ROYAL ACADEMY OF ENGINEERING

FE STEM DATA PROJECT: NOVEMBER 2012 REPORT

FE STEM data project: November 2012 report

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www.thedataservice.org.uk/statistics/other_statistics_and_research

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Jane Imrie (NCETM), Daniel Sandford Smith (Gatsby Charitable Foundation), Ruth Wright (Engineering Council) who have helped with the classifications used in this report and Rhys Morgan (Royal Academy of Engineering) who provided the geographical mapping software used.

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Introduction

The term 'STEM' groups together the subjects of Science, Technology, Engineering and Mathematics. These subjects account for a significant proportion of the qualifications achieved in the FE and skills sector and have been prioritised by successive UK governments on account of the important role they play in the economy[1].

The Royal Academy has led the FE STEM Data Project since its inception in 2010 and has quantified the contribution to STEM education and skills made by the FE and skills system in England through its 2010[2] and 2011[3] reports. This latest report augments previous analysis with a further year of data (2010/2011) and looks at key features in the data in greater depth.

The general process undertaken for the FE STEM Data project is:

1. To classify the qualifications included in the *Learning Aims Database* as variously S, S-related, T, T-related, E, E-related, M, M-related, Numeracy and non-STEM. This was undertaken from scratch for the 2010 report and the same classification reused for the 2011 report. A full updating of the classification was undertaken for this report, comprising more than 15,000 qualifications. In addition, the Apprenticeship frameworks provided through the *National Apprenticeship Service* have also been classified for the first time in this report.

2. To use the classifications above and the data from both the *Individualised Learner Record* and the *Schools QSR datasets* to produce a single Microsoft SSAS OLAP Data Cube that can be accessed using conventional spreadsheet software. The granularity of the Data Cube is at *Aim* level, with the data comprising Learning Aims for the academic years 2007/2008 through to 2010/2011.

3. To analyse the Data Cube to produce charts and figures that exemplify the extent and nature of STEM provision in the FE and skills sector in England using data for 16– to 18-year-olds in schools for comparison as appropriate.

1 Matthew Harrison (2012), Jobs and growth: the importance of engineering skills in the UK economy, Royal Academy of Engineering **www.raeng.org.uk/jobsandgrowth**

2 Andy Frost, Clive Greatorex, Matthew Harrison, David Mason (2010), FE and Skills STEM Data Summary report, October 2010, Blue Alumni / Royal Academy of Engineering **www.thedataservice.org.uk/statistics/other_statistics_and_research**

3 Matthew Harrison (project leader) 2011, FE STEM Data Project July 2011 report, Royal Academy of Engineering **www.thedataservice.org.uk/statistics/other_statistics_and_research**

The Data Cube holds the following dimensions:

- STEM categories (Science, Technology, Engineering, Maths, Numeracy)
- STEM-related qualifications
- Funding stream
- Qualification framework
- Age bands
- Learner attributes including gender, ethnicity, learning difficulty and/or disability, prior attainment level. It should be noted that prior attainment level are not high quality data, but are better for those on Level 2 and Level 3 qualifications than other Learning Aims.
- Institution attributes including type, government office region, subregion
- Academic year
- Qualification level
- Qualification name
- Local education authority
- Provider name

Notes

- S, T, E and M qualifications are taken to be those that contain learning outcomes that are deeply rooted in science, mathematics or engineering and/or are of a 'technical' or 'technology-application/use' nature.
- S, T, E and M qualifications are deemed distinct from other qualifications because they can, for those who wish it, provide the required foundation for progression into further study or employment in an S, T, E or M related field.
- To take account of the modular nature of some qualifications, they are deemed to lie within S,T,E or M when the majority of the assessment objectives are science-, technology-, engineering- or mathematics-focused (and /or the qualification is recognised as a pre-requisite for progression in S,T,E or M).
- They are deemed to be S-, T-, E- or M-***related*** when science, technology, engineering or mathematics feature in many learning objectives (and/or the qualification provides a degree of learning that will aid progression in S, T, E or M).
- They are deemed to be outside of S, T, E or M if S, T, E or M does not feature in at least some learning objectives for all learners (not just those who take S, T, E or M related options within the qualification).
- By convention adopted by the FE STEM Data project, qualifications allied to medicine (such as nursing) and qualifications allied to agriculture and animal keeping are deemed outside of STEM.
- Mathematics has been further subdivided into mathematics and numeracy in order to distinguish the 'life skills' associated with numeracy qualifications from mathematics as a pure/applied discipline.
- There is a significant quantity of both mathematics and numeracy embedded in qualifications of all types and in a wide range of subjects. This is not accounted for in the analysis presented here.
- Unless explicitly stated otherwise, charts show data for qualifications achieved by learners at all levels in the FE and skills sector in England for the academic year 2010/11.
- 'Achievements' are defined as the number of achievements for a particular qualification in a given year and is the preferred measure because it describes what the FE and skills sector has produced in that year. However, care should be taken when considering achievement data aggregated across more than one qualification as this will not necessarily equate to the number of learners because learners can achieve more than one qualification in a given year. For robust comparison with schools data it was necessary to use 'Completions' and where this has been done it is stated in the charts. A full definition of the terms 'Enrolments', 'Completions' and 'Achievements' can be found in Section 3 of the October 2010 report.
- Unless explicitly stated otherwise, charts which represent data for **all** of STEM show **combined** data for S, T, E and M **and** 'S-, T-, E- and M-***related*** qualifications.
- "Hybrid" qualifications are those that are classified as combinations of S, T, E, M and numeracy.
- When interpreting the data it should be noted that learners cross borders and that some local authorities (LAs) collaborate on provision.
- Regional and LA data are associated with the place where learning took place.
- For reference, the following are examples of the various 'Levels' of qualifications quoted in this report: 'Level 1' – GCSE grades D–G; 'Level 2' – GCSE grades A*–C, Intermediate Apprenticeships; 'Level 3' – A Levels, Advanced Apprenticeships; 'Level 4' and above – Higher Apprenticeship, HNC/HND and Foundation Degree.

Section 1: Overview of STEM in the FE and skills sector in England

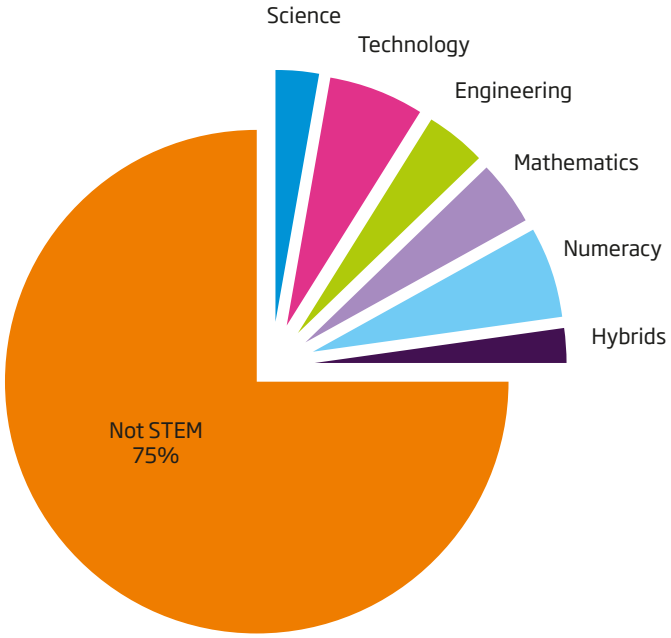


Figure 1 : Proportions of funded qualifications achieved in the FE and Skills Sector in 2010/11 (includes STEM-related)

6.67 million qualifications were achieved in the FE and skills sector in England in 2010/2011.

1.65 million of these were in STEM and STEM-related subjects or in numeracy.

Each STEM subject contributes fairly evenly to the 25% of post-16 achievements that are in STEM subjects[4]. 'Hybrid' qualifications are those that were classified as combinations of S,T,E,M and numeracy.

4 In Figure 1.3 of the 2011 report the equivalent figure was 28%, although much of the three percentage point difference is due to rounding effects in the production of that figure. Less than one percentage point difference is due to the effects of the reclassification undertaken for the 2012 report or differences in uptake of STEM qualifications.

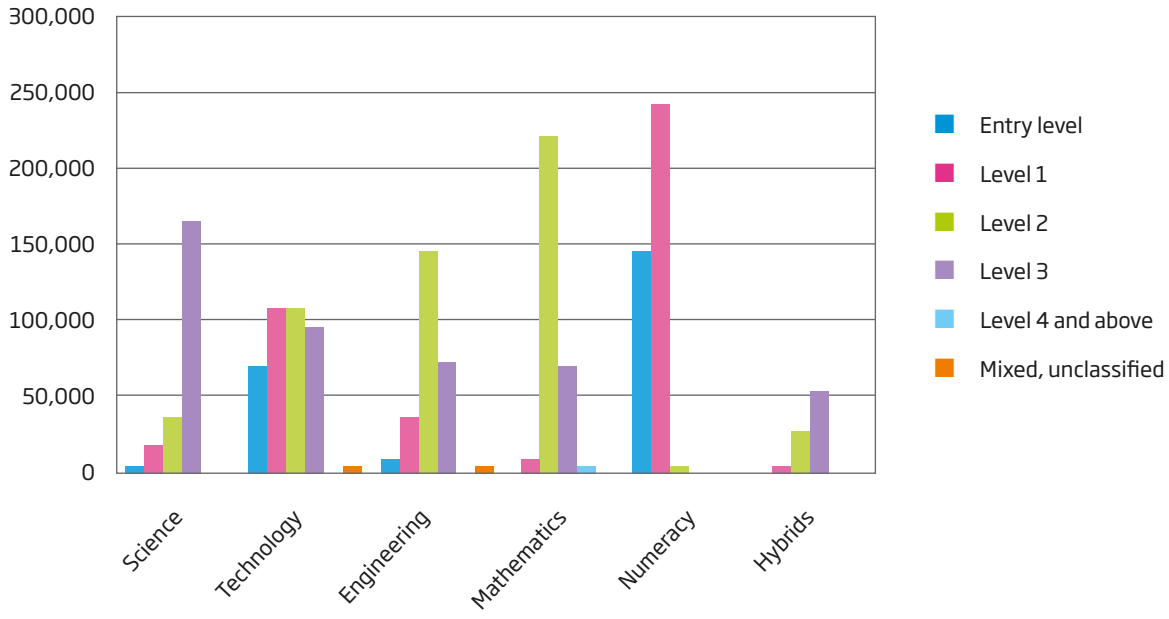


Figure 2 : Numbers of funded STEM (including STEM-related) qualifications in the FE and skills sector 2010/11

The number of qualifications achieved at each qualification level varies between STEM subjects. Numeracy qualifications are predominantly achieved at lower levels; technology, engineering and mathematics at lower and intermediate levels (Level 2); and science and hybrid qualifications at advanced level (Level 3).

Relatively few STEM qualifications at Level 4 and above are funded by the *Skills Funding Agency* in the FE and skills sector in England and therefore few achievements at Level 4 and above are shown in this report. Many more, funded in the Higher Education sector through the *Higher Education Funding Council* and through the *Student Loan Company* are achieved in England but are not shown here[5].

5 These are routinely reported by the *Higher Education Statistical Agency*

Section 2: Year on year trend analysis

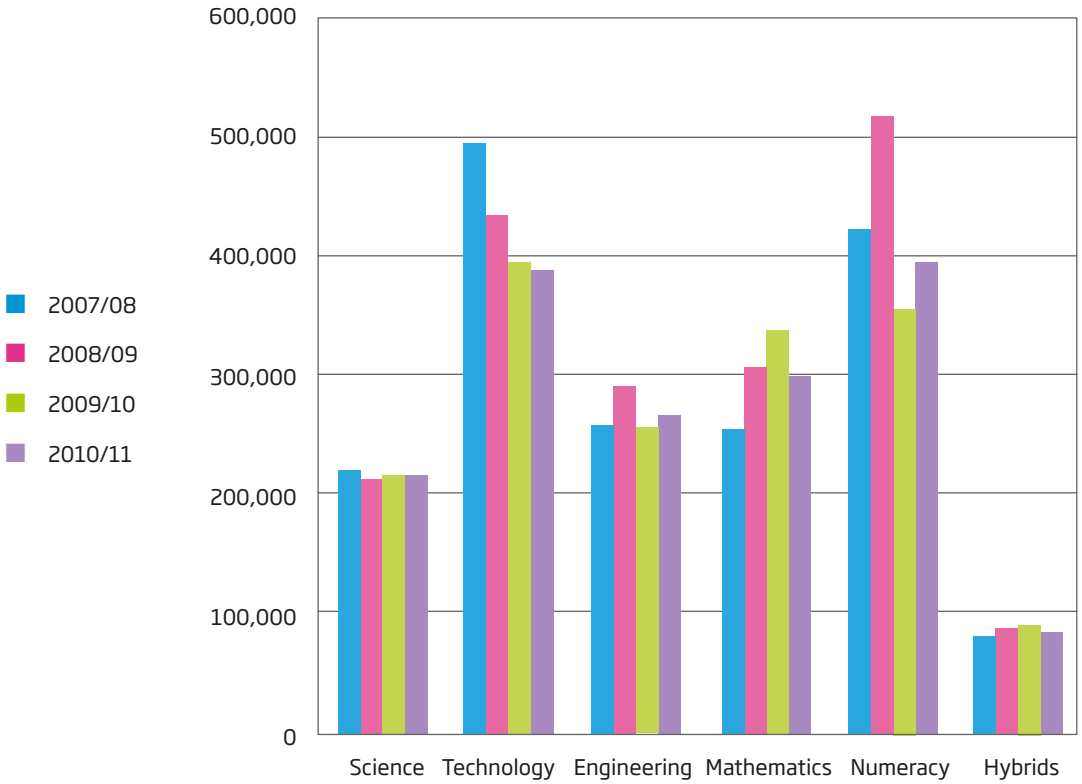
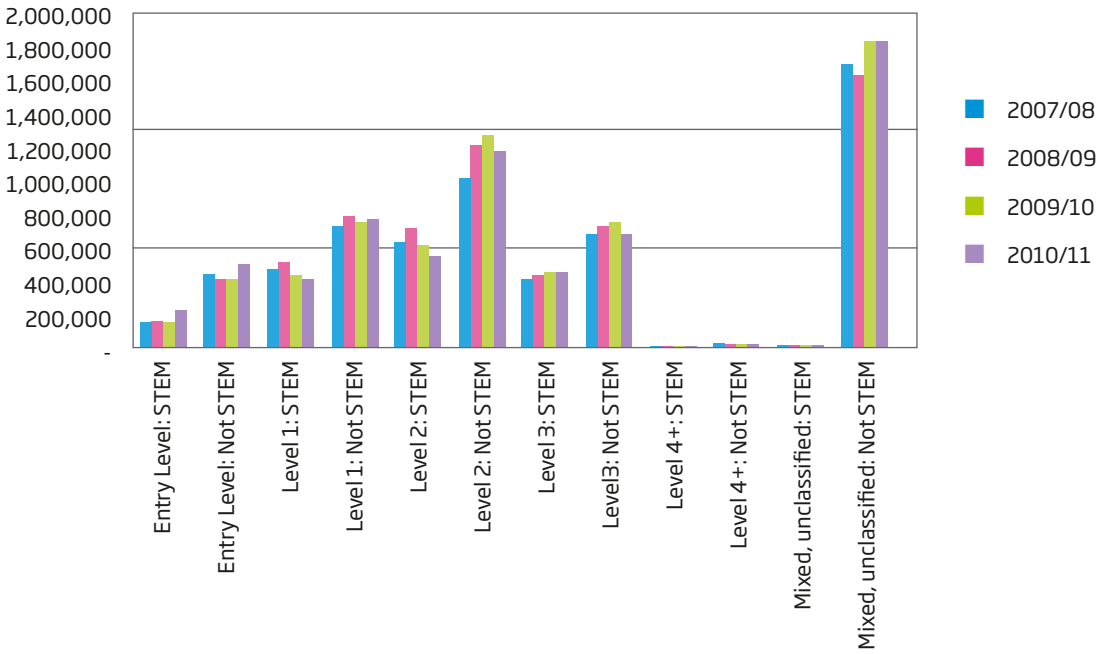


Figure 3: Numbers of funded STEM (including STEM-related) qualifications achieved in the FE and skills sector over four academic years

This report provides the first opportunity to inspect trends as data have now been collected over four years. Care should be taken with trend analysis but it does appear that over the period 2007–2011:

- The number of achievements in science, engineering and hybrids has held.
- The number of achievements in technology qualifications has dropped significantly.
- The number of achievements in mathematics and numeracy varies between years but with no obvious overall trend.



Comparing the number of STEM achievements with those in non-STEM subjects shows that trends for STEM subjects broadly follow those for non-STEM subjects. However, growth in non-STEM subjects seen at Level 2 is not replicated for STEM subjects.

Figure 4: Numbers of funded STEM (including STEM-related) qualifications achieved in the FE and skills sector over four academic years

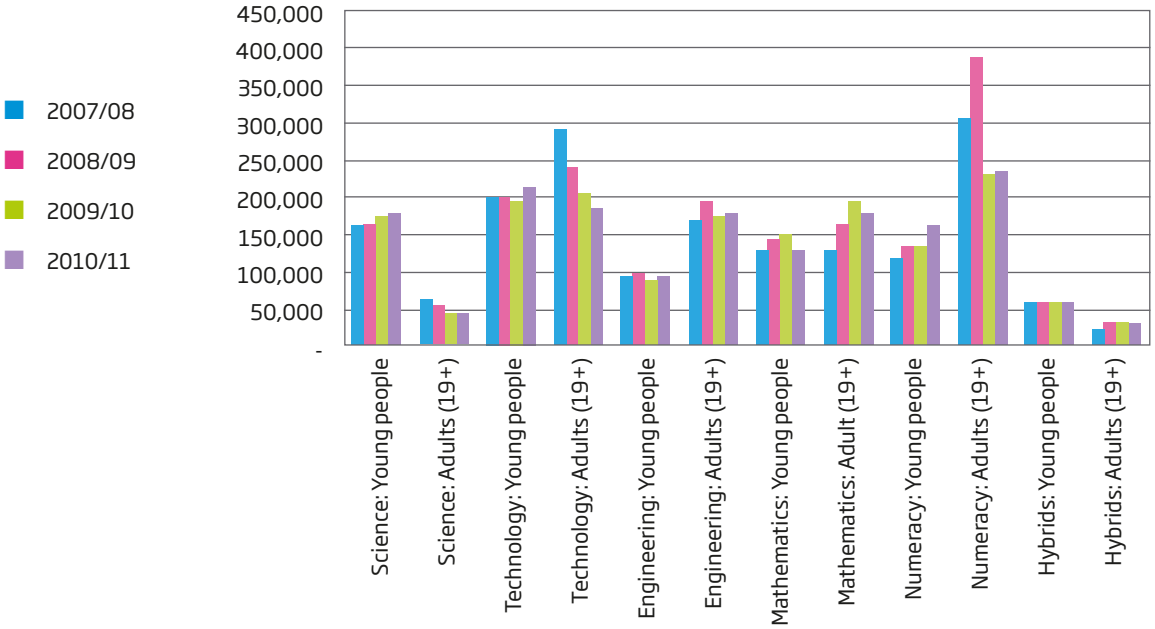


Figure 5: Numbers of funded STEM (including STEM-related) qualifications achieved in the FE and skills sector over four academic years

Inspecting trends for both young people (aged 16–18) and adults (aged 19+), the general trend for STEM achievements among adults is mostly downward (with the exception of engineering and mathematics). The trends for young people are often more positive.

The number of 16- to 18-year-olds in England dropped by more than 10% in the period 2007–2011[6]. Despite this, the number of qualifications (all subjects) achieved by 16- to 18-year-olds in the FE and skills sector rose by 17% from 2.3 million to 2.7 million.

Looking for the latest evidence, the Association of Colleges 2012 College Enrolment Survey[7] of one-third of Colleges in England would suggest that there may be a current upward trend in STEM across all ages:

- 51% of colleges surveyed reported a rise in enrolments for engineering courses, compared to 12% reporting a decline.
- 37% reported a rise in science enrolments. 17% reported a decline.
- 35% reported a rise in mathematics enrolments. 16% reported a decline.

6 Office of National Statistics

7 Association of Colleges (AoC), 2012 College Enrolment Survey, September 2012

Section 3: Young people aged 16–18 years

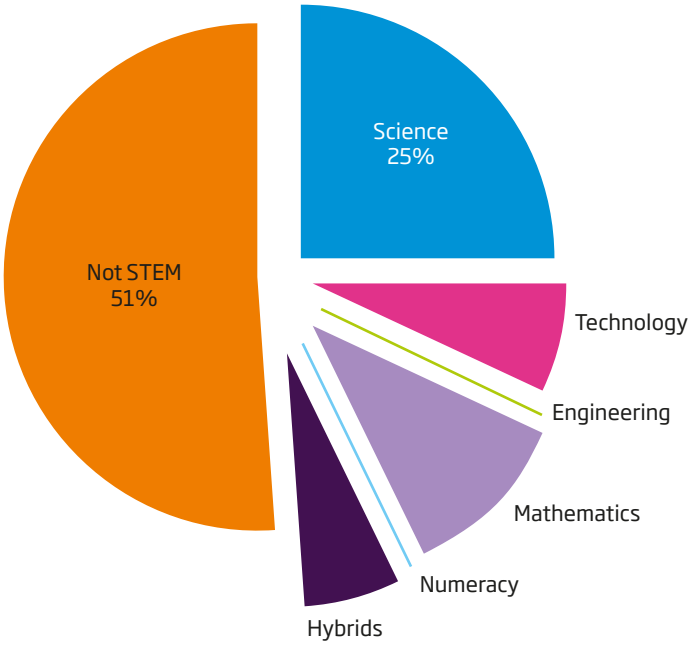


Figure 6: Proportions of funded qualifications completed in schools in England in 2010/11 (includes STEM-related)

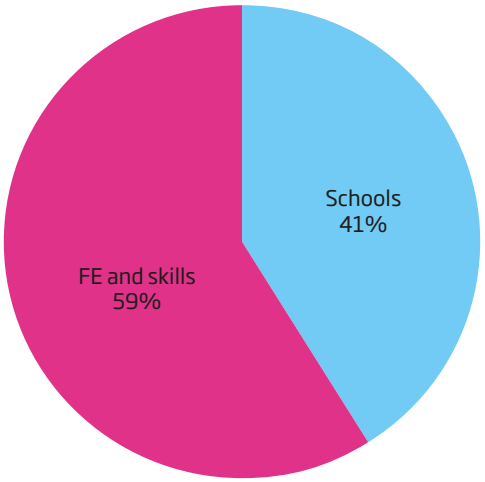


Figure 7: Proportions of funded STEM qualifications completed by 16- to 18-year-olds in England 2010/11 (1,623,000 total)

1.37 million qualifications were achieved by 16- to 18-year-olds in schools in England in 2010/2011. In the FE and skills sector it was 3.07 million.

In schools, 667,000 of these were in STEM and STEM-related subjects or in Numeracy. In the FE and skills sector it was 956,000.

In marked contrast to STEM completions in the FE and skills sector, in schools individual STEM subjects contribute in different degrees to the 49% of 16–18 completions that are in STEM subjects. Much higher proportions of completions in science and mathematics and much lower proportions of completions in engineering and numeracy are evident.

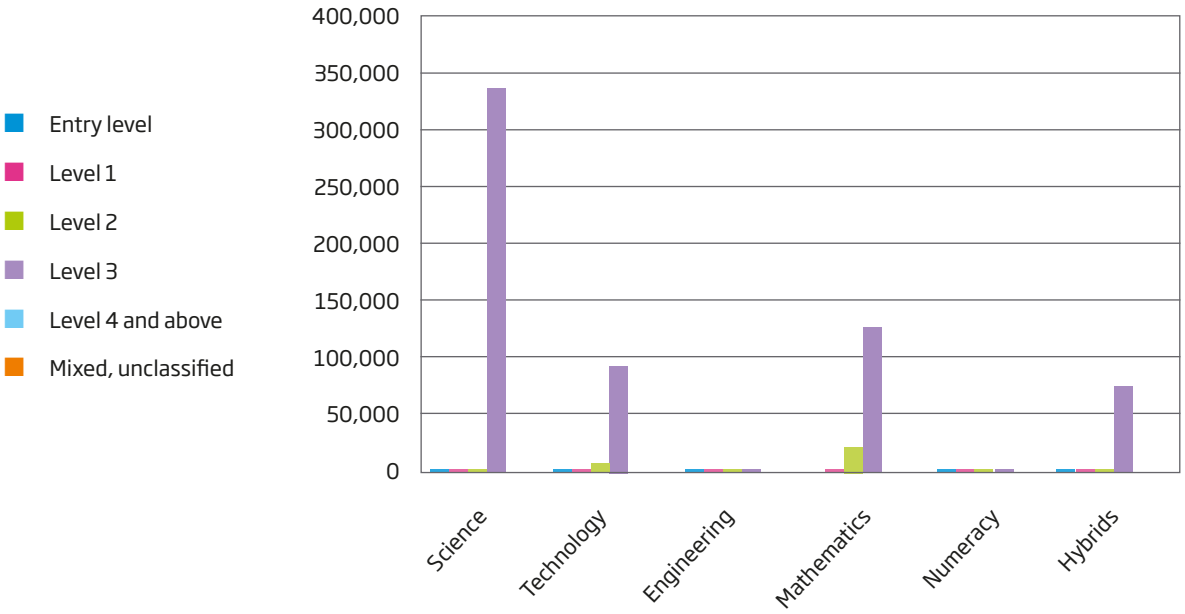


Figure 8: Numbers of funded STEM (including STEM-related) qualifications completed by students aged 16+ in schools in England 2010/11

STEM completions in schools are dominated by Level 3 completions, particularly in science.

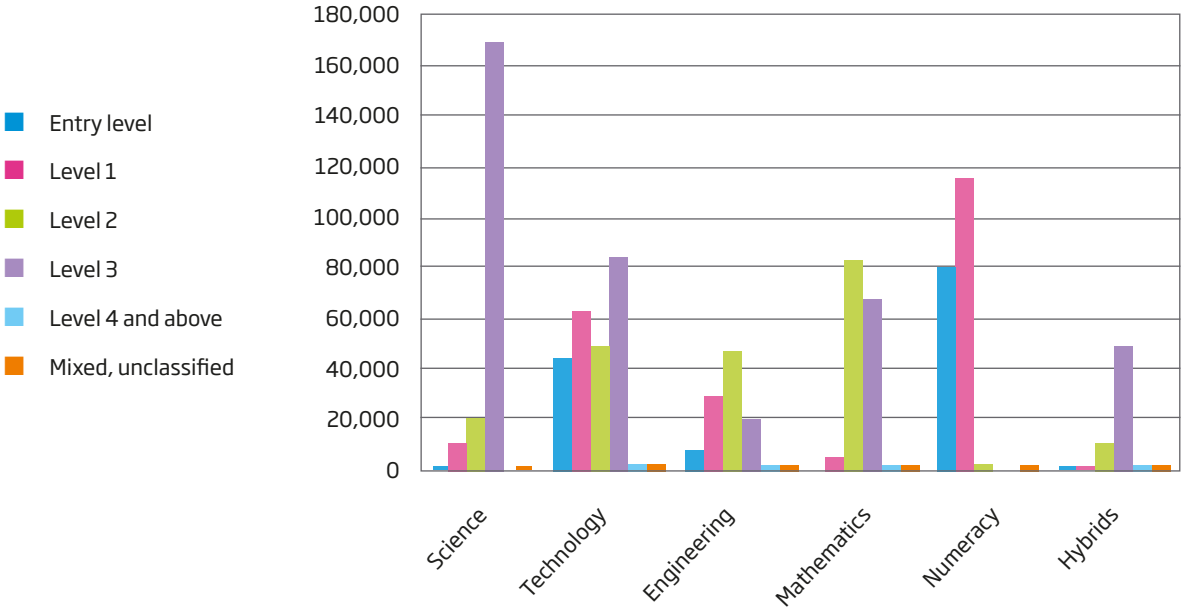


Figure 9: Numbers of funded STEM (including STEM-related) qualifications completed by 16- to 18-year-olds in the FE and skills sector 2010/11

In the FE and skills sector there is a broader mix of levels, although Level 3 still dominates in science and also in technology.

Section 4: Analysis of apprenticeships

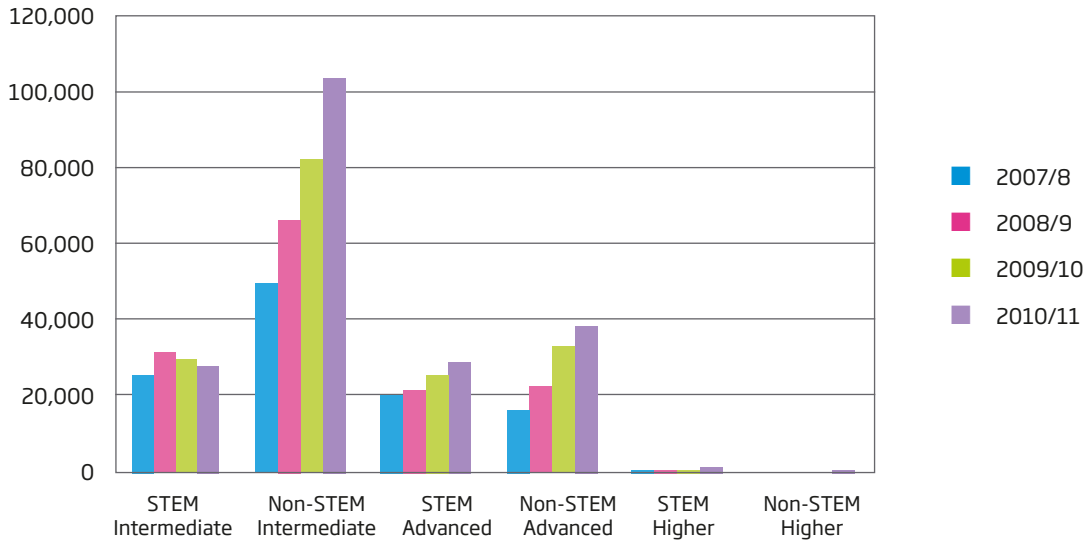


Figure 10: Apprenticeship framework achievements 2010/11 (all ages)

Using the S,T,E,M (and related) classification of the Apprenticeship frameworks provided through the *National Apprenticeship Service* produced uniquely for this project, the dominance of non-STEM apprenticeships at Level 2 (Intermediate) is self-evident.

However at the Advanced level the number of achievements in STEM and non-STEM apprenticeships are broadly comparable.

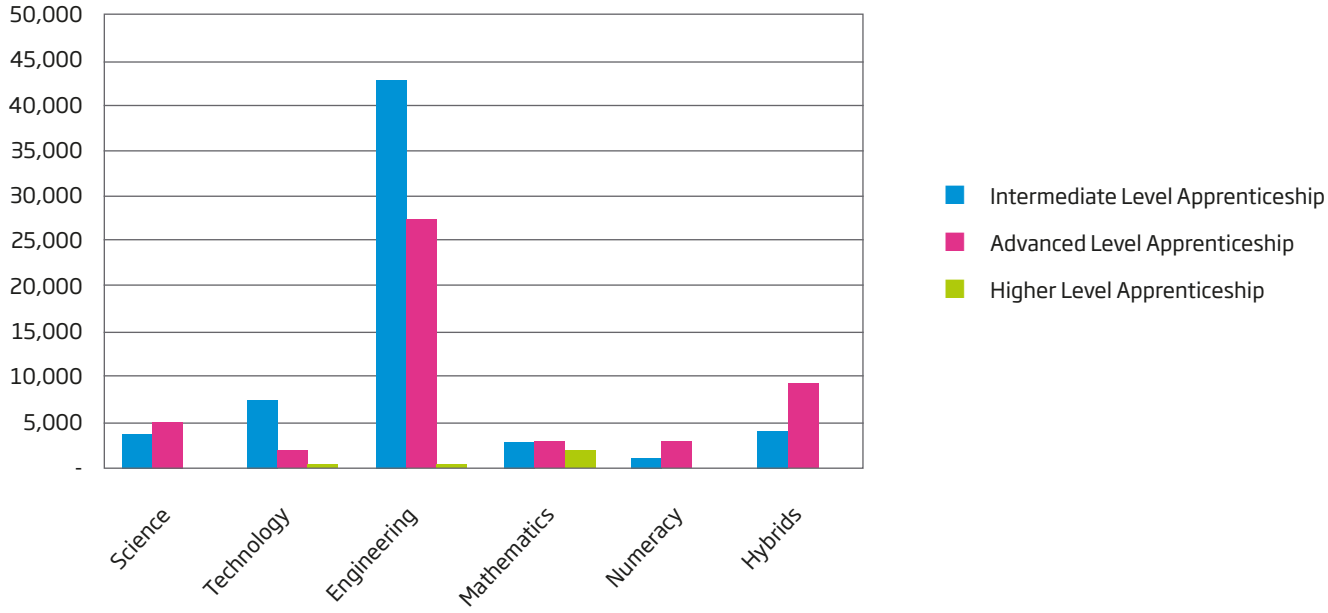


Figure 11: Starts in STEM (including STEM-related) Apprenticeship frameworks 2010/11

STEM apprenticeships are dominated by engineering apprenticeships.

Non-STEM apprenticeship starts in 2010/11

Intermediate	239,124
Advanced	104,035
Higher	1

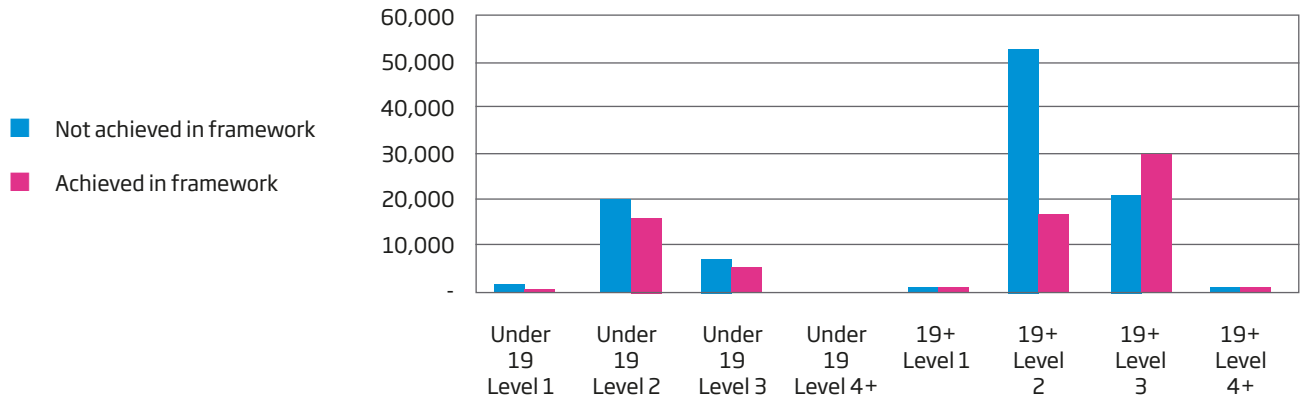


Figure 12: Funded and unfunded achievements in engineering and engineering-related qualifications approved for Apprenticeship frameworks, 2010/11

The FE STEM Data project approach to the classification of apprenticeships both by framework and by the qualifications approved for frameworks allows unique insight into the provision of technical qualifications. More engineering qualifications 'approved' for Apprenticeship frameworks are achieved outside of Apprenticeship frameworks than within, with the strongest effect being due to the achievements of adults at Level 2.

42% of the 'approved' engineering qualifications achieved outside of frameworks were NVQ-type qualifications. The remainder were VRQ-type qualifications as this particular analysis does not include Key Skills or Functional Skills qualifications.

STEM apprenticeships are recognised for their high wage returns[8] and for their role in transition to Registered Technician status[9]. STEM qualifications offer significant wage value, particularly when used in SET occupations[10]. Therefore the labour market reacts positively to the type of qualifications being analysed here. Reasons for the relatively high number of 'approved' engineering qualifications being taken outside of frameworks are unclear and need further examination. It may be that leaners or their employers are selecting only some of the qualifications in a particular framework or that they are adding to approved qualifications gained earlier or elsewhere. However, it is clear, when policy makers take stock of the engineering skills pipeline, both framework and non-framework achievements have to be assessed.

8 A recent example – NAO (2012), National Audit office report on adult Apprenticeship, February 2012

9 Technician Council (2012), Professional Technician: the future, Technician Council, 2012 (available to download from **www.professional-technician.org.uk**)

10 Charley Greenwood, Matthew Harrison, Anna Vignoles (2011), Institute of Education / Royal Academy of Engineering **http://tinyurl.com/ambfecp**

Section 5: Diversity

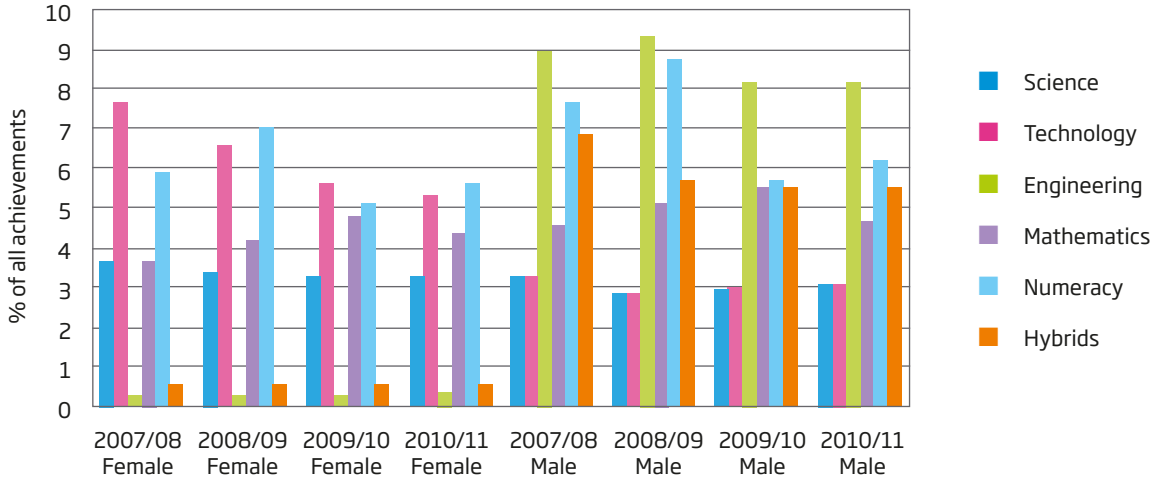


Figure 13: Funded achievements in STEM qualifications, FE and skills sector

The under-representation of women in engineering is well known as clearly evident in the FE STEM data. However, their historical dominance of technology qualifications is a new finding – as is the downward trend in recent years.

The finding that the hybrid qualifications are taken mostly by men is explained by the prevalence of engineering in these qualifications.

The gender balance in other subjects is more even, with trends for men being broadly similar to the trends for women.

In 2010/11 the percentage of achievements in non-STEM subjects by women of all ages was 57% (2.82 million Female, 2.16 million Male).

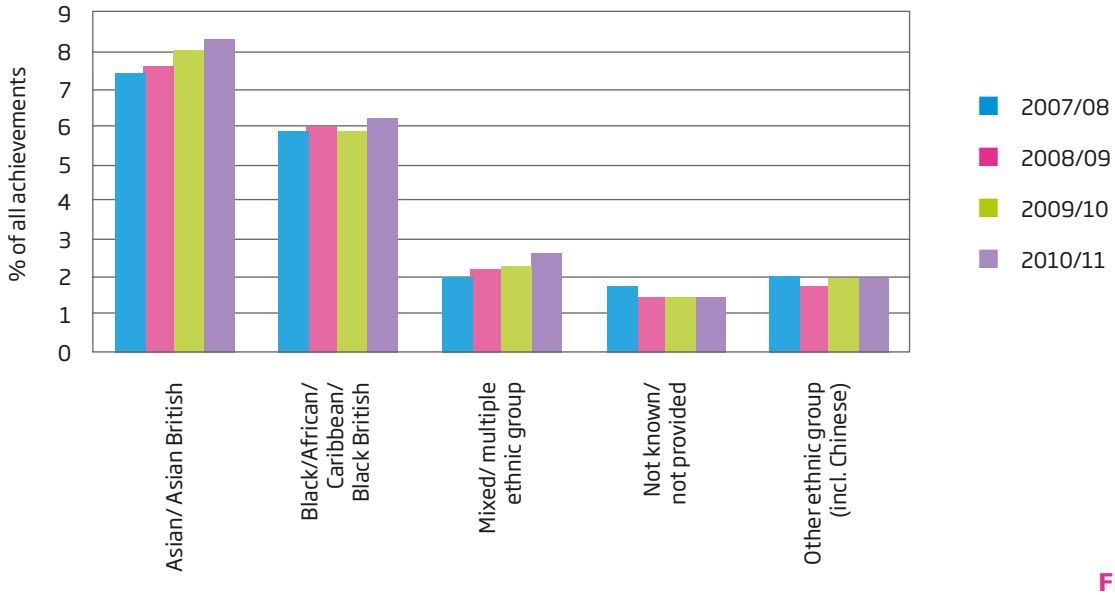


Figure 14: Funded STEM achievements in FE and skills sector

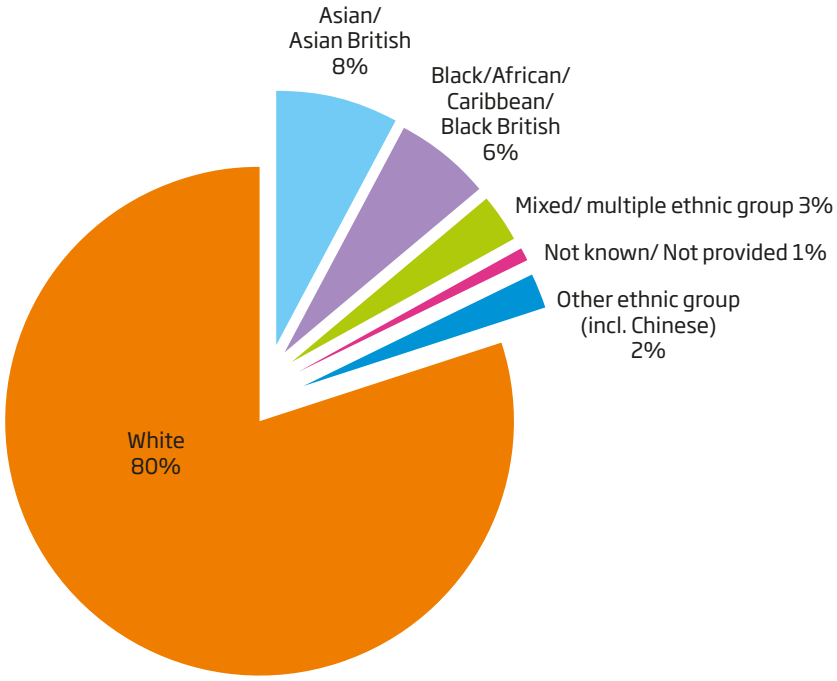


Figure 15: Funded STEM qualifications achieved FE and skills sector, 2010/11

Learners from a range of minority ethnic groups achieve 20% of the STEM qualifications in the FE and skills sector in England when people from minority ethnic groups make up 14% of the UK population as a whole[11]. The same proportions of achievements are seen for each minority ethnic group for non-STEM subjects, suggesting that either learners from minority ethnic groups are over-represented in the FE and skills sector or they achieve more qualifications on average.

The titles used for each ethnic group are the ones used in the datasets used in this report. No further disaggregation is possible.

In 2010/11, 338,000 STEM qualifications were achieved by learners from minority ethnic groups. The equivalent number for non-STEM subjects was 1.02 million.

STEM achievements among most ethnic minority groups have been increasing slightly year on year.

11 Office of National Statistics

Section 6: Access to higher education courses

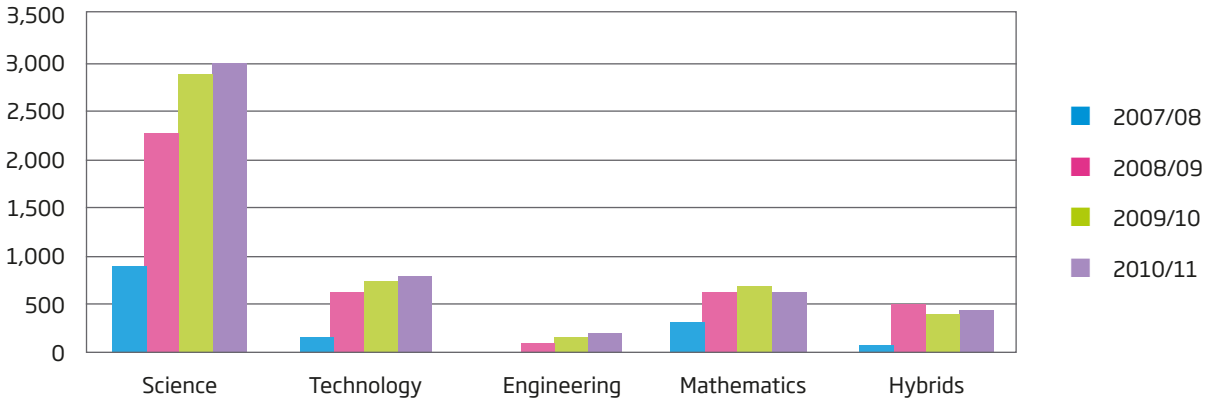


Figure 16: Funded achievements in Access to HE courses, FE and skills sector, STEM and STEM-related subjects

The achievement of Level 3 STEM qualifications in the FE and skills sector enabling progression to STEM higher education has been analysed in previous reports.

This is augmented here with an analysis of STEM Access to HE courses.

By way of comparison, access to HE courses in nursing

2007/08	1,082 achievements
2008/09	2,056
2009/10	2,876
2010/11	3,105

Section 7: Adults over the age of 25

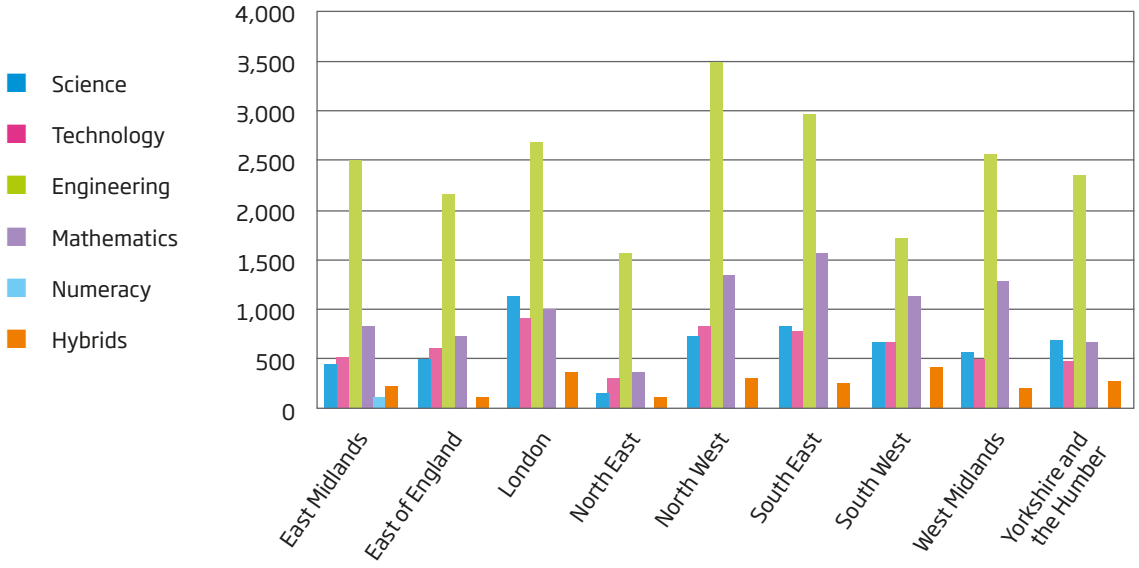


Figure 17: Funded achievements in STEM qualifications, FE and skills sector

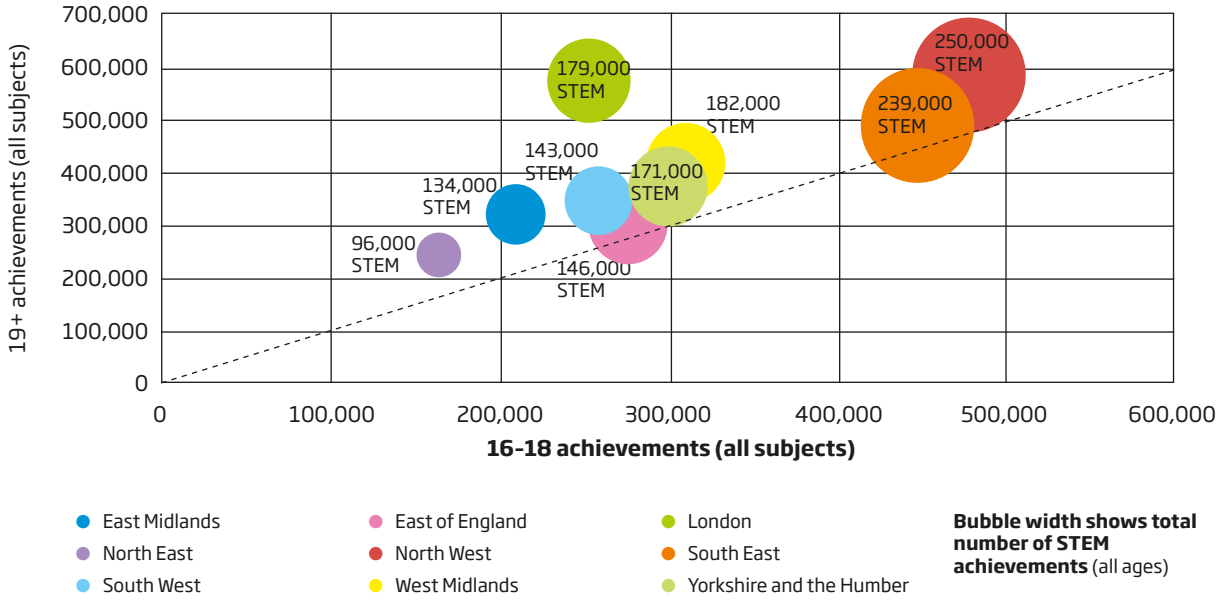
From 2013, learners aged 25 and over will be required to fund the full cost of courses at Level 3 and above.

Analysis of such achievements in 2010/11 allows an assessment of the proportion of STEM achievements likely to be affected by this policy change.

Nationally, fewer than 3% of STEM achievements are likely to be affected, although there is considerable variation between subjects:

Science	2.66%	Mathematics	2.89%
Technology	1.42%	Numeracy	0%
Engineering	8.19%	Hybrids	0.46%

Section 8: Regional variations



The FE and skills sector provides STEM and non-STEM courses to both adults and young people. Overall there are more achievements by adults than young people but the proportions can vary significantly (in the East of England there is almost an even balance whereas adult learners are in the majority in London).

Figure 18: Funded achievements in FE and skills sector, 2010/11

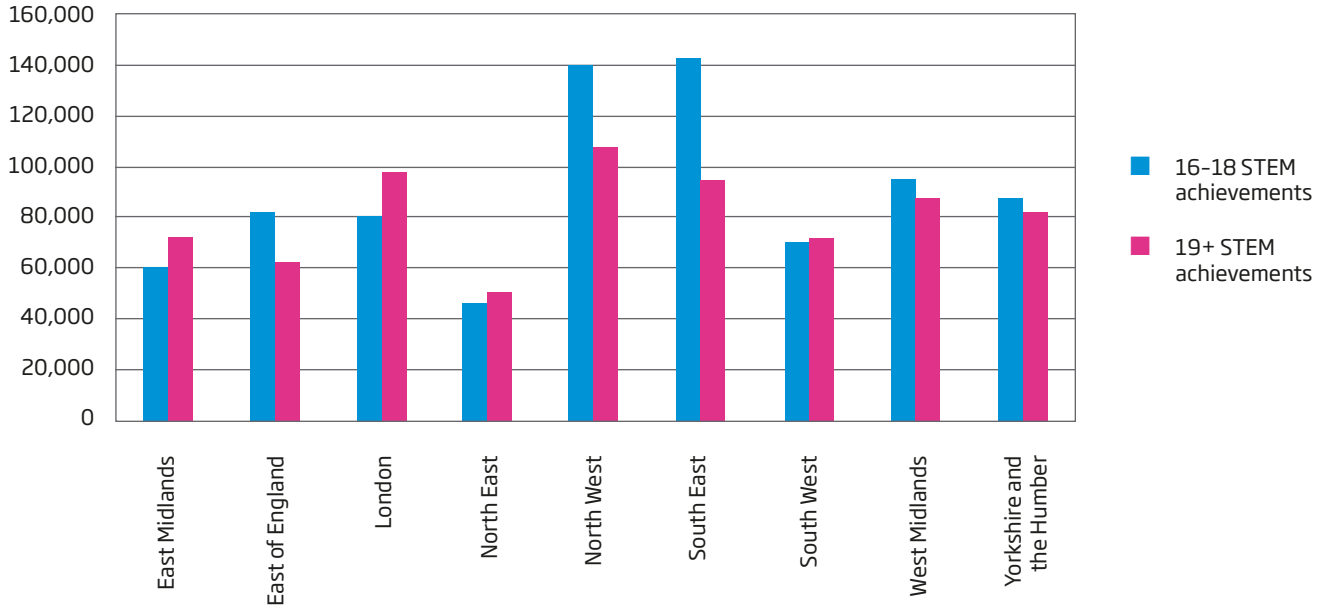


Figure 19: Funded STEM achievements FE and skills sector, 2010/11

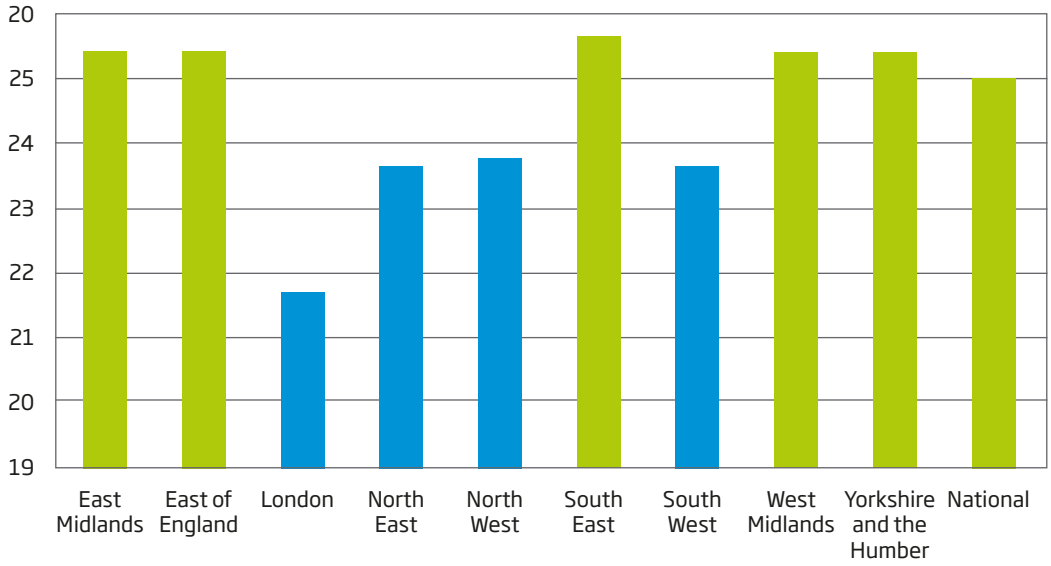


Figure 20: Percentage of funded achievements (all ages) that are STEM, 2010/11

The proportion of achievements that are in STEM subjects vary around the country, although with the exception of London, variations in the STEM proportion at UK regional level are fairly small.

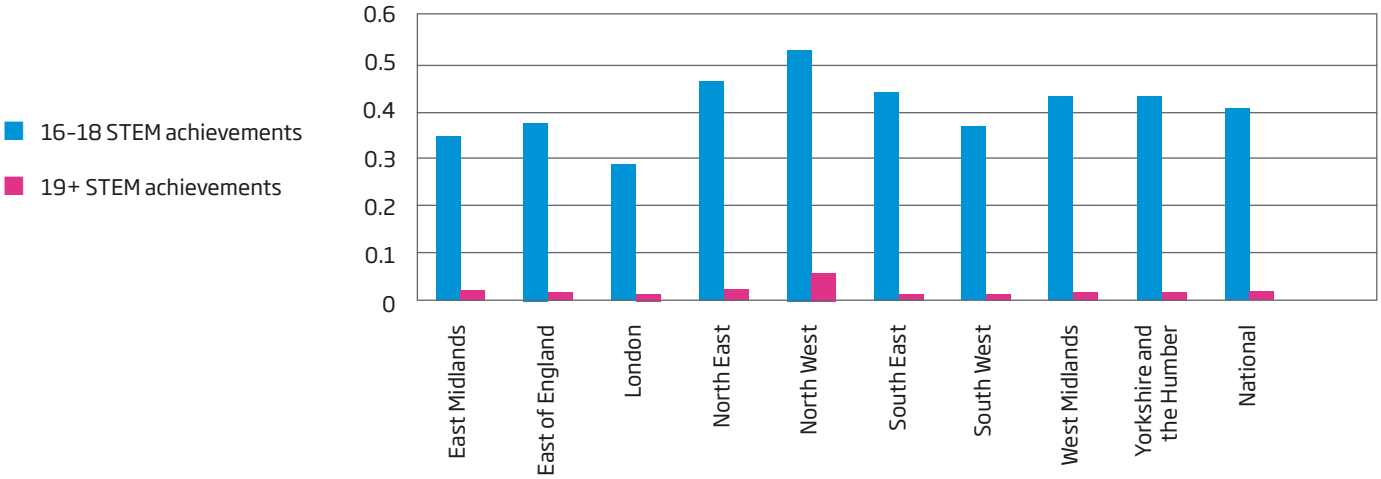
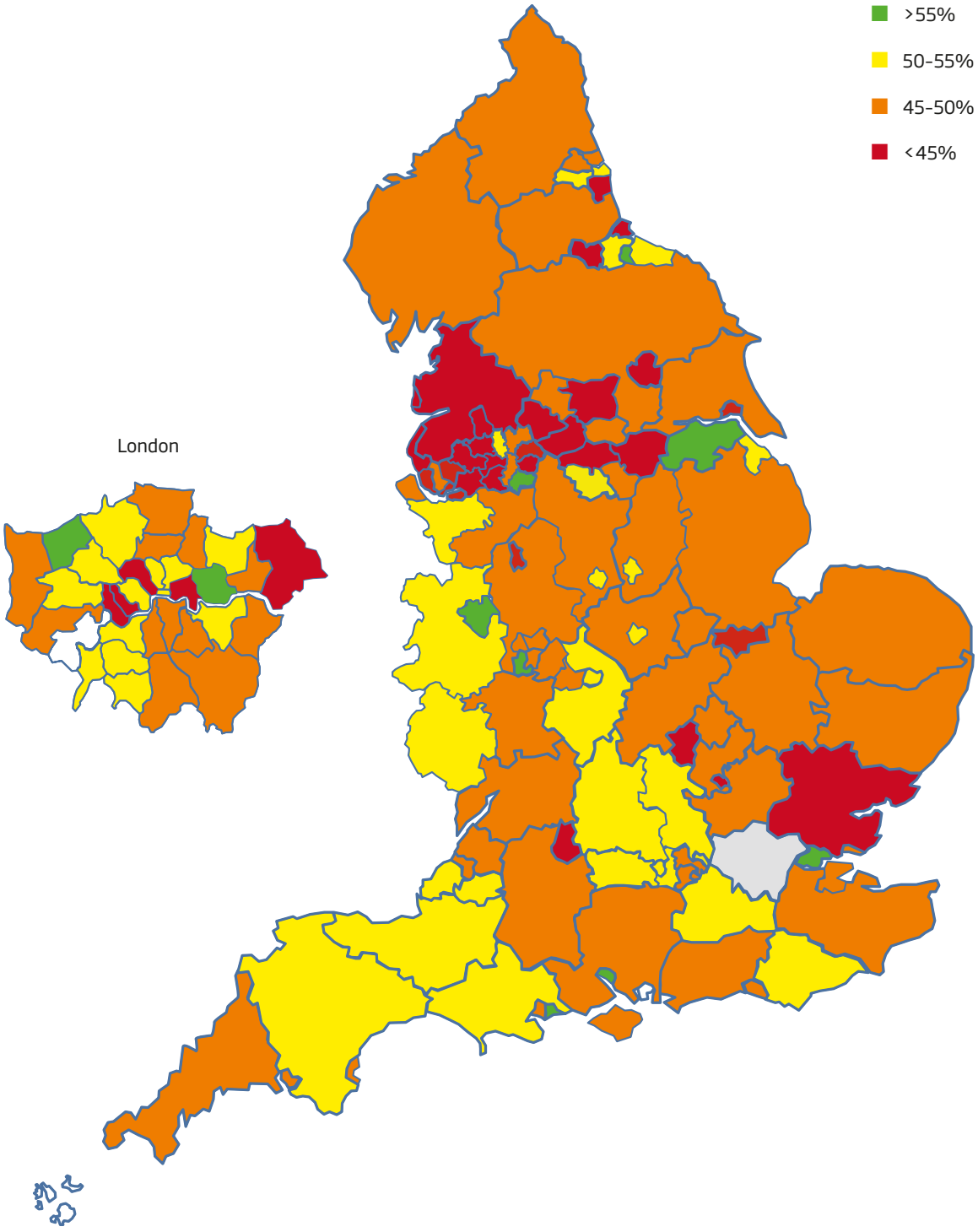


Figure 21: Ratio of funded STEM achievements 2010/11 to size of regional population according to 2011 Census

Variations between regions become more marked when both age and size of population are taken into account.

Census data: **www.ons.gov.uk/ons/publications/index.html**



Analysis at UK regional level masks very significant variations found at sub-regional level. In the 2010/11 maps shown here local education authority boundaries are used.

Figure 22: Percentage of 16-18 completions in schools that are STEM

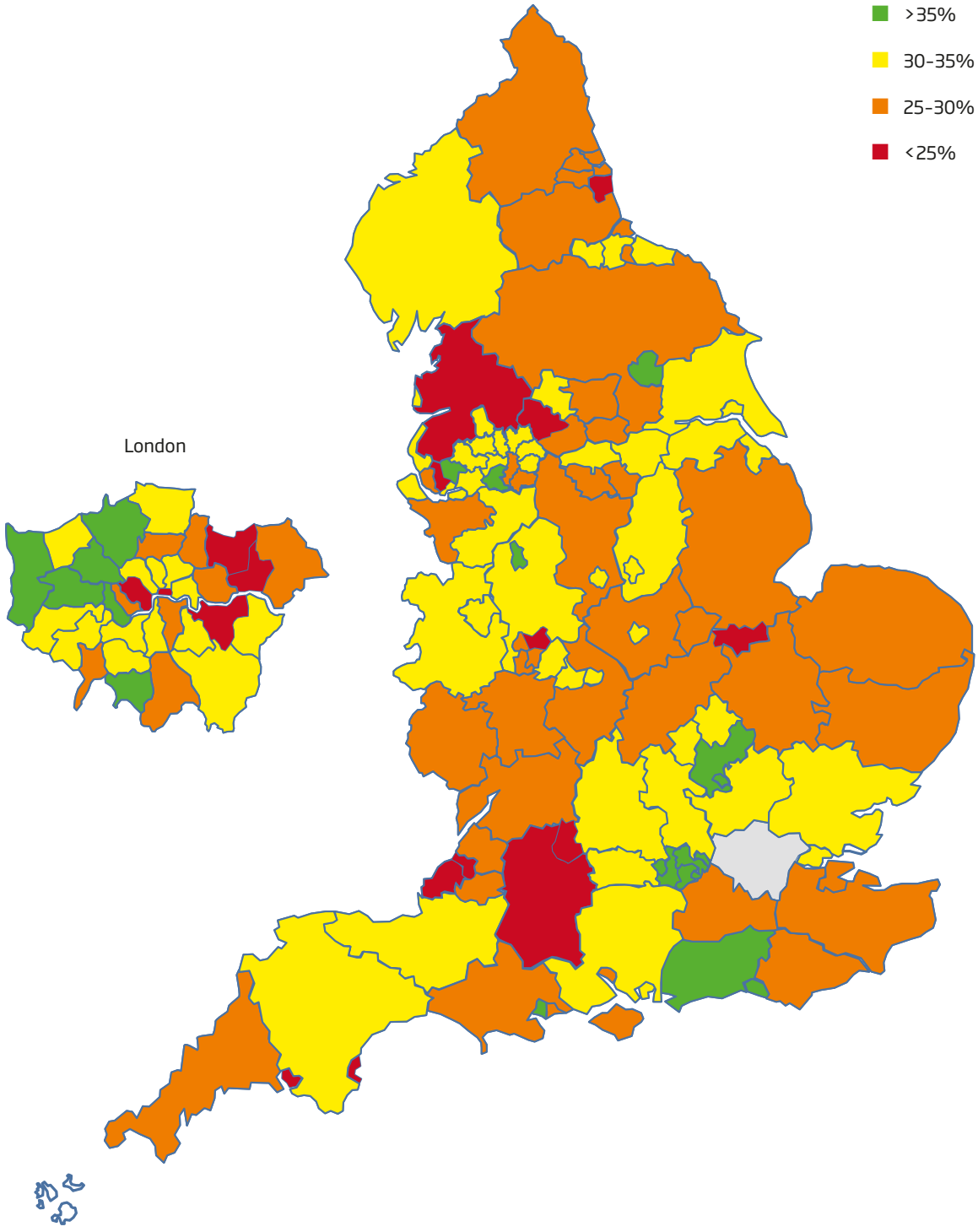
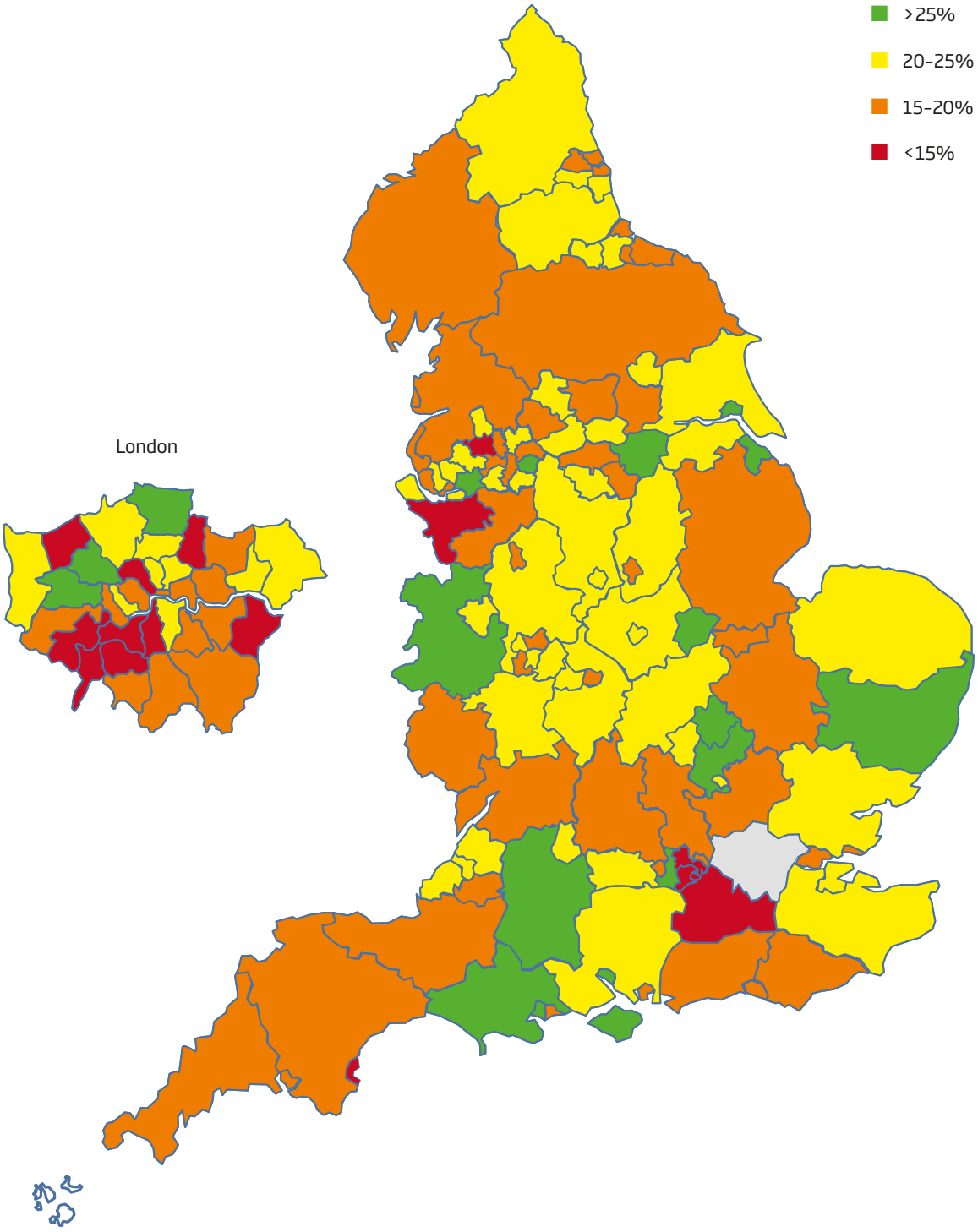


Figure 23: Percentage of 16-18 achievements in FE and skills sector that are STEM

Low proportions of STEM in schools are not always compensated for by the STEM achievements of young people in the FE and skills system.



The relative paucity of STEM achievement among adults is evident with few areas of England reaching 25%.

There are some steep gradients in the proportion of STEM, particularly but not exclusively in London.

Figure 24: Percentage of 19+ achievements in FE and skills sector that are STEM

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