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CaSE
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Socioeconomic Diversity in STEM Higher Education

Summary:

Amongst undergraduate students, a better-than-average level of socioeconomic status (SES) diversity was found in the Biological and Computer sciences.

However, in the Physical, Mathematical, Engineering and Technological sciences, degree courses showed significantly lower socioeconomic diversity than the Higher Education average. The science, technology, engineering and maths (STEM) community, along with government, has a responsibility to recognise these trends and ensure fair access to STEM education for people from all backgrounds.

Introduction:

How do individuals from lower socioeconomic backgrounds fare in their opportunities to pursue STEM undergraduate degrees at UK higher education institutions? This short study shows that it may depend partly on their choice of subject.

Our starting point is the belief that having a diverse intake leads to a more innovative and responsive STEM workforce. Moreover, as a largely publicly-funded institution, UK higher education has a responsibility to maintain fair access to all parts of society.

With the price of Higher Education rising to up to £9,000 per annum, it is especially important to ensure that social background does not influence a student's opportunities to pursue a STEM career or to study STEM subjects. Given that those working in STEM occupations earn almost 20% more than those working in other fields[i], access to STEM subjects should be entirely merit-based.

Unfortunately, lower socioeconomic status may still be a barrier to STEM education. In this report, we used data collected by the Higher Education Statistics Agency (HESA[ii]), to investigate the socioeconomic diversity of UK students embarking upon STEM degrees between 2004 and 2010.

There are obvious limitations to this approach – for instance, it doesn't take into account regional or institutional variability. Nor does it give clues to the reasons behind the variation – for instance, it may be affected by the profile of universities which tend to offer STEM degrees. Our findings should not suggest that well-performing disciplines do not still need to improve, as the comparator we are using is the average across Higher Education. Nevertheless, some of the results are a cause for concern.

Main Findings

- We examined a number of measures of socioeconomic diversity:
    a. Proportion of students from lower socio-economic backgrounds
    b. Proportion of students from state-school backgrounds
    c. Proportion of students from low higher-education participation neighbourhoods
    (For mature students, only the latter of these is available)

- We found an encouraging rise in the proportion of non-mature students (i.e. under 21 years old) entering Higher Education ('HE') judged against each of these metrics.

- This general improvement across Higher Education from 2004 to 2010 (see additional materials for 1998-2004 figures) also applied to STEM students.

Biological Sciences & Computer Sciences – better than average:

- Biological and Computer sciences were responsible for much of the overall improvement in STEM, consistently attracting a greater than average (across all HE subjects) proportion of young people from lower socioeconomic backgrounds, state schools, and low-participation neighbourhoods.

- For mature students (over 21 years old), Biological and Computer sciences again performed better than the HE average.

Physical and Mathematical Sciences – below average, but better for mature students:

- The proportion of non-mature students from lower socioeconomic backgrounds and low-participation neighbourhoods studying Physical and Mathematical sciences was consistently lower than the average across all subjects, and did not appear to be rising in line with the overall average.

- Although the proportion of young students studying Mathematics from state schools was in line with the average across all subjects, the proportion studying Physics was consistently lower, and neither rose significantly over time.

- In contrast to the results for young students, the proportion of mature students hailing from low-participation neighbourhoods studying Mathematical and Physical sciences was generally greater than the average across all subjects.

Engineering and Technology – mixed picture, but needs improvement

- The proportion of young students from lower-socioeconomic backgrounds and state schools enrolling in Engineering and Technology subjects was largely in line with the average across all subjects.

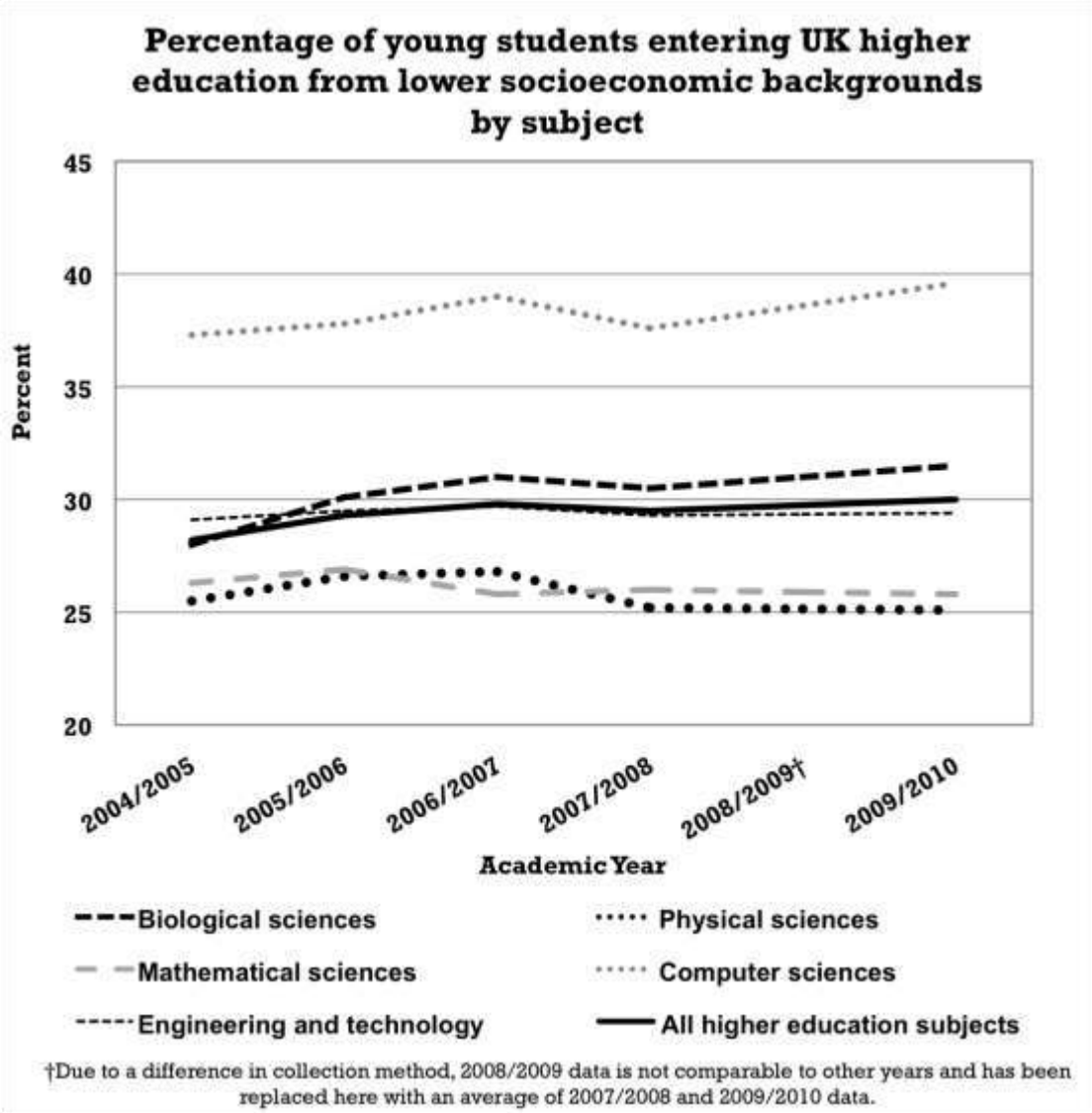
- The proportion of young students hailing from low-participation neighbourhoods enrolling in Engineering and Technology subjects was consistently lower than the average across all subjects.

- The proportion of mature students hailing from low-participation neighbourhoods studying Engineering and Technological sciences in line with the average across all subjects.

Percentage of young students entering UK higher education from lower-socioeconomic backgrounds by subject: academic years 1998/1999 to 2009/2010

	Biological sciences	Physical sciences	Mathematical sciences	Computer sciences	Engineering and technology	All subjects
2004/2005	*28.0*	*25.5*	*26.3*	*37.3*	*29.1*	*28.2*
2005/2006	*30.1*	*26.6*	*26.9*	*37.8*	*29.5*	*29.3*
2006/2007	*31.0*	*26.8*	*25.8*	*39.0*	*29.7*	*29.8*
2007/2008	*30.5*	*25.2*	*26.0*	*37.6*	*29.3*	*29.5*
2008/2009†	*33.8*	*27.4*	*27.0*	*38.9*	*31.1*	*32.3*
2009/2010	*31.5*	*25.1*	*25.8*	*39.6*	*29.4*	*30.0*

Notes: Data from HESA, defining lower SES groups as NS-SEC Classes 4, 5, 6 and 7. †Due to differences in the collection method, 2008/2009 data is not directly comparable with other years.



What next?

Although our analyses have found the social backgrounds of Biological and Computer sciences UK undergraduates to be fairly diverse, Physical, Mathematical, Engineering and Technological sciences showed lower than average levels of diversity.

CaSE has previously discussed possible reasons for the underrepresentation of students from lower-socioeconomic backgrounds in STEM subject areas[iii]. For instance:

- The UK's shortage of specialist science and mathematics teachers is particularly pronounced in socially-disadvantaged areas[iv].

- "Triple science" GSCEs (biology, chemistry, and physics as separate subjects) are more commonly available to pupils in independent rather than in state schools[v].

- Independent school pupils are over-represented in entries for science and maths at A-level, whereas state school pupils are over-represented amongst arts and humanities subjects for the same[vi].

- Students from lower-socioeconomic backgrounds may be forced to study at local universities while living in the family home for financial reasons. We know that previous increases in university fees have led to more students from some backgrounds studying at a local university[vii]. A restricted choice of university may lead to a restricted choice of STEM courses. For example, whilst 116 UK universities offer degree courses in the Biological sciences, only 58 offer some variety of Physical sciences degree[viii].

- STEM applicants may be more reliant on skill and knowledge, as opposed to potential, possibly disadvantaging those students from poorer schools.

At CaSE, we believe that science and engineering are essential to the UK's society and economy. It is important that everyone with the ability and inclination is given the opportunity to study STEM subjects. Indeed, we speculate that one of the reasons for some STEM subjects performing better on socio-economic diversity amongst mature entrants (e.g. engineering and maths in particular) is that older students who missed out first time round better recognise the potential of these subjects than their younger counterparts.

We hope the Department for Education's 2011 pledge to recruit more specialist science and mathematics teachers will be fulfilled[ix], and will specifically target areas in need of the most help.

Although the number of pupils studying separate sciences at GCSE has risen in recent years[x], this may be largely due to the specialist science schools network, which has now had its funding withdrawn. We feel it only fair that all pupils in all schools, not just some, have the opportunity to study triple science at GCSE, and we hope the Government will redouble its efforts to make this a reality.

With tuition fees rising, UCAS figures have shown a slight decrease in university applications this year[xi]. However they did not show the disproportionate drop in applications from low SES individuals or in STEM, which bodes well for diversity. Most universities offer bursaries, with some specifically aimed at STEM subjects. To maintain and improve upon current levels of diversity, it is imperative that students are well informed about available financial assistance before they consider undergraduate study. We argue that additional STEM-specific bursaries should be developed, targeted at schools[xii], and that more universities, especially those in less traditionally academic areas, consider opening or re-opening STEM departments.

We further recommend that research is done to understand why the differences between these subjects exist, and what can be learned from well-performing subjects in terms of improving socio-economic diversity in those that do not fare as well.

Methodology

Data Collection

Figures for the percentage of students by subject-type from lower-socioeconomic classes and from low participation neighbourhoods were obtained from the HEFCE website[xiii] for academic years 1998/1999 to 2001/2002, and from the HESA website[xiv] for academic years 2002/2003 to 2009/2010. HEFCA and HESA gathered their data from the UCAS and HESA records. As the current subject categories used were defined in 2004/2005, only data from 2004/2005-2009/2010 were included in the main analyses. Figures from 1998/1999 – 2003/2004 have been included as additional materials.

Measures

Lower socioeconomic status classification 1998/1999 to 2001/2002

HEFCE assessed the widening participation of lower-socioeconomic status groups in HE by focusing on students whose parents' professions fell into classes IIM, IV and V of the 1990 Standard Occupational Classification (SOC):

Social Class	Description
I	Professional
II	Intermediate
IIIN	Skilled non-manual
IIIM	Skilled manual
IV	Semi-skilled manual
V	Unskilled manual

Lower socioeconomic status classification 2002/2003 to 2009/2010

From 2002/2003, socioeconomic status was assessed using the Office of National Statistics Socioeconomic Classification (NS-SEC) and is therefore not directly comparable with the previous SOC measure. HESA assessed widening participation of lower-socioeconomic status groups by focusing on students whose parents' professions fell into classes 4, 5, 6 and 7 of the NS-SEC:

Socioeconomic groups	Description
1	Higher managerial and professional occupations
2	Lower managerial and professional occupations
3	Intermediate occupations
4	Small employers and own account workers
5	Lower supervisory and technical occupations
6	Semi-routine occupations
7	Routine occupations
8	Never worked and long-term unemployed

In the academic year 2008/2009, the question relating to NS-SEC on the UCAS application form changed, reverting back to the original format again in 2009/2010. This makes the 2008/2009 data incomparable with other years, and so in line with HESA's recommendation, we excluded the 2008/2009 socioeconomic status data from our analyses.

Type of school

Previous institution attended was classed as a state school if it did not qualify as 'independent'. Students from sixth-form or further education colleges are therefore included as being from state schools.

Low Participation Neighbourhood classification

Between 1998/1999 and 2005/2006, low-participation neighbourhoods were defined using the Super Profiles method as those areas with HE participation rates less than two-thirds of the national average. Between 2006/2007 and 2009/2010, low-participation neighbourhoods were defined using the POLAR2 method as those neighbourhoods falling in the lowest 20% of the UK in terms of HE participation rates. A full description of the Super Profiles and POLAR2 methods can be found on the HESA website[xv]. The relatively high (in UK terms) participation rate in Scotland coupled with the very high proportion of HE that occurs in FE colleges means that the figures for Scottish institutions could misrepresent their contribution to widening participation. HESA and HEFCE have therefore not produced low participation data for institutions in Scotland or for Scottish domiciled students.

Statistical Analysis

As the percentage data were bound by 0 and 100, an arcsine transformation was applied to overcome the possible problems of skewed variance. The data were then normalized using a Van der Waerden transformation and standardised to a mean of 0 and standard deviation of 1. The significance of change in percentage over time was assessed using linear regression in R[xvi].

Additional Tables

Table 1: Percentage of young students entering UK higher education from lower-socioeconomic backgrounds by subject: academic years 1998/1999 to 2009/2010

	Biological sciences and physical sciences	Biological sciences	Physical sciences	Mathematical sciences and Mathematical sciences	Computer sciences	Engineering and technology	All subjects
	24.7	*NA*	*NA*	*29.9*	*NA*	*NA*	*26.6*	*25.1*
1998/1999*								
1999/2000	*24.7*	*NA*	*NA*	*30.2*	*NA*	*NA*	*27.1*	*25.3*
2000/2001	*24.8*	*NA*	*NA*	*30.2*	*NA*	*NA*	*27.1*	*25.4*
2001/2002	*25.0*	*NA*	*NA*	*32.0*	*NA*	*NA*	*28.0*	*26.0*
	27.5	*NA*	*NA*	*33.7*	*NA*	*NA*	*30.3*	*28.4*
2002/2003*								
2003/2004	*27.9*	*NA*	*NA*	*34.4*	*NA*	*NA*	*30.0*	*28.6*
2004/2005	*NA*	*28.0*	*25.5*	*NA*	*26.3*	*37.3*	*29.1*	*28.2*
2005/2006	*NA*	*30.1*	*26.6*	*NA*	*26.9*	*37.8*	*29.5*	*29.3*
2006/2007	*NA*	*31.0*	*26.8*	*NA*	*25.8*	*39.0*	*29.7*	*29.8*
2007/2008	*NA*	*30.5*	*25.2*	*NA*	*26.0*	*37.6*	*29.3*	*29.5*
	NA	*33.8*	*27.4*	*NA*	*27.0*	*38.9*	*31.1*	*32.3*
2008/2009†								
2009/2010	*NA*	*31.5*	*25.1*	*NA*	*25.8*	*39.6*	*29.4*	*30.0*

Notes: *1998/1999-2001/2002 data from HEFCE, defining lower socioeconomic status as Social Classes IIIM, IV and V. 2002/2003-2009/2010 data from HESA, defining lower socioeconomic status groups as NS-SEC Classes 4, 5, 6 and 7. Subject groupings changed in 2004/2005. †Due to the collection method, 2008/2009 data is not directly comparable with other years.

Table 2: Percentage of young students entering UK higher education from state schools by subject: academic years 1998/1999 to 2009/2010

	Biological sciences and physical sciences	Biological sciences	Physical sciences	Mathematical sciences and computer sciences	Mathematical sciences	Computer sciences	Engineering and technology	All subjects
1998/1999*	*85.7*	*NA*	*NA*	*89.8*	*NA*	*NA*	*83.9*	*85.0*
1999/2000	*85.5*	*NA*	*NA*	*89.7*	*NA*	*NA*	*84.3*	*84.9*
2000/2001	*86.1*	*NA*	*NA*	*90.8*	*NA*	*NA*	*86.0*	*85.7*
2001/2002	*87.0*	*NA*	*NA*	*91.0*	*NA*	*NA*	*86.0*	*86.0*
2002/2003*	*88.3*	*NA*	*NA*	*91.9*	*NA*	*NA*	*87.3*	*87.2*
2003/2004	*87.9*	*NA*	*NA*	*91.9*	*NA*	*NA*	*86.9*	*86.8*
2004/2005	*NA*	*88.2*	*85.5*	*NA*	*86.7*	*95.0*	*86.1*	*86.7*
2005/2006	*NA*	*89.7*	*86.3*	*NA*	*86.8*	*95.1*	*87.4*	*87.4*
2006/2007	*NA*	*90.3*	*86.9*	*NA*	*87.9*	*95.4*	*87.2*	*87.8*
2007/2008	*NA*	*90.4*	*86.4*	*NA*	*87.8*	*95.5*	*87.6*	*88.0*
2008/2009	*NA*	*90.8*	*86.5*	*NA*	*88.7*	*95.8*	*87.9*	*88.5*
2009/2010	*NA*	*91.2*	*86.0*	*NA*	*89.3*	*96.2*	*88.4*	*88.8*

*1998/1999-2001/2002 data taken from HEFCE. 2002/2003-2009/2010 data taken from HESA. Subject groupings changed in 2004/2005.

Table 3: Percentage of young students entering UK higher education from low participation neighbourhoods by subject: academic years 1998/1999 to 2009/2010

	Biological sciences and physical sciences	Biological sciences	Physical sciences	Mathematical sciences and computer sciences	Mathematical sciences	Computer sciences	Engineering and technology	All subjects
1998/1999*	*12.7*	*NA*	*NA*	*13.5*	*NA*	*NA*	*11.6*	*12.3*
1999/2000	*12.3*	*NA*	*NA*	*13.6*	*NA*	*NA*	*12.4*	*12.4*
2000/2001	*12.7*	*NA*	*NA*	*13.6*	*NA*	*NA*	*12.0*	*12.5*
2001/2002	*13.0*	*NA*	*NA*	*14.0*	*NA*	*NA*	*13.0*	*13.0*
2002/2003*	*13.7*	*NA*	*NA*	*14.5*	*NA*	*NA*	*12.7*	*13.3*
2003/2004	*14.3*	*NA*	*NA*	*16.3*	*NA*	*NA*	*13.7*	*13.9*
2004/2005	*NA*	*15.0*	*12.6*	*NA*	*12.2*	*17.7*	*12.6*	*13.7*
2005/2006	*NA*	*14.9*	*13.1*	*NA*	*12.6*	*19.0*	*12.6*	*14.0*
2006/2007†	*NA*	*9.8*	*8.3*	*NA*	*7.4*	*12.3*	*7.8*	*9.0*
2007/2008	*NA*	*10.8*	*9.4*	*NA*	*8.2*	*12.9*	*8.3*	*9.7*
2008/2009	*NA*	*11.0*	*8.6*	*NA*	*8.1*	*13.0*	*8.2*	*10.1*
2009/2010	*NA*	*11.7*	*8.9*	*NA*	*8.2*	*13.5*	*8.8*	*10.3*

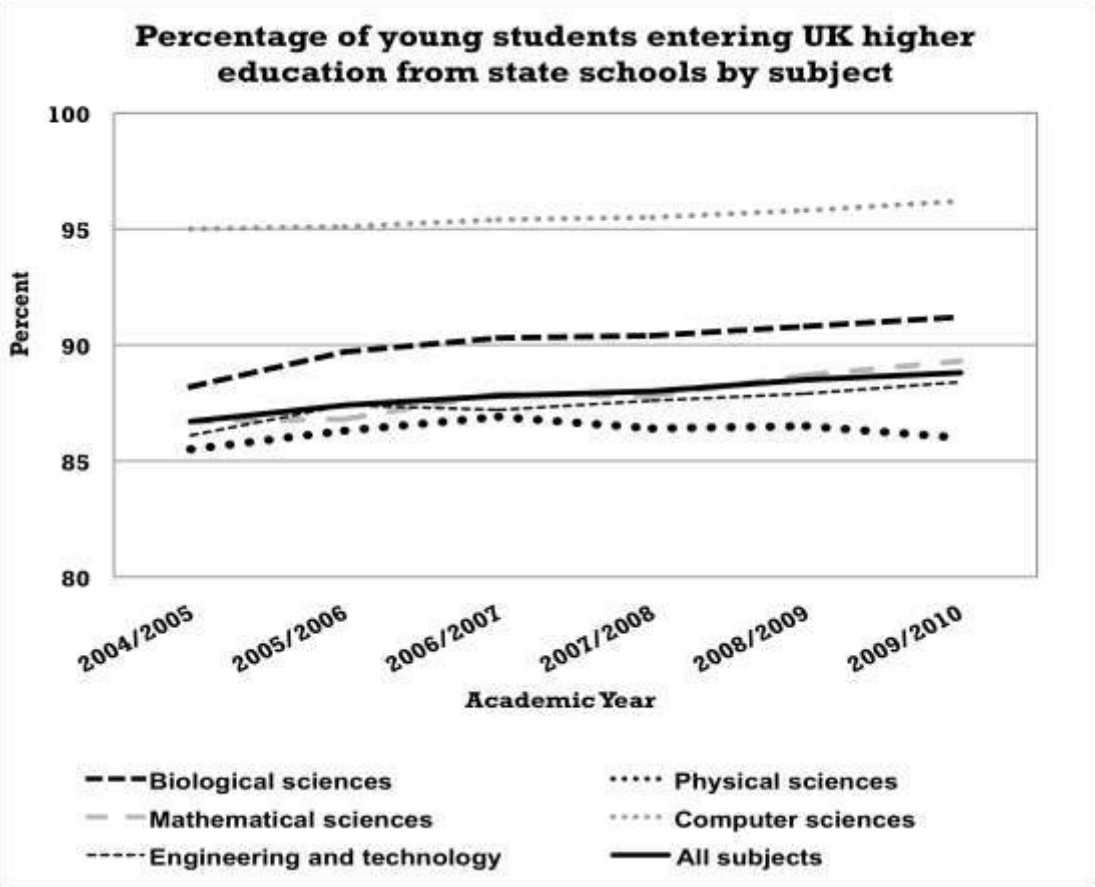
*1998/1999-2001/2002 data taken from HEFCE. 2002/2003-2009/2010 data taken from HESA. Subject groupings changed in 2004/2005. †In 2006/2007, the method used to produce the low participation indicator changed from Super Profile to POLAR2. Data published from 2006/07 is not comparable with previous data.

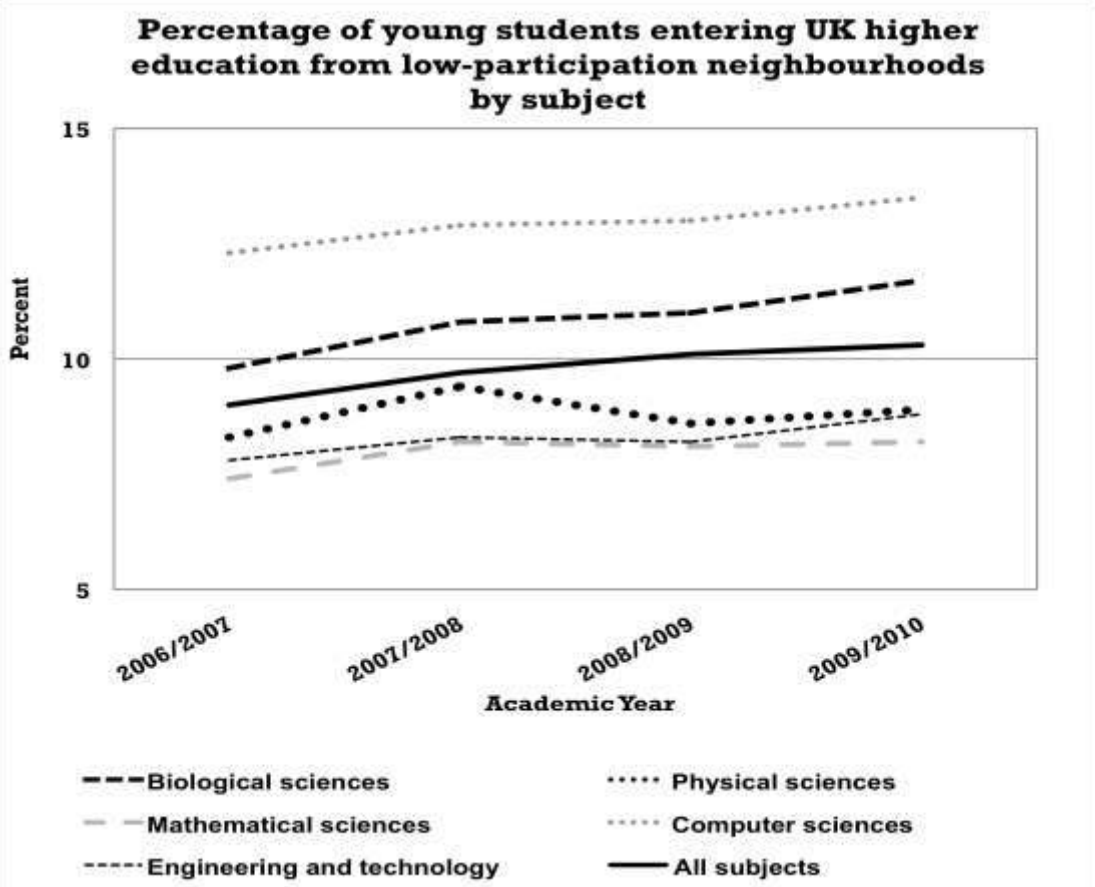
Table 4: Percentage of mature students entering UK higher education from low participation neighbourhoods by subject: academic years 1998/1999 to 2009/2010

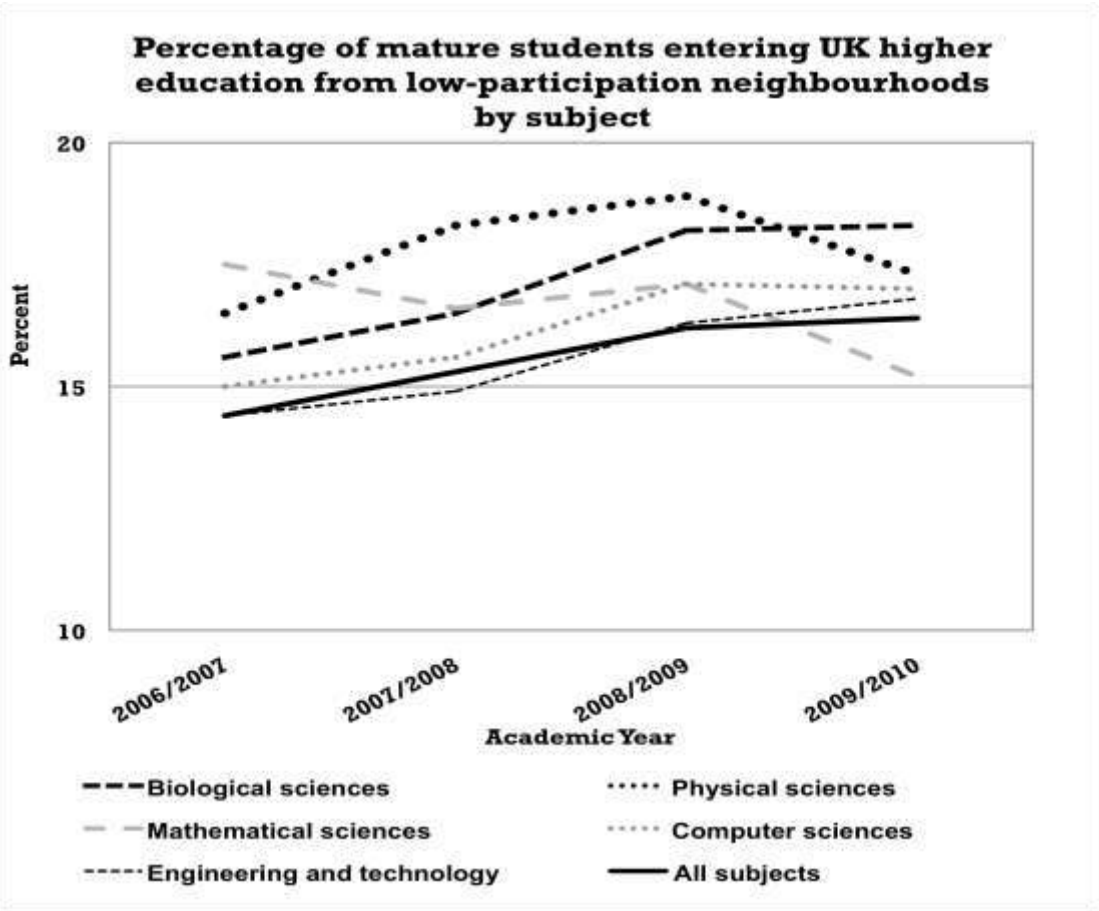
	Biological sciences and physical sciences	Biological sciences	Physical sciences	Mathematical sciences and computer sciences	Mathematical sciences	Computer sciences	Engineering and technology	All subjects
1998/1999*	*19.6*	*NA*	*NA*	*19.3*	*NA*	*NA*	*19.9*	*19.1*
1999/2000	*20.8*	*NA*	*NA*	*20.5*	*NA*	*NA*	*20.8*	*19.9*
2000/2001	*20.5*	*NA*	*NA*	*19.7*	*NA*	*NA*	*20.9*	*19.7*
2001/2002	*21.0*	*NA*	*NA*	*21.0*	*NA*	*NA*	*21.0*	*20.0*
2002/2003*	*22.2*	*NA*	*NA*	*20.4*	*NA*	*NA*	*22.1*	*20.5*
2003/2004	*23.2*	*NA*	*NA*	*22.8*	*NA*	*NA*	*23.0*	*21.4*
2004/2005	*NA*	*23.3*	*23.0*	*NA*	*21.3*	*24.7*	*23.0*	*21.8*
2005/2006	*NA*	*24.5*	*23.2*	*NA*	*21.9*	*25.4*	*22.4*	*22.6*
2006/2007†	*NA*	*15.6*	*16.5*	*NA*	*17.5*	*15.0*	*14.4*	*14.4*
2007/2008	*NA*	*16.5*	*18.3*	*NA*	*16.6*	*15.6*	*14.9*	*15.3*
2008/2009	*NA*	*18.2*	*18.9*	*NA*	*17.1*	*17.1*	*16.3*	*16.2*
2009/2010	*NA*	*18.3*	*17.3*	*NA*	*15.2*	*17.0*	*16.8*	*16.4*

*1998/1999 - 2001/2002 data taken from HEFCE. 2002/2003 - 2009/2010 data taken from HESA. Subject groupings changed in 2004/2005. †In 2006/2007, the method used to produce the low participation indicator changed from Super Profile to POLAR2. Data published from 2006/07 is not comparable with previous data.

Additional Figures






Percentage of mature students entering UK higher education from low-participation neighbourhoods by subject
Percent
20
15
10
2006/2007
2007/2008
2008/2009
2009/2010
Academic Year
Biological sciences
Physical sciences
Mathematical sciences
Computer sciences
Engineering and technology
All subjects

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