This is illustrated in Figure 14 which shows the probabilities for typical[12] students with different levels of KS5 mean points score (using the results of model 2).

The size of the effect was not large: at the mean value of KS5 points score mean (35.1) CM students had a probability of a first of 0.94, compared with 0.92 for non-CM students. For higher values of the KS5 points score mean the probabilities for CM and non-CM students were even closer.

[12] Typical students in this case were female, white, English speaking, attended a comprehensive school, taking a course in biological sciences subject group, parents educated to degree level, in socioeconomic classification group 1, with values of continuous variables equal to the mean. The means for the continuous variables are shown in Table A5 of Appendix A.

Table 24: regression parameters for a model predicting the probability of achieving at least an upper second in a subject with significant quantitative element (Model 1=student level variables; Model 2=school level variables; Model 3 = excluding census variables, due to missing data)

Effect		**Model 1 (n=17,230)**	**Model 2 (n=17,230)**	**Model 3 (n=31,795)**
Intercept		2.432 (0.098)*	2.383 (0.100)*	2.220 (0.077)*
Taken Core Maths	No			
	Yes	0.417 (0.161)*	0.426 (0.160)*	0.350 (0.122)*
Gender	Female			
	Male	-0.556 (0.053)*	-0.560 (0.053)*	-0.522 (0.036)*
KS5 points score		0.053 (0.003)*	0.056 (0.003)*	0.040 (0.002)*
IDACI score		-1.528 (0.205)*	-1.547 (0.206)*	
Candidate total qualification size		0.307 (0.057)*	0.292 (0.057)*	0.226 (0.033)*
Ethnic group	White			
	Other	-0.306 (0.167)*	-0.293 (0.167)	
	Asian	-0.190 (0.085)*	-0.197 (0.085)*	
	Black	-0.765 (0.089)*	-0.748 (0.089)*	
	Chinese	0.945 (0.539)	0.910 (0.539)	
	Mixed	-0.178 (0.111)	-0.172 (0.111)	
	Unclassified	0.019 (0.227)	0.051 (0.227)	
Language	English			
	Other	-0.174 (0.074)*	-0.164 (0.074)*	
	Unclassified	-0.035 (0.355)	0.084 (0.367)	
Socioeconomic status (SES)	1			
	2	0.005 (0.077)	0.006 (0.077)	-0.120 (0.053)*
	3	-0.267 (0.089)*	-0.266 (0.089)*	-0.350 (0.062)*
	4	-0.180 (0.101)	-0.177 (0.101)	-0.216 (0.071)*
	5	-0.125 (0.119)	-0.123 (0.119)	-0.192 (0.084)*
	6	-0.200 (0.093)*	-0.200 (0.093)*	-0.435 (0.064)*
	7	-0.302 (0.103)*	-0.299 (0.103)*	-0.424 (0.072)*
	8	-0.543 (0.287)	-0.536 (0.287)	-0.373 (0.212)
	9	-0.214 (0.091)*	-0.208 (0.091)*	-0.374 (0.061)*
Parents educated to degree level	Yes			
	No			-0.002 (0.038)
	Don’t know / refused			-0.162 (0.055)*
Subject group	Biological Sciences			
	Business	0.541 (0.078)*	0.552 (0.078)*	0.527 (0.051)*
	Engineering	0.076 (0.219)	0.099 (0.220)	0.329 (0.122)*

Effect		Model 1 (n=17,230)	Model 2 (n=17,230)	Model 3 (n=31,795)
	Geography	0.278 (0.121)*	0.287 (0.121)*	0.442 (0.090)*
	Physical Sciences	0.452 (0.207)*	0.459 (0.207)*	0.392 (0.122)*
	Psychology	0.202 (0.085)*	0.200 (0.085)*	0.326 (0.060)*
	Social Sciences	0.059 (0.074)	0.062 (0.074)	0.100 (0.051)*
	Other	0.075 (0.151)	0.089 (0.152)	0.189 (0.103)
School type	Comp / Academy			
	6th Form College		0.131 (0.245)	-0.379 (0.064)*
	FE College		0.310 (0.694)	-0.733 (0.059)*
	Independent		-3.291 (1.340)*	0.185 (0.083)*
	Other		-0.126 (0.075)	-0.187 (0.074)*
	Selective		0.462 (0.112)*	0.463 (0.106)*
Centre KS5 points score			-0.018 (0.007)*	

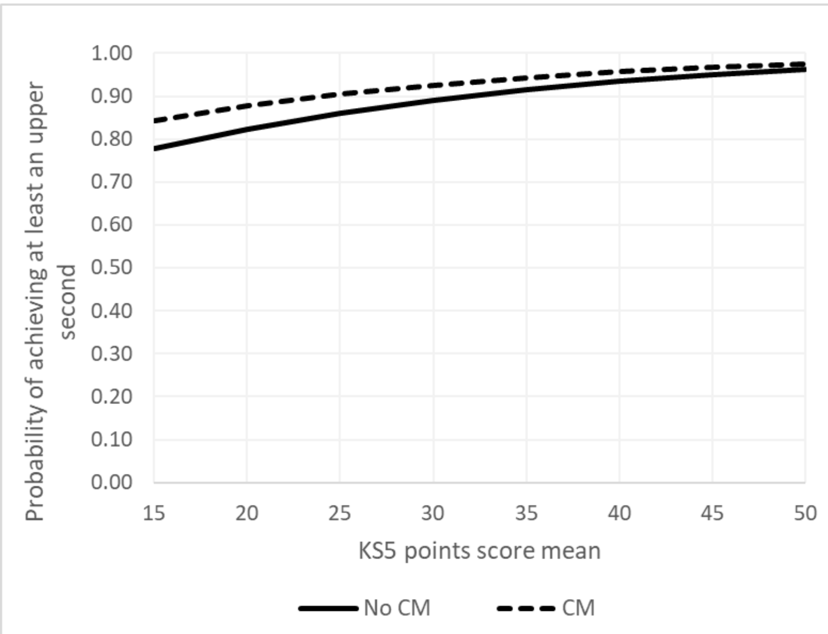

Figure 14: Predicted probabilities of achieving at least an upper second by CM uptake and KS5 mean points score.

Conclusions

The main purpose of the analysis presented in this report was to investigate whether students taking Core Maths were more likely to progress to, less likely to drop out from, and more likely to achieve a good HE degree in subjects with a quantitative element than those not taking the qualification.

We found that students taking CM were significantly more likely to progress to a subject with a quantitative element (probability of 0.49 for a typical CM student compared to 0.39 for a typical non-CM student). This was not surprising as many students will have taken the qualification in the expectation of studying further in a quantitative subject. This finding held across all subject groups apart from social sciences where there was a negative effect of taking CM. This negative effect may be because some of the subjects included in the social sciences category had little or no quantitative element to them (e.g. sociology, politics, social work). This is a drawback of only using high level subject classifications. Further research could use finer subject classifications to investigate whether the negative effect was present across all subjects within this group, or whether there were positive effects of taking CM in subjects with a more quantitative element (e.g., economics).

Some interesting interaction effects were present in some subject groups. In particular, interactions between gender and CM status for biological sciences subjects and psychology subjects, meaning that the effect of CM was only positive for female students. This may be because CM gave female students the mathematical confidence to progress in these subjects, whereas for males the confidence was already present. Previous research has suggested that females tend to be less confident about their own mathematical ability than males (e.g., Smith, 2014). In two other subject groups (physical sciences and business and management) there was a positive interaction between taking CM and KS5 points score mean, meaning that the effect of taking CM was larger for higher ability students.

CM students were significantly less likely to drop out from a quantitative subject, either in year 1 or year 2. However, for both outcome variables (drop out in year 1; drop out in year 1 or year 2), this effect was small. The effect held for most subject groups, with the notable exception of geographical and environmental sciences where CM students were more likely to drop out.

Finally, in terms of degree class achieved, CM students had higher probabilities of achieving a first or at least an upper second-class degree in a quantitative subject. The size of the effect on the probability of achieving a first was not small (0.51 for CM students, 0.43 for non-CM students). However, it was only statistically significant if certain background characteristics (not available for all students) were not controlled for. The effect was much smaller on the probability of achieving at least an upper second (0.94 for CM students, 0.92 for non-CM students), but this is partly because such a high proportion of students achieved this anyway. Perhaps surprisingly, there was no evidence of differences in the effect of taking CM for the different subject groups (i.e. no significant interaction effect between CM and subject group). Again, this may be related to using the high-level subject grouping. Using finer subject classifications instead might have identified significant differences between subjects in the effect of taking CM, perhaps due to their differences in mathematical content. Alternatively, the issue may be that our analysis is limited by the fairly small numbers of CM students taking each individual subject group.

Taken together, these findings suggest that taking CM may be beneficial to students taking a quantitative subject at HE. Students taking CM were less likely to drop out and more likely to achieve a good degree. However, the usual caveat applies here: association does not mean causation. There may be other reasons why CM students were less likely to drop out and more likely to achieve a good degree that were not directly related to taking CM.

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Appendix A

Table A1: Mean values of continuous variables used in regression models (probability of progression)

Variable	Students	Mean
KS5 points score	184,485	33.86
IDACI score	84,945	0.17
Candidate qual total size	185,240	3.21
Centre KS5 points score	184,570	32.15

Table A2: Mean values of continuous variables used in regression models (probability of dropout year 1)

Variable	Students	Mean
KS5 points score	75,095	33.23
IDACI score	36,440	0.17
Candidate qual total size	75,480	3.19
Centre KS5 points score	75,125	32.03

Table A3: Mean values of continuous variables used in regression models (probability of dropout year 1 or year 2)

Variable	Students	Mean
KS5 points score	60,655	33.42
IDACI score	30,865	0.18
Candidate qual total size	60,975	3.26
Centre KS5 points score	60,680	31.94

Table A4: Mean values of continuous variables used in regression models (probability of first)

Variable	Students	Mean
KS5 points score	31,980	35.09
Candidate qual total size	32,150	3.30
Centre KS5 points score	31,990	32.26

Table A5: Mean values of continuous variables used in regression models (probability of at least an upper second)

Variable	Students	Mean
KS5 points score	31,980	35.09
IDACI score	17,315	0.17
Candidate qual total size	32,150	3.30
Centre KS5 points score	31,990	32.26

Appendix B

This appendix presents the full output from all regression models fitted for the analyses of progression to HE in subjects with a quantitative element (by subject group).

Table B1: regression parameters for a model predicting the probability of progressing to a Biological Sciences subject (Model 1=student level variables; Model 2 = school level variables; Model 3 = interactions; Model 4 = excluding census variables, due to missing data)

Effect		Model 1 (n=84,895)	Model 2 (n=84,895)	Model 3 (n=84,895)	Model 4 (n=183,830)
Intercept		-2.812 (0.025)*	-2.805 (0.027)*	-2.814 (0.027)*	-2.882 (0.023)*
Taken Core Maths	No				
	Yes	0.233 (0.080)*	0.241 (0.080)*	0.563 (0.113)*	0.162 (0.065)*
Gender	Female				
	Male	0.714 (0.027)*	0.715 (0.027)*	0.732 (0.028)*	0.747 (0.018)*
KS5 points score		-0.010 (0.001)*	-0.009 (0.001)*	-0.009 (0.001)*	
Ethnic group	White				
	Other	-0.092 (0.106)	-0.089 (0.106)	-0.091 (0.106)	
	Asian	-0.173 (0.053)*	-0.173 (0.053)*	-0.175 (0.053)*	
	Black	0.021 (0.054)	0.023 (0.054)	0.026 (0.054)	
	Chinese	-0.268 (0.255)	-0.262 (0.255)	-0.263 (0.255)	
	Mixed	-0.077 (0.062)	-0.077 (0.062)	-0.073 (0.062)	
	Unclassified	-0.054 (0.118)	-0.049 (0.118)	-0.051 (0.118)	
Language	English				
	Other	-0.237 (0.047)*	-0.241 (0.047)*	-0.241 (0.047)*	
	Unclassified	0.059 (0.183)	0.045 (0.183)	0.041 (0.183)	
SEN status	None				
	SEN, no statement	-0.166 (0.065)*	-0.162 (0.065)*	-0.160 (0.065)*	
	SEN, statement	-0.814 (0.227)*	-0.806 (0.227)*	-0.806 (0.227)*	
School type	Comp/Academy				
	6th Form College		0.071 (0.166)	0.071 (0.166)	-0.052 (0.060)
	FE College		-0.149 (0.444)	-0.149 (0.444)	0.184 (0.046)*
	Independent		1.035 (0.716)	1.035 (0.717)	-0.241 (0.056)*
	Other		-0.172 (0.054)*	-0.168 (0.054)*	-0.189 (0.055)*
	Selective		0.025 (0.066)	0.022 (0.066)	0.011 (0.066)
School gender	Mixed				
	Boys				
	Girls				
Centre KS5 point score			-0.011 (0.004)*	-0.011 (0.004)*	-0.013 (0.003)*
	Female				

Effect		Model 1 (n=84,895)	Model 2 (n=84,895)	Model 3 (n=84,895)	Model 4 (n=183,830)
Taken core maths*Gender	**Male**			-0.564 (0.153)*	

Table B2: regression parameters for a model predicting the probability of progressing to a Psychology subject (Model 1=student level variables; Model 2 = school level variables; Model 3 = interactions; Model 4 = excluding census variables, due to missing data)

Effect		Model 1 (n=84,690)	Model 2 (n=84,690)	Model 3 (n=84,690)	Model 4 (n=183,830)
Intercept		-2.299 (0.019)*	-2.309 (0.02)*	-2.312 (0.02)*	-2.469 (0.016)*
Taken Core Maths	**No**				
	Yes	0.144 (0.091)	0.143 (0.091)	0.252 (0.101)*	0.256 (0.076)*
Gender	**Female**				
	Male	-1.144 (0.036)*	-1.143 (0.036)*	-1.129 (0.037)*	-1.229 (0.027)*
KS5 points score		0.003 (0.001)*	0.004 (0.001)*	0.005 (0.001)*	
IDACI score		0.306 (0.112)*	0.262 (0.113)*	0.262 (0.113)*	
SEN status	**None**				
	SEN, no statement	-0.200 (0.071)*	-0.195 (0.071)*	-0.194 (0.071)*	
	SEN, statement	-0.102 (0.218)	-0.108 (0.218)	-0.109 (0.218)	
Centre KS5 point score			-0.011 (0.004)*	-0.011 (0.004)*	-0.009 (0.003)*
Taken core maths*Gender	**Female**				
	Male			-0.480 (0.225)*	

Table B3: regression parameters for a model predicting the probability of progressing to a Physical Sciences subject (Model 1=student level variables; Model 2 = school level variables; Model 3 = interactions; Model 4 = excluding census variables, due to missing data)

Effect		**Model 1 (n=84,895)**	**Model 2 (n=84,895)**	**Model 3 (n=84,895)**	**Model 4 (n=183,830)**
Intercept		-3.879 (0.040)*	-3.892 (0.043)*	-3.895 (0.043)*	-4.016 (0.035)*
Taken Core Maths	No				
	Yes	0.563 (0.120)*	0.574 (0.119)*	0.676 (0.122)*	0.682 (0.094)*
Gender	Female				
	Male	0.234 (0.047)*	0.233 (0.047)*	0.233 (0.047)*	0.280 (0.033)*
KS5 points score		-0.014 (0.002)*	-0.015 (0.002)*	-0.016 (0.002)*	
Ethnic group	White				
	Other	-0.394 (0.189)*	-0.376 (0.189)*	-0.371 (0.189)*	
	Asian	-0.445 (0.085)*	-0.442 (0.085)*	-0.440 (0.085)*	
	Black	-0.529 (0.109)*	-0.513 (0.109)*	-0.510 (0.109)*	
	Chinese	-0.056 (0.361)	-0.069 (0.361)	-0.063 (0.361)	
	Mixed	-0.378 (0.120)*	-0.374 (0.120)*	-0.374 (0.120)*	
	Unclassified	-0.242 (0.206)	-0.231 (0.206)	-0.232 (0.206)	
Candidate total qualification size		0.166 (0.040)*	0.155 (0.041)*	0.154 (0.041)*	0.100 (0.019)*
School type	Comp/Academy				
	6th Form College		0.278 (0.224)	0.274 (0.223)	0.056 (0.069)
	FE College		-0.776 (0.999)	-0.787 (0.999)	-0.214 (0.063)*
	Independent		-2.906 (7.090)	-2.907 (7.087)	-0.053 (0.067)
	Other		-0.121 (0.084)	-0.118 (0.084)	-0.139 (0.081)
	Selective		0.239 (0.085)*	0.240 (0.085)*	0.222 (0.082)*
Taken core maths*KS5 points score				0.031 (0.012)*	

Table B4: regression parameters for a model predicting the probability of progressing to a Engineering & Technology subject (Model 1=student level variables; Model 2 = school level variables; Model 3 = interactions; Model 4 = excluding census variables, due to missing data)

Effect		Model 1 (n=84,895)	Model 2 (n=84,895)	Model 3 (n=84,895)	Model 4 (n=183,830)
Intercept		-6.446 (0.096)*	-6.558 (0.101)*	-6.541 (0.101)*	-6.322 (0.068)*
Taken Core Maths	No				
	Yes	1.183 (0.132)*	1.142 (0.133)*	0.926 (0.159)*	1.146 (0.087)*
Gender	Female				
	Male	2.050 (0.083)*	2.044 (0.083)*	2.045 (0.083)*	2.302 (0.048)*
KS5 points score		-0.020 (0.003)*	-0.018 (0.003)*	-0.018 (0.003)*	
Ethnic group	White				
	Other	0.840 (0.177)*	0.810 (0.177)*	0.805 (0.177)*	
	Asian	0.573 (0.097)*	0.562 (0.096)*	0.558 (0.096)*	
	Black	0.591 (0.109)*	0.555 (0.109)*	0.552 (0.109)*	
	Chinese	0.862 (0.399)*	0.893 (0.396)*	0.887 (0.396)*	
	Mixed	0.380 (0.135)*	0.364 (0.135)*	0.361 (0.135)*	
	Unclassified	0.234 (0.265)	0.217 (0.264)	0.222 (0.264)	
Candidate total qualification size		-0.173 (0.060)*	-0.164 (0.059)*	-0.158 (0.059)*	0.098 (0.022)*
School type	Comp/Academy				
	6th Form College		0.617 (0.384)	0.617 (0.383)	0.626 (0.119)*
	FE College		-0.114 (1.075)	-0.113 (1.075)	1.323 (0.089)
	Independent		-2.062 (6.471)	-2.072 (6.521)	-0.144 (0.132)
	Other		0.638 (0.123)*	0.623 (0.123)*	0.632 (0.104)*
	Selective		0.168 (0.186)	0.137 (0.186)	0.090 (0.159)
Centre KS5 points score			-0.028 (0.010)*	-0.022 (0.011)*	-0.050 (0.006)*
Taken core maths*KS5 points score				-0.080 (0.029)*	

Table B5: regression parameters for a model predicting the probability of progressing to a Geographical & Environmental Sciences subject (Model 1=student level variables; Model 2 = school level variables; Model 3 = excluding census variables, due to missing data)

Effect		**Model 1 (n=84,690)**	**Model 2 (n=84,690)**	**Model 3 (n=183,755)**
Intercept		-4.256 (0.069)*	-4.258 (0.069)*	-4.858 (0.043)*
Taken Core Maths	No			
	Yes	0.495 (0.172)*	0.499 (0.172)*	0.491 (0.152)*
Gender	Female			
	Male	0.198 (0.064)*	0.196 (0.064)*	0.179 (0.047)*
KS5 points score		0.026 (0.003)*	0.021 (0.003)*	0.018 (0.002)*
Ethnic group	White			
	Other	-1.217 (0.414)*	-1.229 (0.414)*	
	Asian	-0.547 (0.132)*	-0.551 (0.132)*	
	Black	-0.756 (0.191)*	-0.767 (0.191)*	
	Chinese	-1.355 (0.947)	-1.389 (0.946)	
	Mixed	-0.288 (0.156)	-0.303 (0.156)	
	Unclassified	-0.141 (0.275)	-0.164 (0.276)	
IDACI score		-1.905 (0.315)*	-1.723 (0.315)*	
Candidate total qualification size		0.130 (0.056)*	0.124 (0.057)*	-0.097 (0.035)*
Centre KS5 points score			0.039 (0.008)*	0.083 (0.005)*

Table B6: regression parameters for a model predicting the probability of progressing to a Social Sciences subject (Model 1=student level variables; Model 2 = school level variables; Model 3 = excluding census variables, due to missing data)

Effect		**Model 1 (n=84,690)**	**Model 2 (n=84,690)**	**Model 3 (n=183,755)**
Intercept		-2.094 (0.023)*	-2.091 (0.025)*	-1.979 (0.017)*
Taken Core Maths	No			
	Yes	-0.390 (0.085)*	-0.400 (0.086)*	-0.315 (0.069)*
Gender	Female			
	Male	-0.331 (0.025)*	-0.331 (0.025)*	-0.442 (0.017)*
KS5 points score		-0.005 (0.001)*	-0.007 (0.001)*	-0.009 (0.001)*
Ethnic group	White			
	Other	-0.178 (0.085)*	-0.176 (0.085)*	
	Asian	0.017 (0.037)	0.014 (0.037)	
	Black	0.079 (0.045)	0.083 (0.045)	
	Chinese	-0.429 (0.213)*	-0.447 (0.214)*	
	Mixed	0.038 (0.051)	0.035 (0.051)	
	Unclassified	-0.060 (0.098)	-0.067 (0.099)	
SEN status	None			
	SEN, no statement	-0.039 (0.054)	-0.045 (0.054)	
	SEN, statement	-0.457 (0.186)*	-0.439 (0.186)*	
IDACI score		0.485 (0.097)*	0.548 (0.098)*	
Candidate total qualification size		-0.047 (0.022)*	-0.053 (0.022)*	-0.132 (0.012)*
School type	Comp/Academy			
	6th Form College		-0.216 (0.136)	-0.105 (0.040)*
	FE College		-0.251 (0.407)	-0.357 (0.035)*
	Independent		-4.464 (7.290)	-0.101 (0.041)*
	Other		-0.117 (0.043)*	-0.100 (0.041)*
	Selective		0.104 (0.051)*	0.088 (0.048)
Centre KS5 points score			0.008 (0.003)*	0.012 (0.003)*

Table B7: regression parameters for a model predicting the probability of progressing to a Business & Management subject (Model 1=student level variables; Model 2 = school level variables; Model 3 = interactions; Model 4 = excluding census variables, due to missing data)

Effect		**Model 1 (n=84,690)**	**Model 2 (n=84,690)**	**Model 3 (n=84,690)**	**Model 4 (n=183,755)**
Intercept		-2.668 (0.027)*	-2.667 (0.029)*	-2.668 (0.029)*	-2.502 (0.020)*
Taken Core Maths	No				
	Yes	0.179 (0.067)*	0.171 (0.067)*	0.242 (0.074)*	0.144 (0.054)*
Gender	Female				
	Male	0.968 (0.023)*	0.967 (0.023)*	0.967 (0.023)*	0.815 (0.015)*
KS5 points score		-0.015 (0.001)*	-0.014 (0.001)*	-0.015 (0.001)*	-0.012 (0.001)*
Ethnic group	White				
	Other	0.204 (0.077)*	0.203 (0.077)*	0.205 (0.077)*	
	Asian	0.355 (0.040)*	0.357 (0.040)*	0.357 (0.040)*	
	Black	0.389 (0.044)*	0.384 (0.044)*	0.384 (0.044)*	
	Chinese	0.401 (0.162)*	0.410 (0.162)*	0.411 (0.162)*	
	Mixed	0.170 (0.052)*	0.170 (0.052)*	0.170 (0.052)*	
	Unclassified	0.109 (0.099)	0.099 (0.100)	0.098 (0.100)	
Language	English				
	Other	0.417 (0.035)*	0.413 (0.035)*	0.413 (0.035)*	
	Unclassified	0.283 (0.152)	0.293 (0.152)	0.294 (0.152)	
SEN status	None				
	SEN, no statement	-0.197 (0.056)*	-0.195 (0.056)*	-0.195 (0.056)*	
	SEN, statement	-0.592 (0.167)*	-0.606 (0.167)*	-0.607 (0.167)*	
IDACI score		-0.460 (0.104)*	-0.474 (0.104)*	-0.474 (0.104)*	
Candidate total qualification size		-0.173 (0.023)*	-0.169 (0.023)*	-0.170 (0.023)*	-0.199 (0.012)*
School type	Comp/Academy				
	6th Form College		-0.226 (0.157)	-0.230 (0.157)	0.084 (0.053)
	FE College		0.404 (0.338)	0.399 (0.338)	-0.244 (0.043)*
	Independent		0.890 (0.711)	0.891 (0.711)	0.150 (0.039)*
	Other		0.124 (0.046)*	0.125 (0.046)*	0.138 (0.046)*
	Selective		-0.122 (0.057)*	-0.122 (0.057)*	-0.189 (0.058)*
Taken Core Maths*KS5 points score				0.015 (0.007)*	