Evaluation of the University of Liverpool CPD course for A-Level geology teachers and an analysis of entries to A-Level geology, 2002-2018

Report for the University of Liverpool

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1 Executive summary

1.1 Methodology

- This report analyses trends in A-Level geology entries in England from 2002-18 and evaluates the reach and impact of the University of Liverpool's CPD course for A-Level geology teachers.
- It uses pupil-level data from the National Pupil Database (NPD) and the HESA student record, as well as data provided by the University of Liverpool on course participation.
- The impact evaluation compares the performance of schools and colleges that took part in the course to performance in a group of statistically matched control establishments.
- Multilevel regression models were fitted to the matched data, with an indicator to flag whether a school or college had taken part in the course. The models were adjusted to take account of pupil-level characteristics.
- Four outcomes were evaluated over the period 2007-2018: number of entries to A-Level geology, attainment at A-Level geology, progression to study geosciences at degree level, and progression to study any STEM subject at degree level.

1.2 Main findings

Trends in A-Level geology

- A-level geology increased in popularity for students in England between 2009 and 2014, but since then entries have declined every year, to a low of 1,313 in 2018.
- The number of schools and colleges in England entering students to A-Level geology remained relatively stable between 2002 and 2014, but has declined since 2014, falling to just 119 in 2018.
- The proportion of female A-Level geology students is increasing but remains relatively low at 35% in 2018.
- Geography matters for A-Level geology students. In 2018, 19% of A-Level geology students attended schools and colleges in the North West and 17% in the South West, but just 3% in London, 7% in the North East and 7% in the East Midlands.

Evaluation of the CPD course

- In 2018, 51% of A-Level geology students in England were registered at a school or college that had participated in the course. 42% of the schools and colleges in England that offered A-Level geology had participated.
- When schools and colleges that had participated in the course entered students for A-Level geology, they tended to enter more students, on average, than those that offered geology but which had not participated. In 2018, the average for those participating schools that offered A-Level geology in that year was 13 students, compared to 9 for other establishments.
- The impact evaluation found evidence that participating in the course had a positive effect on A-Level attainment in some of the outcome years considered, of between 1/7 and nearly 1/3 of a grade per student.
- It did not find evidence that participating in the course had a positive effect on any of the other outcomes considered.
- However, the impact evaluation was subject to a number of limitations, as described in section 1.3.

1.3 Limitations

- The National Pupil Database (NPD) only covers England, so the report only considers trends in entries to geology A-Level from schools and colleges located in England.
- Likewise, the evaluation of the CPD course excludes course participants from establishments elsewhere in the UK.
- The quasi-experimental approach used for the impact evaluation relies on constructing a control group of schools that are statistically similar to the schools and colleges that took part in the CPD course, using data from the NPD.
- Creating a control group in this way means that we were unable to control for factors not observed or recorded in the NPD.
- Some control schools may have taken part in similar courses or other relevant CPD. If this improved outcomes in control schools, it may have led to underestimation of effects.
- As the CPD course engaged a considerable proportion of those schools and students entering A-Level geology, the pool of potential control groups was limited, resulting in less than optimal matching.
- The effects observed in the impact evaluation should be considered tentative given these limitations.

2 Introduction

The University of Liverpool's CPD course for A-Level geology teachers is, in its current form, a two day course, provided free of charge to teachers of A-Level geology. It includes lectures, practical sessions and opportunities to discuss good practice. The course is the longest running of its type in the UK, having run almost continuously for 30 years.

In this report, we evaluate the reach and impact of the course during the period 2002-18. We begin with an analysis of trends in entries to A-Level geology and a demographic profile of A-Level geology entrants in England over the same period. We go on to demonstrate the reach of the course during this period, establishing the number of institutions participating in the programme as a proportion of all institutions offering A-level geology in England.

Finally, we carry out an impact evaluation, estimating the impact of participating in the course on four outcomes:

- Number of entries to A-Level geology
- Attainment (grades achieved) at A-Level geology
- Progression to study geosciences at degree level
- Progression to study any science, technology, engineering or maths (STEM) subject at degree level

Analysis was carried out the National Pupil Database and the HESA student record. Coverage includes all students completing A- or AS-Levels in state-funded or independent establishments in England for the period 2002 to 2018.

Two appendices, comprising more detailed summary data tables, are also included.

These are:

- Appendix one: Trends in A-Level geology, further data tables
- Appendix two: Evaluation of the CPD course, further data tables

2.1 Acknowledgments

This publication includes analysis of the Department for Education National Pupil Database, linked to the HESA student record. Inferences or conclusions derived from the NPD or the HESA student record in this publication are the responsibility of FFT Education Datalab and not the Department for Education or HESA.

3 Datasets and background information

3.1 Overview

This work has been completed by analysing the Department for Education's National Pupil Database and the HESA student record.

Coverage includes all students completing A- or AS-Levels in state-funded or independent establishments in England for the period 2002 to 2018.

3.2 Description of the datasets

The University of Liverpool provided a list of schools and colleges which participated in their CPD course for geology A-Level teachers between 2001 and 2017. We matched the list to publicly available data on educational establishments in England, including closed schools, to add the 7-digit code (known as LAESTAB) by which establishments are indexed in government educational datasets. This step meant that we could link the list of schools to corresponding records in the National Pupil Database (NPD).

NPD is an administrative data resource maintained by the Department for Education and provides a history of enrolments, attendance, exclusions and attainment in national tests and public examinations (e.g. GCSE and A-level) for all pupils who have been in state-funded education since 2002. For this project, we use data on A-level and AS-level entry and attainment for all 16-18 year olds entering such qualifications in England between 2002 and 2018. We also use some additional variables from NPD about each student. These include average grade achieved in GCSEs, gender, free school meal eligibility at age 15 and government office region.

NPD has been matched to the Higher Education Statistics Agency (HESA) Student Record, which means that students who enter higher education following their A-levels can be observed. We identify students studying at level 6 of the National Qualifications Framework (equivalent to a Bachelor's degree). Using JACS codes, we then classify students according to the subject of their degree identifying those doing i) geosciences ii) physical sciences and iii) any STEM subject.

3.3 Background information

This report is mainly focused on A-Level geology. The report also discusses attainment earlier in a student's career, at GCSE or equivalent. Both types of qualification have been reformed in recent years and the grades used have changed. The section below outlines these changes and sets out how measures of attainments have been used in this report.

GCSE

All GCSEs in England have been reformed in recent years, which has involved a move from A*-G grades to 9-1 grades. Grades are not directly comparable, except at a number of key grade thresholds:

- achieving a grade 7 or above is equivalent to achieving a grade A or above
- achieving a grade 4 or above is equivalent to achieving a grade C or above
- achieving a grade 1 or above is equivalent to achieving a grade G or above

A table displaying how all grades relate to one another can be found here.

A-Level

A-Levels have been graded from A*-E for the entire period covered by this report. These grades can also be converted into numerical scores, which is useful for the purposes of the evaluation in section 3. However, the points awarded for each A-Level grade differed over the period under consideration. To allow comparison, all average point scores have been put in terms of points awarded from 2016 onwards, ranging from 60 for an A* grade through to 10 for an E grade.

Grade	Points
A*	60
A	50
B	40
C	30
D	20
E	10
U	0

4 Trends in A- and AS-Level geology entries

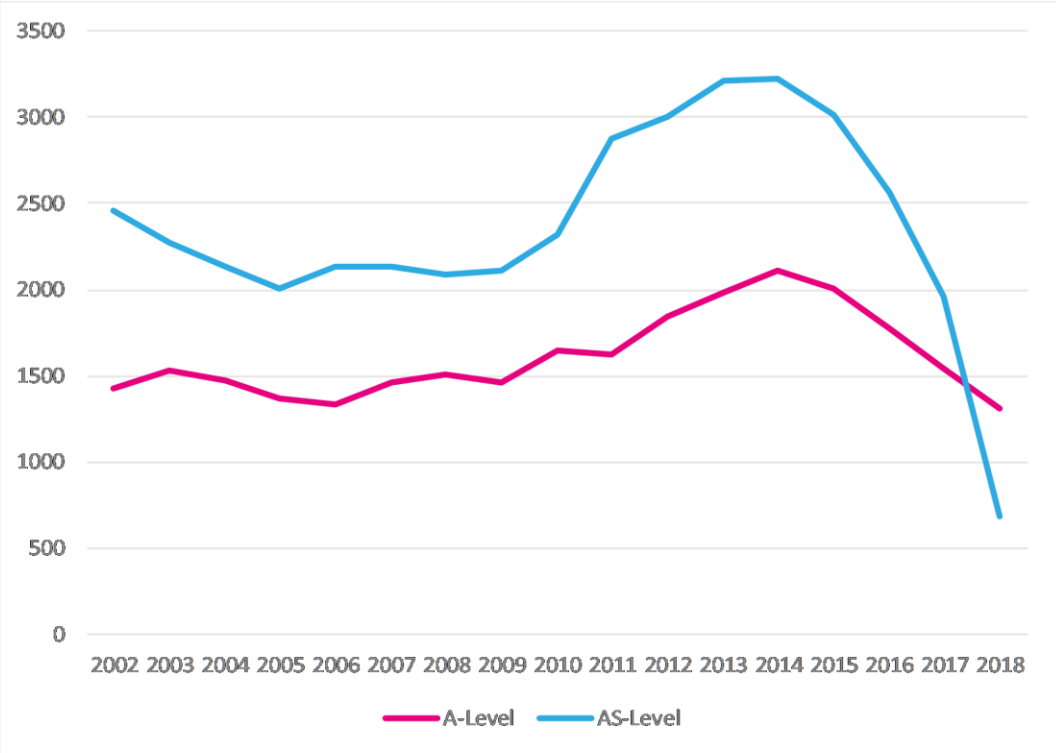
4.1 Overview

This section reviews trends in entries to A- and AS-Level geology. Coverage includes all those completing A- or AS-Levels in state-funded or independent establishments in England for the period 2002 to 2018. A- and AS- Level geology courses were available to students in England through two exam boards during the period covered by this report: OCR and Eduqas (WJEC).[1]

4.1.1 Student entries to A-Level geology

Between 2002 and 2018, entries to A- and especially AS-Level geology have varied quite substantially, as shown in figure 4.1.

Figure 4.1: Students entering A- and AS-Level geology in England, 2002-18



Both A- and AS-Level entries increased between 2009 and 2014, since when there has been a decline every year, with A-Level entries falling from 2106 in 2014 to 1313 in 2018. The decline in AS-Levels is not surprising; AS-Level entries in all subjects have sharply declined following A-Level reforms.[2]

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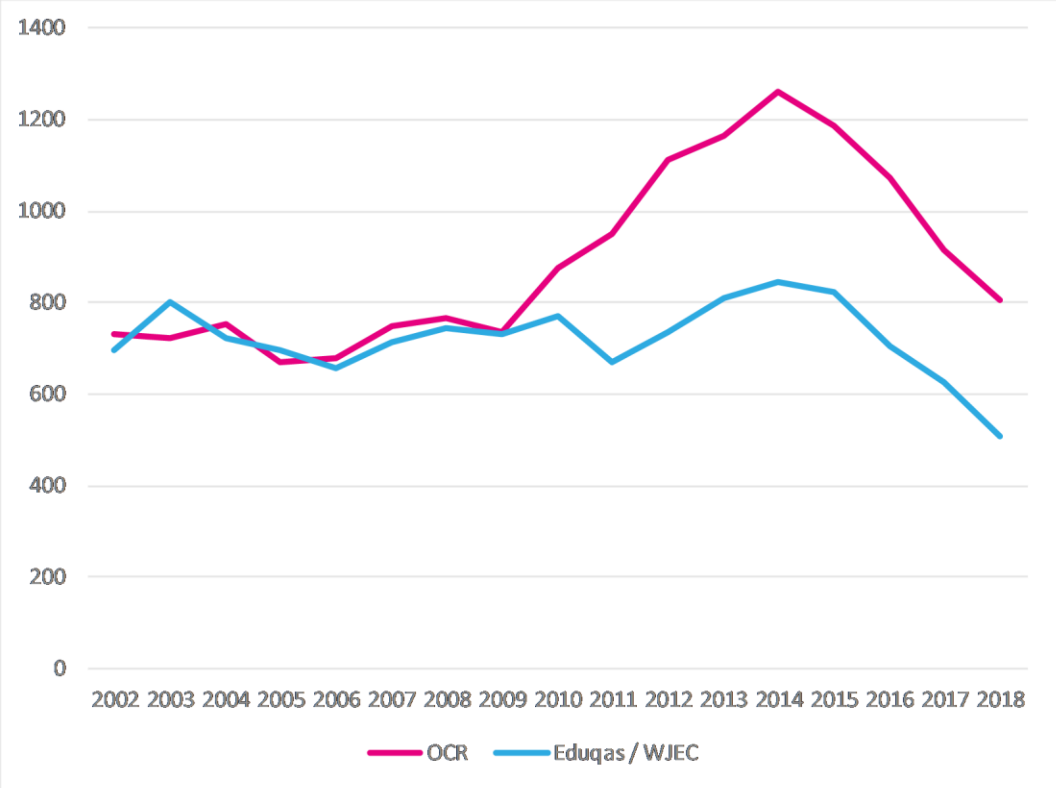
[1] WJEC provides Welsh government regulated qualifications to all state schools in Wales. It also provides qualifications that are taught in schools in England. The Eduqas brand was introduced to differentiate between these two types of qualification; the board is in the process of rebranding all the qualifications it offers for schools in England as Eduqas qualifications, rather than WJEC qualifications. A-Level geology courses that were previously branded as WJEC were reformed and re-branded as Eduqas in 2018.

[2] Comparison graphs and data for all subjects are available at: https://ffteducationdatalab.org.uk/2018/08/who-is-still-entering-as-levels-in-england/

Figure 4.2: Students entering A-geology in England by exam board, 2002-18

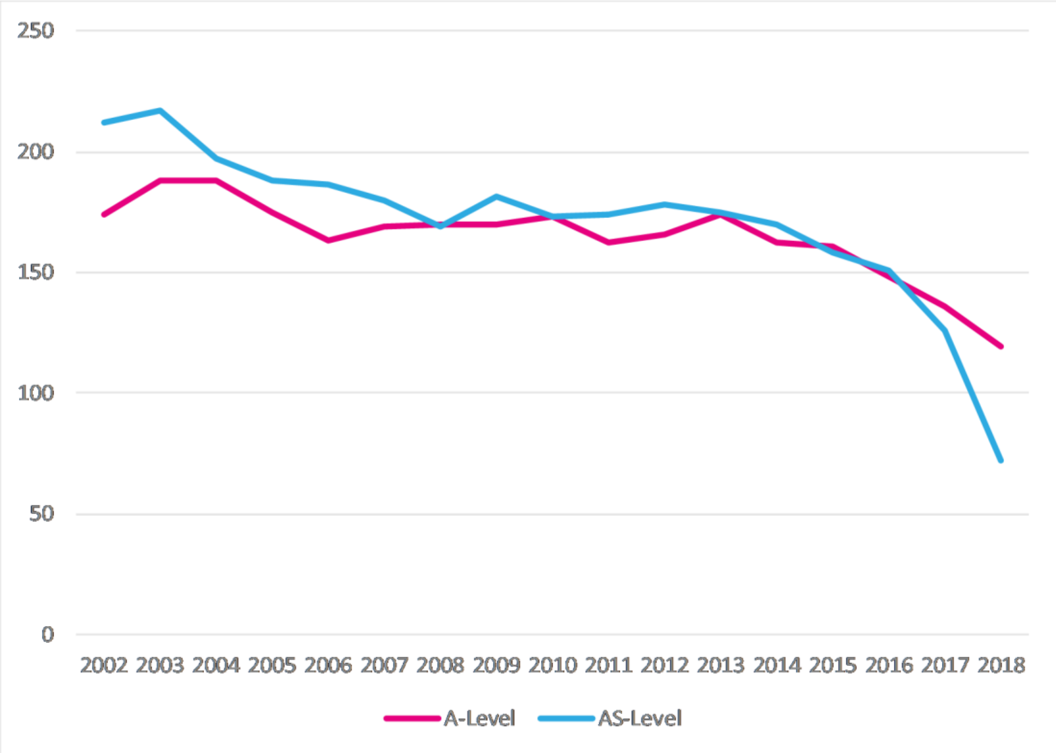


The bulk of the increase in A-Level entries from 2009-14 came from OCR, with Eduqas / WJEC entries remaining relatively stable, as shown in figure 4.2. Entries from both exam boards have fallen since 2014.

4.1.2 Schools and colleges offering A-Level geology

Figure 4.3 shows the total number of schools and colleges in England that entered at least one student for A- or AS-level geology. The pattern here is rather different to the pattern seen when looking at student entries. While the number of students entering A- and AS-Level increased between 2009 and 2014, the number of establishments entering students did not. The mean number of student entries to A-Level geology per school increased from 9 in 2009 to 13 in 2014.

Figure 4.3: Schools and colleges in England with one or more students entered for A- or AS-Level geology, 2002-18



From 2014 onwards, we do see a trend that is more in line with the number of student entries; the number of establishments entering students for geology declined. As noted above, a decline in AS-Level is to be expected following reforms, but the number of establishments entering students for geology A-Level has also fallen, albeit less sharply, from 162 in 2014 to 119 in 2018.

4.2 Demographics of A-Level geology entrants

In this part, we review trends in the pupil and establishment characteristics of A-Level geology students between 2002 and 2018. Appendix 1 includes more detailed summary data tables and additional graphs; sections 4.2.1 – 4.2.5 each correspond to one of the tabs in the appendix.

As in section 4.1, coverage includes all those completing geology A-Level in state-funded or independent establishments in England. However, data on some pupil characteristics is unavailable for the first few years of this period. This is because the National Pupil Database, on which this analysis was based, did not collect this data for those years. Where this is the case, it is indicated in the text below. See section 3.2 for more information on the National Pupil Database.

4.2.1 Gender

Here we consider only male and female students, as recorded in the National Pupil Database. The majority of A-Level geology students were male in every year from 2002-18. The proportion of female students was at its lowest from 2010-14, ranging from 29-31% during those years. However, it has since risen to 35% in 2018. Figure 4.5 shows the number of entries to A-Level geology, broken down by gender, from 2002-18. Both the increase in entries up to 2014, and the decrease afterwards, were more pronounced for male than for female students.

Figure 4.4: Proportion of A-Level geology entries by gender, 2002-18

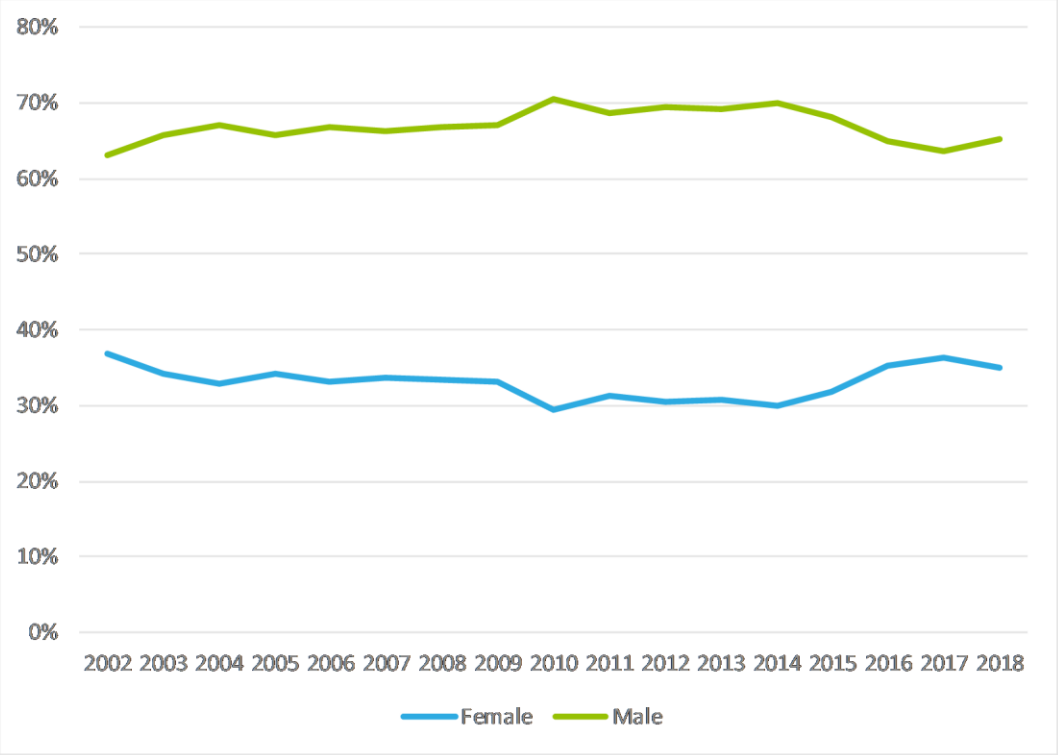
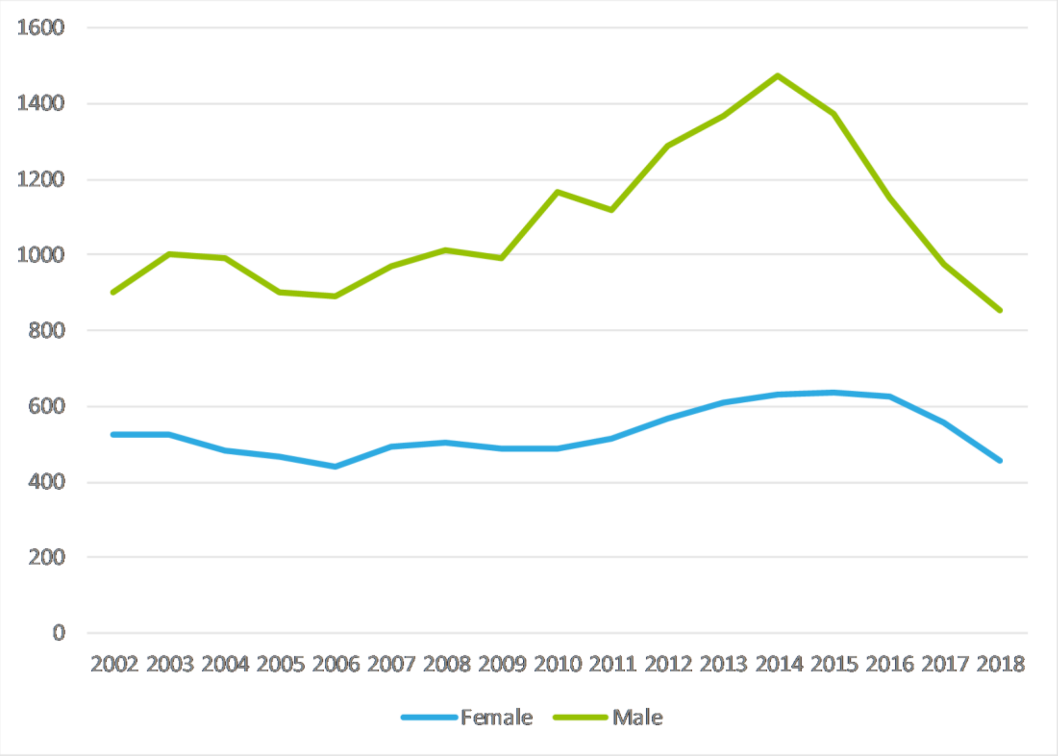


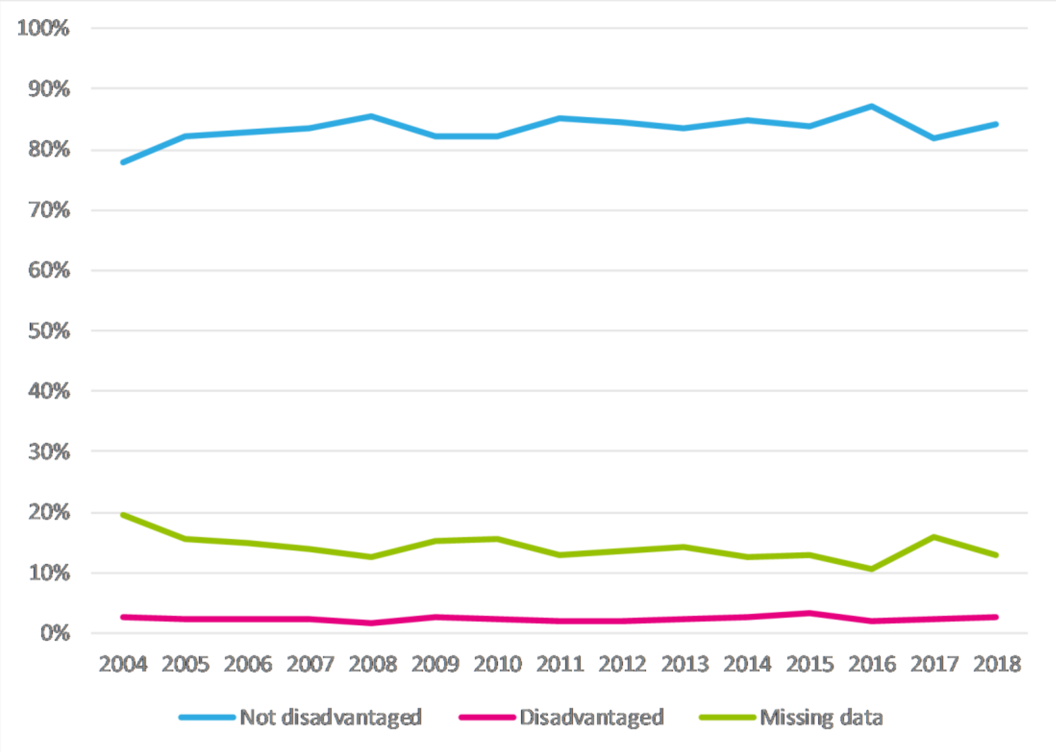
Figure 4.5: A-Level geology entries 2002-18, by gender



4.2.2 Disadvantage

Disadvantaged students are here defined as those eligible for free school meals (FSM) in their final year of compulsory schooling. A low proportion of A-Level geology students were disadvantaged; between 2 and 3% for every year for which data was available. This compares to between 12 and 14% of secondary school students in England during the same period.[3] Data on FSM eligibility is not available for pupils who completed their compulsory schooling in independent schools. These pupils compose much of the group with missing data in the chart below.

Figure 4.6: A-Level geology entries by FSM-eligibility, 2004-18



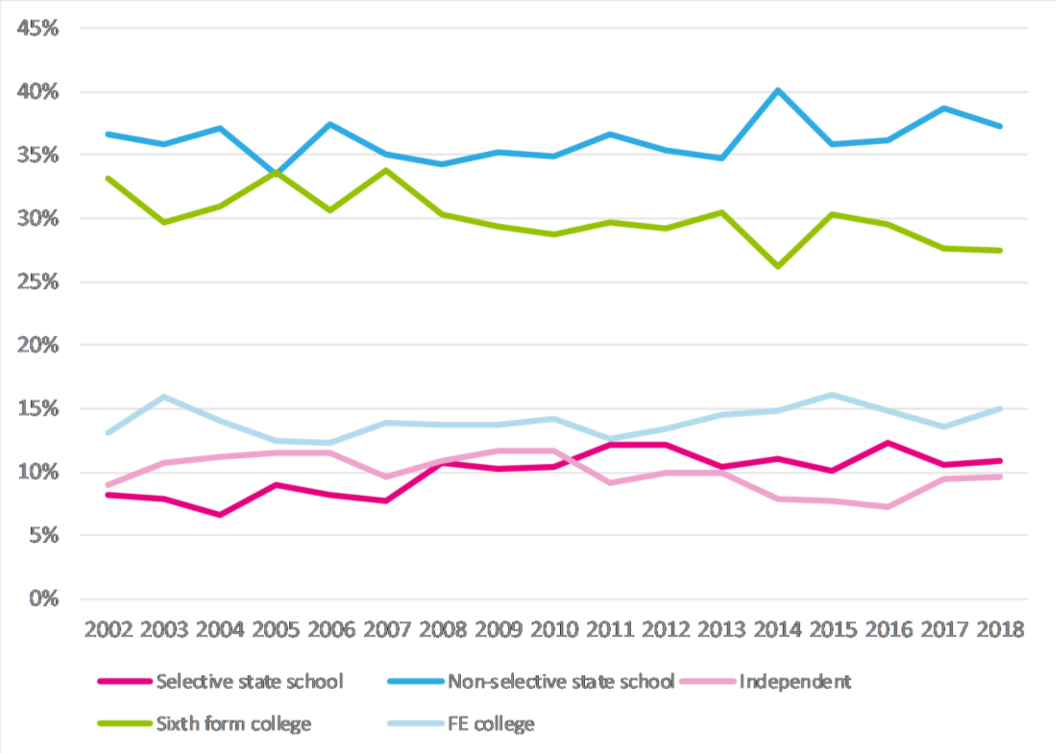
Data on disadvantage was unavailable prior to 2004.

[3] National figures are available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/719226/Schools_Pupils_and_their_Characteristics_2018_Main_Text.pdf

4.2.3 Type of establishment

A-Level geology students are most likely to go to a state-funded, non-selective school; 37% of 2018 geology students went to this type of school. More than a quarter (27%) went to a sixth form college. Geology students were least likely to go to an independent or grammar school, just 10% and 11% in 2018.

Figure 4.7: A-Level geology entries by type of school attended, 2002-18

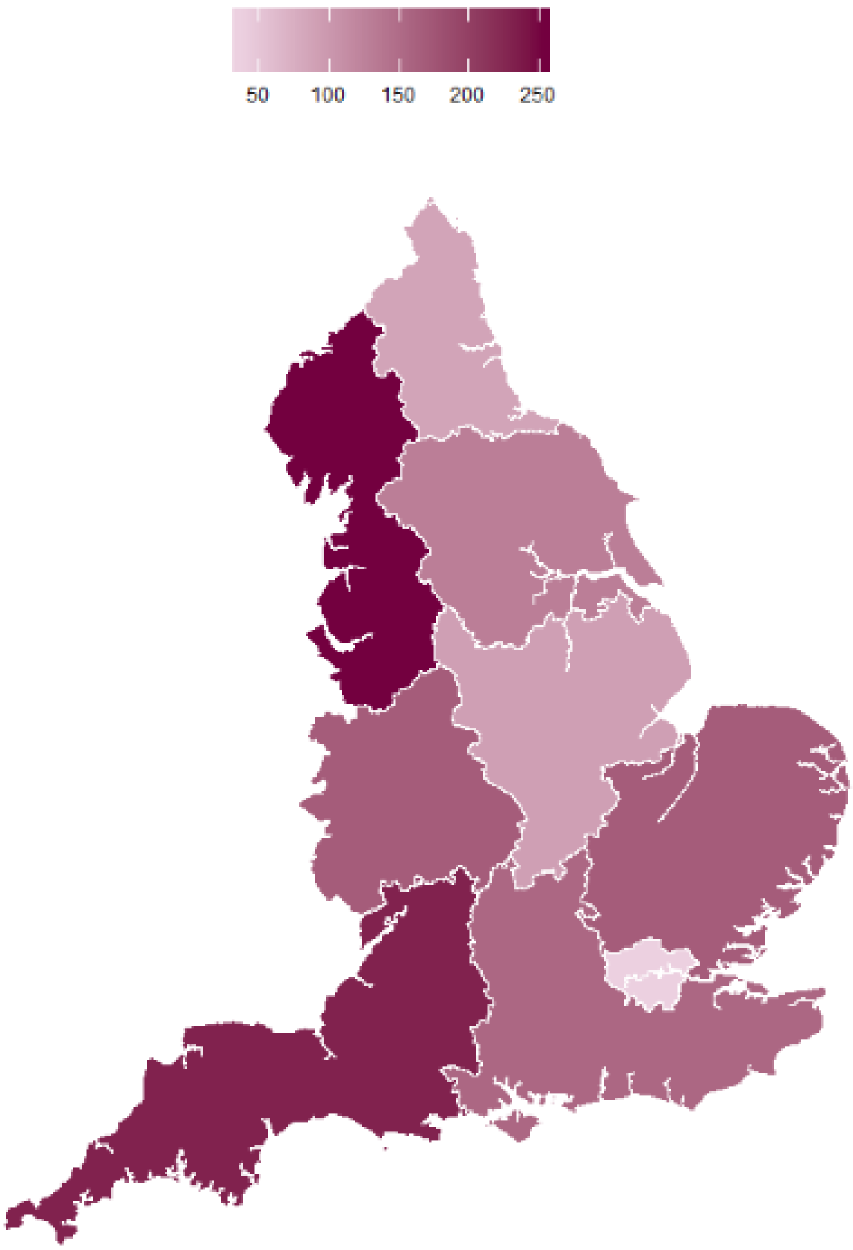


4.2.4 Region

A student's region is here defined as the region in which the school or college where they took their A-Levels is located.

There were some quite striking regional differences. Since 2014, A-Level geology students have been more likely to come from the North West or the South West than any other region, with 19% and 17% of A-Level geology students based in these regions in 2018. A low proportion of students came from the North East and the East Midlands (both 7% in 2018) and from London (3% in 2018). For almost every year from 2002-18, students from London made up a lower proportion of A-Level geology students than students from any other region. This is particularly striking given the high pupil population in London.

Figure 4.8: A-Level geography entries by region, 2018



4.2.5 Prior attainment at GCSE

We looked at the percentage of A-Level geology students who attained various grade ranges at GCSE English and GCSE maths. The grade ranges were: A* (9 in recent years), A*-A (9-7 in recent years) and A*-C (9-4 in recent years).[4]

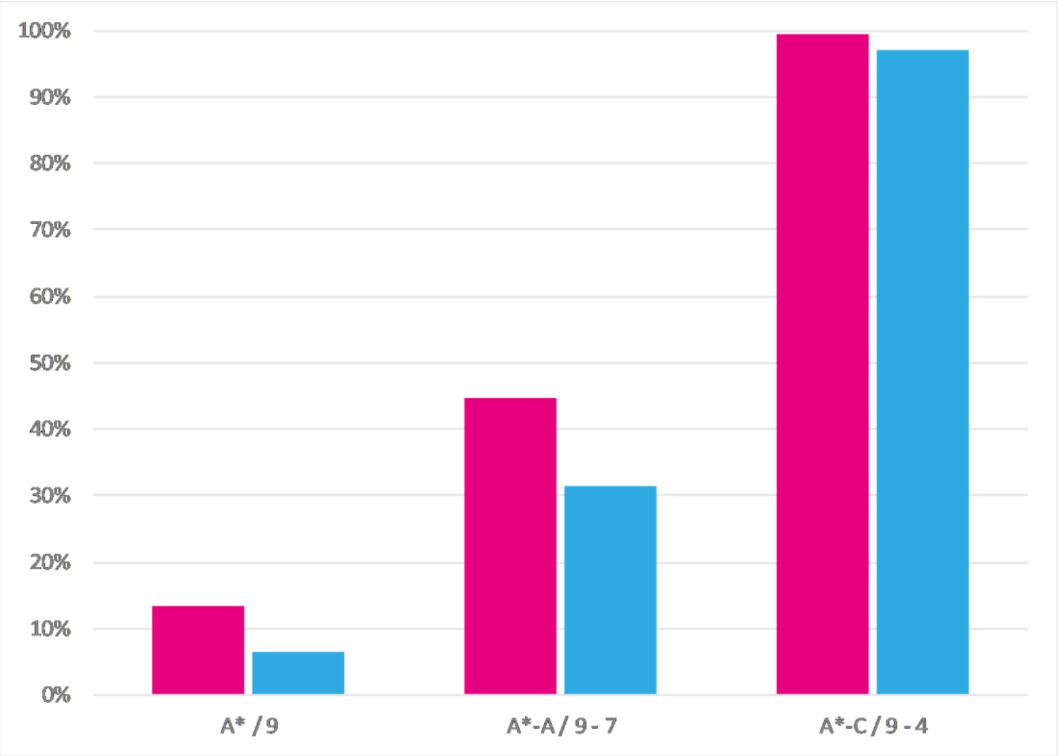
English and maths were used instead of looking at an average across all subjects because almost all students have consistently taken GCSEs in these subjects, so we avoid any problems that might be caused by changes over time in the types of qualifications entered by students at Key Stage 4.[5]

A-Level geology students tended to achieve high grades in both GCSE English and maths. Almost all students achieved A*-C (9-4); in 2018, 97% reached this level in English and 99% in maths. For comparison, only 62% of all students in England reached this level in English, and 60% in maths. As shown in figure 4.10, A-Level geology students achieved higher grades in maths than in English, with 7% of students attaining the top A* / 9 grade in English GCSE in 2018, and 14% in maths. This compares to 2% in English and 3% in maths for all students in England. [6]

The English GCSE grades of A-Level geology students were fairly consistent over the period considered. Maths grades, however, improved during the same period, as shown in figure 4.10. This increase was particularly steep from 2007 to 2013, when the proportion of A-Level geology students achieving an A*-A (9-7) increased from 30% to 49%.

Data on prior attainment was not available prior to 2004.

Figure 4.9 GCSE grades attained by A-Level geology students, 2018



[4] See section 3.3 for more information on GCSE grading and the change from A*-G to 9-1.

[5] Between 2004 and 2012, there was significant growth in 'alternative' non-GCSE qualifications. Since then, schools have been incentivized to pursue more academic GCSE qualifications. See https://ffteducationdatalab.org.uk/2019/06/if-the-ebacc-were-scrapped-would-anything-change/

[6] Source for national figures: JCQ https://www.jcq.org.uk/examination-results/gcses/2018/main-results-tables/gcse-full-course-results-summer-2018

Figure 4.10: A-Level geology students by GCSE maths grade range, 2004-18

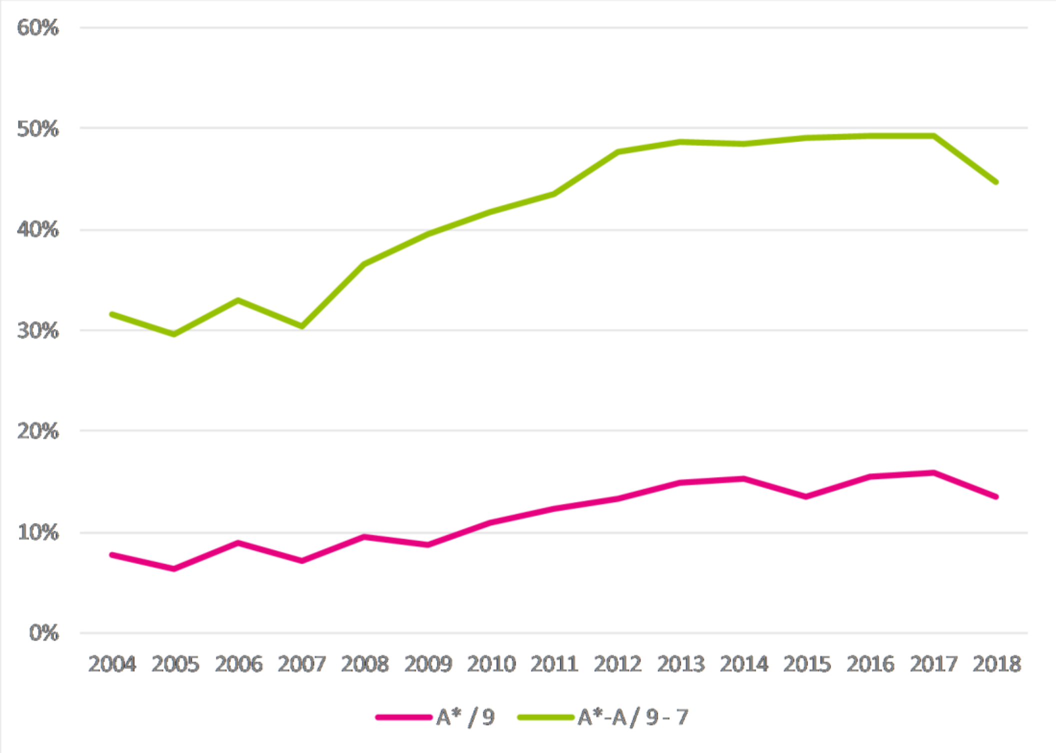
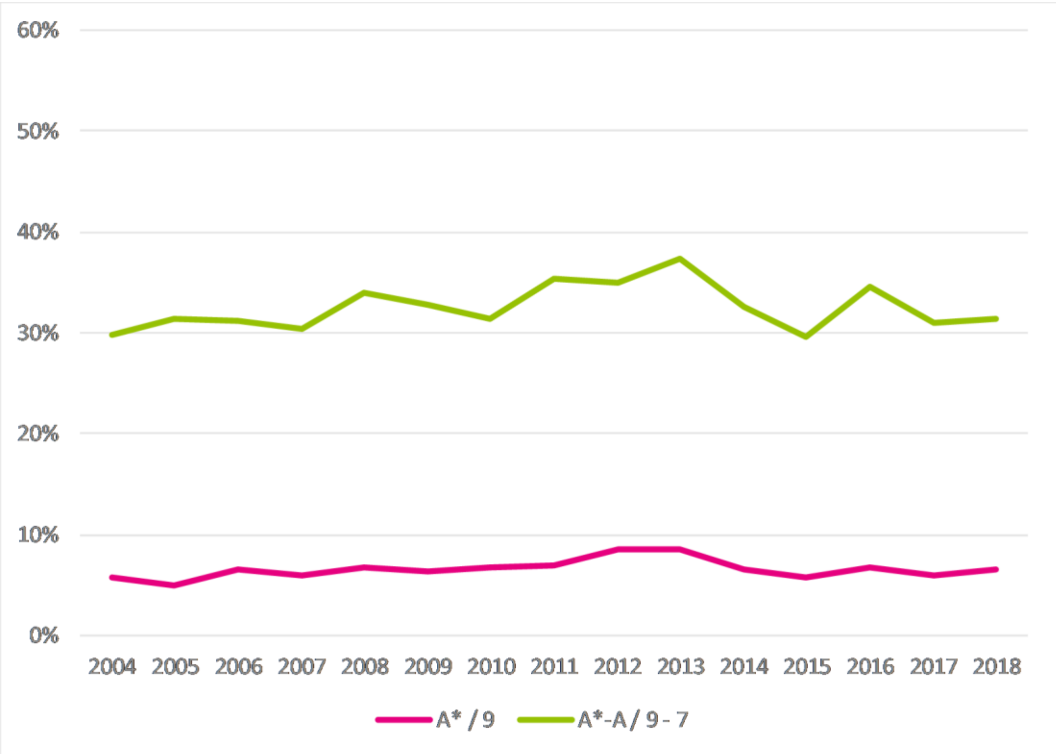


Figure 4.11: A-Level geology students by GCSE English grade range, 2004-18



5 Reach of the A-Level geology CPD course

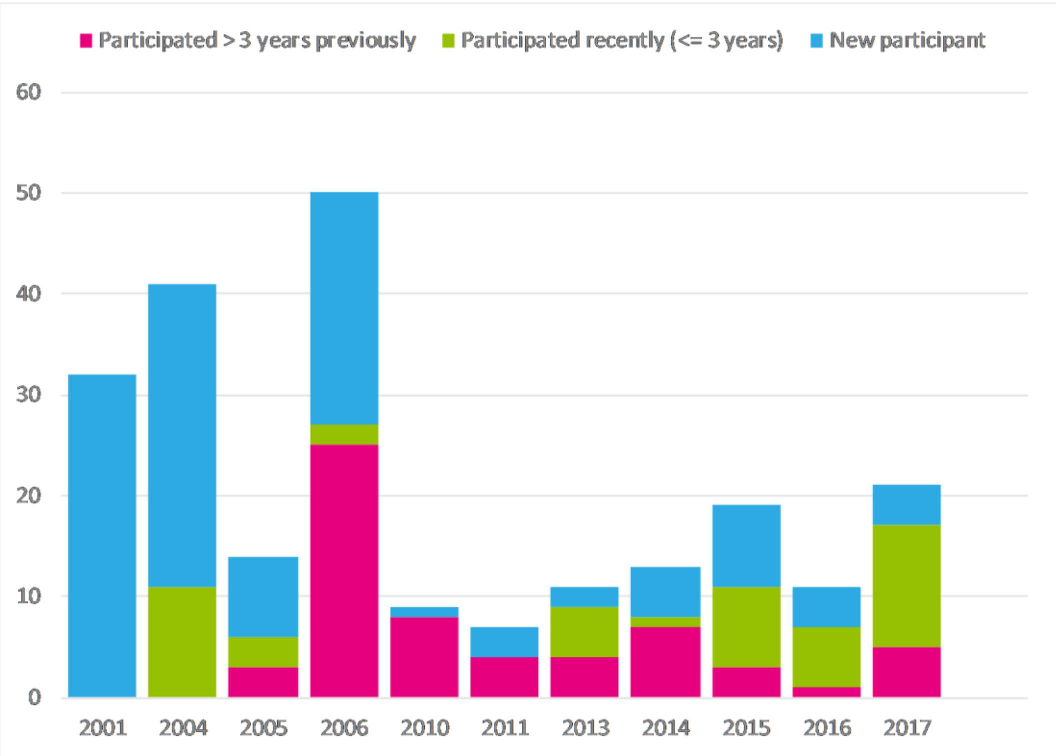
In this section, we review the reach of the University of Liverpool CPD course for A-Level geology teachers between November 2000 and June 2017. Appendix 2 includes more detailed summary data tables and additional graphs.

5.1 Overview

The course ran once or twice per academic year during this period, with the exception of 2002-03, 2007-09 and 2012. It was open to all UK schools and colleges, and also accepted participants from one university and an educational field centre.

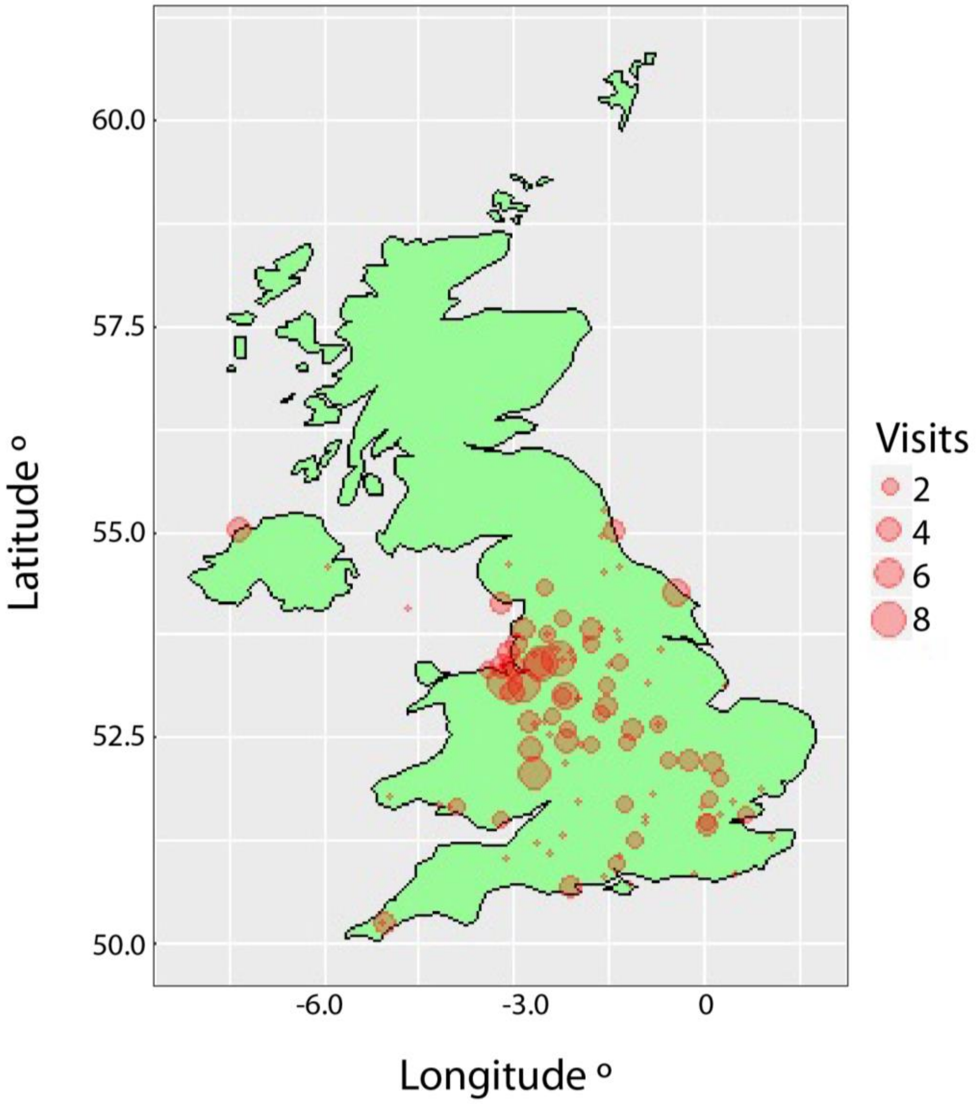
In total, teachers from 127 establishments participated in the course during this period. Repeat participation was common; 43% of establishments participated more than once, and nearly a fifth (18%) participated on three or more occasions. The course also continued to attract new establishments each year, as shown in figure 5.1.

Figure 5.1: Establishments in England participating in the CPD course by year and previous attendance, 2001-17



Establishments from all over the UK attended the course, although there were more visits from schools located in the North West and West Midlands - unsurprisingly, given the location of the course. Figure 5.2 shows the location of establishments that attended and the number of occasions that staff from those establishments attended the course.

Figure 5.2: Course attendees by location and number of visits

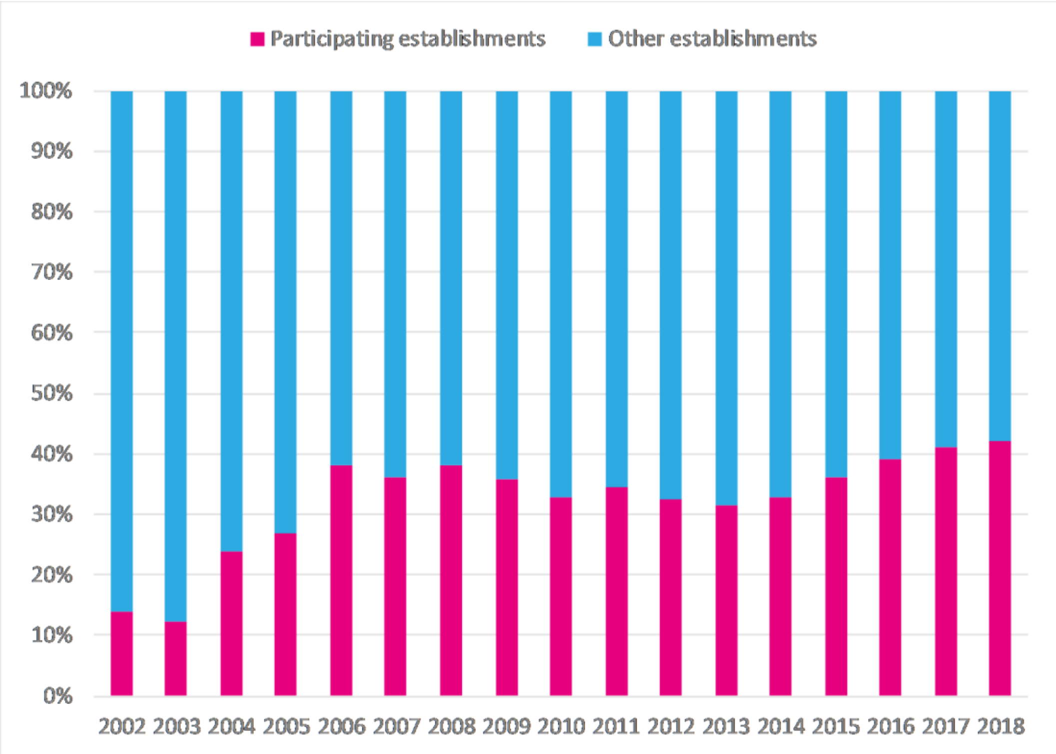


5.2 Proportion of establishments engaged

In this section, we establish the proportion of those schools and colleges that offer A-Level geology that have attended the course. This analysis will use the National Pupil Database, which only includes data on students who attended state-funded or independent establishments in England. For this reason, we have excluded establishments from the rest of the UK from this section of the evaluation.

Teachers from 106 schools or colleges in England took part in the course between 2001 and 2017. For the remainder of this section, these 106 establishments will be referred to as *participating establishments.* They made up 42% of establishments in England entering students for geology A-Level in 2018; a substantial proportion, as shown in figure 5.3. In every year since 2006, a third or more of establishments in England entering students for geology A-Level had participated in the course.

Figure 5.3: Proportion of those establishments that entered students for A-Level geology that had attended the CPD course, 2002-18



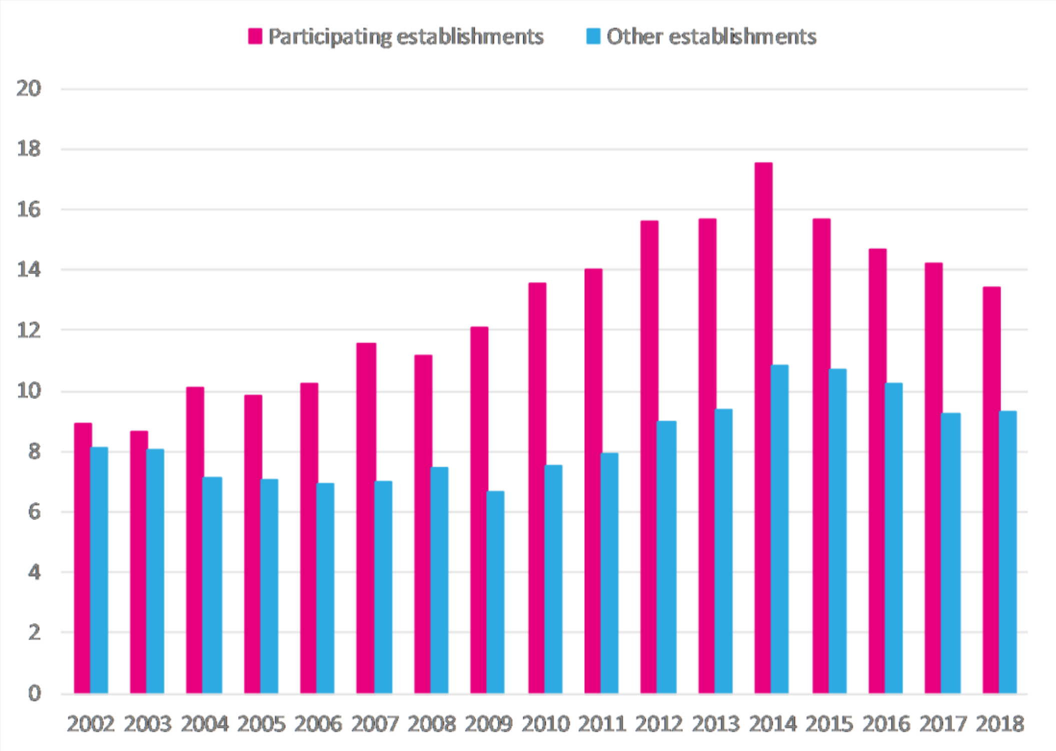
5.3 Number of student entries

Not every school that participated in the course entered students for A-Level geology every year. In 2018, for example, 50 of the 106 establishments that had ever participated did so. However, those participating establishments that did enter students tended to enter more than other establishments. In 2018, for example, the 50 participating establishments that entered students entered an average of 13 students each, compared to an average of 9 for other establishments.

5.4 Proportion of students engaged

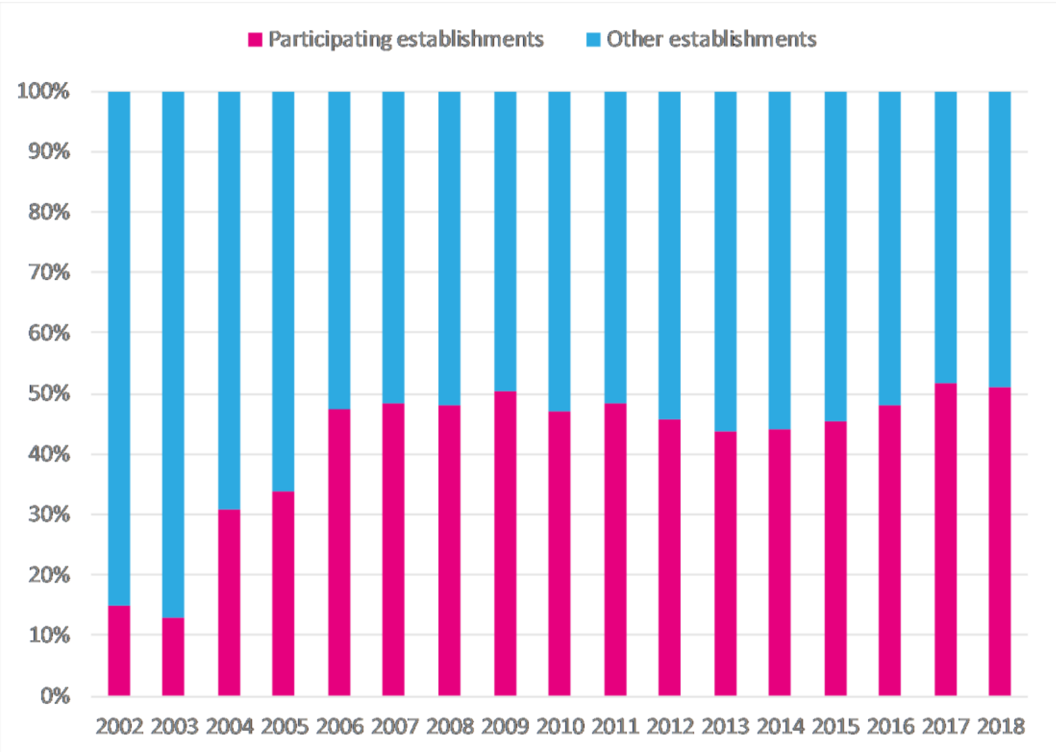
In both 2017 and 2018, the majority of A-Level geology students went to an establishment that had taken part in the course. In each year since 2006, between 44 and 52% of A-Level geology students attended an establishment which had participated in the course.

Figure 5.4: Mean number of students entered for A-Level geology by course attendance, 2002-18



This graph excludes schools and colleges in which no students took the subject.

Figure 5.5: Proportion of A-Level geology students who attended a school or college that had taken part in the CPD course, 2002-18



6 Impact evaluation of the A-Level geology CPD course

6.1 Methodology

This evaluation used what is known as a *quasi-experimental design.* This involves comparing the outcomes of schools and colleges that took part in the course to a matched control group of statistically similar establishments. This approach mimics what would be done in a formal experiment such as a randomised control trial.

We selected establishments that were similar with respect to:

- A-Level geology results in the three years prior to first participation
- Number of A-Level geology entrants in the three years prior to first participation
- Number of students (all subjects) in the first year of participation (this is a measure of school size)
- Average prior attainment at Key Stage 4 in the first year of participation

We used regression models to compare outcomes for establishments that took part in the course to those in the matched control group. In each case, we used a dummy variable to indicate whether a school or college had taken part in the course and we used the school characteristics described above as control variables. This *doubly robust* approach means that our results will remain unbiased if either the model used for matching or the regression model is misspecified. We obtained an average estimate and confidence intervals by bootstrapping.[7]

The impact of participating in the course was evaluated with respect to four outcomes between 2007 and 2018:

- Number of entries to A-Level geology
- Attainment in A-Level geology
- Progression to study geosciences at degree level
- Progression to study any STEM subject at degree level.

From this point onwards, we will refer to schools and colleges that took part in the course as *treated establishments*, and as all other schools and colleges that offered A-Level geology as *potential control establishments.*

6.2 Cohorts

The course ran regularly from November 2000 until May 2006. There was then a substantial break until 2010. To reflect this, we split the participants into two cohorts and evaluated them separately. The first cohort includes all schools and colleges that participated in the programme from 2000-06. The second includes all schools and colleges that participated from 2010 onwards. As the University has a particular interest in the outcomes of establishments that participated from 2014 onwards, we also evaluated these separately as a subset of the second cohort.

The various cohorts are detailed in table 6.1.

Table 6.1: Cohorts by years of participation and number of establishments

Cohort	Years of participation	Number of establishments

[7] Bootstrapping involves repeatedly creating a new dataset by taking a random sample from the original, then repeating the analysis using the fresh data. We found bootstrapped estimates for all models using 1000 iterations.

One	2000-06	81
Two	2010-17	48
Three	2014-17	37

Any establishments that were part of the first cohort, but did not participate again, were considered as potential control establishments for the second and third cohorts.

6.3 Differences between treated and potential control establishments

In this section, we review how the treated establishments compared to the potential control establishments before any matching was carried out.

Treated establishments tended to enter more students to A-Level geology than potential control establishments. In cohort two, for example, treated establishments entered an average of 11 students to A-Level geology in 2018 compared to 4 for potential control establishments. Although they also tended to have more A-Level students across all subjects (1,119 on average compared to 612 for cohort two in 2018), a greater proportion of A-Level students were studying geology in treated establishments than potential controls (0.9% compared to 0.6%, to one decimal place, for cohort two in 2018).

The average A-Level grade attained by students at treated establishments was slightly higher than that attained at potential control establishments. For cohort two in 2018, the average point score for treated establishments was 35.7, compared to 34.1 at treated establishments (both to one decimal place).[8] This difference in point scores is small; both point scores are equivalent to a grade between a C and a B, and difference between them is the equivalent to around a sixth of a grade.

However, students at treated establishments also tended to have achieved higher grades, on average, during Key Stage 4, before taking A-Levels. To show this, we can compare the average Key Stage 4 point score of students in treated establishments to that of students in potential control establishments.[9] For cohort two in 2018, the average point score across all GCSEs or equivalent at Key Stage 4 was 47.9, compared to 46.8 for control establishments.

Unsurprisingly, given the location of the course, a high proportion of the treated establishments were in the North West and the West Midlands. This was particularly the case for cohort two, in which 29% of treated establishments were in the North West and 23% in the West Midlands, compared to 14% and 11% of potential control establishments. Establishments in the East of England and the South West made up 12% and 13% of potential control establishments, but only 4% and 6% of treated establishments.

There were also some differences in school type. Course participants were more likely to be from sixth form colleges than potential control establishments. In cohort two, for example, a third of treated establishments were sixth form colleges, compared to only 7% of potential control establishments. The majority of potential control establishments were state-funded, non-selective schools (58%) but only 27% of course participants.

These differences between the treated and potential control establishments mean that we can't assume that the higher geology attainment and entry numbers seen in treated establishments are

[8] Average points scores relate to letter grades as follows: A*: 60, A: 50, B: 40, C: 30, D: 20, E: 10

[9] A student's Key Stage 4 point score is simply the total number of points scored by that student across all Key Stage 4 qualifications. So if, for example, a student attained nine GCSEs, all at grade 5, their Key Stage 4 point score would be 45.

related to participation in the course. They may be, but they may also be influenced by these other differences. Creating a matched control group that is statistically similar to the treated group will allow us to control for these differences and evaluate the impact of the course.

6.4 Mitigation of confounding effects

Our approach aims to mitigate for the differences, or *confounding effects,* identified in section 6.4 by creating a matched control group that was statistically similar to the group of treated establishments.

Using the nearest neighbour method, we selected a matched control school for each treated school with Euclidean distance as our distance measure.

The National Pupil Database did not began collecting data until 2002. As data on A-Level geology results for three years prior to participation was required for matching, this meant that we were unable to include the 68 establishments that first took part in the course before 2006 in this evaluation.

We assessed how similar the treated and control establishments were to one another, before and after matching, using a measure called the *standardised mean difference.* The mean difference is simply the difference between the average value of the variable for the treated establishments, and the average value for the control establishments. Standardising this measure means that we can compare balance across different variables.

Generally, a standardised mean difference of 0.2 or below is considered to indicate good balance. In this case, although the control groups that we created are much more similar to the treated establishments, some differences above the threshold did remain.

This is because this type of evaluation relies on creating a matched control group that is sufficiently statistically similar to the schools and colleges that took part in the course. In this case, we had to draw our control group from the group of establishments that entered students for A-Level geology, but had not ever taken part in the course. As we saw in section 5, this is a limited pool, particularly in later years; by 2018, 42% of the establishments offering geology had taken part in the course. So, particularly in more recent years, there are not that many potential control establishments to choose from, and for some treated establishments there simply isn't any control school available that is a close match. In such cases, we chosen the closest possible match.

Because of these limitations with the matching process, the results given below should be considered tentative.

6.5 Results

We used multilevel regression models to compare outcomes in treated establishments to outcomes in the matched control schools. We looked at four different outcomes over the period 2007-2018: number of entries to A-Level geology, attainment at A-Level geology, entries to study geosciences at degree levels, and entries to study any STEM subject at degree level.

As discussed above, we were unable to include establishments that first took part in the course before 2006 in the evaluation as the data included in the National Pupil Database is insufficient for matching. Therefore, the first outcome year that we consider is 2007. We evaluated outcomes for three years after the last year of cohort one; this may indicate if there are any longer-term effects.

We were also unable to evaluate outcomes in 2011, the first year after cohort two began. This is because only eight establishments based in England participated in the course in the first year of cohort two; this has not given us sufficient data to fit a model.

The outcome years that were evaluated for each cohort are shown in table 6.3.

Table 6.2: Cohorts by year of participation and outcome year

Cohort	Years of participation	Outcome years
One	2000-06	2007-09
Two	2010-17	2012-18
Three	2014-17	2015-18

6.5.1 Entries to A-Level geology

These results were obtained using a linear regression model, controlling for the number of A-Level entrants in an establishment, establishment type and region. Estimates of the impact of a school or college attending the CPD course on the number of A-Level geology entries from that school are summarised in figure 6.1, and shown in full in table 6.3, with 90% confidence intervals (all to 2 decimal places). The table also includes a column showing the number of treated establishments that were evaluated for each cohort and outcome year.

We would estimate that, for example, for cohort two in 2018 there would be 1.37 more students entering A-Level geology in a treated school than in a control school. In other words, schools and colleges that took part in the course had 1.37 more A-Level geology students in 2018, on average, than statistically similar establishments that did not take part. However, as this confidence interval contains zero, we would say that this result is not statistically significant.

The results shown do not provide evidence that participating in the course has an effect on A-Level entries. In some years, the estimated effect on A-Level entries was positive and in some years it was negative, but none of the results were statistically significant. Hence, the results are inconclusive.

Figure 6.1: Estimated impact of the participation in the course on number of entries to A-Level geology, by cohort and outcome year

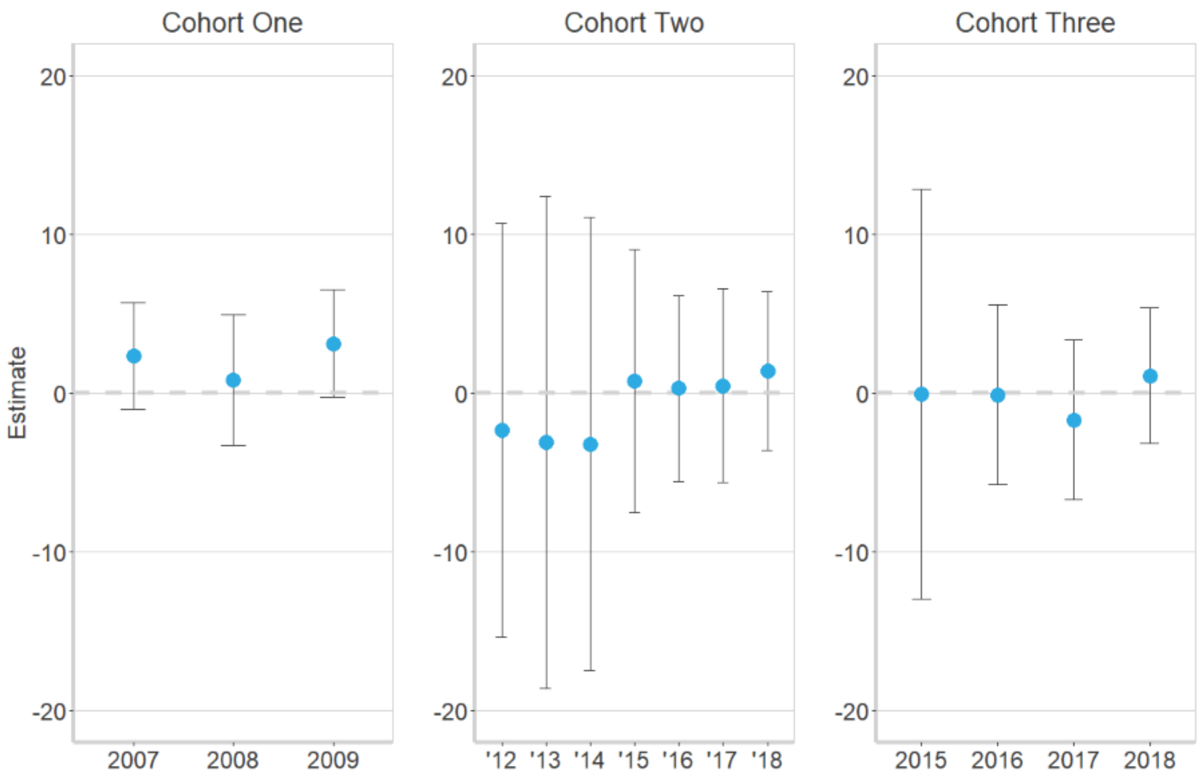


Table 6.3: Estimated impact of the participation in the course on number of entries to A-Level geology, by cohort and outcome year

Cohort	Year	Estimate	Lower CI	Upper CI	No. establishments
One	2007	2.36	-0.99	5.72	22
One	2008	0.83	-3.27	4.93	22
One	2009	3.11	-0.26	6.49	22
-					
Two	2012	-2.35	-15.38	10.68	11
Two	2013	-3.10	-18.60	12.40	11
Two	2014	-3.21	-17.48	11.06	15
Two	2015	0.76	-7.53	9.05	24
Two	2016	0.29	-5.54	6.13	30
Two	2017	0.46	-5.64	6.55	33
Two	2018	1.37	-3.61	6.36	39
-					
Three	2015	-0.05	-12.95	12.85	14
Three	2016	-0.10	-5.74	5.55	20
Three	2017	-1.69	-6.73	3.35	23
Three	2018	1.10	-3.17	5.37	29

6.5.2 Attainment at A-Level geology

These results were obtained using a multilevel regression model, pupils within establishments, controlling for prior attainment, gender and disadvantage.

Estimates of the impact of a school or college attending the CPD course on the attainment of A-Level geology students at that school are summarised in figure 6.2, and shown in full in table 6.4, with 90% confidence intervals (all to 2 decimal places). Attainment is measured here in average point scores. [10]

The table also includes a column showing the number of treated establishments were evaluated for each cohort and outcome year. Any treated establishments that did not enter any students for A-Level geology in the relevant outcome year were excluded.

We would estimate that, for cohort two in 2018, for example, attainment in A-Level geology would be 0.65 points higher in a treated school than in a control school. This is the equivalent of around a fifteenth of a grade. However, as this confidence interval contains zero, we would say that this result is not statistically significant.

These results provide some evidence that participating in the CPD course has a positive effect on attainment in A-Level geology. However, they do not show a consistent effect. Of the estimated effects shown in table 6.4, most are positive, but some are negative, although none of the negative effects are statistically significant. There are some significant positive effects for cohort one in 2007 and 2008, for cohort two in 2014, 2016 and 2017, and for cohort three in 2017. These significant effects range in size from the equivalent of around 1/7 of a grade for cohort one in 2008 to nearly 1/3 of a grade for cohort two in 2017.

[10] Average points scores relate to letter grades as follows: A*: 60, A: 50, B: 40, C: 30, D: 20, E: 10

Figure 6.2: Estimated impact of the participation in the course on A-Level geology attainment, by cohort and outcome year

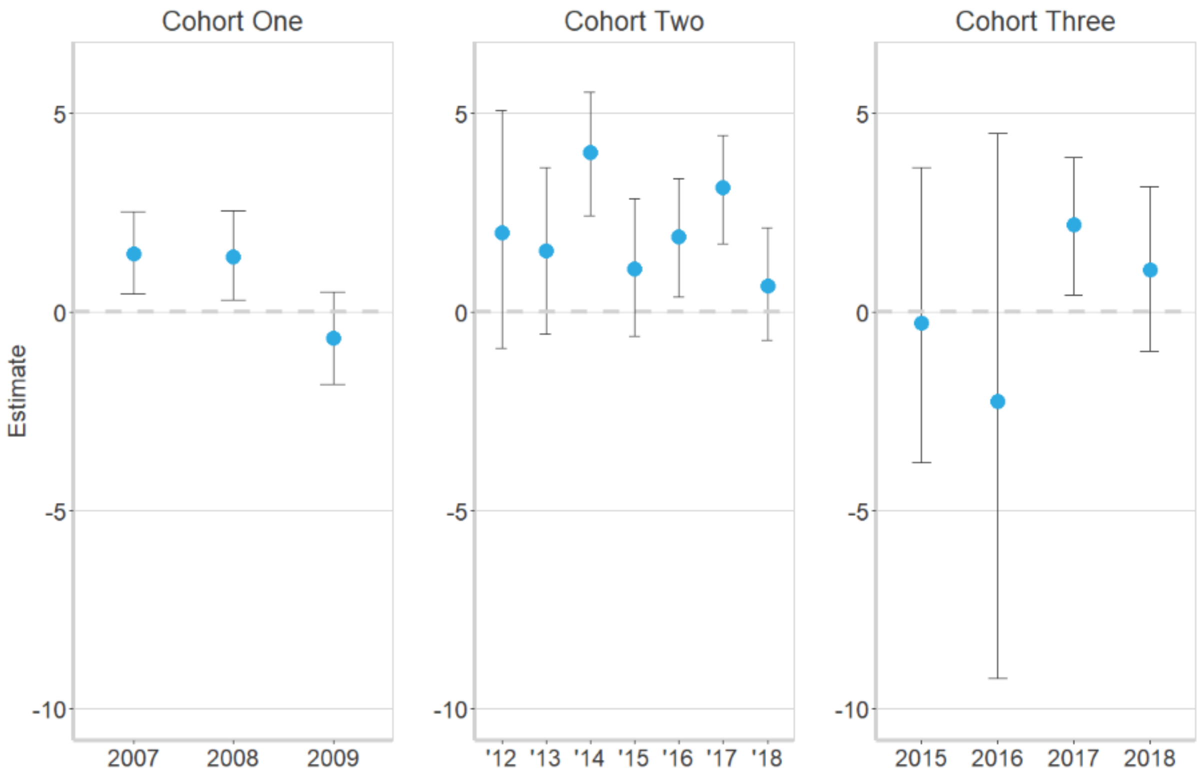


Table 6.4: Estimated impact of the participation in the course on A-Level geology attainment, by cohort and outcome year

Cohort	Year	Estimate	Lower CI	Upper CI	No. establishments
One	2007	1.46	0.45	2.53	21
One	2008	1.40	0.29	2.55	22
One	2009	-0.65	-1.82	0.50	21
-	-				
Two	2012	2.00	-0.90	5.08	9
Two	2013	1.55	-0.55	3.63	9
Two	2014	4.01	2.43	5.54	14
Two	2015	1.09	-0.60	2.86	21
Two	2016	1.89	0.37	3.37	27
Two	2017	3.13	1.72	4.44	28
Two	2018	0.65	-0.71	2.13	29
-	-				
Three	2015	-0.27	-3.79	3.65	14
Three	2016	-2.25	-9.24	4.49	19
Three	2017	2.21	0.44	3.90	21
Three	2018	1.07	-0.98	3.15	23

6.5.3 Progress to geosciences at degree level

In this section we look at how likely A-Level geology students were to progress to study a geoscience subject at university. These results were obtained using a multilevel logistic regression model, pupils within establishments, controlling for prior attainment, and gender.

We would usually also control for disadvantage, here defined as students who are eligible for Pupil Premium. However, as we will see in the demographics section, very few disadvantaged students take A-Level geology (34 students in 2017). Even fewer progress on to study geoscience, in some years none at all. This makes it technically impossible to control for disadvantage as well as other factors like gender. For this reason, these results may underestimate the effect of the course for establishments with a high proportion of disadvantaged A-Level geology students.

Estimates of the impact of a school or college attending the CPD course on likelihood of students from that school progressing to study geology at degree-level are summarised in figure 6.3, and shown in full in table 6.5, with 90% confidence intervals (all to 2 decimal places). The table also includes a column showing the number of treated establishments that were evaluated for each cohort and outcome year. Any treated establishments that did not enter any students for A-Level geology in the relevant outcome year were excluded.

Outcomes here do not include 2018. This is because the most recent HESA data available on progression to university is from 2018; students starting university in the 2017/18 academic year would have taken their A-Levels in the 2016/17 academic year at the latest.

The estimates in table 6.5 are given in the form of odds ratios.[11] These indicate whether the odds of a student from a treated school going on to study geoscience are higher than the odds of a student from a control school doing so. An odds ratio of one means that the odds are the same, a ratio of more than one means they are higher, and less than one that they are lower.

So, for example, in 2017 the odds ratio is 1.07. This indicates that the odds of a student from a treated school going on to study geosciences at degree level were slightly higher than those of a students from a control school. As this confidence interval contains one, we would say that this result is not statistically significant.

These results do not provide evidence that participating in the course has an effect on the likelihood of students studying geology at degree level. Some of the estimates shown in table 6.5 indicate that the odds of students progressing to study geology were higher in establishments that attended the course, but some indicate that they were lower. None of the results were statistically significant. Hence, the results are inconclusive.

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[11] Odds ratios are the ratio of the odds for two groups. The example below explains how they are calculated.

If the probability of a student from a treated school going on to study geoscience was 33%, then the probability of them not going on to study geoscience would be 67%. The odds of a student from a treated school going on to study geoscience would therefore be 33 / 67 = 0.49 (to 2 decimal places). Similarly, if the probability of a student from a control school going on to study geoscience was 20%, then the odds would be 20 / 80 = 0.25.

The odds ratio between treated and control schools would be 0.49 / 0.25 = 1.96 (to 2 decimal places). As this is greater than one, it tells us that in this example, the odds of a student from a treated school going to study geosciences are higher than the odds of a student from a control school.

Figure 6.3: Estimated impact of the participation in the course on progression to study geology at degree level, by cohort and outcome year

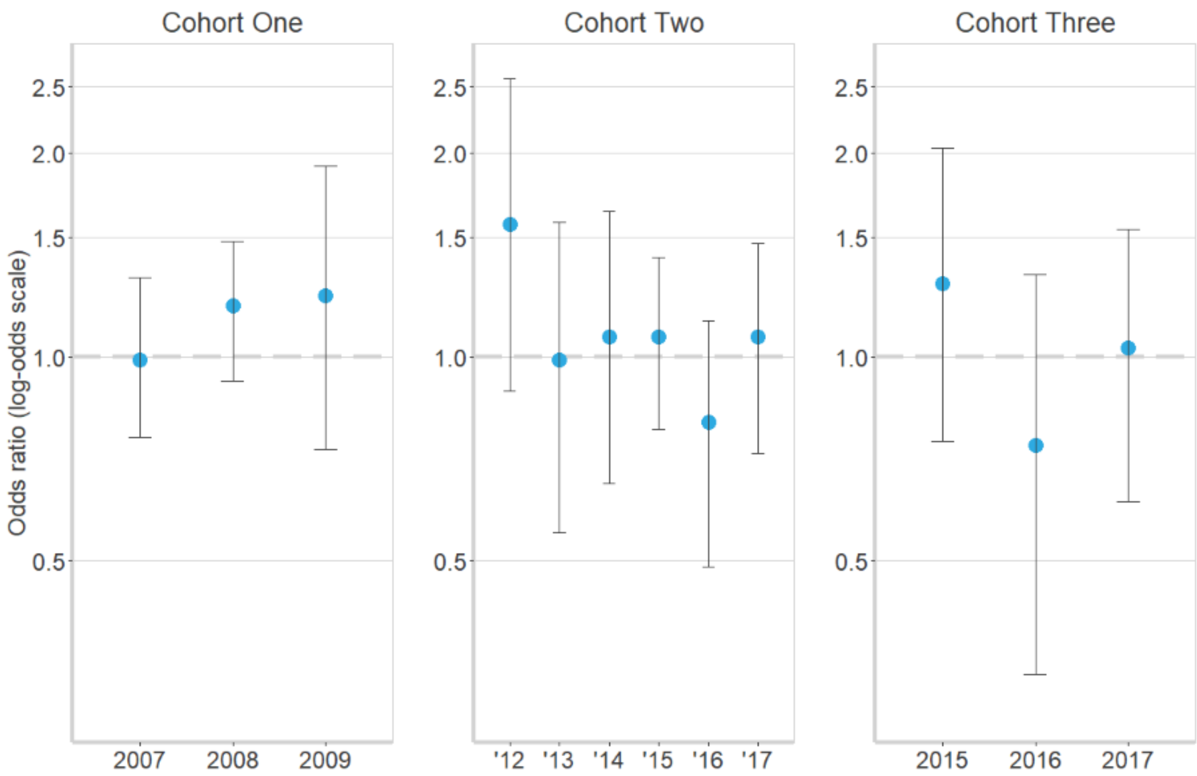

Table 6.5: Estimated impact of the participation in the course on progression to study geology at degree level, by cohort and outcome year

Cohort	Year	Estimate	Lower CI	Upper CI	No. establishments
One	2007	0.99	0.76	1.31	21
One	2008	1.19	0.92	1.48	22
One	2009	1.23	0.73	1.91	21
-	-				
Two	2012	1.57	0.89	2.57	9
Two	2013	0.99	0.55	1.58	9
Two	2014	1.07	0.65	1.64	14
Two	2015	1.07	0.78	1.40	21
Two	2016	0.80	0.49	1.13	27
Two	2017	1.07	0.72	1.47	28
-	-				
Three	2015	1.28	0.75	2.03	14
Three	2016	0.74	0.34	1.32	19
Three	2017	1.03	0.61	1.54	21

6.5.4 Progress to STEM at degree level

These results were also obtained using a multilevel logistic regression model, pupils within establishments, controlling for prior attainment and gender. As for progress to geosciences, we would ideally also have controlled for disadvantage but were unable to do so for technical reasons.

Estimates of the impact of a school or college attending the CPD course on likelihood of students from that school progressing to study STEM at degree-level are summarised in figure 6.3, and shown in full in table 6.5, with 90% confidence intervals (all to 2 decimal places). The table also includes a column showing the number of treated establishments that were evaluated for each cohort and outcome year. Any treated establishments that did not enter any students for A-Level geology in the relevant outcome year were excluded.

Outcomes here do not include 2018. This is because the most recent HESA data available on progression to university is from 2018; students starting university in the 2017/18 academic year would have taken their A-Levels in the 2016/17 academic year at the latest.

As with the estimates for progress to study geosciences, these estimates are given in the form of odds ratios. They can be interpreted as showing how much more likely a student from a treated school would be to progress to study STEM than a student from a control school. An odds ratio of one means that there is no difference in the likelihood, a ratio of more than one means they are more likely, and less than one that they are less likely.

So, for example, in 2017 the odds ratio is 1.02. This indicates that the odds of a student from a treated school going on to study geosciences at degree level were slightly higher than those of a students from a control school. As this confidence interval contains one, we would say that this result is not statistically significant.

These results do not provide evidence that participating in the course has an effect on the likelihood of students studying STEM at degree level. Some of the estimates shown in table 6.6 indicate that the odds of students progressing to study STEM were higher in establishments that attended the course, but some indicate that they were lower. There is just one statistically significant result, for cohort two in 2012. However, the lower confidence interval for this estimate is just 1.01. Therefore, despite the one statistically significant result, overall the results are inconclusive.

Figure 6.4: Estimated impact of the participation in the course on progression to study STEM at degree level, by cohort and outcome year

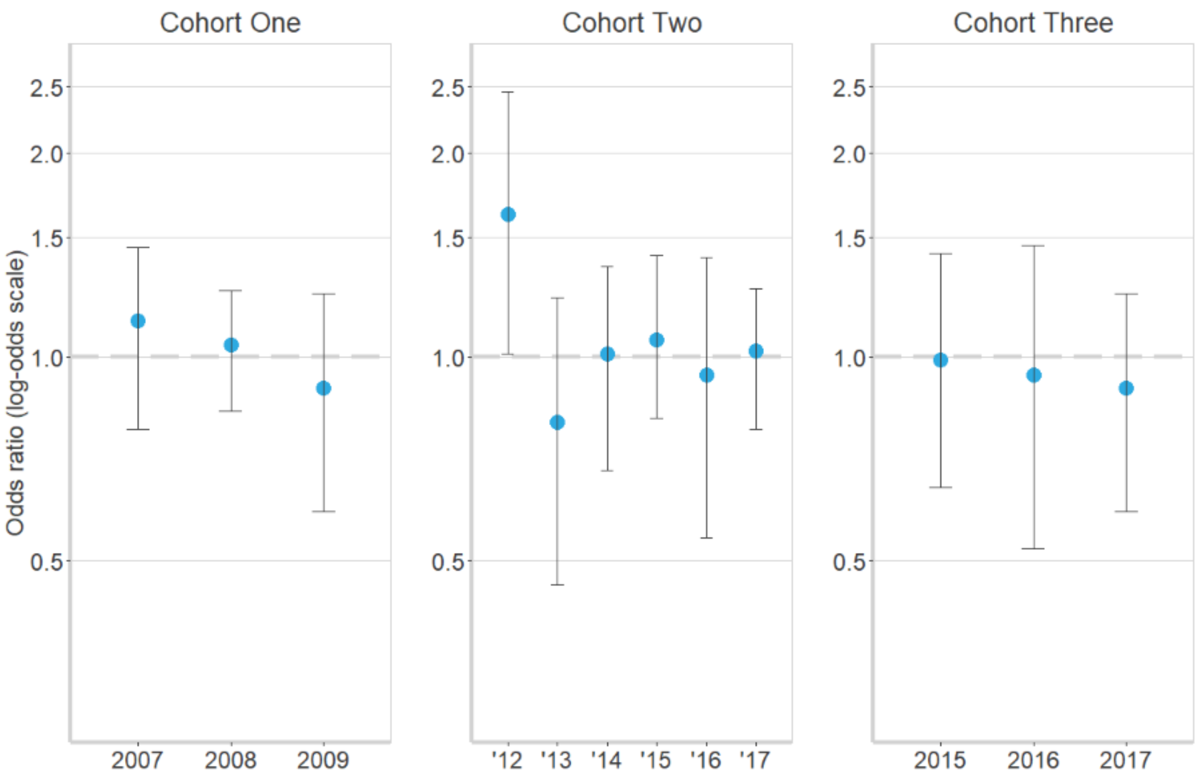

Table 6.6: Estimated impact of the participation in the course on progression to study STEM at degree level, by cohort and outcome year

Cohort	Year	Estimate	Lower CI	Upper CI	No. establishments
One	2007	1.13	0.78	1.45	21
One	2008	1.04	0.83	1.25	22
One	2009	0.90	0.59	1.24	21
-					
Two	2012	1.62	1.01	2.46	9
Two	2013	0.80	0.46	1.22	9
Two	2014	1.01	0.68	1.36	14
Two	2015	1.06	0.81	1.41	21
Two	2016	0.94	0.54	1.40	27
Two	2017	1.02	0.78	1.26	28
-	-				
Three	2015	0.99	0.64	1.42	14
Three	2016	0.94	0.52	1.46	19
Three	2017	0.90	0.59	1.24	21

6.6 Limitations

This impact evaluation was subject to a number of limitations, and for this reason we would consider the results to be tentative.

Perhaps most importantly, the low number of establishments offering A-Level geology and the high proportion of those establishments that had attended the course meant that the pool of potential control establishments was small, and the control group constructed was not as closely matched to the treated group as would ideally be the case.

Similarly, because relatively few establishments took the CPD course each year, some of the models are based on quite a small amount of data. The cohort two estimates for 2012, for example, were based on just 11 treated and 11 control establishments. Those estimates that are based on smaller amounts of data tend to have very wide confidence intervals, meaning we do not get very much meaningful information from the estimates. For cohort two in 2012, we estimate that the impact on A-Level entries is between -15.38 and 10.68; that is, establishments that attended the course might enter anywhere from 15 less students each to 11 more students each to A-Level geology, compared to matched controls. The interval is too wide to tell us much about the impact of the course.

Using a quasi-experimental approach based on administrative data, as we have done here, has a number of inherent limitations. The construction of our control group was based on data recorded in the National Pupil Database, which is limited in scope. For example, it does not include information about social class, parental occupations or school funding levels. Not accounting for factors such as these, that were not observed or recorded in our data, may introduce bias into our estimates.

Some control establishments may have taken part in similar courses or other relevant CPD. If this was the case, our analysis would not be an evaluation of the CPD course against no equivalent support, but instead against no support in some cases and other, similar support in the rest. This could lead us to underestimate the effect of taking part in the course, assuming that the equivalent support had a positive effect on some control establishments' outcomes. We would note, however, that not controlling for this effect may be the relevant analysis as it represents an evaluation of the CPD course against current conditions, with establishments' choices to engage with other CPD being included in the makeup of controls.

The effects observed in the impact evaluation should be considered tentative given these limitations.

7 Conclusions

7.1 Trends in A- and AS-Level geology

A-Level geology had a surge in popularity in England between 2009 and 2014, but since then has been declining. Although more students entered A-Level geology during those years, the number of establishments entering students remained relatively stable; it was not the case that more establishments were offering geology, but rather that those that did were entering more students. However, since 2014 both the number of students taking A-Level geology and the number of establishments offering the subject have fallen, to a low of 1,313 students in 119 establishments in 2018.

Since 2002, geology has tended to be a male-dominated subject, but the proportion of female students has increased in recent years, standing at 35% in 2018. It also tends to be a subject with a low proportion of disadvantaged students and one in which students had attained strong grades at GCSE, particularly in maths.

A-Level geology is more popular in some areas of England than others. In 2018, around a fifth (19%) of A-Level geology students attended establishments in the North West and 17% in the South West, but just 3% in London, 7% in the North East and 7% in the East Midlands.

7.2 Reach of the A-Level geology CPD course

The course has remained popular even as A-Level geology entries have declined. In 2018, 42% of the 119 establishments that entered students for A-Level geology had attended the course. In the same year, 52% of A-Level geology students attended a school or college that had participated.

Since 2017, the majority of A-Level geology students have attended a school or college that has participated in the course. Although some course participants do not go on to offer A-Level geology every year, when course participants do continue to offer the subject they enter more students than other schools and colleges that offer the subject.

7.3 Impact evaluation of the A-Level geology CPD course

The impact evaluation found evidence of a positive effect on A-Level attainment in some of the outcome years, of between 1/7 and nearly 1/3 of a grade. It did not find clear evidence that attending the course had a positive effect on any of the other outcomes considered. However, this evaluation was subject to a number of limitations.

Perhaps the most serious limitation was the limited pool of potential control establishments, caused by the relatively low number of establishments entering A-Level geology and the high proportion of those establishments that had attended the course. With a limited pool to draw from, we were unable to produce a control group that was ideally matched to the course participants.

For this reason, along with the other limitations described in section 6.6, we would be tentative in asserting that the results of this evaluation represent the true size of the impact of the course.