English Education: World Class?

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Foreword

Much debate about education in England focuses on how well our education system is performing, in terms of measures of student progress and attainment.

But it is difficult to assess properly England's education system without comparing it fairly and meaningfully to that of other comparable countries. Unfortunately, such comparisons are not always easy to make, and how well England is performing has remained highly contested territory in political and educational debate.

An accurate understanding of what it would mean for England to have a 'world class' education system becomes even more important as the government introduces new GCSE exams with a new grading system, explicitly designed to set a 'world class standard'. When the new system is in place, it is likely that the proportion of pupils achieving the government's key measure of GCSE success will plunge by around 20 per cent – unless the government waters down its ambition to raise the benchmark for what constitutes a robust pass (from a grade C under the old system to a grade 5 under the reformed system).

This EPI report helps inform these key debates by assessing what a world class standard really looks like in key subjects – translating international PISA data into GCSE equivalents. We then look at how England, parts of England, and other parts of the UK measure up against this world class benchmark.

Later this year we will publish further reports, drawing international comparisons about the size of the gaps between disadvantaged pupils and their peers, and about performance in primary education.

This will eventually allow us to benchmark England across a small range of key indicators, rather than on average GCSE equivalent attainment alone. To compare education systems fairly, we may be interested in the spread of attainment, for example, as well as in the average attainment.

EPI is very grateful to Dr John Jerrim of the Institute of Education for his work on this project. We are also grateful to the Department for Education for allowing us to use the relevant datasets.

As ever, we very much welcome comment on this report.

Rt. Hon. David Laws

Executive Chairman, Education Policy Institute

Executive summary

Over the last decade, England's performance in maths and reading in the OECD's Programme for International Student Assessment (PISA) has remained average, and its ranking among other developed countries has stagnated. England now ranks 24 out of 40 countries in maths and 17 in reading.[1] Given the focus and investment in education under successive governments over the past twenty years, the inability of England to rise up these global rankings and compete with world leading countries may be considered by policy makers as disappointing.

The standards of education in England will also be brought into sharp focus this year when, for the first time, pupils receive their results in new, more challenging, maths and English GCSEs. The new GCSEs will be scored under a numerical 9-1 framework. Over time, the existing A*-G grading system is being phased out for all subjects.

In this report, we conduct two new pieces of analysis. First, we use the latest international assessment data from PISA to identify the five highest performing nations in maths, reading, and science, and consider the extent to which England needs to improve in order to catch up with these top performers. We translate the results into GCSE grades (under both the existing and new systems), so that the world class benchmark is measurable using the English qualifications framework.

Second, we look at how well different parts of the country are performing against this benchmark: comparing local authority areas, areas under each of the eight Regional Schools Commissioners, and the Department for Education's twelve Opportunity Areas.

Finally, we look at the variation in performance across the devolved nations, considering what this means for the level of improvement needed in each home nation in order to compete with the highest performing countries.

Our findings

In order to match the top five performing countries in maths and reading (English Language), pupils in England will need to score an average of a grade 5 under the new 9-1 GCSE framework.[2]

The guidance from the Department for Education states that the new grade 5 represents a 'strong pass' – our analysis finds that this has been set at broadly the right level to be considered as reaching a world class standard.

The required improvement in maths is significantly greater than in reading (English Language). In maths, the biggest challenge appears to be reducing the number of low attaining pupils (those failing to secure a grade C or higher under the existing grading structure).

The average of the top five countries in maths (Singapore, Hong Kong, Macao, Taiwan, and Japan) is currently equivalent to a GCSE point score of 5.4. **The average in England is currently 4.7 – meaning**

[1] This includes the 35 OECD countries and 5 further high performing countries.
[2] The average of maths and reading is 5.15 but we round to the nearest whole number.

that there needs to be an increase of around two-thirds of a GCSE grade, on average, in order to match the top-performing countries.

Under the current system, this means that England needs to increase the number of top performing pupils (those securing an A*-B grade) by over a third and almost halve the number of low performing pupils (those failing to secure a C grade or higher) in maths.

This means that around 96,000 additional pupils need to score an A*-B in maths and the number of low performing pupils needs to fall by 60,000.

The average of the top five countries in reading (Singapore, Hong Kong, Canada, Finland, and the Republic of Ireland) is currently equivalent to a GCSE point score of 4.9. The average GCSE score in England is only slightly lower, at 4.7.

In order to match the average performance of the top five countries in reading, England needs to increase the number of top performing pupils (those securing an A*-B grade) by a sixth and reduce the number of low performing pupils (those failing to secure a C grade or higher), by just under a quarter.

This means that around 42,000 additional pupils would need to score an A*-B in English. The number of low performing pupils also needs to fall by around 42,000.[3]

Half of pupils in England should be scoring a total of 50 points or higher across Attainment 8 subjects in order to match the top performing nations.

As our analysis finds that the world class benchmark in maths and reading (English Language) is equivalent to around a new grade 5, by applying the same criteria to all other Attainment 8 subjects, the total score that the system should be aiming for is 50 (under the new scoring criteria which is starting to be introduced from August 2017).[4] Because we are looking at the level of attainment that England would need to reach to be on par with the average of the highest performing countries, **this suggests that a credible goal is for around 50 per cent of pupils to be achieving 50 points or more across Attainment 8 subjects.**

Currently, only 40 per cent of pupils in England achieve this world class benchmark.

While almost 60 per cent of pupils in England achieved the old measure of 5 A*-C grades (including English and maths), only 39.5 per cent of pupils achieved 50 points or more in Attainment 8 subjects in 2016. **In order to be on a par with the highest performing countries, the proportion of pupils achieving 50 plus points across Attainment 8 subjects needs to increase by over a quarter. This equates to around 60,000 additional pupils.**

[3] By comparison, published statistics show that 158,000 pupils achieved a D grade or lower (including missed or pending results) in GCSE English in 2016: https://www.gov.uk/government/statistics/revised-gcse-and-equivalent-results-in-england-2015-to-2016.

[4] Mathematics and English are double weighted in the attainment 8 calculation. This means we multiply our proposed floor target in each subject (five) by the number of attainment 8 subjects after doubling the value of mathematics and English (ten) to generate a value of 50.

However, performance across England is variable. In London, 45 per cent of pupils achieved the world class benchmark, while fewer than a third achieved it in other parts of the country.

Of the 150 local authority areas in England with results at GCSE, only 14 exceed the benchmark of half of pupils achieving 50 points or more across Attainment 8 subjects. Most of these high performing areas are academically selective – meaning that the performance in these areas is skewed by the selection of high attaining pupils. In some local authority areas, including the Isle of Wight, Knowsley, Blackpool, and Nottingham, the proportion is just over a quarter. Not surprisingly, attainment is particularly low in the government's Opportunity Areas. Here, on average, less than a third of pupils achieved the benchmark in 2016.

The other UK nations also need to improve significantly – particularly Wales.

We also consider how well UK nations perform, compared to our five world leading countries in mathematics and reading. **Scotland and Northern Ireland are only just behind England in terms of the proportion of pupils achieving an A*-B (44 and 43 per cent respectively) in maths. Wales, however, is distinctly lower, at 38 per cent.**

This means that, **in order to compete with the highest performing countries, Scotland and Northern Ireland would each need to improve the proportion of high attaining pupils in maths by over a third, while Wales would need to improve further still – by over a half.**

All of the UK nations need to reduce considerably the proportion of low attaining pupils (those failing to secure a grade C). **Wales needs to halve the proportion of low attaining pupils (from 28 to 14 per cent), while the required reduction in Scotland and Northern Ireland is just under half (from 24 per cent to 14 per cent) – similar to the reduction required in England in maths.**

Conclusion

The findings from this new analysis make clear that England's education system needs to improve significantly if it is to be on par with the leading countries in maths and reading. In particular, England (and indeed the other UK nations) needs to focus on the lowest attaining pupils – who are over-represented in the UK compared to world leading nations.

Once again, the variation in performance across England and the UK is a cause for concern for policy-makers. London continues to outperform the rest of the country against these new world class measures.

The Education Policy Institute will continue to monitor performance against these measures in both England and the wider UK. Later this year, we will expand this work to consider world class benchmarks in primary attainment and in closing the socio-economic attainment gap.

Introduction

In 2000, the Organisation for Economic and Co-Operative Development (OECD) undertook the first in a series of international benchmarking tests, the Programme for International Student Assessment (PISA).

Taking place every three years, PISA assesses 15 year olds from OECD and other participant countries and economies in mathematics, reading and science. In the latest PISA study, conducted in December 2015, 72 countries and economies participated – including all 35 OECD countries and 37 partner countries and economies.

Since the inception of PISA almost two decades ago, England's performance has remained at around average in mathematics and reading and just above average in science. As England's performance has stagnated (particularly in reading and science), countries from a variety of starting points and with a range of historical contexts, such as Poland, Portugal, Norway, and Germany, have shown marked improvements in at least one of the assessment areas.[5] There is arguably, therefore, scope for education standards in England to improve so that young people in this country are able to compete with their peers in educational terms.

In the first section of this report, we match the PISA 2015 performance data with that of English pupils who then went on to take their GCSEs in 2016. We then consider how well pupils in England are performing, compared to the highest performing nations in maths, reading and science. This enables us to identify a new world class benchmark which, if met, would place England amongst those top performing nations.

In the second section of this report, we go on to consider how well different geographical areas and different groups of pupils in England are performing against this new world class benchmark. This updates the Education Policy Institute's reports last year: 'Education in England: Progress and Goals' and 'Education in England: Annual Report 2016'.

This report focuses on identifying and monitoring a world class benchmark for secondary pupils only. Later this year, we will publish similar analysis which will identify world class benchmarks for primary pupils and for the socio-economic gap in attainment.

[5] OECD (2016), 'PISA Results 2015: Volume I', December 2016.

Part 1: Calculating a world class benchmark

We have used the PISA dataset, linked to the National Pupil Database (NPD), to assess how well pupils in England who sat the PISA tests then went on to perform in their GCSEs. We then simulate how the distribution of GCSE grades would need to change in order for England's performance in international assessments to start matching the world's leading countries.

Identifying the world leading countries

We have defined the 'world leading countries' as the **top five highest attaining in each of mathematics, reading, and science as measured by PISA 2015**.

It is important to recognise, however, that there are multiple outcomes from education systems, and that those at the very top of international league tables (i.e. the countries that we focus upon in this report) may also have some other undesirable features in terms of pupils' performance. For instance, although a country may have high average scores, there may also be large socio-economic disparities in achievement.

To help policy makers consider this issue, Figure 1.1 compares England to a group of countries across a range of indicators to establish the strengths and weaknesses of each education system in terms of pupils' outcomes (focusing upon mathematics). The red shading indicates a statistically significant worse performance than England, while blue shading indicates a significantly better performance. The * indicates significantly different from England at the five percent level.

Figure 1.1: Key indicators across OECD and participant economies

Country	Average TIMSS maths score	Average PISA maths score	Average PISA reading score	Gap between highest and lowest achievers	Gap between lowest achievers and median	Socio-economic gap
Singapore	618*	564*	535*	247	135	98*
Hong Kong	615*	548*	527*	232	127	52*
Macao	-	544*	509*	204*	107 *	34*
Taiwan	597*	542*	497	266*	144*	94
Japan	593*	532*	516*	227*	120	79
China	-	531*	494	276*	150*	117*
South Korea	608*	524*	517*	258*	137	92
Switzerland	-	521*	492	247	132	91
Estonia	-	520*	519*	209*	106*	68
Canada	-	516*	527*	227*	117*	67*
Netherlands	530*	512*	503	237	127	79
Denmark	539	511*	500	209*	108*	69
Finland	535*	511*	526*	210*	110*	73
Slovenia	520*	510*	505	228*	118	73
Belgium	546	507*	499	255	138	104*
Germany	522*	506*	509*	230*	119	89
Poland	535*	504*	506	226*	114*	79
Ireland	547	504*	521*	206*	105*	76
Norway	549	502*	513*	219*	113*	67*
Austria	-	497	485*	247	130	89
New Zealand	491*	495	509*	238	122	88
Sweden	519*	494	500	233	120	89
Australia	517*	494	503	242	124	85
England	546	493	500	245	129	80
France	488*	493	499	249	134	110*
Northern Ireland	570*	493	497	204*	108*	75
Czech Republic	528*	492	487*	235	121	107*
Portugal	541	492	498	249	129	97*
Scotland	-	491	493	219*	110*	75
Italy	507*	490	485*	241	123	78
Iceland	-	488	482*	241	122	62*
Spain	505*	486*	496	220*	115*	83
Luxembourg	-	486*	481*	244	123	111*
Latvia	-	482*	488*	200*	101*	67*
Wales	-	478*	477*	201*	101*	52
Hungary	529*	477*	470*	246	128	114*
Slovak Republic	498*	475*	453*	247	130	95
Israel	-	470*	479*	269*	141*	91
United States	539	470*	497	230*	115*	86
Greece	-	454*	467*	234	119	78
Chile	459*	423*	459*	221*	109*	95
Turkey	483*	420*	428*	212*	100*	59*
Mexico	-	408*	423*	193*	96*	56*

We plan to take this analysis further by identifying world class benchmarks in terms of attainment at primary (looking at the Trends in International Maths and Science Study) and minimising socio-economic disparities and raising the attainment of the most disadvantaged groups. However, in this report, our goal is to establish what a world class benchmark looks like in terms of England's average results in national examination measures. Our focus here is therefore solely on countries with the highest average scores in mathematics, reading, and science.

The five top-performing countries in each subject are:

Mathematics: (England average PISA score = 493)

- Singapore (average PISA score = 564)
- Hong Kong (548)
- Macao (544)
- Taiwan (542)
- Japan (532)

Reading in national first language: (England average PISA score = 500)

- Singapore (average PISA score = 535)
- Hong Kong (527)
- Canada (527)
- Finland (526)
- Republic of Ireland (521)

Science : (England average PISA score = 512)

- Singapore (average PISA score = 556)
- Japan (538)
- Estonia (534)
- Taiwan (532)
- Finland (531)

Data

We use the data from the most recent PISA cycle in 2015, when a total of 72 countries participated. While PISA 2000 to 2012 were all paper-based tests, computer-based assessment was used in PISA 2015 for the first time. Rather than assessing pupils' knowledge of national curricula, PISA attempts to capture how well young people can apply reading, science, and mathematics skills in real-world situations.

A two-stage sample design was used to collect the data. Schools were first sampled with probability proportional to size, and then pupils randomly selected from within. A total of 5,194 pupils from 206 schools in England participated in PISA 2015, which reflects official response rates of 92 percent at the school level and 88 percent at the pupil level.[6] These are high response rates for a social survey conducted in England, with the sample consequently looking similar to the national population in

[6] School-level response rates in England were 83 percent before replacement schools were included and 92 percent after. See Appendix A for further discussion of this issue.

terms of a range of variables. [7] This is similar to the response rates achieved in most other countries, and is fully compliant with the standards set by the OECD. In England, almost every participating pupil is within the same year group (Year 11), which is not the case in most other countries, due to variable school starting dates and the use of grade repetition.[8] Further details on the comparison of GCSE grades for the PISA 2015 sample for England compared to the national grade distribution based upon data from all Year 11 pupils is provided in Annex A. Throughout our analysis, we apply the final pupil response weights to take into account the complex PISA survey design.

The PISA 2015 sample for England has been linked to the National Pupil Database (NPD), which includes administrative data on pupils' backgrounds along with their performance on national examinations. Critically, this includes pupils' GCSE grades. A successful link has been made for 4,914 pupils (95 percent of the sample).[9] The total number of pupils with valid information on GCSE mathematics grades is 4,778 pupils (92 percent of the sample) and 4,735 pupils (91 percent of the original sample) for English Language grades.

Although in this project we are attempting to benchmark GCSEs against the PISA study, it is important to recognise that these two assessments differ in non-trivial ways. First, whereas GCSEs measure pupils' knowledge, understanding, and application of material taught within national curricula, PISA focuses more upon the application of skills in real-world situations. Importantly, there is no writing component in PISA equivalent to this aspect of the English GCSE. Second, previous analysis of the PISA test questions found that they typically require a greater amount of reading than GCSE examinations, particularly in science.[10] Third, the tests are taken around six months apart, with Year 11 pupils first taking PISA in November/December 2015 and then sitting their GCSEs in May/June 2016. Fourth, whereas GCSEs continue to be implemented using pen and paper, PISA 2015 was a computer-based assessment. Finally, GCSEs are a high-stakes test for pupils and schools, who have a great deal riding upon the results. This is not the case for PISA, which is a low-stakes test, with the results having little direct impact on pupils or schools.

The main implication of these differences is that, although PISA scores and GCSE grades will be positively correlated, it is unlikely that there will be an exact relationship. Indeed, previous research has suggested that demographic groups perform differently across the two assessments.[11] There will consequently be an element of uncertainty in our results, and the benchmarks we set for England to become a world leading PISA country. Nevertheless, given that PISA scores and GCSE grades

[7] See Appendix B of Jerrim, J. and Shure, N. 'Achievement of 15-Year-Olds in England: PISA 2015 National Report., 2016'

[8] PISA draws an age-based sample, meaning all pupils are around age 15/16 at the time of the assessment. In England, the timing of the assessment means almost all the selected pupils are within Year 11. However, in other countries, pupils of this age are spread across different school year groups.

[9] Independent school pupils were less likely to have linked GCSE data than state school pupils. Although the high overall linkage rate should mean that this has only a relatively minor impact upon our results, the multiple imputation methodology we shall describe in the following section should further limit any potential bias due to linkage not being possible.

[10] G. Ruddock, T. Clausen-May,C. Purple and R. Ager, Validation Study of the PISA 2000, PISA 2003 and TIMSS-2003 International Studies of Pupil Attainment (DfES Research Report 772). Slough: NFER, 2016

[11] J. Jerrim and G. Wyness, 'Benchmarking London in the PISA Rankings', February 2016.

correlated at around 0.7 to 0.8 our results provide reasonably good approximations as to how England's PISA scores are likely to change for a given increase in GCSE grades. [12]

A full explanation of the method used to simulate the distribution of GCSE scores in high performing countries is included in Annex B.

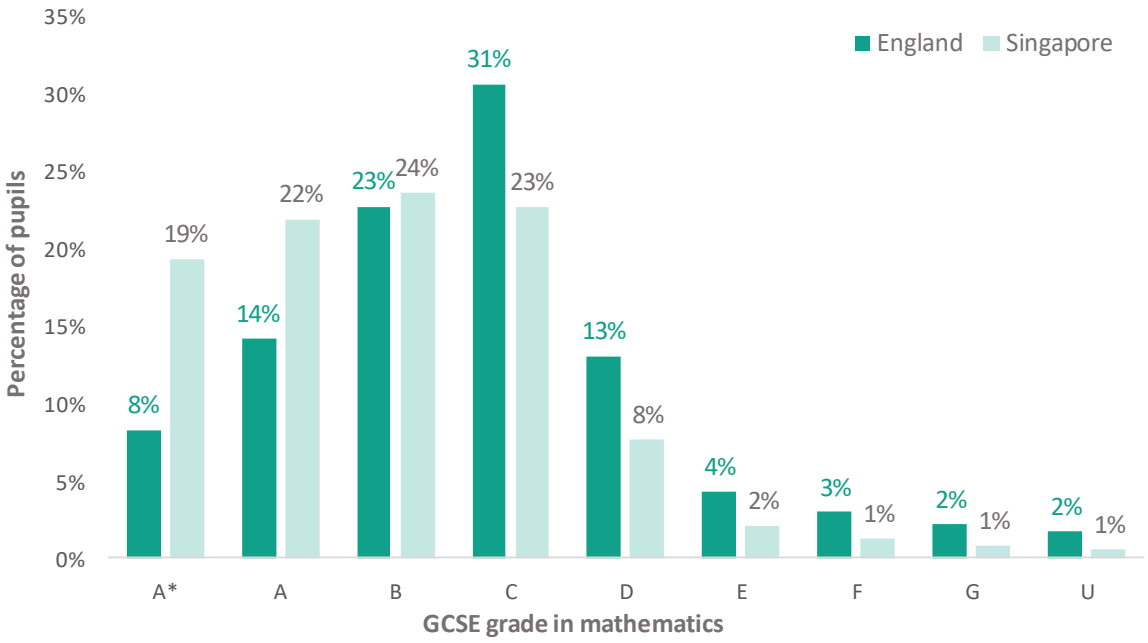
Results

Our results are presented as a series of graphs, comparing the GCSE grades of pupils in England to the estimated distribution in each of the comparator countries. These are provided for each of the three subject areas (mathematics, reading, and science).

Mathematics

The top performing PISA nations in mathematics are (in order): Singapore, Hong Kong, Macao, Taiwan, and Japan. Figure 1.2 below compares the distribution of GCSE grades in England with the highest performing nation in maths, Singapore. This illustrates that, to match Singapore's performance in PISA mathematics, England needs to reduce significantly its long tail of under achievement, while simultaneously increasing the proportion of pupils reaching the top grades. For instance, while England has around 22 percent of pupils achieving an A or A* in GCSE mathematics, we predict that the analogous figure in Singapore would be approximately 41 percent. Likewise, the proportion of pupils failing to achieve a grade C would need to fall by half, from 24 per cent down to 12 per cent. Together, this demonstrates that a pronounced change in GCSE mathematics performance is likely to be needed in order for England to catch up with the leading East Asian nations in mathematics.

Figure 1.2: Distribution of GCSE scores in mathematics in England and Singapore (simulated)



[12] The correlation of PISA scores and GCSE grades relates to the author's own calculations

Figure 1.3 shows the simulated grade distribution in all five of the high performing countries. The table highlights the relatively low proportion of high performers in England and the large proportion of those failing to secure a grade C.

In the highest performing countries, 61 per cent of pupils secure the equivalent of an A*-B grade (compared to 45 per cent in England) in maths while only 14 per cent fail to secure the equivalent of a C grade or higher (compared to 24 per cent in England).

In order to match the average performance of the top five countries in maths, England needs to increase the number of top performing pupils (those securing an A*-B grade) by just over a third (from 45 per cent to 61 per cent) and almost halve the number of low performing pupils (those failing to secure a C grade or higher, from 24 per cent to 14 per cent).

This means that around 96,000 additional pupils need to score an A*-B in maths and the number of low performing pupils also needs to fall by 60,000.[13]

Figure 1.3: Distribution percentage of pupils' GCSE scores in mathematics in England and the top five performing countries (simulated)

Grade	England	Singapore	Hong Kong	Macao	Taiwan	Japan	Top 5 Ave.
A*	8	19	16	14	16	13	16
A	14	22	20	20	20	19	20
B	23	24	26	26	23	25	25
Total percentage achieving A* - B grades	45	65	62	60	59	57	61
C	31	23	25	27	25	28	26
D	13	7	8	8	9	9	8
E	4	2	3	2	3	3	3
F	3	1	2	1	2	2	2
G	2	1	1	1	1	1	1
U	2	1	1	1	1	1	1
Total percentage achieving D - U grades	24	12	15	13	16	16	14

With the introduction of new numeric GCSE grades in 2017 for mathematics and English Language, with other subjects following suit in future years, it is important that we consider how these results translate into the new national metrics. Figure 1.4 illustrates the percentage of pupils who need to achieve new GCSE grades 1, 2 or 3 (broadly equivalent to the old alphabetic D, E, F and G grades), 4, 5 and 6 (equivalent to the old B and C grades) and 7, 8 and 9 (equivalent to A* and A). We have also

[13] By comparison, published statistics show that 231,000 pupils achieved an A*-B in GCSE (or equivalent) mathematics in 2016 and 171,000 pupils achieved a D grade or lower (including missing or pending results): https://www.gov.uk/government/statistics/revised-gcse-and-equivalent-results-in-england-2015-to-2016.

created an average numeric GCSE score for each country, following official guidance on the conversion between the old alphabetic and new numeric grades.[14] Figure 1.4 suggests that **over a third of pupils in England will need to achieve a grade of 7 or above to equal the standard of mathematics in the leading East Asian countries, while less than a sixth would fail to reach at least grade four. Put differently, the average mathematics grade in England will need to increase by around two-thirds of a GCSE grade – from 4.7 to 5.4 to match the standards set in these world leading countries.**[15]

[14] This implies the following rules. U = 0; G = 1; F = 1.5; E = 2; D = 3; C = 4; B = 5.5; A = 7; A* = 8.5. (see Department for Education 2016: 3

[15] Due to the way in which Ofqual are converting old alphabetic grades into new numerical scores, there could be some ceiling effects on our estimates of the average points score needed. Specifically, a maximum score of 8.5 is being assigned to an A*, while a maximum score of 9 points will be assigned to grade 9 under the new numeric system. In reference to this analysis, this means the top Singaporean students will be assigned a score of 8.5 for their predicted A* GCSE grade, when in reality some of these children should receive a score of 9. This may mean we are slightly underestimating the average mathematics grades in the very top performing countries – and that we are therefore actually reporting a lower bound.

Figure 1.4: The distribution of (simulated) GCSE grades in mathematics using the new numeric system

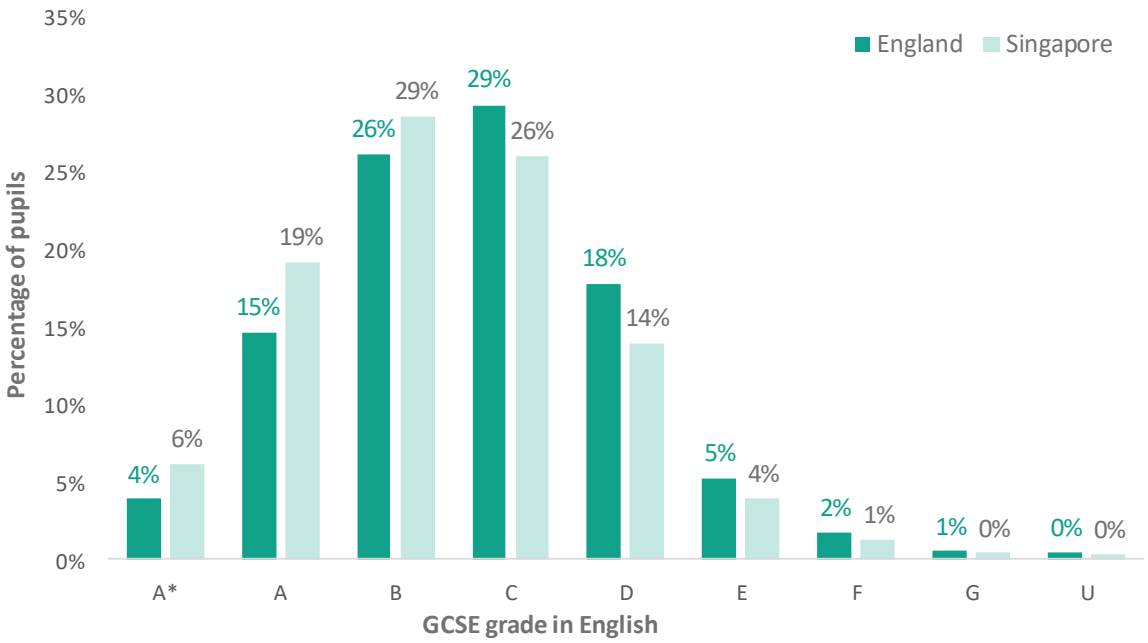
	%U	% 1/2/3	% 4/5/6	% 7/8/9	Average grade
Singapore	1	12	47	41	5.68
Hong Kong	1	13	51	35	5.45
Macao	1	13	53	34	5.4
Taiwan	1	15	48	36	5.41
Japan	1	15	53	32	5.26
China	1	17	49	33	5.23
South Korea	1	17	51	30	5.14
Switzerland	1	17	53	29	5.09
Estonia	1	17	56	26	5.05
Canada	1	18	54	27	5.02
Netherlands	1	19	53	27	4.99
Denmark	1	18	57	25	4.95
Finland	1	18	56	25	4.95
Slovenia	1	19	54	26	4.93
Belgium	1	20	53	26	4.9
Germany	1	20	55	24	4.86
Poland	1	20	55	24	4.86
Ireland	1	20	57	23	4.84
Norway	1	21	56	22	4.79
Austria	2	22	53	23	4.77
New Zealand	2	22	54	22	4.71
Sweden	2	22	55	22	4.72
Australia	2	23	53	23	4.71
England	2	22	53	22	4.72
France	2	23	53	23	4.72
Czech Republic	2	23	53	22	4.69
Portugal	2	23	53	22	4.69
Italy	2	24	53	22	4.65
Iceland	2	24	53	21	4.64
Spain	2	23	56	19	4.59
Luxembourg	2	24	54	21	4.61
Latvia	1	24	56	18	4.51
Hungary	2	26	53	19	4.47
Slovak Republic	2	26	53	19	4.47
Israel	3	28	51	19	4.41
United States	2	27	54	17	4.39
Greece	3	31	52	15	4.19
Chile	4	37	50	9	3.76
Turkey	4	37	49	9	3.72
Mexico	5	41	48	6	3.53

English Language

We now turn to English Language GCSE outcomes. The top performing countries in this subject are: Singapore, Hong Kong, Canada, Finland and the Republic of Ireland.

As Figure 1.5 shows, at most grades the difference between England and Singapore is smaller in reading than it is in mathematics.

Figure 1.5: Distribution of GCSE scores in reading in England and Singapore (simulated)



England's relatively good performance in this subject is also demonstrated in Figure 1.6 (former alphabetic grading system) and Figure 1.7 (conversion into the new reformed numeric grades).

We find that the improvement needed in English is slightly less than in maths.

In the highest performing countries, 52 per cent of pupils secure the equivalent of an A*-B grade (compared to 45 per cent in England) while only 19 per cent fail to secure the equivalent of a C grade or higher (compared to 26 per cent in England).

In order to match the average performance of the top five countries in reading, England needs to increase the number of top performing pupils (those securing an A*-B grade) by a just under a sixth (from 45 per cent to 52 per cent) and reduce the number of low performing pupils (those failing to secure a C grade or higher), by just over a quarter (from 26 per cent to 19 per cent).

This means that around 42,000 additional pupils would need to score an A*-B in English. The number of low performing pupils also needs to fall by 42,000.[16]

[16] By comparison, published statistics show that 219,000 pupils achieved an A*-B in GCSE English or equivalent and 158,000 pupils achieved a D grade or lower (including missed or pending results in GCSE English in 2016: https://www.gov.uk/government/statistics/revised-gcse-and-equivalent-results-in-england-2015-to-2016.

When we convert this onto the new, numerical system, **we estimate that the average English Language GCSE grade needs to increase from around 4.7 to 4.9 for England to become a world leading country in this particular subject area.**

Figure 1.6: Distribution of percentage of pupils' GCSE scores in reading in England and the top five performing countries (simulated)

Grade	England	Singapore	Hong Kong	Canada	Finland	Republic of Ireland	Top 5 Ave.
A*	4	6	5	5	5	5	5
A	15	19	18	18	18	17	18
B	26	29	30	29	29	29	29
Total percentage achieving A* - B grades	45	54	53	52	52	51	52
C	29	26	29	28	28	29	28
D	18	13	14	14	14	15	14
E	5	4	4	4	4	4	4
F	2	1	1	1	1	1	1
G	1	0	0	0	0	0	0
U	0	0	0	0	0	0	0
Total percentage achieving D - U grades	26	18	19	19	19	20	19

Table 1.7 The distribution of (simulated) GCSE grades in English Language using the new numeric system

	%U	% 1/2/3	% 4/5/6	% 7/8/9	Average grade
Singapore	0	19	56	25	5.01
Hong Kong	0	19	58	23	4.93
Canada	0	20	57	23	4.94
Finland	0	20	57	23	4.94
Ireland	0	20	58	22	4.88
Estonia	0	21	58	21	4.85
South Korea	0	22	56	22	4.82
Japan	0	22	57	21	4.83
Norway	0	22	56	21	4.81
New Zealand	0	25	54	21	4.75
Germany	1	24	56	20	4.76
Macao	0	22	58	19	4.74
Poland	0	23	57	19	4.72
Slovenia	0	24	56	19	4.72
Netherlands	0	25	56	19	4.7
Australia	1	25	55	19	4.71
Sweden	0	25	55	19	4.67
Denmark	0	25	57	18	4.64
England	0	25	56	19	4.65
France	1	26	53	20	4.65
Belgium	0	25	55	19	4.66
Portugal	0	25	56	18	4.66
Taiwan	0	25	57	18	4.64
United States	1	26	55	19	4.64
Spain	1	25	57	18	4.62
China	1	27	54	19	4.6
Switzerland	1	26	56	18	4.58
Latvia	0	27	57	16	4.53
Czech Republic	1	28	54	17	4.53
Austria	1	28	55	17	4.53
Italy	1	27	56	17	4.54
Iceland	1	29	55	16	4.47
Luxembourg	1	29	53	17	4.49
Israel	1	30	52	17	4.48
Hungary	1	31	54	14	4.35
Greece	1	32	53	14	4.33
Chile	1	33	54	12	4.23
Slovak Republic	1	34	52	13	4.21
Turkey	1	40	51	8	3.93
Mexico	1	41	50	8	3.89

Science

The top five performing countries in this subject are Singapore, Japan, Estonia, Taiwan and Finland. The results for science are presented in Figure 1.8. As pupils can take a range of qualifications in science we consider outcomes in terms of points in those qualifications (where 8 is equivalent to an A*) rather than a grade in a single GCSE. The points measure performance within the qualifications taken which fulfil the science criteria of the English Baccalaureate.[17]

Figure 1.8: Distribution of percentage of pupils' GCSE scores in science in England and the top five performing countries (simulated)

EBacc Pillar points	England	Singapore	Japan	Estonia	Taiwan	Finland	Top 5 Ave.
8	4	8	5	5	6	5	6
7.5	3	4	3	3	3	3	3
7	8	12	10	9	9	9	10
6.5	6	7	7	7	7	7	7
6.0	14	16	16	16	16	15	16
5.5	9	9	10	10	10	10	10
5	16	15	17	17	16	16	16
Total achieving 5 points or higher	60	71	68	67	67	65	68
4.5	8	7	8	8	8	8	8
Below 4.5	30	22	24	24	26	26	24
Total achieving 4.5 points or below	38	29	32	32	34	34	32

Consistent with previous research, we find that modest improvement is needed at the top end of the science achievement distribution in England.[18] There needs to be an increase of over a quarter in the proportion of pupils achieving seven EBacc pillar points and above in science for England to catch up with the highest performing countries. The proportion of pupils achieving 5 points (or a 'strong pass') or higher needs to increase by just over an eighth for England to match the average of the highest performing countries (an increase of 48,000 pupils).

The more pressing issue facing England in science is to improve the skills of the lowest achieving pupils. In particular, Figure 1.8 indicates that **England needs to reduce the proportion of pupils within an EBacc science points score below 4.5 by just under a sixth (a reduction of around 36,000 pupils) to perform on a par with the top five countries in PISA science.**

Attainment 8

As one of the main aggregate measures of school performance, it is worth considering what the results above might imply for an approximate Attainment 8 benchmark. Together, Figure 1.4 and

[17] These are core and additional science, double award science and biology, chemistry and physics.
[18] J. Jerrim and N. Shure, PISA 2015 National Report for England, 2016, https://www.gov.uk/government/publications/pisa-2015-national-report-for-england

Figure 1.7 indicate that for England to be amongst the world's top performers, the average grade in English will need to be 4.9. The average in mathematics needs to be 5.4.

This suggests that the benchmark for average attainment levels in England for English and mathematics should be set at the new grade 5 (i.e. a 'strong pass'). If we apply the same criteria to all other Attainment 8 subjects (i.e. that an average grade 5 becomes the aim for every subject) this then implies that the average Attainment 8 score that the system should be aiming for is 50 (under the new scoring criteria which is being introduced gradually from August 2017).[19] Because we are looking at the level of attainment that England would need to reach to be on a par with the average of the highest performing countries, **we consider that a credible aim is for around 50 per cent of pupils to be achieving 50 points or more across Attainment 8 subjects.**

[19] Mathematics and English are double weighted in the Attainment 8 calculation. This means we multiply our proposed floor target in each subject (5) by the number of Attainment 8 subjects after doubling the value of mathematics and English (to 10) to generate a value of 50.

Part 2: England's performance against a world class benchmark

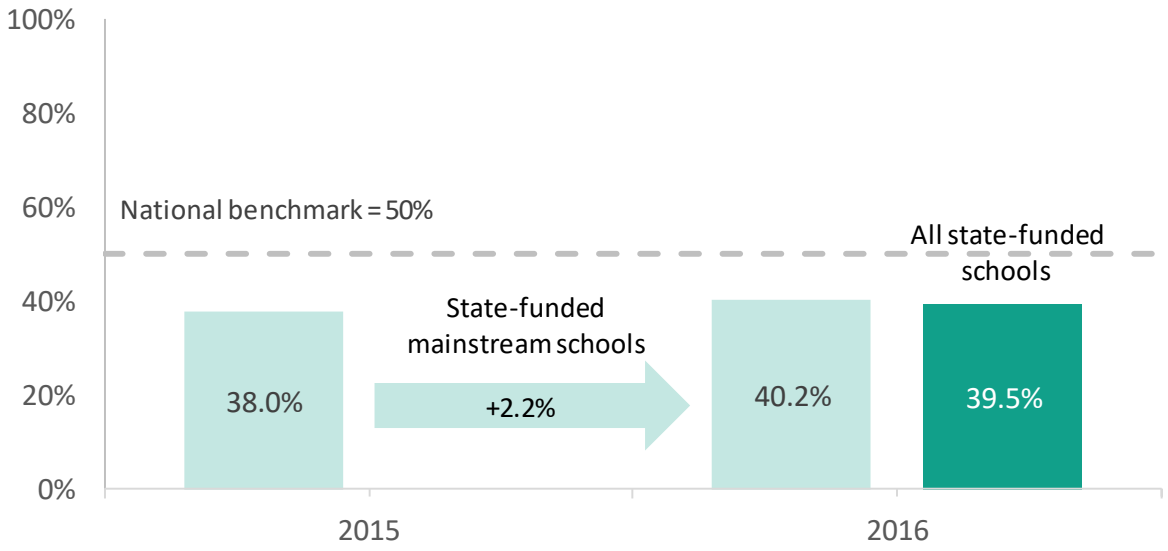
This section examines how well England is performing against our world class benchmark of 50 per cent of pupils to achieving 50 points or more across Attainment 8 subjects. As well as looking at England overall, we also look at different geographical areas, including: a breakdown of the 150 local authority areas;[20] areas covered by the eight different Regional Schools Commissioners; and the 12 Opportunity Areas selected by the Department for Education for targeted intervention.

Overall performance in England

In 2016, 39.5 per cent of pupils achieved the equivalent of 50 points across Attainment 8 subjects. These figures are based on the attainment of pupils in all state-funded schools. We have previously reported the 2015 result as 38.0 per cent.[21] This figure was for state-funded mainstream schools only. On a like-for-like basis the 2016 result represents a 2.2 percentage point increase on 2015.

This analysis highlights that the percentage of pupils achieving our world class benchmark, using the new, higher threshold for a good pass, will be lower than those achieving the expected level under the previous system. Nearly 60 per cent of pupils were achieving the previous standard of five GCSEs at grades A*-C, including English and mathematics, and this falls to just under 40 per cent under the new system. **In order to be on a par with the highest performing countries, the proportion of pupils achieving 50 plus points across Attainment 8 subjects needs to increase by just over 10 percentage points. This equates to around 60,000 additional pupils.**

Figure 2.1: Percentage of secondary school pupils meeting our benchmark



[20] Excludes the Isles of Scilly and City of London.

[21] N. Perera and M. Treadaway 'Education in England: Annual Report 2016', April 2016.

Performance by local authority area

Figure 2.2 shows the proportion of pupils that achieved 50 points or more across Attainment 8 subjects by local authority area, and the map in Figure 2.3 plots relative performance between areas.[22] We find that:

- There were 14 local authority areas that exceeded the benchmark of half of pupils achieving 50 points or more across Attainment 8 subjects;
- The highest performing local authority areas were Richmond-upon-Thames, Kingston-upon-Thames, and Wokingham;
- London continues to maintain its relatively high performance. Overall, 45 per cent of pupils in London met the world class benchmark. Nearly all local authority areas in London were relatively high performing and 9 of the 14 authorities that exceeded the benchmark of 50 per cent are in London.
- The majority of local authority areas (136) did not exceed the benchmark of half of pupils achieving 50 points or more across Attainment 8 subjects;
- Of those local authority areas that were below the benchmark, 12 authorities were within 5 percentage points of it;
- However, 8 authorities were more than 20 percentage points below the benchmark. In the lowest performing areas – Isle of Wight, Knowsley, Blackpool, and Nottingham – just over a quarter of pupils achieved 50 points or more across Attainment 8 subjects. In other words, the number of pupils achieving the benchmark in these lowest performing areas would need to double in order for them to meet our benchmark.

When interpreting these findings, it important to note that 36 local authorities include at least one selective school. Ten of these local authorities (Bexley, Buckinghamshire, Kent, Lincolnshire, Medway, Slough, Southend-on-Sea, Torbay, Trafford, and Sutton) are defined as 'wholly-selective', while the remaining 26 are defined as 'partially-selective'. The tables highlight those local authorities which are either wholly or partially-selective.

[22] This analysis is based on pupils that are resident in each local authority area rather than pupils that attend schools in each local authority area."

Figure 2.2: Performance at the end of secondary school by local authority area - part 1 of 2[23]

Rank	Local authority (WS/PS= wholly/partially selective)	Percentage of pupils achieving 50+ points
78	Barking and Dagenham	38.7
4	Barnet (PS)	54.9
123	Barnsley	33.7
18	Bath and North East Somerset	47.7
85	Bedford	38.3
33	Bexley (WS)	43.4
112	Birmingham (PS)	34.9
62	Blackburn with Darwen	40.4
148	Blackpool	25.9
102	Bolton	36.0
68	Bournemouth (PS)	39.7
76	Bracknell Forest	38.8
132	Bradford	32.2
39	Brent	42.8
55	Brighton and Hove	41.1
125	Bristol City of	32.7
6	Bromley (PS)	53.8
7	Buckinghamshire (WS)	52.6
43	Bury	42.3
54	Calderdale (PS)	41.2
40	Cambridgeshire	42.6
47	Camden	42.1
84	Central Bedfordshire	38.6
30	Cheshire East	44.4
29	Cheshire West and Chester	44.5
82	Cornwall	38.6
120	Coventry	34.2
64	Croydon	40.1
115	Cumbria (PS)	34.7
111	Darlington	34.9
141	Derby	30.5
97	Derbyshire	36.5
56	Devon (PS)	41.1
136	Doncaster	31.8
72	Dorset	39.4
135	Dudley	31.9
79	Durham	38.7
20	Ealing	47.0

Rank	Local authority (WS/PS= wholly/partially selective)	Percentage of pupils achieving 50+ points
60	East Riding of Yorkshire	40.6
69	East Sussex	39.5
50	Enfield (PS)	41.6
63	Essex (PS)	40.2
99	Gateshead	36.3
28	Gloucestershire (PS)	44.6
61	Greenwich	40.5
27	Hackney	44.7
91	Halton	37.3
23	Hammersmith and Fulham	45.6
44	Hampshire	42.3
41	Haringey	42.6
14	Harrow	50.5
146	Hartlepool	29.1
87	Havering	38.1
98	Herefordshire	36.4
21	Hertfordshire	46.6
26	Hillingdon	45.1
31	Hounslow	44.4
150	Isle of Wight	25.4
49	Islington	42.0
8	Kensington and Chelsea	52.5
53	Kent (WS)	41.3
145	Kingston upon Hull City of	29.7
2	Kingston upon Thames (PS)	57.8
93	Kirklees (PS)	37.0
149	Knowsley	25.7
65	Lambeth	40.1
75	Lancashire (PS)	39.0
95	Leeds	36.9
126	Leicester	32.7
83	Leicestershire	38.6
74	Lewisham	39.1
94	Lincolnshire (WS)	36.9
133	Liverpool (PS)	32.2
116	Luton	34.6
134	Manchester	32.1
80	Medway (WS)	38.7

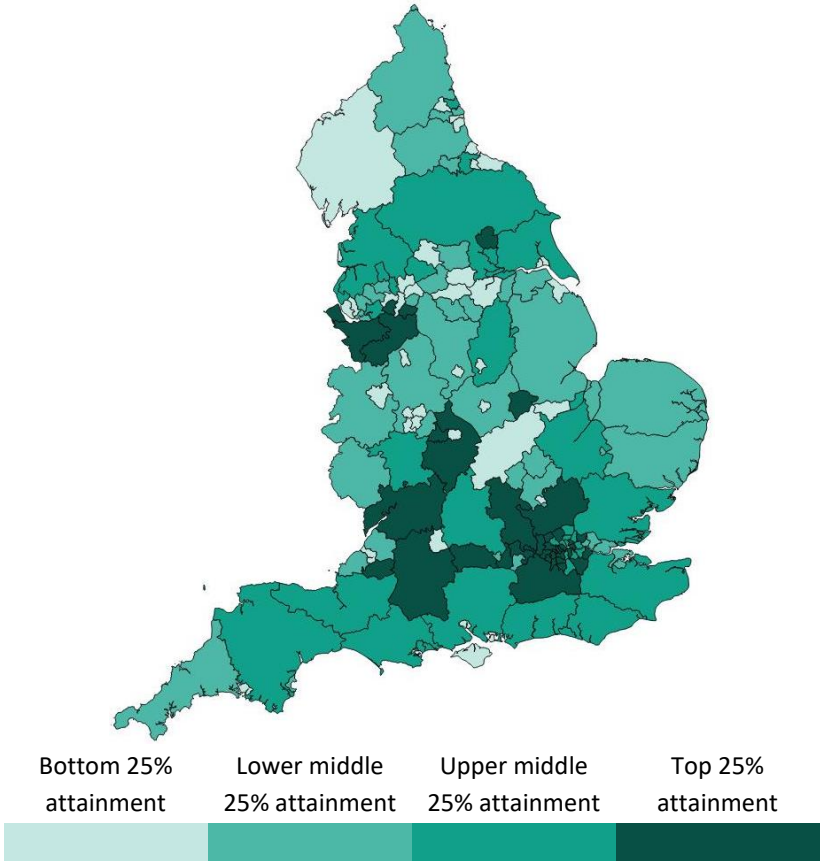
[23] Results from new GCSEs will use a scale of 1 to 9, with 9 being the top grade. 2020 will be the first year that all results will be reported according to this new scale. Between 2017 and 2019, scores for legacy GCSEs will be based on an interim scale which converts alphabetical grades into numbers from 1 to 8.5. Our analysis is based on this interim points scale.

Figure 2.2: Performance at the end of secondary school by local authority area - part 2 of 2

Rank	Local authority (WS/PS= wholly/partially selective)	Percentage of pupils achieving 50+ points
12	Merton	51.2
130	Middlesbrough	32.3
88	Milton Keynes	37.8
119	Newcastle upon Tyne	34.3
58	Newham	41.0
104	Norfolk	35.8
128	North East Lincolnshire	32.4
106	North Lincolnshire	35.6
86	North Somerset	38.2
42	North Tyneside	42.5
45	North Yorkshire (PS)	42.3
117	Northamptonshire	34.6
108	Northumberland	35.5
147	Nottingham	26.9
59	Nottinghamshire	40.9
144	Oldham	29.8
52	Oxfordshire	41.4
138	Peterborough	31.1
137	Plymouth (PS)	31.7
46	Poole (PS)	42.1
139	Portsmouth	30.6
105	Reading (PS)	35.6
13	Redbridge (PS)	51.1
122	Redcar and Cleveland	34.0
1	Richmond upon Thames	62.3
118	Rochdale	34.6
107	Rotherham	35.6
11	Rutland	51.6
143	Salford	29.8
142	Sandwell	30.3
71	Sefton	39.4
103	Sheffield	35.8
81	Shropshire	38.7
37	Slough (WS)	42.9
22	Solihull	46.0
67	Somerset	39.9
96	South Gloucestershire	36.8
100	South Tyneside	36.3

Rank	Local authority (WS/PS= wholly/partially selective)	Percentage of pupils achieving 50+ points
129	Southampton	32.3
73	Southend-on-Sea (WS)	39.3
35	Southwark	43.4
101	St. Helens	36.2
89	Staffordshire	37.7
24	Stockport	45.5
66	Stockton-on-Tees	40.0
140	Stoke-on-Trent (PS)	30.6
109	Suffolk	35.4
127	Sunderland	32.6
16	Surrey	49.2
9	Sutton (WS)	52.4
121	Swindon	34.1
92	Tameside	37.1
114	Telford and Wrekin (PS)	34.8
110	Thurrock	35.0
90	Torbay (WS)	37.3
34	Tower Hamlets	43.4
5	Trafford (WS)	54.4
113	Wakefield	34.9
131	Walsall (PS)	32.3
51	Waltham Forest	41.6
17	Wandsworth	49.2
70	Warrington	39.4
32	Warwickshire (PS)	43.6
25	West Berkshire	45.2
57	West Sussex	41.1
15	Westminster	49.9
77	Wigan	38.8
38	Wiltshire (PS)	42.8
10	Windsor and Maidenhead	52.3
36	Wirral (PS)	43.0
3	Wokingham	55.0
124	Wolverhampton (PS)	33.2
48	Worcestershire	42.0
19	York	47.6

Figure 2.3: Relative performance at the end of secondary school by local authority area



Performance by Regional Schools Commissioner region

In 2014 the Department for Education introduced eight Regional Schools Commissioners (RSCs), primarily as part of the academies and free schools programmes. The RSCs are split across eight regions, as shown in Figure 2.4 below.

The RSCs have a range of responsibilities, including intervening in under performing academies and free schools; supporting the development of academy sponsors and taking action to improve poorly performing sponsors; considering applications from local authority schools to convert to academy status; advising on new free schools; and brokering support for underperforming local authority schools.

Figure 2.4: Coverage of the RSCs

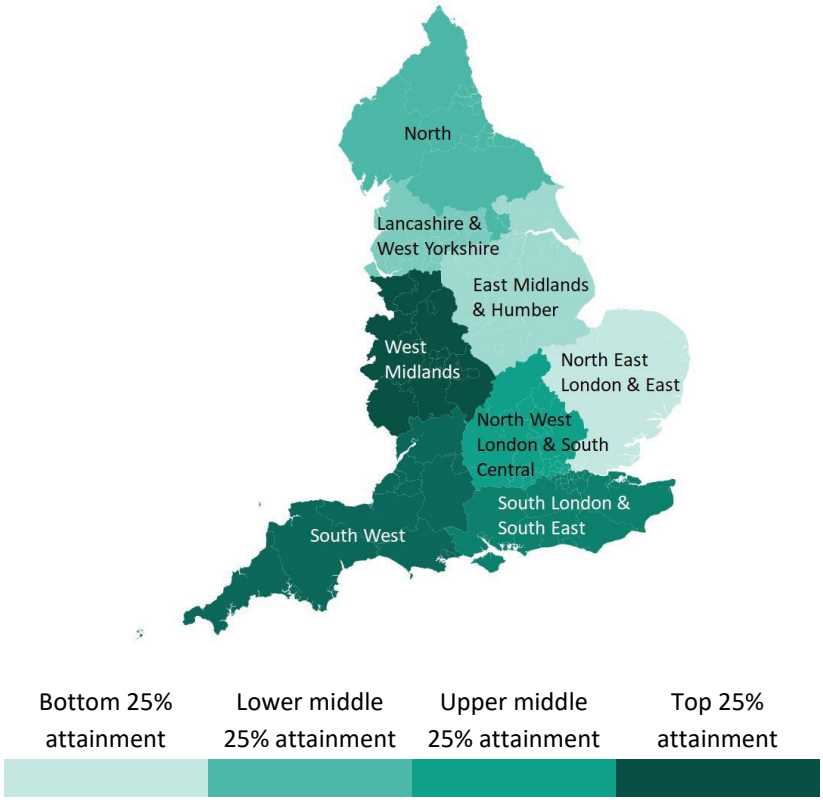


Figure 2.5 shows that there is variation between the regions in terms of performance against the world class benchmark. The North West London and South Central region had the highest level of secondary attainment, with 44.2 per cent of pupils achieving 50+ points in Attainment 8. Attainments levels were lowest in the East Midlands & Humber, Lancashire & West Yorkshire, and North regions.[24]

No region is currently meeting the benchmark of half of pupils achieving 50 or more points across their Attainment 8 subjects.

Figure 2.5: Performance at the end of secondary school by RSC region

Rank	RSC region	Percentage of pupils achieving 50+ points in Attainment 8 (2017 points scale)
1	North West London & South Central	44.2
2	South London & South East	42.7
3	South West	39.7
4	North East London & East	39.5
5	West Midlands	37.3
6	North	37.1
7	Lancashire & West Yorkshire	36.9
8	East Midlands & Humber	36.1

[24] For the purpose of the RSC regions London has been split across three different RSCs. Attainment levels across London as a whole are higher than any RSC region at 45 per cent).

Performance in Opportunity Areas

In October 2016, the Department for Education announced that it had identified 6 areas in the country which were 'the most challenged when it comes to social mobility'. These areas were: West Somerset, Norwich, Blackpool, Scarborough, Derby, and Oldham. They were identified using the Social Mobility Index, published by the Social Mobility Commission in January 2016.[25] The six identified areas were not the six worst performing areas identified by the Commission – West Somerset and Norwich were the worst two, but the remaining four areas fell within the 9th and 30th worst performing areas under this measure.

In January 2017, the Secretary of State announced a further six Opportunity Areas: Bradford, Doncaster, Fenland & East Cambridgeshire,[26] Hastings, Ipswich, and Stoke-on-Trent, along with a further investment of £3.5 million (£2m from the Education Endowment Foundation and £1.5m from the Department for Education) to establish a research school for each of the 12 Opportunity Areas.

Figure 2.6: Locations of the Opportunity Areas

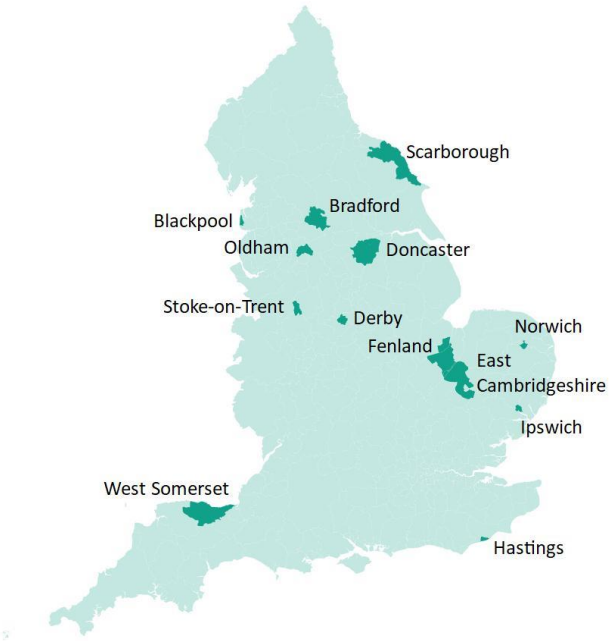


Figure 2.7 shows the attainment of pupils in each Opportunity Area. Attainment in Opportunity Areas is, on average, much lower than in other areas. In Opportunity Areas, 31.1 per cent of pupils achieved 50 plus points across their Attainment 8 subjects. This is nearly 9 percentage points lower than in non-Opportunity Areas.

This means that each opportunity area is well below the benchmark of half of pupils achieving 50 plus points. Blackpool, Fenland, Scarborough, Norwich, and Oldham would all need to see increases of over 20 percentage points in order to reach this benchmark.

[25] See: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/496103/Social_Mobility_Index.pdf.
[26] Figures for Fenland and East Cambridgeshire are shown separately.

Figure 2.7: Performance at the end of secondary school by Opportunity Area

	Secondary schools: % of pupils achieving 50+ points in Attainment 8 (2017 points scale)
Pupils in all opportunity areas	**31.1**
East Cambridgeshire	41.1
West Somerset	33.5
Hastings	32.7
Bradford	32.2
Doncaster	31.8
Ipswich	31.7
Stoke-on-Trent UA	30.6
Derby UA	30.5
Oldham	29.8
Norwich	29.7
Scarborough	28.7
Fenland	28.5
Blackpool UA	25.9
Pupils in other areas	**39.9**

Part 3: Performance in Wales, Scotland, and Northern Ireland

In this section, we look at how well pupils in Wales, Scotland, and Northern Ireland are performing compared to both England and the five leading countries we identify in Part 1 of this report. To make these comparisons, we use the same method as we do in Part 1 – we simulate GCSE attainment in each of the devolved nations based on their PISA scores. This approach enables us to make a consistent comparison, despite different qualification systems in each country.

We look first at the distribution of grades in each of the devolved nations, including England, in both mathematics and English.

We find that, in maths, England has a larger proportion of pupils securing the top grades (A*-B) than other UK countries. In English Language, 45 per cent of pupils in England and Northern Ireland scored an estimated A*-B – higher than in the other UK nations.

Scotland's performance is around the UK average in both maths and English Language, while Wales has a distinctly lower than average proportion of pupils achieving top grades and a long tail of underperformance in both subjects.

Figure 3.1: Distribution of GCSE grades in mathematics in the UK (simulated)

	England	Wales	Scotland	N. Ireland
A*	8	5	7	6
A	14	11	14	13
B	23	22	23	23
C	31	35	32	33
D	13	15	14	14
E	4	5	4	4
F	3	4	3	3
G	2	2	2	2
U	2	2	1	2

Figure 3.2: Distribution of GCSE grades in mathematics in the UK (simulated)

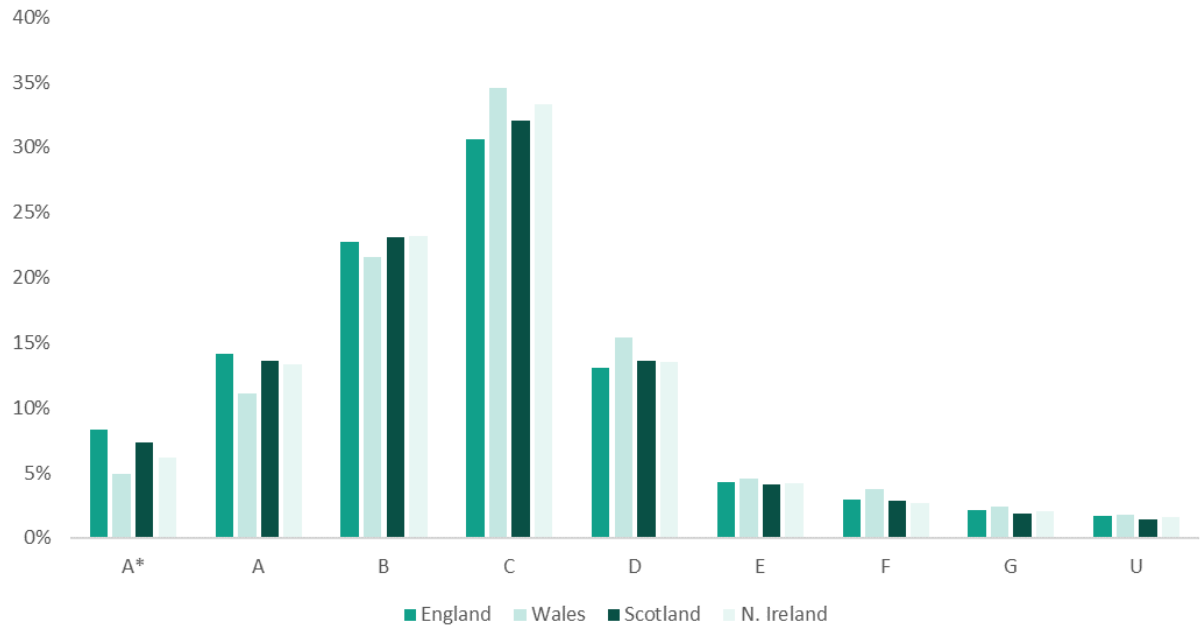
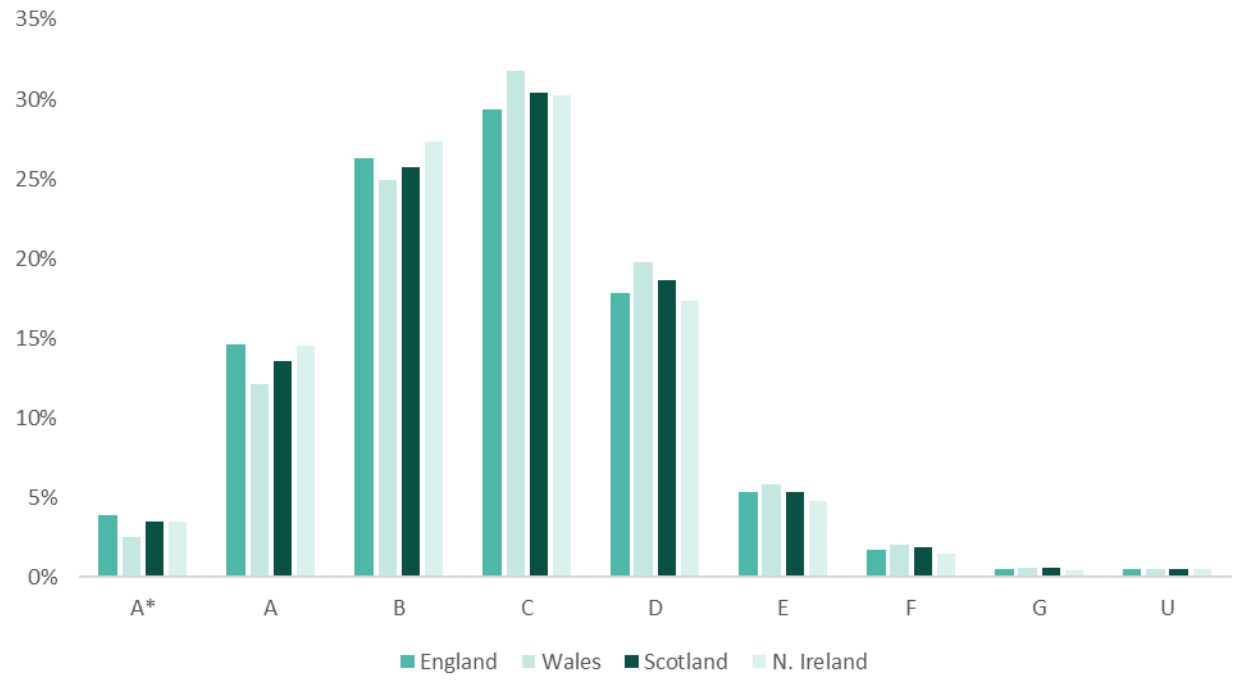


Figure 3.3: Distribution of GCSE grades in English Language in the UK (simulated)

	England	Wales	Scotland	N. Ireland
A*	4	3	3	3
A	15	12	14	15
B	26	25	26	27
C	29	32	30	30
D	18	20	19	17
E	5	6	5	5
F	2	2	2	1
G	1	1	1	0
U	0	1	1	0

Figure 3.4: Distribution of GCSE grades in English Language in the UK (simulated)



We now turn to how well UK nations perform, compared to our five world leading countries in each of mathematics and English Language. As Figure 3.5 shows, **Scotland and Northern Ireland are only just behind England in terms of the proportion of pupils achieving an A*-B (44 and 43 per cent respectively) in maths. Wales, however, is distinctly lower, at 38 per cent.**

This means that, **in order to compete with the highest performing countries, Scotland and Northern Ireland would each need to improve the proportion of high attaining pupils in maths by over a third.**

They would also need to reduce considerably the proportion of low attaining pupils (those failing to secure a grade C). **The required reduction in Scotland and Northern Ireland is just under half (from 24 per cent to 14 per cent in each case).**

The situation is starkest in Wales. I**n order to compete with the highest performing countries, Wales would need to improve the proportion of high attaining pupils in maths by 60 per cent, whilst halving the proportion of low attaining pupils (from 28 to 14 per cent).**

Figure 3.5: Distribution of percentage of pupils' GCSE scores in mathematics in the UK and the top five performing countries (simulated)

Grade	England	Singapore	Hong Kong	Macao	Taiwan	Japan	Wales	Scotland	N. Ireland	Top 5 Ave.
A*	8	19	16	14	16	13	5	7	6	16
A	14	22	20	20	20	19	11	14	13	20
B	23	24	26	26	23	25	22	23	23	25
Total achieving A* - B grades	45	65	62	60	59	57	38	44	43	61
C	31	23	25	27	25	28	35	32	33	26
D	13	7	8	8	9	9	15	14	14	8
E	4	2	3	2	3	3	5	4	4	3
F	3	1	2	1	2	2	4	3	3	2
G	2	1	1	1	1	1	2	2	2	1
U	2	1	1	1	1	1	2	1	2	1
Total achieving D - U grades	24	12	15	13	16	16	28	24	24	14

In English Language, as Figure 3.4 shows, Northern Ireland and Scotland would need to improve the proportion of pupils securing a grade B or higher – by just under a sixth in Northern Ireland and by just over a fifth in Scotland. **Wales, on the other hand, would need to improve by almost a third – from 40 per cent of pupils to 52 per cent.**

Again, all three devolved nations need to reduce the proportion of pupils failing to secure a grade C. **Northern Ireland would need to reduce the proportion by just over a fifth and Scotland would need to reduce the proportion by just under a third. Wales needs to reduce its proportion of low performing pupils by just over a third – from 29 per cent to 19 per cent.**

Figure 3.4: Distribution of percentage of pupils' GCSE scores in English Language in the UK and the top five performing countries (simulated)

Grade	England	Singapore	Hong Kong	Canada	Finland	Republic of Ireland	Wales	Scotland	N. Ireland	Top 5 Ave
A*	4	6	5	5	5	5	3	3	3	5
A	15	19	18	18	18	17	12	14	15	18
B	26	29	30	29	29	29	25	26	27	29
Total achieving A* - B	45	54	53	52	52	51	40	43	45	52
C	29	26	29	28	28	29	32	30	30	28
D	18	13	14	14	14	15	20	19	17	14
E	5	4	4	4	4	4	6	5	5	4
F	2	1	1	1	1	1	2	2	1	1
G	1	0	0	0	0	0	1	1	0	0
U	0	0	0	0	0	0	1	1	0	0
Total achieving D - U grades	26	18	19	19	19	20	29	27	24	19

Part 4: Conclusions and policy implications

Over the last 25 years England has participated in a number of international studies of school pupils' academic achievement.

Since the inception of PISA 17 years ago, England's performance has remained at around average in mathematics and reading and just above average in science. As England's performance has stagnated (particularly in reading and science), countries from a variety of starting points and with a range of historical contexts have shown marked improvements in at least one of the assessment areas. The goal of this paper has been to consider how pupils' achievement in national GCSE examinations needs to improve in order for England to become a world leading education system, as judged by the PISA rankings.

These findings of course need to be interpreted in light of the limitations of this research. First, although PISA covers similar subject areas to GCSE examinations, they nevertheless measure young people's skills in subtly different ways. This includes the extent to which they are curriculum versus problem-solving focused, the amount of reading involved, the mode of the assessment (paper versus computer) and the importance of the results for young people and their schools. Each of these factors may potentially contribute to differences in PISA scores and GCSE grades, meaning that there is not a one-to-one correspondence between these different assessments. In other words, although an increase in national examination performance of the magnitude we suggest is needed should also lead to a marked improvement in PISA scores, the precise level of the change is subject to a degree of uncertainty. Nevertheless, the benchmarks we have identified would firmly place England's education system amongst the world's leading countries. Second, this paper has been about standards, and the clear establishment of world leading benchmarks. It has not attempted to prescribe possible policy responses or interventions to enable policy makers, teachers, and educators to reach these goals. Of course, understanding the factors and potential initiatives needed to reach the goals we have set continues to be an important line of related research. The Education Policy Institute will continue to analyse and explore these factors throughout its forthcoming programme of work, looking, for example, at the supply and quality of teachers and leaders, school admissions and the characteristics of under performing pupils.

Despite these limitations, we argue that the first step towards making real progress in improving pupils' educational achievement in key academic subjects is that ambitious yet realistic benchmarks need to be set. This paper has set the bar for the government, schools, teachers and young people to achieve, in order for England's education system to become 'world class'. With the recent changes made to GCSE examinations, now is perhaps the optimum time for us to be considering what acceptable standards of national achievement look like.

Annex A: A comparison of the distribution of GCSE grades in PISA compared to national figures

There are at least three reasons why the distribution of GCSE grades based upon the PISA sample may not exactly match national figures based upon population level data. These are:

1. Non-response. Although response rates to PISA are high, there is still some non-response at both the school and pupil level. Specifically, the non-response rate at the school level in England was 17 percent (8 percent once replacement schools are included in the figures), while 12 percent of pupils were absent from schools on the day of the test. Schools and pupils who do not participate tend to be lower achievers, which could in turn lead the distribution of GCSE grades observed for the PISA sample being *higher* than in the population.[27]

2. Non-linkage. As noted in section 2, GCSE data could not be linked for some pupils. This was particularly a problem for private school pupils (some of whom may have also taken international GCSEs rather than the English national qualification). In this paper, we have attempted to address this issue via multiple imputation of missing GCSE data. However, this could still lead to some discrepancy between PISA-sample based figures and official GCSE data.

3. Sampling error. PISA is a sample survey, meaning that there is some uncertainty (sampling error) surrounding the estimates. This random error could lead to the distribution of GCSE grades based upon the PISA sample to be either higher or lower than in national examination data.

It is therefore important that some comparison is made between our estimates of the GCSE grade distribution based upon the PISA sample and official figures based upon population level data. This information is presented in Table A1. Figures refers to the cumulative percentage of pupils achieving each grade. The 'official' estimates include school pupils only, and not those individuals who may have taken these qualifications beyond the age of 16 (e.g. 17 and 18 year olds who were required to re-sit). Consistent with the discussion above (and the first point in particular), GCSE grades in the PISA sample tend to be slightly higher than in official population level statistics. For instance, around 76 percent of the PISA sample achieved at least a C grade in mathematics, compared to around 71 percent in official population estimates. The analogous figures for English Language are 74 and 71 percent respectively.

[27] Micklewright,J.; Schnepf,S. and Skinner, C. (2012) 'Non-response biases in surveys of school children: the case of the English PISA Samples', Journal of the Royal Statistical Society Series A 175(4):915–938.

Table A1: The distribution of GCSE grades in PISA versus official population level statistics

Mathematics

	PISA (without imputation)	PISA (with imputation)	Population
A*	8%	8%	7%
A	22%	23%	20%
B	44%	45%	40%
C	75%	76%	71%
D	89%	89%	85%
E	93%	93%	91%
Average grade	4.67	4.72	4.47

English

	PISA (without imputation)	PISA (with imputation)	Population
A*	4%	4%	4%
A	18%	19%	18%
B	44%	45%	43%
C	74%	74%	71%
D	92%	92%	89%
E	97%	97%	96%
Average grade	4.63	4.64	4.53

Annex B: Methodology

Our empirical methodology is based upon multiple imputation. The PISA-NPD file for England includes both pupils' PISA test scores (plausible values) and their grades in GCSE examinations. We append to this the public use PISA data files for all other comparator countries. Hence we have a set of variables (PISA scores) which are observed for all participating pupils in all countries, and another set of variables (GCSE outcomes) which are only observed for pupils in England. The fact that GCSE grades are not observed in other countries is treated as a missing data problem, which we attempt to solve via multiple imputation. In other words, we predict how well children in other countries would have done had they taken GCSE exams, based upon how they performed on the PISA 2015 test. This prediction is estimated using the relationship between PISA scores and GCSE grades in England. One particular advantage of using multiple imputation by chained equations is that we are able to retain in our analysis even those pupils in England whose GCSE data could not be matched. Hence all 5,194 pupils who participated in PISA 2015 in England are included in our results.

The imputation model

Our imputation model applies multiple imputation by chained equations (MICE). A simple multi-nominal logistic regression model underpins the prediction of GCSE grades, and this is of the form:

$$\log(\frac{(\pi_{ij})}{(\pi_{iJ})}) = \alpha_j + \beta_j . PISA_i$$

Where:

π_{ij} = The probability of child i of obtaining GCSE grade j.

PISA = A vector of dummy variables referring to pupils PISA scores on the first plausible value.[28]

In our main specification, PISA scores are entered into the model in the form of dummy variables, based upon the level the pupil achieved in the PISA 2015 test.[29] For instance, in mathematics, pupils are divided into one of six groups based upon how they performed on the PISA test (see Jerrim and Shure 2016: Tables 4.3 and A1 for further details). By using dummy variables, we are allowing for potential nonlinearities between PISA levels and GCSE grades. The final pupil senate weight is applied, with the imputation models run separately for England in combination with each comparator country. We investigate the robustness of our results below, where a more complex imputation model is estimated, using gender, socio-economic status, and immigrant status (in addition to PISA scores) as the key covariates in the model underlying the prediction of GCSE grades. Moreover, we also investigate the robustness of our results to using raw PISA scores (percentage correct) rather than scaled scores (plausible values) as the key covariate in the imputation model.

Once the multiple imputation stage is complete, we follow Rubin's Rules (Rubin 1987) to predict the likely distribution of performance on GCSE examinations in each comparator country. From these

[28] We have experimented with using all ten plausible values and find very little change to our substantive results.

[29] In reading and science, we combine the bottom two categories due to the low number of observations in each individually.

results, we can infer how England's GCSE grade distribution needs to change in order for it to become one of the leading education systems in the world.

Robustness Test

In the main body of the paper, we have used multiple imputation to create predicted GCSE grade distributions for a selection of other countries. The only covariate included within these imputation models was a series of dummy variables capturing how well children performed on the PISA test. We have tested the robustness of our results in two ways.

In addition to how children performed on the PISA test, robustness test A also includes in the imputation model a selection of demographic characteristics. Specifically, information on gender, socio-economic status and immigrant group (first generation, second generation or country native) have been added. Moreover, as we have added variables (and hence complexity) to this model, we also change the estimation method from multi-nominal to ordinal logistic regression. This allows us to see whether our substantive conclusions remain broadly the same when a quite different specification of the underlying imputation model is used.

Instead of using PISA scale scores (plausible values) in the imputation model, robustness test B investigates how our results change if we use raw scores (percentage correct statistics) instead. This is important as it allows us to check whether our results are robust to potential issues with the methodology used by the OECD to construct the PISA scale scores (plausible values). Specifically, for each child we calculate the percentage of mathematics, reading and science test questions they answered correctly. We then divide children into five groups (quintiles) for each subject area based upon the proportion of questions they answered correctly[30]. When implementing this alternative procedure, we also restrict the analysis to the subset of children who actually completed test questions within each specified domain (e.g. the subsample of children who were actually randomly selected to complete mathematics questions – see Jerrim et al 2017 for further details). Replication materials for both of these alternative methods are available from the authors upon request.

Overall, the broad pattern of the results continue to hold, with little change to the substantive conclusions reached. Further details, including a set of alternative results based upon these robustness tests, are available from the authors upon request.

[30] These quintiles were based upon pooled international data, including all OECD countries and any non-OECD country sitting above England in the PISA mathematics rankings (i.e. Singapore, Hong Kong, Macao, Taiwan, China were also included). The senate weight was applied, with each country given equal weight in determining the quintile cut-off thresholds.

English Education: World Class?

Jon Andrews, Dr John Jerrim and Natalie Perera

August 2017

There continues to be much debate about the standards of education in England, in terms of measures of pupil progress and attainment. But it is has, to date, been difficult to properly assess England's education system without comparing it fairly and meaningfully to that of other comparable countries.

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