

How do shortages of maths teachers affect the within-school allocation of maths teachers to pupils?

Introduction and background

The Nuffield Foundation has a keen interest in enabling all young people to study maths beyond the age of 16. Research which it has funded to date has demonstrated the comparatively low rates of participation in England, Wales, and Northern Ireland, and developed ways to increase it. Most recently, this has been seen in the development of the new post-16 Core Maths qualification, and in the Smith Review of post-16 mathematics.

One of the key challenges in increasing maths participation is addressing the shortage of maths teachers. This report which was funded by the Nuffield Foundation and produced by Education Datalab presents an analysis of the ways in which schools have responded to the shortage. It uses the latest Schools Workforce Census (SWC) from November 2016 to examine the maths teaching workforce and issues relating to supply and retention. The main analysis is based on 1,149 schools. Throughout the analysis comparisons with English are made, since the curriculum and qualification structure is similar to maths departments across Key Stages 3 to 5.

Key findings

Teacher shortage and allocation: what we already know

- The variation in teacher effectiveness appears to be particularly marked in mathematics (Burgess, 2015). It is therefore critical that schools are able to recruit, develop and retain good maths teachers.
- England has had an overall shortage of maths teachers since the 2012-13 academic year and severe shortages since the 2016-17 academic year. A recent government report identified maths as having among the worst shortages of any subject. According to the Times Educational Supplement, which creates an index of success in appointing a teacher from their jobs portal and survey data, maths has been the most difficult subject to appoint to in every year since its index started in 2011 (TES Global, 2016).
- In terms of teacher supply, the shortage of maths teachers is partly due to economic recovery and the fact that higher private sector wages are available for those with a maths degree. This also explains why maths and science teachers have some of the highest rates of early-career attrition.
- Demand for maths teachers has increased because of policy changes requiring students who fail maths GCSE to continue studying the subject up to age 18. There is also some evidence that the new GCSEs and Progress 8 accountability metric have caused many schools to increase maths and English timetables in Key Stages 3 and 4.
- There is a growing body of literature on the allocation of teachers to pupils within schools. The first strand of the literature has looked at which pupils get access to high quality teachers. Three studies from the US have found

that classes containing disadvantaged pupils are more likely to be taught by inexperienced or less qualified teachers. In England, two comparable studies have been conducted; one found that teachers with no post-compulsory qualifications in maths were more likely to be allocated to low-ability sets and the other found that classes containing disadvantaged pupils were more likely to have inexperienced teachers.

- The second strand of the literature has looked at how schools respond to accountability incentives in allocating their teachers. A 2008 study by Boyd showed how the introduction of a fourth-grade examination which would be used in accountability measures, led schools to reallocate their experienced teachers to fourth-grade classes.

Comparison of the profiles of those teaching English and maths

- There are many similarities between maths and English departments in secondary schools. Both subjects have similar timetable commitments in Key Stages 3 and 4. Where a school has a sixth form, they usually deliver both GCSE (or other level 2) resit qualifications alongside A Levels in maths and English. Moreover, both departments will generally teach all pupils in a school at GCSE level.
- There are differences and similarities between the 2 groups in terms of characteristics. Maths teachers are less likely to have a maths degree (44%) than English teachers are to have an English degree (65%). Among maths teachers that do not have a maths degree, the two largest groups are those with physics and economics/business degrees.

- Maths teachers are teaching slightly more hours in maths, than English teachers are in English. These differences in average hours taught per teacher mean that overall, 3,500 fewer maths teachers are needed.
- Maths and English teachers have similar pay, which would imply that they have similar levels of responsibility.
- Levels of age and experience are relatively similar: maths teachers are on average 0.5 years older and 0.4 years less experienced.
- The analysis tracks the transitions of teachers between November 2010 and 2016 in order to look in differences in career paths of maths and English teachers.
- The analysis shows the proportion of 2016 teachers who have moved into teaching more maths or English since 2010. Surprisingly, the proportion is lower in maths (12%) than in English (13%). By contrast, a smaller proportion of maths teachers (9%) were teaching more hours in 2010 than 2016 than English teachers (11%). The data shows that a decline in full time equivalent hours is not responsible for this, so it would appear to suggest that fewer maths than English teachers are progressing to leadership roles as they become more experienced.
- Fewer maths teachers (19%) have entirely or partially switched out of teaching maths into other subjects than is the case in English (24%).
- The analysis concludes that maths departments have less risk of losing maths teaching hours to other responsibilities in the school. However, they faced two slightly higher risks of attrition between 2010 and 2016: at the start of teachers' careers, and due to retirement at the end of their careers.

Allocation of teachers across key stages

- The analysis clearly shows that schools are more likely to allocate maths teachers who are inexperienced or do not have a maths degree to Key stages 3 or 4 rather than Key Stage 5. The same is true for English.
- Forty-eight per cent of all maths teaching is delivered by a teacher with a maths degree. Fourteen per cent of all maths teaching is delivered by an inexperienced maths teacher.
- Fifty-seven per cent of maths teaching hours at Key Stage 5 are delivered by a teacher with an academic degree in the subject, whereas the figure for Key Stage 3 is just 43 per cent.

Schools with differing levels of post-16 maths resit entries

- The analysis explores whether schools where a high proportion of sixth form students are re-sitting GCSE maths are more likely to allocate inexperienced or specialist teachers to Key Stage 5 teaching. To do this, it divides schools into 3 equal sized groups: schools where between 0 and 4.8 per cent of the sixth form cohort are resitting GCSE maths; schools in which between 4.8 and 12.4 are resitting; and schools in which between 12.4 and 59.8 per cent are resitting.

The data shows that high-retake schools have significantly more inexperienced or non-maths degree teachers allocated to Key Stage 5 maths. However, these patterns largely reflect the shortages of experienced and specialist maths teachers in these schools.

School demographic differences in the allocation of teachers across key stages

- For this section of the analysis, all schools with sixth forms are grouped into five equal-sized quintiles according to their overall free school meals (FSM) proportion.
- The data shows that students in all year groups in the most disadvantaged schools are much more likely to be taught maths by an inexperienced teacher and that the gradients for each key stage are not very different.
- Key Stage 5 maths students in the most disadvantaged schools are almost twice as likely to have an inexperienced teacher than in the least disadvantaged schools (9.5% versus 5.3%). The statistics for English are very similar.
- In the most affluent schools, 64.8 per cent of maths lessons have a teacher with a maths degree, compared to 51.9 per cent in the most disadvantaged schools. The comparative figures for English are much higher, with less differentiation between key stages, and with slightly less gradient by social demographic of the school.

Regional differences in the allocation of teachers across the key stages

- At Key Stage 3, the highest proportion of teachers without maths degree is to be found in the East Midlands and the East of England. At Key stage 4, the areas with the highest proportion are the East of England and London. At Key Stage 5 the highest proportion of teachers without a maths degree are in the East of England and the South East.
- The use of teachers who principally teach another subject almost entirely falls on Key Stage 3 across all regions. The use of these teachers is more prevalent in Key Stage 3 English than it is in maths.
- At all key stages, the percentage of maths and English lessons delivered by inexperienced teachers is highest in London. This is consistent with London's status as a city that trains large numbers of novice teachers each year.

Conclusion

- This analysis concludes, in line with previous studies, that teachers who are inexperienced or do not have a degree in the subject are most frequently allocated to teach Key Stage 3 classes, regardless of whether the school's sixth form is delivering a large number of GCSE retake classes or not. It therefore seems that maths and English Heads of Department both place a value on ensuring that experienced and well-qualified teachers are delivering the GCSE retake classes.
- Post-16 maths seems to be insulated from direct harm by shortages of maths teachers, though of course if pupils arrive ill-prepared from Key Stage 3 this will have knock-on effects.
- The authors of the analysis recognise the limitations of the data presented in this report. Further research into direct measures of shortages data such as applications per post, appointable applicants interviewed, and headteacher perceptions of quality of applicants will be necessary in order to gain a more rounded view of the situation.

The full document can be downloaded from:

<http://www.nuffieldfoundation.org/sites/default/files/files/Within-school%20allocations%20of%20maths%20teachers%20to%20pupils%20v%20FINAL.pdf>