

# The employment trajectories of Science Technology Engineering and Mathematics graduates

Executive summary - February 2018

Professor Emma Smith and Dr Patrick White



**STEM**

The graphic features a central white box with the word 'STEM' in bold black letters. Below it are four smaller boxes: 'SCIENCE' with a microscope icon, 'TECHNOLOGY' with a circuit board icon, 'ENGINEERING' with gear icons, and 'MATHEMATICS' with a calculator icon. The background is a complex network of white icons and lines on a dark blue gradient, representing a digital or technical landscape.

**SCIENCE**

**TECHNOLOGY**

**ENGINEERING**

**MATHEMATICS**

## Acknowledgements

---



The Nuffield Foundation is an endowed charitable trust that aims to improve social well-being in the widest sense. It funds research and innovation in education and social policy and also works to build capacity in education, science and social science research. The Nuffield Foundation has funded this project, but the views expressed are those of the authors and not necessarily those of the Foundation. More information is available at **[www.nuffieldfoundation.org](http://www.nuffieldfoundation.org)**

## Introduction

The aim of this study is to contribute to the ‘STEM skills deficit’ debate by providing much needed evidence on STEM career trajectories in the graduate labour market. The research draws on data from four national data sources: the Higher Education Statistics Agency (HESA) Destination of Leavers from Higher Education survey (DLHE), the Annual Population Survey (APS), the 1958 National Child Development Study (NCDS) and the 1970 Birth Cohort Study (BCS). It also refers to earlier work using UCAS data. It provides detailed empirical evidence on the career paths of STEM graduates from the early 1980s to the current decade. The study addresses the following research questions:

1. What are the destinations of STEM graduates directly after graduation?
2. What are the occupational positions of older STEM graduates, aged 25 to 64?
3. What are the longer-term occupational trajectories of STEM graduates?
4. How do patterns of employment for STEM graduates compare with employment patterns for those with degrees in other subjects and with non-graduates?
5. How closely is participation in STEM careers related to individual characteristics such as sex, ethnicity and educational background?

## Summary of main findings

The main findings from the study are outlined below. Further information on the datasets and definitions used in this research appear in Appendices A and B of the full report. A fuller discussion of the results is also presented in the report.

### What are the destinations of STEM graduates directly after graduation?

Data from the HESA first destination survey from 1994 to 2011 were used to establish patterns in the early career destinations of recent graduates, and to examine variation over time and between subject areas. The key findings were:

- The destinations of STEM graduates have remained remarkably stable over time, regardless of the particular degree subject studied. This is the case despite major changes in higher education policy – such as the introduction of, and subsequent increase in, tuition fees – and changes in the national economy.
- The majority of STEM graduates enter graduate-level employment shortly after graduating. But while levels of unemployment for recent graduates have remained reasonably stable over the past twenty years, they are among the highest for those with computer science (around 13%) and engineering degrees (around 10%) – two of the main subject areas where concern about shortages has been raised.
- Around 50% of employed computing and engineering graduates enter (highly skilled) STEM jobs, but a relatively high proportion (18% and 14%, respectively) are employed in routine occupations six months after graduating. This, alongside findings on unemployment rates, suggests two routes for graduates from these disciplines: one that leads to highly-skilled professional jobs and another that leads to routine employment or unemployment.
- A disproportionate number of graduates from higher status universities enter HS STEM roles in the six months following graduation, compared to more recently-established institutions. In some years almost twice the proportion of employed graduates from Russell Group universities found employment in HS STEM roles compared to their peers in University Alliance/ Million+ institutions.
- A larger proportion (around 25%) of graduates from the physical, mathematical and biological sciences remain in education and undertake additional training prior to entering the workforce compared to engineering (12%-16%) and computer science (around 12%) graduates. This may be because their undergraduate degrees do not provide them with the necessary knowledge and skills to enter the HS STEM occupations they are aiming for, or that additional study is required – or perceived to be required – to make them desirable to employers.

## Executive Summary

### What are the occupational situations of older STEM graduates, aged 25 to 64?

Annual Population Survey (APS) data from 2004 to 2010 were analysed in order to establish the occupational positions of older STEM graduates. The key findings were:

- The vast majority (87%) of STEM graduates are employed in graduate-level jobs. However, only just over half that proportion (46%) work in HS STEM positions.
- STEM graduates were employed in many different (often non-STEM) occupational groups but only a minority (about 17%) worked in the key STEM 'shortage' occupational areas as science, ICT or engineering professionals.
- The biological sciences stand out as relatively weak in terms of HS STEM employment outcomes for both recent and more established graduates. Biological science graduates were less likely than those from other key STEM disciplines to be employed in STEM jobs; only 32% were working in these roles compared with 46% of all STEM graduates. The proportions entering graduate-level jobs were similar, however: 82%, compared with 87% for all STEM graduates.
- Professional engineering occupations attract relatively few graduates from other disciplinary backgrounds: over 70% of graduates employed in this area have engineering degrees. Similarly, the ICT sector is very reliant on maths and computer science graduates (over two-thirds of graduates in this sector have maths or computer science degrees). This may be because of the specialised nature of these occupational areas but, given that the majority of engineering and ICT professional jobs are filled by non-graduates, it is surprising that there are not more graduates from other STEM backgrounds working in these areas.
- Relatively high proportions of STEM graduates are employed in the teaching profession and this is the most common occupational destination for maths (26%), biology (19%) and physics (17%) graduates. But only a relatively small proportion of STEM graduates work in roles likely to involve substantial amounts of laboratory work. These outcomes do not reflect the curricula of most STEM degrees – particularly in the natural sciences – where there tends to be considerable emphasis on laboratory skills and much less coverage of subject-related pedagogy. This is particularly important given the frequently reported shortages of suitably qualified graduates to teach mathematics and physics in school. It may reflect the influence of STEM employers, through the sector subject bodies, on the content of undergraduate STEM degree programmes in these subject areas.

### What are the longer-term occupational trajectories of STEM graduates?

Data from six sweeps of the 1958 National Child Development Study (NCDS) and five sweeps of the 1970 Birth Cohort Study (BCS) were used to examine long-term occupational trajectories. Particular attention was paid to movement in and out of graduate professions and HS STEM occupations.

- The cohort study data show considerable movement out of scientific jobs as workers get older, with no evidence that many STEM graduates enter HS STEM occupations later in their careers. Some workers left the STEM sector altogether but others may have been promoted into management positions that were not classified as HS STEM roles. The route into HS STEM jobs seems predicated on early entry and there seems to be either limited opportunities or little desire to enter STEM occupations later in life.
- Sectors such as education and health appeared to avoid the problem of attrition faced by those areas that are heavily reliant on HS STEM workers. Levels of employment in these areas remained stable as cohort members aged and some areas, such as functional management, increased their share of graduate workers.

### How do patterns of employment for STEM graduates compare with employment patterns for those with degrees in other subjects and with non-graduates?

All four datasets were used to determine the extent to which patterns of employment for STEM graduates compared with those with degrees in other subjects and those who did not have degrees. The most important findings were:

- The variation in employment destinations between STEM graduates is, in many respects, greater than the variation between those with STEM and non-STEM degrees. Because of this, simply grouping subjects into STEM and non-STEM is not particularly useful and can hide important differences between subject groups and individual subjects. For example, biological science graduates who found employment six months after graduation were three times less likely to be in HS STEM jobs than employed engineering graduates and only half as likely as employed STEM graduates as a whole. Interestingly, at this early stage of their careers, however, social studies graduates had a similar level of employment in HS STEM positions as those with biological science degrees.
- The destinations of STEM and non-STEM graduates were similar in terms of the status of the occupations they worked in and the most common areas of work. By age 30, similar proportions had graduate jobs and, for the most part, the largest recruiting occupations for both groups were teaching and functional management.

- There is some evidence of a ‘slower start’ among non-STEM graduates in terms of securing graduate-level jobs. But any longer term advantage of STEM degrees over non-STEM degrees, in terms of the ability to secure and retain graduate-level employment, is minimal. There was certainly no evidence of dramatically better employment outcomes for STEM graduates as a whole.
- The majority of HS STEM positions are held by non-graduates. APS data showed that, overall, 53% of HS STEM positions were held by non-graduates. Even among younger workers aged 25-29, more than one-third (37%) of HS STEM jobs were filled by employees without undergraduate degrees.

### **How closely is participation in STEM careers related to individual characteristics such as sex, age and educational background?**

All four data sets were used to examine inequalities in participation in STEM careers. The findings revealed important issues in two main areas: the participation of women and the employment prospects of graduates from pre-1992 universities.

- Gendered patterns of participation in STEM subject areas and the wider STEM labour market persist. Female STEM graduates were as likely as men to gain employment in graduate jobs (86% of female graduates and 87% of males) but were less likely to secure work in the HS STEM sector (32% and 55%, respectively). These patterns are established soon after graduation and persist through to late career. This was a consistent finding in all the datasets used in this analysis. Not only do fewer women study for STEM degrees in the first place, a smaller proportion of female than male STEM graduates go on to work in the sector.
- Inequalities in career trajectories were greatest for female graduates from male dominated subject disciplines, particularly engineering and computer science. This is important given the shortage discourses surrounding those two subject areas.
- There are clear differences in the early career destinations of STEM graduates from different types of institution. Graduates from the former polytechnics have poorer early career opportunities than those graduating from more research-intensive institutions, particularly in terms of HS STEM roles. This is particularly evident for computing, engineering and technology graduates. These inequalities in participation in HS STEM jobs are surprising given the long history of the polytechnics in providing advanced vocational training for the industrial sector. They are also important in the light of calls to increase the number of young people studying for science degrees.

### **Summary of the implications of the main findings**

There are several key findings to emerge from this study. Each finding, along with some of its most important implications, is listed below. A more comprehensive list of implications can be found at the end of the report.

#### **Finding 1: Only a minority of STEM graduates enter HS STEM occupations, even in shortage areas**

As employers recruit only a minority of STEM graduates for HS STEM roles, there are large numbers of STEM graduates that could potentially work in HS STEM roles, many with degrees in ‘shortage’ areas or related disciplines.

Simply increasing the number of students in the ‘STEM pipeline’ is unlikely to be an efficient way of providing employers with the graduate employees they want. This is particularly the case in some STEM subjects, such as the biological sciences, that provide a very small proportion of the HS STEM workforce.

#### **Finding 2: The three key STEM shortage occupations (science, engineering and ICT professionals) attract only a minority of STEM graduates. The highest recruiting occupational groups are teaching and functional management.**

STEM graduates are either being attracted to other occupations areas or failing to find work in HS STEM roles. The majority are not going into highly paid sectors such as banking and finance but into areas such as education and into lower-level management positions. Employment in STEM shortage areas is either unattractive or unobtainable for the majority of STEM graduates.

Even though teaching is the most common occupational destination for STEM graduates, many degrees cover little in the way of subject-based pedagogy. This is particularly important given that the recruitment of science teachers has traditionally been difficult.

## Executive Summary

### **Finding 3:**

**A substantial proportion of STEM graduates move out of HS STEM roles as their careers progress but few older workers move into HS STEM positions.**

Retaining current workers in HS STEM positions could help reduce the number of vacancies to be filled by recent graduates.

Attracting older STEM graduates into the sector for the first time may help fill current vacancies. Non-STEM graduates and non-graduates – of any age – could also be sources of new recruits.

### **Finding 4:**

**The majority of HS STEM workers are non-graduates.**

STEM degrees, or graduate-level education in any subject area, are not a pre-requisite for employment in all HS STEM jobs, even if they are considered desirable.

The emphasis on participation in higher education in recent decades may be over-shadowing other routes into HS STEM jobs such as apprenticeships.

### **Finding 5:**

**There are large differences in the proportion of different groups of STEM graduates entering HS STEM jobs. Much smaller proportions of graduates in some STEM subjects, from some types of university, and from different social groups, enter HS STEM occupations than others.**

Particular groups of STEM graduates, in particular biological science graduates and those graduating from post-1992 institutions, are currently under-represented in the HS STEM workforce and could be a valuable source of potential employees if targeted effectively.

The differential participation in HS STEM careers of graduates from post-1992 institutions is striking and may reflect a gap between the skills and knowledge of the students graduating from these institutions and the requirements or expectations of employers.

### **Finding 6:**

**There is little variation between the immediate and longer-term occupational destinations of STEM and non-STEM graduates in terms of graduate-level employment.**

The vast majority of graduates are employed in graduate-level positions by the end of their twenties. STEM employers are competing for workers in a context in which most graduates are able to find high status, professional-level work. The salaries and working conditions they offer must reflect this if they are to remain competitive.

Encouraging students to study STEM degrees on the basis of better labour market outcomes is ethically questionable. STEM graduates have little advantage over non-STEM graduates in terms of securing graduate-level employment and most STEM graduates never work in HS STEM jobs.

---

## Conclusion

For this project we analysed four high quality data sources to examine the careers of STEM graduates. Although STEM graduates were our main focus, for comparative purposes we also analysed data on non-STEM graduates and non-graduates. We examined occupational destinations shortly after graduation, longer-term career trajectories and historical trends in the STEM labour market. Although the demand for STEM workers has not been measured directly – through an examination of unfilled posts, for example – we have occasionally used patterns in the STEM labour market and the trajectories of STEM graduates and workers to make inferences about demand. The consistency of the results from our analyses of the four different data sets suggests that the findings are robust. The most important conclusions are outlined directly below.

There is no evidence of a shortage of STEM graduates *per se*. Only a minority of STEM graduates ever work in HS STEM occupations, and an even smaller proportion are employed in key ‘shortage’ areas. Any mismatch between the supply and demand for STEM workers cannot, therefore, be attributed to the number of students graduating with STEM degrees. Problems with the ‘supply’ of STEM workers are more likely to be explained by the willingness of graduates to pursue careers in STEM fields and the recruitment practices of employers.

There are large differences between STEM subjects in terms of the proportion of graduates that go on to work in STEM fields, particularly in highly skilled positions. Engineering does well in this regard, while in some subject areas – such as biological sciences – smaller proportions of graduates go on to work in HS STEM positions than in some non-STEM subjects.

There is also a stark contrast between the employment trajectories of graduates from ‘elite’ universities and those from some of the newer, post-1992 institutions.

There is attrition from STEM occupations over the course of individuals’ careers that is not seen in other fields. A larger proportion of STEM workers move out of highly skilled positions later in their careers. Unlike in other professions, such as education or health, this is not balanced by an intake of more mature recruits; graduates are unlikely to enter STEM positions if they do not do so shortly after graduation.

Most highly skilled STEM workers are non-graduates. Any increase over time in the proportion of STEM workers with degrees appears to only reflect the historical increase in participation in higher education. Focusing too much attention on graduates ignores the source of the majority of the STEM workforce.

School of Media,  
Communication and Sociology  
Bankfield House, 132 New Walk,  
Leicester, LE1 7JA  
t: +44 (0)116 223 1450  
e: [pkw4@le.ac.uk](mailto:pkw4@le.ac.uk)  
w: [www.le.ac.uk](http://www.le.ac.uk)



Printed by Print Services,  
University of Leicester,  
on FSC certified stock.