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# Which students benefit from retaking Mathematics and English GCSEs post-16?

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## Introduction

Following the Wolf Report (Wolf, 2011), the UK Government legislated that from September 2013 all young people who did not achieve a grade C in Mathematics and English General Certificate of Secondary Education (GCSEs) had to continue studying these subjects post-16. Therefore, since 2014, students failing this requirement have continued to work towards achieving these qualifications or an approved interim qualification as a 'stepping stone' towards a GCSE. For some students, reaching the GCSE standard may potentially have required progressive stepping stones, for example, through Functional Skills qualifications, or through Foundation and Higher Free Standing Mathematics Qualifications.

According to a report published by the Policy Exchange in summer 2014 (Porter, 2015), 27% of the cohort who took GCSE English did not achieve a grade C or above (just over 125,000 students) and 31% of the cohort who took GCSE Mathematics did not achieve a grade C or above (just below 180,000 students). These students, who should have retaken English and Mathematics post-16, could also have been studying a variety of different courses. Some could have gone on to study academic courses, such as General Certificate of Education Advanced Subsidiary/Advanced levels (GCE AS/A levels), some could have been following alternative courses at different levels, such as BTECs, Cambridge Nationals, Cambridge Technicals, or vocationally related qualifications, and some might not have taken any other qualification.

Changes to the funding policy for 16–19 students in state-funded schools and colleges (for details, see <https://www.gov.uk/guidance/16-to-19-funding-how-it-works>) and the reform of post-16 accountability

measures (DfE, 2017) are likely to have had an impact on enrolments in these centres and on entries for all types of qualifications in Key Stage 5 (KS5), but in particular for GCSEs in English and Mathematics. The 2015/16 academic year was the first in which it became a condition of colleges' funding that students who had previously achieved a grade D in English or Mathematics should retake the qualification. As a result, the overall number of entries among students aged 17 and over increased (Ofqual, 2016; 2017).

Recently, educational bodies across the sector, for example, The Office for Standards in Education, Children's Services and Skills (Ofsted), (Burke, 2016; Exley, 2016); the Association of Employment and Learning Providers (Martin, 2017); the Association of Colleges (Exley & Belgutay, 2017); the National Association of Head Teachers (NHAT, 2017); and the Learning and Work Institute (Belgutay, 2017) have been calling for a change in the resit policy. Their main reasons for requesting a review of the policy include:

- concerns over the lack of resources across the education system due to the increasing number of students required to retake the qualifications (e.g., insufficient funding; pressure on staff; logistical issues). This is a particular challenge for further education (FE) colleges, where the majority of the students retaking English and Mathematics GCSEs are enrolled;
- the huge numbers of learners aged 17 and older who failed to improve their grades after resitting GCSEs in English and/or Mathematics. In fact, the 2015/16 Ofsted Annual Report (Ofsted, 2016) stated that many students were still not getting at least a grade C by the age of 19;

- having to retake English and/or Mathematics GCSEs again and again until a grade C is achieved can be demotivating for many students and attendance to the lessons can become quite low; and
- for many students, an alternative qualification may be a more appropriate means of improving their English and Mathematics skills and ensuring that they are ready for work or further study. High-quality alternative curricula and qualifications (e.g., Functional Skills) for students aged 16–18 for whom GCSEs are not appropriate have been proposed by some of the educational bodies mentioned.

However, in April 2017, the Education and Skills Funding Agency (ESFA) confirmed that the condition of funding for post-16 institutions for 2017–18 would make resits compulsory for students who obtained a grade 3 or D in either English or Mathematics<sup>1</sup> (ESFA, 2017). Furthermore, the funding regulations stated that all 16 to 18-year-old students with a near pass (previously grade D, now grade 3) in these subjects must continue studying and then resit the GCSE, rather than take an alternative stepping stone qualification. For those students receiving grades lower than a D (and now a grade 3), the option of studying an alternative qualification is available.

The aim of this research was to contribute to the discussion on the English and Mathematics GCSEs resit policy by investigating the uptake of GCSEs in English and Mathematics in post-16 schools and colleges in England, and the types of students who are more likely to improve their grades as a result of resitting the qualifications. In particular, the following research questions were addressed:

1. How many KS5 students take GCSEs in English and/or Mathematics?
2. What grades did students have in their first GCSE attempt in these subjects?
3. Was the GCSE English and/or Mathematics grade obtained in the resit better than in the first attempt?
4. What types of students were more likely to improve their GCSE English and/or Mathematics grade if they resat the qualification in KS5?
5. Does taking GCSE English and/or GCSE Mathematics in KS5 have an effect on students' performance in Level 3 (A level and equivalent) qualifications?

## Data and methodology

The KS5 extract from the 2016 National Pupil Database (NPD) was used in this research. The NPD is a database held by the Department for Education (DfE), consisting of results for all students in all qualifications/subjects in schools and colleges in England, as well as student characteristics such as age and gender. Data from the school census, which is primarily available for students from state-maintained schools, provided information on student characteristics such as ethnicity, special education needs, or level of deprivation.

The analyses carried out focused on 538,707 students who were 17 years-old at the start of the academic year 2015/16 and for whom there were records of qualifications, at any level, taken in 2015 or 2016 (when they were expected to be in Year 12 and 13, in the sixth form).

1. Note that June 2017 saw both the first cohort of students sit the reformed GCSEs (graded 9–1) and the final cohort take resits under the legacy version of the qualifications (graded A\*–C).

It is important to note now that this research did not follow up students who did not achieve grade A\*–C in GCSE English and/or Mathematics at the end of Key Stage 4 (KS4) and investigate their GCSE uptake in KS5. The Policy Exchange (Porter, 2015), Education Datalab (Allen, 2016) and the Department for Education (DfE, 2016) have produced reports looking at GCSE resits in English and/or Mathematics from that point of view.

The statistical methods used to answer the research questions varied from simple descriptive statistics to more robust and sophisticated analyses using propensity scores or regression techniques. In particular, statistical modelling was used to investigate:

- the types of students that were more likely to improve their GCSE English and/or Mathematics grades; and
- the effect of resitting GCSE English and/or Mathematics on students' performance in Level 3 qualifications.

For clarity, we explain the methods and describe their application in each specific context, together with their results, later in the article.

## Results

### Uptake of GCSE English and Mathematics by KS5 students

#### GCSE English

There were 72,995 students who sat GCSE English (English or English Language) during KS5. Of those, 8,382 (11.5%) did not have a record in the NPD of having sat the qualification during KS4 (sessions prior to November 2014). Note that the students considered in this research were in Year 13 in the academic year 2015/16 and that they were counted as taking GCSE in English whilst in KS5 if they sat the examination in the November 2014 session, or in any 2015 or 2016 session (November or June).

Some of the students considered in this research sat the GCSE only once during their KS5 years, but others had multiple attempts. Table 1, showing the distribution of the number of attempts in KS5, indicates that almost 70% of the students only sat the GCSE English once. However, a quarter of the students did so twice, and 7% three or four times.

**Table 1: Distribution of the number of GCSE English attempts in KS5**

No. attempts	No. candidates	% candidates
1	49,780	68.20
2	18,121	24.82
3	4,125	5.65
4	969	1.33

Figure 1 shows the grade achieved in the first attempt by the students who sat GCSE English in KS5 (note that this first attempt might have been at secondary schools during KS4 – Years 10 and 11). As expected, the majority of the candidates did not achieve grades A\*–C in their first attempt at GCSE (only 9.4% of them did so overall). The group of candidates who had not sat the GCSE during KS4 achieved better grades; for example, 3% obtained a grade A\* in their first attempt and 52% achieved grades A\*–C. This contrasts with the percentages for the group that was resitting: only 3.8% and 0.6% achieved grades A\*–C or A\*–B respectively in their first attempt.

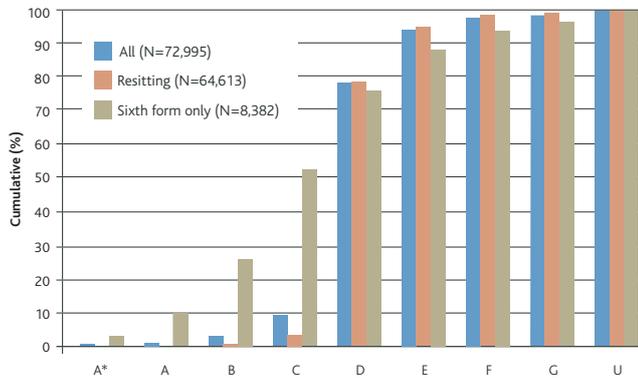


Figure 1: Grade distribution in GCSE English at first attempt

The percentage of candidates, amongst those who had resat the qualification in KS5, who improved their grade was calculated. If a candidate had sat the GCSE in English more than once in school, the best grade was considered as a baseline to calculate the improvement in KS5. More than half of the students (53%) did not improve their grade in GCSE English when they resat the qualification in KS5. Table 2 shows the changes by grade.

Table 2 shows that around 35% of the students with a grade C in GCSE English by the end of KS4 achieved the same grade during KS5, 28% improved their grade and achieved a grade B, and 17% performed worse and achieved a grade D. Overall, 65% of these pupils failed to improve their grade. Similarly, only 46% of the candidates with grade D in GCSE English by the end of KS4 (note that these candidates needed to continue studying English, as they did not achieved grades A\*-C) improved their grade.

### GCSE Mathematics

There were 67,759 students who sat GCSE Mathematics during KS5 (slightly lower than the number of students sitting GCSE English). Of those, 9,615 (14.2%) did not have a record in the NPD of having sat the qualification during KS4 (sessions prior to November 2014). As for GCSE English, the students considered in this research were in Year 13 in the academic year 2015/16, and they were counted as taking GCSE in Mathematics whilst in KS5 if they sat the examination in the November 2014 session or in any 2015 or 2016 session (November or June).

Table 2: Changes in GCSE English grade (best grade in KS4 vs. best grade in KS5)

Best grade in KS4	Best grade in KS5									No. candidates
	A*	A	B	C	D	E	F	G	U	
A*	16.67	33.33	0.00	16.67	16.67	16.67	0.00	0.00	0.00	6
A	35.00	31.67	6.67	15.00	5.00	5.00	0.00	0.00	1.67	60
B	6.19	31.86	36.58	12.98	5.31	0.88	1.18	2.06	2.95	339
C	1.48	6.17	27.54	34.67	17.20	4.17	1.56	4.04	3.17	2,302
D	0.03	0.34	3.95	41.80	27.35	13.19	4.42	3.53	5.39	52,158
E	0.04	0.24	2.08	20.29	29.90	25.45	9.93	4.86	7.21	7,879
F	0.07	0.74	1.19	7.67	18.39	30.68	20.63	8.27	12.36	1,343
G	0.00	0.31	3.09	16.36	14.81	18.21	16.98	13.89	16.36	324
U	0.50	1.49	2.48	14.36	21.29	17.82	12.87	6.44	22.77	202

Table 3, showing the distribution of the number of GCSE Mathematics attempts in KS5, indicates that over 60% of the students only sat the qualification once. However, a quarter of the students did so twice, 9% three times, and just over 4% resat the qualification four times.

Table 3: Distribution of the number of GCSE Mathematics attempts in KS5

No. attempts	No. candidates	% candidates
1	42,579	62.84
2	16,605	24.51
3	5,828	8.60
4	2,747	4.05

Figure 2 shows the grade achieved in the first attempt by the students who sat GCSE Mathematics in KS5 (note that this first attempt might have been at secondary schools during KS4 – Years 10 and 11). As expected, the majority of the candidates did not achieve grade A\*-C in their first attempt at GCSE (only 14% of them did so overall – this percentage is higher than in English though). The group of candidates who had not sat the GCSE during KS4 achieved better grades; for example, 8% obtained a grade A\* in their first attempt and 60% achieved grade A\*-C. This contrasts with the percentages for the group that was resitting: only 6.3% and 1.0% achieved grade A\*-C or A\*-B respectively in their first attempt.

The percentage of candidates, amongst those who had resat the qualification in KS5, who improved their grade was also calculated for GCSE Mathematics. As before, if a candidate had sat the GCSE in Mathematics more than once in school, the best grade was considered as a baseline to calculate the improvement in KS5. Almost 60% of the students did not improve their grade in GCSE Mathematics when they resat the qualification in KS5. Table 4 shows the changes by grade.

Table 4 shows that around 51% of the students with a grade C in GCSE Mathematics by the end of KS4 achieved the same grade during KS5, 31% improved their grade and achieved a grade B, and 13% performed worse and achieved a grade D. Overall, 66% of these students failed to improve their grade. Similarly, just over 40% of the

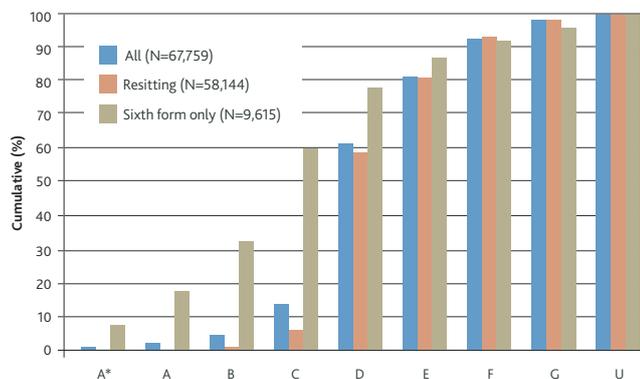


Figure 2: Grade distribution in GCSE Mathematics at first attempt

candidates with grade D in GCSE Mathematics by the end of KS4 (note that these candidates needed to continue studying Mathematics, as they did not achieved grades A\*-C) improved their grade.

### Which students were more likely to improve their GCSE grades in English and Mathematics?

An investigation into the types of students who were more likely to improve their GCSE English/Mathematics grades as a result of resitting during their KS5 years was carried out in this research. In particular, the following candidates' characteristics were looked at: gender, overall attainment at Level 2 (measured by the average KS4 points per entry<sup>2</sup>), type of centre attended, number of attempts in GCSE English/Mathematics during KS5, resitting GCSE Mathematics/English or not, and size of their Level 3 portfolio of qualifications.

Multilevel logistic regression modelling was used as an analytic framework to identify and control for the range of factors already mentioned. Logistic regression is a type of regression analysis that is used when the dependent variable or outcome is a dichotomous variable (i.e., it takes only two values, which usually represent the occurrence or non-occurrence of some event) and the independent variables are continuous, categorical, or both. It is used to predict the probability that the event of interest will occur as a function of the independent variables (see, e.g., Hosmer & Lemeshow, 2000). A multilevel model

2. Here, per entry means per GCSE or equivalent entry.

was proposed due to the hierarchical or clustered structure of the data (students grouped within centres). If we failed to recognise this hierarchical structure, then the standard errors of the regression coefficients would be underestimated, leading to an overstatement of the statistical significance. Detailed discussions of the implementation and outcomes of the multilevel logistic regression can be found in Goldstein (2011).

For the purpose of the analyses presented in this article, the dependent variable for the model was the improvement (or not) of the grade in GCSE English/Mathematics.

The models in this research take the following form:

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \beta_0 + \beta_1 IV1_{ij} + \beta_2 IV2_{ij} + \beta_3 IV3_{ij} + \dots + \beta_k IVk_{ij} + u_j$$

where  $p_{ij}$  is the probability of student  $i$  in centre  $j$  improving their GCSE grade by the end of KS5,  $IV1$  to  $IVk$  are the independent variables,  $\beta_0$  to  $\beta_k$  are the regression coefficients or fixed effects and  $u_j$  is a random variable at centre level which followed a normal distribution with mean zero.

A positive regression coefficient for an independent variable means that the variable increases the probability of the outcome, while a negative regression coefficient means that the variable decreases the probability of the outcome. The size of the coefficient gives an indication of the size of the effect that the variable is having on the probability of the outcome. In particular, a large regression coefficient means that the variable strongly influences the probability of the outcome; while a near-zero regression coefficient means that the variable has little influence on the probability of the outcome. However, it is important to keep in mind the scale of the independent variables when interpreting the regression coefficients (e.g., the variable *percentage of Level 3 qualifications* has a range between 0 and 100, whilst the variable *number of attempts in GCSE English* ranges from 1 to 4).

The results of the regression model for English are presented in Table 5 and the results for Mathematics are presented in Table 6. All the variables were statistically significant predictors of GCSE English and GCSE Mathematics grade improvement. In other words, each of the candidate characteristics displayed a statistically significant association (either positive or negative) with improving the GCSE grade in KS5. A discussion of these associations follows.

Table 4: Changes in GCSE Mathematics grade (best grade in KS4 vs. best grade in KS5)

Best grade in KS4	Best grade in KS5									No. candidates
	A*	A	B	C	D	E	F	G	U	
A*	27.27	0.00	9.09	18.18	18.18	0.00	18.18	0.00	9.09	11
A	52.75	37.36	4.40	2.20	2.20	0.00	0.00	1.10	0.00	91
B	4.62	35.64	46.37	10.89	1.82	0.33	0.00	0.00	0.33	606
C	0.28	1.96	31.37	50.90	13.35	1.62	0.11	0.11	0.28	3,513
D	0.00	0.01	0.29	39.72	33.19	16.62	5.09	2.25	2.82	38,168
E	0.00	0.01	0.15	14.04	29.66	32.09	13.57	5.04	5.45	8,440
F	0.00	0.00	0.02	3.76	14.50	28.48	28.40	15.28	9.56	4,091
G	0.00	0.05	0.05	1.26	5.13	12.98	19.13	30.94	30.46	2,065
U	0.00	0.09	0.09	1.21	2.07	5.44	8.63	20.79	61.69	1,159

## Gender

Gender was a significant predictor of GCSE grade improvement, once the other individual and centre characteristics were accounted for. In particular, female students were more likely to improve their grades in GCSE English than male students. Conversely, male students were more likely to improve their grades in GCSE Mathematics than female students.

## Average KS4 points per entry

Prior performance (e.g., in GCSE and equivalent qualifications) was positively associated to GCSE grade improvement in both English and Mathematics, with students of high prior attainment more likely than students of low attainment to achieve an improvement.

## Centre type<sup>3</sup>

In English and Mathematics, against the baseline of comprehensive schools, candidates in FE colleges were significantly less likely to improve their GCSE grade, once the other candidate characteristics were controlled for. Conversely, candidates in sixth form colleges and schools in the 'Other' category were more likely to improve their grade.

**Table 5: Characteristics of candidates improving their GCSE English grade – regression model results**

Variables		Estimate	Standard Error	p-value
Intercept		-1.196	0.095	<.0001
Gender	Female [Male]	0.121	0.020	<.0001
Average KS4 points per entry		0.059	0.002	<.0001
Centre type	Sixth form college	0.238	0.101	0.018
	Academy (comprehensive)	-0.042	0.060	0.486
	Academy (modern)	0.152	0.157	0.334
	Academy (selective)	-1.168	0.202	<.0001
	FE college	-0.960	0.072	<.0001
	Grammar	0.045	0.659	0.945
	Independent	0.028	0.109	0.798
	Other	0.491	0.161	0.002
	Secondary modern [Comprehensive]	0.250	0.224	0.264
No. of attempts in GCSE English		-0.370	0.012	<.0001
Resitting GCSE Maths	No [Yes]	-0.077	0.021	0.000
Percentage of Level 3 qualifications		0.014	0.000	<.0001

There were some contrasting results for English and Mathematics: Against the baseline of comprehensive schools, candidates in selective academies were less likely to improve their GCSE English grade (no significant effect in Mathematics) than candidates in comprehensive schools. Similarly, candidates in independent schools were more likely to improve their GCSE Mathematics grade (no significant effect in English) than candidates in comprehensive schools.

3. Note that 55% and 47% of the students retaking GCSE English and GCSE Mathematics, respectively, were in FE colleges; around 20% of students in each subject were in comprehensive academies; between 9% and 12% were in sixth form colleges or comprehensive schools; and just below 5% were in independent schools.

**Table 6: Characteristics of candidates improving their GCSE Mathematics grade – regression model results**

Variables		Estimate	Standard Error	p-value
Intercept		0.328	0.089	<.0000
Gender	Female [Male]	-0.270	0.020	<.0001
Average KS4 points per entry		0.026	0.002	<.0001
Centre type	Sixth form college	0.463	0.081	<.0001
	Academy (comprehensive)	-0.007	0.048	0.883
	Academy (modern)	0.029	0.124	0.818
	Academy (selective)	-0.087	0.241	0.717
	FE college	-0.518	0.059	<.0001
	Grammar	-0.441	0.524	0.401
	Independent	0.571	0.093	<.0001
	Other	0.421	0.126	0.001
	Secondary modern [Comprehensive]	0.092	0.172	0.593
No. of attempts in GCSE Maths		-0.341	0.010	<.0001
Resitting GCSE English	No [Yes]	-0.080	0.022	0.000
Percentage of Level 3 qualifications		0.008	0.000	<.0001

Candidates in non-selective academies (comprehensive or secondary modern), secondary modern schools or grammar schools were not significantly more or less likely to improve their GCSE grade in either subject than candidates in comprehensive schools.

## Number of attempts in GCSE English/Mathematics

The probability of improving the grade in GCSE English or in GCSE Mathematics decreased with an increasing number of resits in the subject. Figure 3 shows that, for example, the probability of improving the grade for students with one resit attempt was around 0.72 in English and 0.76 in Mathematics, for those with two attempts decreased to 0.63 in English and 0.69 in Mathematics and, for those with three attempts to 0.55 in English and 0.61 in Mathematics (note that this is for a female student, in a comprehensive school, not resitting both English and Mathematics, with average KS4 prior attainment, and with 40 per cent of their qualifications taken at Level 3). However, it should be noted that the students who resat English and/or Mathematics several times might have been those who struggled the most with these subjects and, therefore, their chances of improving the grade were low.

## Resitting GCSE Mathematics/English

Attempting a resit in GCSE Mathematics as well as resitting GCSE English (or the other way around) was significantly associated with a higher probability of improving the grade. The effect was, however, fairly small (see Tables 5 and 6).

## Percentage of Level 3 qualifications taken alongside

The volume of Level 3 qualifications taken by students resitting a GCSE in English or Mathematics was positively associated with GCSE grade improvement. In particular, Figure 4 shows that students with higher percentages of Level 3 qualifications were more likely than students with lower percentages (or no Level 3 qualifications) to improve their GCSE English and Mathematics grades. As before, we should note that the

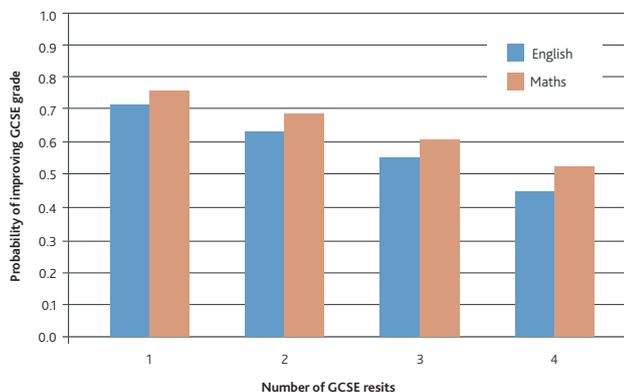


Figure 3: Probability of improving the GCSE grade, by number of resits

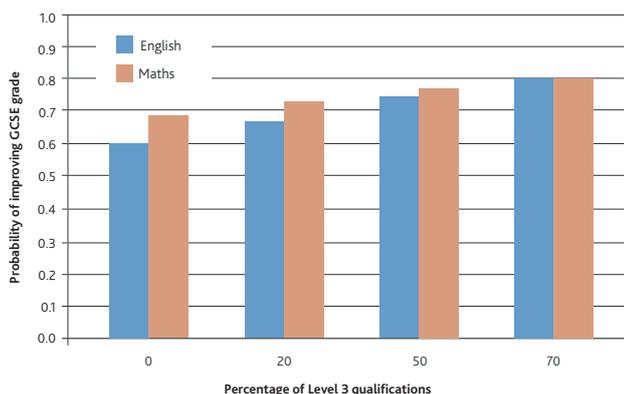


Figure 4: Probability of improving the GCSE grade, by the percentage of Level 3 qualifications

probabilities shown in Figure 4 are for a female student, in a comprehensive school, not resitting both English and Mathematics, with average KS4 prior attainment, and one resitting attempt in the subject. This could be the result of students taking a higher percentage of Level 3 qualifications (e.g., more AS and A levels) perhaps being more academically motivated than those with lower percentages of qualifications at Level 3.

### Effect of resitting GCSE English and/or Mathematics on students' performance at Level 3

This section of the article investigates the effect of resitting GCSE English and/or Mathematics on students' performance at Level 3, which was measured by the total GCE A level and equivalent points score.

A total of 334,655 students (aged 17 at the start of the 2015/16 academic year) were considered for this investigation. These students took, at least, one qualification at Level 3. Just over 13 per cent of them (45,589 students) took GCSE English and/or Mathematics alongside<sup>4</sup>.

In a first step, descriptive analyses were carried out to look at the uptake and performance of Level 3 qualifications for two different groups of students: no resits, resitting GCSE English and/or Mathematics.

Table 7 and Table 8 that follow suggest that uptake and overall performance in Level 3 varies by whether the student resits or not.

Table 7 shows that the total number of Level 3 entries was lower for candidates with resits. In particular, the average number of A level subjects attempted by candidates without resits was two, whilst for those with resits was below one (in fact, looking at those figures, students resitting GCSE English and/or Mathematics did not seem very likely to study AS or A level subjects in KS5).

Table 8, which shows the total GCE A level and equivalent points score for the same groups of students, indicates that there was a

substantial difference in the performance at Level 3. In particular, the difference between students with no resits and those with at least one was just over 40 points. This is equivalent, for example, to an A level at grade B or two AS levels at grades A and C<sup>5</sup>.

Table 7: Uptake of Level 3 qualifications, by resitting behaviour

Level 3 entries at Level 3 <sup>6</sup>	Resitting	Mean	SD	Min	Max
Total entries	No	3.41	0.71	0.17	9.00
	GCSE English and/or Maths	2.61	0.95	0.17	9.00
No. of A levels	No	2.11	1.35	0	7
	GCSE English and/or Maths	0.62	1.08	0	6
No. of AS levels	No	0.91	0.89	0	8
	GCSE English and/or Maths	0.40	0.81	0	9

Table 8: Performance at Level 3 (total GCE A level and equivalent points score), by resitting behaviour

Resitting	Mean	SD	Min	Max
No	117.78	51.83	0.00	510.50
GCSE English and/or Maths	75.48	44.07	0.00	305.00

However, the above descriptive analyses do not account for possible differences in the two groups of students (no resits, resitting English and/or Mathematics) and it is necessary to disentangle the effect of the resits from other confounding factors that are likely to affect, in particular, the students' performance.

Therefore, in the following analyses, background characteristics of the different groups of students are accounted for. In order to do so, propensity scores were used to control for imbalances in the characteristics of the students with the different resitting behaviours (e.g., total number of entries at Level 3, number of A levels, number of AS levels, prior attainment at Level 2, gender, ethnicity, special needs, first language, free school meals eligibility, level of deprivation, and type of centre). Overall, performance at Level 3 is then compared for comparable groups of students resitting and not resitting GCSE English and/or Mathematics alongside Level 3 qualifications.

Previous studies carried out at Cambridge Assessment (e.g., Gill, 2014) have used either nearest neighbour methods or inverse probability weighting to match groups. The main practical difficulty of these methods is that the propensity score must be estimated. Researchers have found that a misspecification of the propensity score model can result in bias of the estimated effects (e.g., Kang & Schafer, 2007; Smith & Todd, 2005). As a consequence, the above strategies do not often achieve the goal of balancing the characteristics of the two groups under consideration. However, recent research by Imai and Ratkovic (2014) suggests that this issue can be addressed by adjusting the way in which the propensity score is produced so that it is deliberately designed to

4. In particular, 25,671 students took GCSE English and 27,272 took GCSE Mathematics.

5. For details on the performance point scores for each qualification see DfE (2017).

6. Note that 'Total entries at Level 3' in Table 7 refers to the total number of GCE A level and equivalent entries. There are Level 3 qualifications that are 'smaller' than an A level and, therefore, the total number of entries at Level 3 can be smaller than one.

achieve balance between the groups even if the underlying model (i.e., the model that captures the relationship between the background characteristics and the group a candidate is assigned to) is not correctly specified. Although this method is relatively robust to model misspecification, its successful application requires identifying a complete set of confounders, which is not always possible.

The covariate balancing propensity score (CBPS) methodology has been implemented in the R package CBPS (Fong, Ratkovic, & Imai, 2014), which has been used in this research. Statistical significance of the differences between the groups of students with the different resitting patterns was assessed using the R package 'survey' (Lumley, 2015). This package allows us to calculate the standard errors of the estimates whilst accounting for the multilevel structure of the data. In particular, a two-level multilevel structure was considered, with students clustered within centres.

Results of the estimates of the average performance at Level 3 for both groups of students (no resits, resitting English and/or Mathematics GCSEs) after the covariate balancing propensity score method was applied to the data in this research are given in Table 9. The difference, together with its standard error, is also reported.

**Table 9: Performance at Level 3 (total GCE A level and equivalent points score), by resitting behaviour - propensity score estimates**

<i>Resitting GCSE English and/or Maths</i>	<i>Level 3 points score</i>
No resits	82.18
At least one resit	75.48
Difference/Standard Error	-6.704/0.4974

Table 9 shows that when only 'comparable' candidates are considered in the analyses there is a statistically significant effect, although small, of resitting GCSE English and/or Mathematics on performance at Level 3. This indicates that the differences observed before the propensity score procedure was carried out (Table 8) were largely due to the different composition of the two groups of students.

In particular, the analyses carried out after the propensity score procedure show that the difference in the performance at Level 3 between candidates with different resitting behaviours was just below seven points, which means that candidates resitting English and/or Mathematics in KS5 obtained on average seven points less than similar candidates not resitting the GCSEs. Although smaller than before (Table 8), this difference is still of practical importance (e.g., the number of points is equivalent to a grade E at AS level and it is just a bit short of a grade E at A level) and, therefore, statistically significant.

An assumption for the propensity score estimates to hold is based on the effectiveness of reducing the covariate imbalance between the two groups of students under consideration. In this research, for each background covariate, the absolute values of the mean differences before and after matching were inspected and showed a good match. Note that the propensity score analysis only controls for cohort characteristics that were put into the analysis. There would have been other confounding factors, such as student motivation, that could bias the results but data was not available for them.

## Summary and conclusions

Good grades (A\*-C) in GCSEs in English and Mathematics are considered the benchmark to which all young people should attain. They are necessary to progress to AS/A level and university, apprenticeships and employment. Without them, students' choices could be reduced. Students who do not get the grades at age 16 can 'remedy' that in KS5.

In this research, there were 72,995 students who sat GCSE English and 67,759 students who sat GCSE Mathematics during their KS5 years. Some of these students only sat the GCSE qualification once during KS5 but others did so multiple times. For example, around 25 per cent of the students in both subjects sat the qualifications twice.

The majority of the students taking English and Mathematics GCSEs during their KS5 years had not achieved a good grade (A\*-C) by the end of KS4. Furthermore, the data showed that 53% of the students taking GCSE English and 60% of those taking GCSE Mathematics did not improve their grade, despite one or more attempts. In fact, many of them obtained lower grades than the first time they took the exams. The shadow education secretary has recently said that a shortage of Mathematics and English teachers in schools and FE colleges may lay behind the failure of many students to improve their grades (Griffiths, 2016). Additionally, Impetus (2017) reported that issues with funding might mean that schools are not dedicating enough time to prepare for the resits and therefore are not giving students the chance to achieve a good grade. NHAT (2017), however, reports that forcing young people to resit the qualifications when so many still fail to improve their grades can be demotivating and disheartening, resulting in further disengagement with the subject and little likelihood of improving their previous performance. Nonetheless, and despite the fact that some students will not improve their GCSE English or Mathematics grades in KS5, even after multiple resit opportunities, there are other students who really value the chance to achieve the grade they need to progress to FE or employment.

In order to investigate which students have better chances to improve their GCSE English or Mathematics grades when resitting the qualifications in KS5, multilevel logistic regression analyses were carried out. The outcomes of the analyses showed that female students were more likely to improve their GCSE English grades than males, whilst the opposite was true for GCSE Mathematics. Students of high prior attainment were more likely than students of low prior attainment to achieve an improvement. This last finding supports research from Impetus (2016) that shows that students from disadvantaged backgrounds, who usually have lower prior attainment than students from more affluent backgrounds, are more likely than middle-class or more wealthy students to leave education at age 19 without achieving a good grade in English and/or Mathematics.

Porter (2015) reported that FE colleges had much higher numbers of students who decided to retake English or Mathematics at GCSE. This could be because students with low achievement in these qualifications might be disengaged from school and keen to move to college, or because schools and sixth form colleges have higher entrance criteria for entering post-16 education, and therefore students with lower grades at GCSE have to move to an alternative type of centre. Another explanation could be that FE colleges usually offer a wider range of qualifications, including at Level 2 and below, than other types of centres. Our research showed that against the baseline of comprehensive schools, students in FE colleges were significantly less likely to improve their GCSE grades.

And, conversely, students in independent schools were more likely to get better grades in their resits than in their first attempt.

The regression analyses also showed that the probability of improving the grade in English or Mathematics decreased with the number of resitting attempts. However, the students with more resits might be those who struggle the most with these subjects and, therefore, their chances of improving the grade are low. Resitting both English and Mathematics was, however, significantly associated with a higher probability of improvement.

The students retaking English and/or Mathematics in KS5 could also be studying a variety of different courses at different levels. This research showed that, students with higher percentages of Level 3 qualifications were more likely than students with lower percentages (or no Level 3 qualifications) to improve their grades. This may be because students who are trying to achieve a higher level qualification are more motivated to get a good grade in their GCSEs than those who are not taking any Level 3 qualification at the same time.

The fact that students take GCSE English and Mathematics in KS5 has an impact on the number of and performance in AS/A levels and other Level 3 qualifications. As expected, this research showed that the total number of Level 3 entries, and in particular the number of AS/A level qualifications, was lower for candidates with resits than for those without resits. There was also a difference in the performance at Level 3 between the group of students who resat English and/or Mathematics and the group of students who did not, even after taking into account students' background characteristics using propensity score matching techniques. Specifically, the difference between students with no resits and those with at least one was just under seven points. This difference, which is statistically significant and of practical importance, is equivalent, for example, to a grade E at AS level.

Although the policy of improving literacy and numeracy levels amongst school children and ensuring that all young people gain 'good' qualifications in English and Mathematics by the age of 19 seems to be a good idea, its implementation has perhaps not had the intended impact in practice. In fact, Ofsted, DfE advisers and other educational bodies have recently questioned the GCSE resits policy in English and Mathematics (e.g., Ofsted 2016; Belgutay, 2017; Martin, 2017; NHAT, 2017; Offord, 2017; Ward, 2017) for a variety of reasons, as discussed in the introductory section of this article. Firstly, schools and colleges might not have the delivery capacity to offer English and/or Mathematics to KS5 students. Secondly, and as shown in this research, the GCSE resits improvement rates continue to be low. Thirdly, there might be more fitting solutions or alternative pathways to enable students' English and Mathematics skills to develop further (e.g., high-quality Functional Skills qualifications or other qualifications relevant to the world of work). The outcomes of this research could add one more reason to consider whether compulsory resitting of English and Mathematics GCSEs for all students with a grade D is the right policy: the fact that the retakes might be hindering the KS5 prospects of some students.

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# How many students will achieve straight grade 9s in reformed GCSEs?

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## Introduction

*"It's difficult to make predictions, especially about the future" (Danish proverb)*

As General Certificate of Secondary Education (GCSE) qualifications are reformed in England, the grading scale is changing from students being awarded grades A\*–G to being awarded grades 9–1, with grade 9 representing the highest grade and also relating to a level of achievement above that of the existing grade A\*. This process began in practice in summer 2017 when Mathematics, English Language, and English Literature GCSEs were awarded on the new grading scale. The majority of subjects with large entries will be switching to the new grading scale as part of awarding in summer 2018 and the remainder will be switching in summer 2019<sup>1</sup>.

This article attempts to predict the number of pupils who will achieve a perfect set of grade 9s in whichever reformed GCSEs they choose to take. This question sprang to prominence in the media in April 2017 when Tim Leunig, the then chief scientific advisor of the Department for Education (DfE), tweeted that he expected only two pupils to achieve grade 9 in all of their GCSEs. This led to contact between the TES and Cambridge Assessment and, subsequently, to the author giving his own alternative view that 'hundreds' of pupils will achieve grade 9 in every GCSE that they take<sup>2</sup>. For the remainder of this article we will refer to this accomplishment as achieving 'straight' grade 9s.

This article gives more details of how such a prediction might be made. As well as the evident interest in this question externally, it may be of substantive importance as it relates to the extent to which reformed GCSEs, and grade 9 in particular, will be able to discriminate between the very highest performing students.

Since making the original forecast of 'hundreds' of pupils to achieve straight grade 9s in April 2017, more information about attainment in reformed GCSEs has been published by both The Office of Qualifications and Examination Regulation (Ofqual)<sup>3</sup> and the DfE<sup>4</sup>. Naturally, this article makes use of this later information but the rationale is the same as for the earlier predictions. Note that, at the time of writing, the latest national pupil level data available to the author dates from summer 2016.

One method of making the prediction would be to retrospectively set the grade 9 boundary in all existing GCSEs using the formula used to

define how many should achieve grade 9 in each subject (see Benton, 2016). It would then be a simple task to just count how many pupils actually attained notional grade 9s in all of the GCSEs they had entered. However, it was not possible to access the raw marks achieved by pupils on a national level, and the techniques employed in this article are entirely based upon data regarding the grades achieved by pupils.

## Some simple methods of estimation

To begin with, we consider a very simple way to estimate the number of pupils who will achieve straight grade 9s to illustrate how it might be possible to reach a prediction of around two pupils. The first step is to consider the number of students who achieved straight grade A\* in all of their GCSEs historically. Based on Gill (2017), who provides numbers based on students taking at least 5 GCSEs in June 2015, this value might be taken to be 3,300. Next, using an early proposal for the definition of grade 9 (Ofqual, 2014, p.20), we might assume that in every GCSE, around half of those awarded grade A\* would be awarded grade 9. Thus, we might assume that, amongst those achieving straight grade A\*s, half of these would fail to achieve grade 9 in the first GCSE we consider. This leaves just 1,650 candidates. Applying the same idea to the second GCSE again reduces the number by half to 825 pupils. If we continue with this process of halving the values until we reach 10 GCSEs, then we end up with a prediction of just 3 pupils to achieve straight grade 9s.

However, there are a number of flaws in the above calculation. Firstly, in each subject, the percentage of candidates who will be awarded grade 9 as a percentage of those who would have been awarded grade A\* is a little higher than 50 per cent. It varies between subjects, as the percentage who will be awarded grade 9 is tied to the percentage historically awarded grade A or above rather than A\* (see Benton, 2016).

1. <https://www.gov.uk/government/publications/get-the-facts-gcse-and-a-level-reform/get-the-facts-as-and-a-level-reform>

2. <https://www.tes.com/news/school-news/breaking-news/exclusive-major-exam-board-predicts-hundreds-will-get-straight-grade>

3. <https://www.gov.uk/government/news/guide-to-gcse-results-for-england-2017>

4. <https://www.gov.uk/government/statistics/revised-gcse-and-equivalent-results-in-england-2016-to-2017>