Report

The Science Technician Workforce in English Secondary Schools

National Foundation for Educational Research (NFER)

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Jack Worth

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Executive Summary

Despite the important role school science technicians play in delivering a high-quality science education, there has been relatively little attention paid to the science technician workforce (Gatsby, 2017). This is in contrast to the science teacher workforce, which has been the focus of several policy initiatives, primarily because of under-recruitment to initial teacher training and emerging teacher shortages.

This report sheds new light on changes in science technician provision in secondary schools in England since 2011/12 and the characteristics, pay and contractual arrangements of the science technician workforce. It is based on findings from analysis of data from the Department for Education's (DfE) School Workforce Census (SWC), an annual snapshot data collection covering the employment records of all teaching and non-teaching staff employed in state-sector schools in England (but the data does not cover technicians in colleges, industry or higher education).

Provision of science technician support

We estimate the size of the school science technician workforce and the extent of support technicians provide to secondary school science departments using a range of established metrics. These include the full-time equivalent (FTE) number of technicians per school, FTE number of technicians per science teacher, FTE number of technicians per 100 pupils and the Association for Science Education (ASE) service factor (total technician contracted working hours per week divided by the total weekly hours of science teaching).

There is a set of clear and consistent findings from the analysis about how science technician support in secondary schools has changed over time and varies between schools. Each of the measures shows that the average level of science technician support has fallen between 2011/12 and 2018/19:

- The average number of FTE science technicians per school has fallen by 16 per cent
- The median number of FTE science technicians per 100 pupils has fallen by 13 per cent
- The median number of FTE science technicians per science teacher has fallen by 15 per cent
- The median science technician service factor (as defined by ASE) has also fallen by 15 per cent
- The proportion of schools at or above the ASE's suggested minimum service factor threshold of 0.65 has fallen from 21 to 15 per cent of secondary schools.

There is also considerable variation in the level of science technician support across schools and at least part of this variation is explained by geographical region. Regions in the north of England have considerably lower levels of technician support than in London and the south of England. There are also differences in the level of science technician support by school context: schools with less-deprived pupil intakes tend to have higher support ratios than schools with more-deprived pupil intakes and academies tend to have a slightly higher support ratio than local authority maintained schools.

Characteristics of the school science technician workforce

The SWC data confirms findings from other surveys that the science technician workforce is around three-quarters female and three-quarters aged over 40 in 2018/19. Around half of school science technicians work part-time, although nearly half of those who work part-time work at least four days per week. Most of the school science technician workforce is employed on a term-time only basis, which comes with a significantly lower salary compared to those technicians on a full-year contract. This salary difference by contract period is larger than the salary difference due to a science technician's experience level.

The median science technician FTE annual salary has been flat in real-terms between 2011/12 and 2018/19; in other words, pay has grown at roughly the same rate as the rate of inflation. Teacher pay has not grown any more over the same period either: the starting salary of a newly-qualified teacher has remained 40 per cent higher than the FTE annual salary of the average science technician, which is around £17,000, throughout this period. Technician pay is higher in London than in the rest of the country, as it is for teachers, but unlike for teachers, technician pay is not regulated to be higher in London.

In 2011, the House of Commons Science and Technology Committee described the pay and conditions of science technicians as 'appalling' and called for the creation of 'a career structure that will attract skilled and dedicated people to work as technicians' (GB. Parliament. HoC. Science and Technology Committee, 2011). Our findings suggest there has been no significant improvement in the pay and employment conditions of science technicians in the nine years since this report was published.

Retention and turnover of school science technicians

The turnover rate of science technicians has been around 20 per cent between 2014/15 and 2018/19, having risen from around 15 per cent in 2011/12. High turnover means that school leaders experience staffing uncertainty and, if replacements are made, incur recruitment costs of hiring new staff. However, many schools may have chosen not to replace science technicians who have left, reducing the overall workforce size.

The overall turnover rate for science technicians is about the same as it is for teachers (Worth *et al.*, 2018). However, the proportion of science technicians leaving the school system is a lot higher and the proportion moving schools is a lot lower compared to teachers, for whom the rates are around ten per cent for both.

Younger science technicians and those approaching, or at, retirement age are more likely to leave the state-funded school sector than those in their 40s and 50s. Younger technicians are more likely to move school than older technicians. There is higher turnover among science technicians in schools with lower Ofsted ratings, which may relate to a lower quality of working environment in those schools.

Conclusions

The level of science technician support in England's secondary schools has fallen between 2011/12 and 2018/19

All the measures that we have explored of the extent of science technician support available within school science departments show that science technician support has fallen between 2011/12 and 2018/19. Given the reduction in real-terms per pupil school funding over this period, the most likely explanation is that the fall is due to schools reducing their expenditure on science technicians as their budgets have been squeezed (Cramman *et al.*, 2019; Britton *et al.*, 2019). However, we cannot definitively rule out other explanations, such as increasing science technician shortages, also playing a part.

Most schools are, as a result, operating with a science technician workforce that is smaller than the minimum support threshold recommended by the ASE. This could be having a detrimental impact on the workload of science teachers, which several previous research studies have linked to the level of science technician support (Gatsby, 2017). However, relatively little robust quantitative research has been conducted to demonstrate the relationship between levels of school science technician support and science teacher workload.

Recommendation 1: The Government should consider what policy measures might encourage schools to increase the level of science technician provision and support

Recommendation 2: More research should be conducted to understand better the relationship between science technician support and science teacher workload

The pay and conditions of school science technicians has not improved since the House of Commons Science and Technology Committee described them as 'appalling'

In 2011, the House of Commons Science and Technology Committee described the pay and conditions of science technicians as 'appalling' and called for the creation of 'a career structure that will attract skilled and dedicated people to work as technicians' (GB. Parliament. HoC. Science and Technology Committee, 2011). Since then the average pay of school science technicians has been flat in real terms between 2011/12 and 2018/19.

Most school science technicians are employed on a term-time only contract. The proportion of school science technicians employed term-time only (which comes with a lower salary) has increased slightly in academies since 2011/12, but remained the same in local authority maintained schools. The turnover rate of school science technicians is around 20 per cent in 2017/18, having risen by five percentage points since 2011/12. It is therefore clear that there has been no significant improvement in the pay and employment conditions of science technicians since the Science and Technology Committee's most recent report covering the science technician workforce.

Recommendation 3: The Government should review science technician pay and conditions, considering what policy measures might help to attract and retain science technicians in the future

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1 Introduction

1.1 Overview and motivation for this research

School science technicians play an important role in delivering science education in England. Their support is particularly with assisting science teachers with practical aspects of science learning, such as maintaining the necessary equipment, preparing and setting up experiments and giving technical help to pupils in practical lessons. This support helps to reduce the workload of science teachers that would otherwise be spent on these activities (Gatsby, 2017). However, relatively little attention has been paid to the science technician workforce.

Science teachers have been the focus of several recent policy initiatives, primarily because of under-recruitment to initial teacher training (particularly for physics and chemistry) and emerging teacher shortages. These have included bursaries and early-career payments for teacher training in science subjects and a maths and physics teacher supply package (DfE, 2020; DfE, 2017).

In contrast, there have been no recent policy initiatives focussed on science technicians, despite their important role in delivering a high-quality science education. A 2002 House of Commons Science and Technology Committee report on science education from 14 to 19 called for 'action [to be] taken within the next year to address the appalling pay and conditions of science technicians and to create a career structure that will attract skilled and dedicated people to work as technicians' (GB. Parliament. HoC. Science and Technology Committee, 2002). A 2011 House of Commons Science and Technology Committee report on practical experiments in school science lessons considered that 'teachers supported by motivated and informed technical staff will spend less time on risk assessment and other bureaucracy and more on ensuring high quality teaching outcomes' and reiterated its predecessor's recommendation (GB. Parliament. HoC. Science and Technology Committee, 2011).

The motivation of this research report is to highlight the changes in school science technician provision, workforce characteristics and contractual and pay arrangements since 2011, using a new source of data.

1.2 Previous research on science technicians

The most comprehensive survey of the science technician workforce is the landmark study by the Royal Society and the ASE (2001). The survey explored science technician provision across the countries of the UK and in different types of school, and described the personal characteristics, working conditions, job descriptions and career progression and training prospects of science technicians. The findings were based on survey responses from 5,026 science technicians in 1,917 schools across the UK. The study concluded that science technician staffing ratios (based on the ASE service factor) in schools were typically below the minimum recommended level, particularly in comprehensive schools. It also concluded that 'working conditions for technicians are extremely varied' and that there is a 'general perception among technicians that school senior management does not understand the job of a technician and consequently does not value it'.

The most recent assessment of science technician staffing ratios in schools is a study by the University of Durham on practical science in schools and colleges in England and Scotland

(Cramman *et al.*, 2019). The study found that the number of technicians employed and the ratio with pupils was lower in state schools in England compared to independent schools. The survey also provided information on science technicians' qualifications, subject specialisms, professional development, available practical science equipment and personal characteristics.

Several smaller-scale surveys of science technicians have also been conducted since 2001, including a 2016 survey by Preproom.org, a 2017 survey by the ASE and a 2019 Unison survey of school technicians (among whom 64 per cent were science technicians) (Galvin and Knight, 2016; Chandler-Grevatt, 2017; Unison, 2019). The ASE study of around 500 technicians, heads of science departments and science teachers, concluded that numbers of technicians in schools was decreasing despite increasing numbers of students on roll. A 2020 ASE survey of 472 science technicians found that over 80 per cent of science technicians had some concerns over an increased workload or changes to working practices, as they prepared to return to fully reopened schools and colleges in September 2020, after the school closures due to Covid-19 (ASE, 2020).

The important role of science technicians in delivering practical science education in the UK was highlighted in a 2017 study by the Gatsby Foundation (Gatsby, 2017). The research drew on findings from international visits and qualitative interviews, concluding that 'technicians underpin most of our 10 benchmarks [for good practical science]'. The international comparisons revealed that the UK has 'well above-average technician support by international standards', citing the examples of the United States, Germany and Finland where no school science technicians are usually employed. The report highlights that 'schools in countries that have no technicians have other ways of providing technical support', such as en-suite prep rooms for teachers and paying teachers extra for the time to prepare experiments. The qualitative interviews in the Gatsby research revealed 'unease at the difficulty in recruiting qualified and experienced technicians, the main reason being given as the low salary on offer'. Cost analysis concludes that reallocating preparation and support work from science teachers to science technicians results in cost savings for schools, suggesting that 'reducing technicians' contracted time is a false economy because it increases the load on teachers'.

1.3 Methodology

The aim of our analysis is to build on the themes of this previous research and provide an up-to-date picture of the science technician workforce in England's secondary schools. The report is based on findings from analysis of data from the Department for Education's (DfE) School Workforce Census (SWC). The SWC is an annual snapshot data collection covering the employment records of all teaching and non-teaching staff employed in state-sector schools in England. The data has been collected every November since 2010.

The main focus of our research is data on school science technicians, which are classified in the SWC as school support staff. The SWC includes data on each staff member's role, which enables science technicians to be identified as distinct from other support staff, particularly from other technicians (e.g. IT technicians, art technicians). The SWC also includes data on each individual's school, contract and personal characteristics. SWC records for the same individual are linked from one year to the next using their name, date of birth and national insurance number (and teacher reference number, but only for teachers). This enables analysis of science technicians moving school and leaving employment in the state-funded education system.

We combine the data on science technicians with data on the numbers of science teachers, the number of pupils enrolled in the school and school characteristics. The data on science teachers also comes from the SWC, combining contract information and data on which subject each teacher teaches. In around one-third of secondary schools no subject data is collected for any teachers, due to the data collection methods. All of our analysis that uses the number of science teachers[1] is therefore based on a subset of secondary schools. Data on the number of pupils enrolled in the school comes from the DfE's School Census and school characteristics come from DfE's Get Information About Schools database and Ofsted's school inspection outcomes data releases.

There are a number of limitations with the data that may affect the interpretation of the findings. These data quality issues, and our approach to dealing with them, are described in detail in Appendix A. The issues relate to missing or erroneous data and interpretation of cases where secondary schools report having no science technicians, despite having other support staff (including other types of technician) employed. Missing and erroneous data are difficult to verify and correct, but we have made our best endeavours to make reasonable adjustments and assumptions where necessary. As shown in Appendix A, the broad picture given by our findings is not particularly sensitive to what we assume about why some schools appear to have no science technicians, because the numbers of such schools is relatively low.

We also encountered and dealt with other data quality issues, including data from the 2010 SWC being excluded from our analysis as there were substantial amounts of missing data for the crucial full-time equivalent variable.

While these limitations mean that the figures reported should be treated with a degree of caution, we believe the findings remain of a similar or higher quality compared to previous surveys. The relative advantage of administrative data is that it is based on a census of all schools, and is therefore not based on inferring from a sample, which may or may not be representative of the population.

1.4 Structure of this report

Section 2 of this report presents data on the extent of science technician provision in secondary schools over time and in different types of secondary school. Section 3 describes the personal and contractual characteristics of the science technician workforce, including their pay. Section 4 presents findings on science technician retention and turnover. Section 5 draws together the key conclusions from the research findings.

[1] Defined as teachers who are recorded as teaching at least one timetabled session of biology, chemistry, physics or general science.

2 Provision of school science technician support

Key findings

We estimate the size of the school science technician workforce and the extent of technician support technicians offer to secondary school science departments using a range of metrics. There is a clear set of consistent findings from the analysis about how science technician support in secondary schools has changed over time and varies between schools. Each of the measures shows that:

- the average level of science technician support across schools has fallen over time. The proportion of schools at or above the ASE's suggested minimum service factor threshold of 0.65 has fallen from 21 per cent of secondary schools in 2011/12 to 15 per cent in 2018/19.
- there is considerable variation in the level of science technician support across schools and at least part of this variation is explained by geographical region. Regions in the north of England have considerably lower levels of science technician support than in London and the south.
- there are some differences in the level of science technician support by school context: schools with less-deprived pupil intakes tend to have higher support ratios than schools with more-deprived pupil intakes and academies tend to have slightly higher support ratios than local authority maintained schools.

2.1 Introduction

One of the main focuses of the 2001 Royal Society and ASE science technician survey and the 2019 Durham study was to establish the extent of science technician support provided to secondary school science departments (Royal Society and ASE, 2001; Cramman *et al.*, 2019). The surveys used different ratio-based metrics to systematically measure the extent of technician support, which we adopt in our analysis.

We begin this section by considering the contextual factors that may be influencing changes in the demand for science technician provision in schools, before presenting data on the number of FTE science technicians per secondary school. We use these to estimate the total number of science technicians employed in England's state secondary schools.

While the number of FTE science technicians per school is straightforward to calculate, it does not take account of the size of the school (or science department), which is an important factor for determining the level of required support. We therefore focus on other metrics as better proxies for the extent of science technician support. Nonetheless, the Durham study found that 'there was a positive correlation between the Heads of Science's satisfaction with sufficiency of technical support and the number of FTE technicians within their school' suggesting that it remains somewhat useful as a metric of the extent of science technician support (Cramman *et al.*, 2019).

The rest of the section presents data on a number of more suitable metrics for assessing the level of science technician support in schools: the FTE number of technicians per science teacher, per 100 pupils, and the ASE's service factor. We explore how these metrics have changed over time and vary between schools of different types and in different contexts.

2.2 Contextual factors influencing the demand for school science technician provision

There are a number of policy and contextual changes over the period from 2011/12 to 2018/19 worth considering as potential drivers for the changes in science technician provision.

The first is the introduction of new GCSE and A level science qualifications in September 2016, which replaced controlled assessment of practical work with written exam questions. Exam boards were asked to specify a minimum number of practical activities that students must complete, with schools required to confirm that they enabled their students to do the full range of practical work and each student required to keep a record of their work (Ofqual, 2015). At least 15 per cent of the total GCSE exam marks would be allocated to questions that draw on students' practical experiences. While it is plausible that the lack of direct assessment of practical work in science lessons could have led to reduced demand for science technician support, the Durham practical science study found 'little evidence of systemic change in the amount of practical work occurring in school science lessons' between 2015 and 2017.

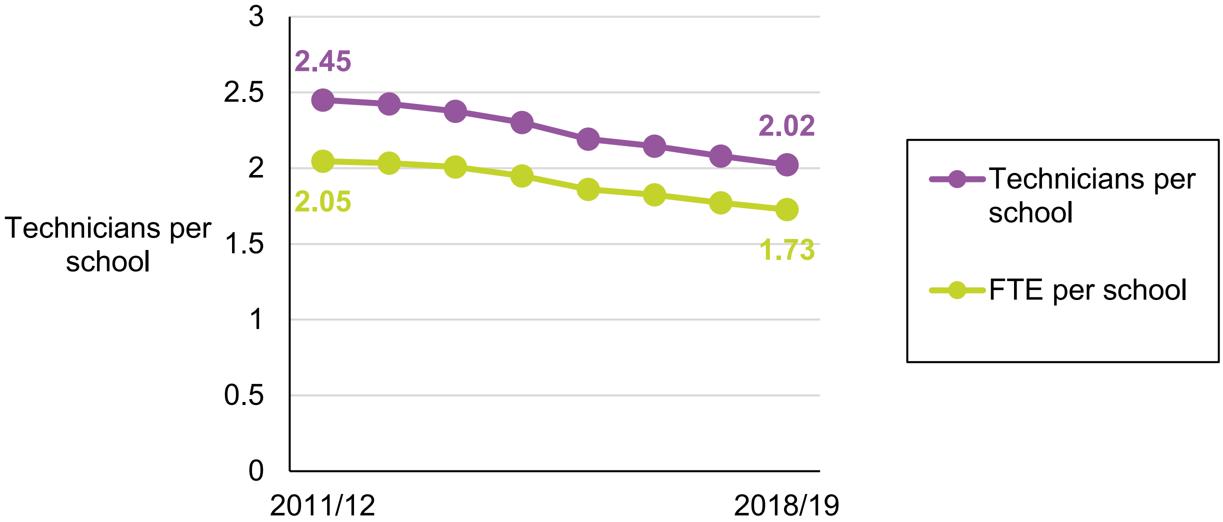
The second is the impact of schools' financial position on the ability to employ a full complement of science technicians. School finances have been squeezed between 2011/12 and 2018/19: the Institute for Fiscal Studies estimate that real-terms secondary school expenditure per pupil fell by 6.9 per cent during this period due to funding not keeping pace with increases in costs (Britton, *et al.*, 2019). Financial constraints may have influenced schools' decisions about how much science technician support the school could afford to provide.

The third is the growing strength of the wider labour market during the period 2011/12 (ONS, 2020). This may have led to more, and more attractive, employment opportunities being available elsewhere for potential science technicians. This may have made it more challenging for schools to recruit science technicians. During the same period there were signs of increasing science teacher shortages, particularly in physics and chemistry (Foster, 2019).

2.3 Number of science technicians per secondary school

Figure 1 shows the mean headcount number of science technicians per school (i.e. number of individuals) and the FTE number of science technicians per school over time. The data shows a clear downward trend in both measures of the number of technicians per school. The FTE number of science technicians per school has fallen from 2.05 in 2011/12 to 1.73 in 2018/19. This is a fall of 16 per cent over 8 years.

Figure 1 Mean headcount and FTE number of science technicians per school



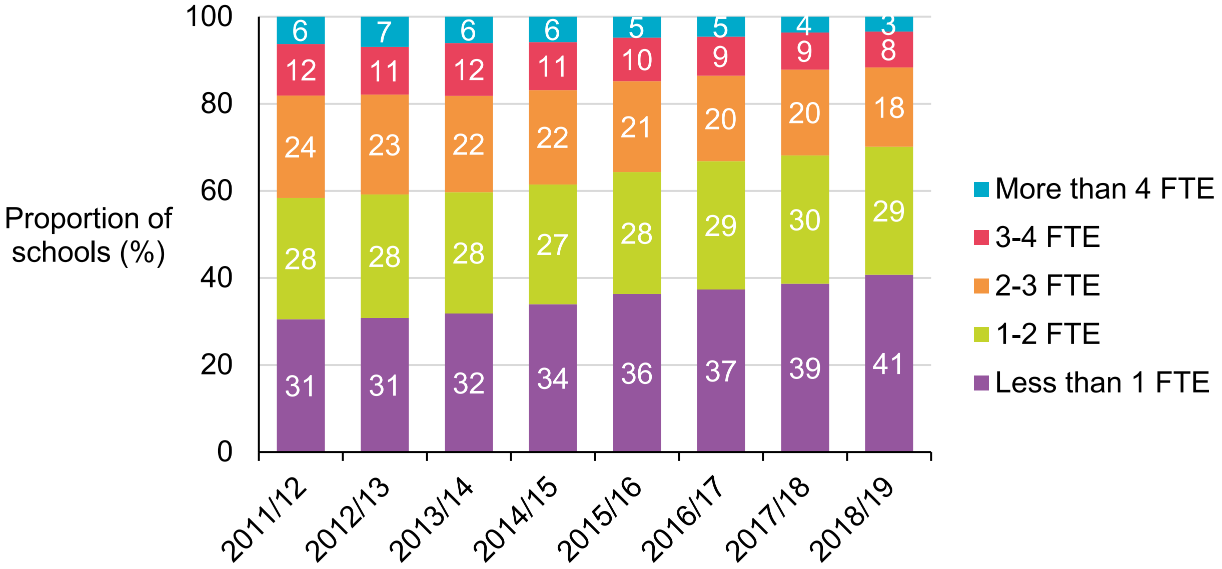
Source: NFER analysis of SWC data.

The 2018 Durham study estimated that the FTE number of science technicians per English state school, among those who responded to their survey, was 2.5 in 2015, 2.6 in 2016 and 2.5 in 2017 (Cramman *et al.*, 2019). Our analysis finds that the average FTE number of science technicians per school is around 25 per cent lower than the Durham figures. This could be for a number of reasons, including missing data from the SWC affecting our estimates, an unrepresentative survey sample in the Durham study (although the report states that the 'school sample for state schools in England has been weighted by deprivation in order to make the sample nationally-representative'), or the inclusion of colleges in the Durham study, which would mean the underlying populations are different. Sensitivity analysis of different approaches to dealing with missing SWC data (see Appendix A) suggests that data quality issues with the SWC cannot alone explain the differences between the estimates in this report and those in the Durham study.

Despite the Durham study finding no decrease in average FTE technicians per school over the years of the study, Heads of Science surveyed in 2018 were more likely to report that they had experienced a decrease in science technician numbers (26 per cent) than an increase (3 per cent) between 2016 and 2017 (Cramman *et al.*, 2019). This is consistent with the SWC data, which shows a clear steady fall in technician numbers throughout that period.

Figure 2 shows that there is considerable variation between different schools in the size of the science technician workforce. Around 40 per cent of secondary schools in 2018/19 had less than one FTE and 11 per cent had more than 3 FTE technicians. The clear trend within the distribution between 2011/12 and 2018/19 is a reduction in the proportion of schools with an FTE of more than two science technicians and an increase in the proportion of schools with an FTE of less than one. This trend is consistent with the overall fall in the average FTE number of technicians per school.

Figure 2 Distribution of the number of science technicians per school



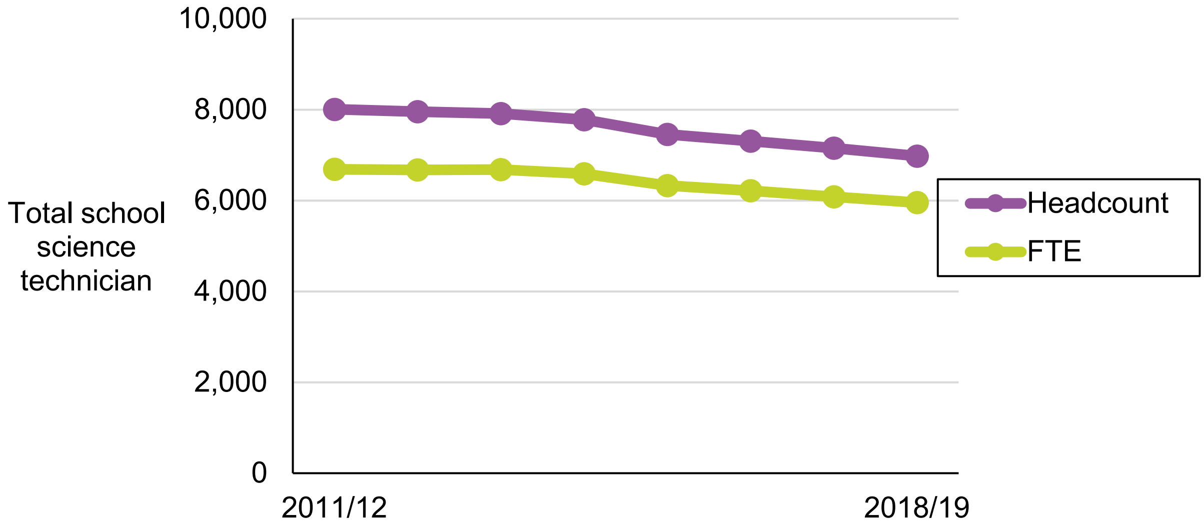
Source: NFER analysis of SWC data.

2.4 Estimated total number of science technicians in England

We estimate the total number of science technicians in the English state sector over time by combining the estimates of the headcount and FTE number of science technicians per school with data on the number of state secondary schools in England. Figure 3 shows our estimates of total headcount and FTE number of science technicians. However, given the missing data issues with the SWC that we detail in Appendix A, it is challenging to reliably estimate the total number of science technicians in England's schools.

The data shows that the estimated overall number of science technicians fell over time between 2011/12 and 2018/19, a finding that is clear regardless of data quality issues. The estimated total FTE number of science technicians in England fell from around 6,700 in 2011/12 to around 6,000 in 2018/19, a fall of around 11 per cent. Our sensitivity analysis suggests that the true number of FTE science technicians is likely to be between 6,300 and 7,000 in 2011/12 and between 5,800 and 6,700 in 2018/19. The fall in the total number of science technicians is less steep than the fall in the number of technicians per school (16 per cent – as shown in Figure 1). This is because the number of state-funded secondary schools grew by 5.5 per cent between 2011/12 and 2018/19.

Figure 3 Estimated total headcount and FTE science technicians in England

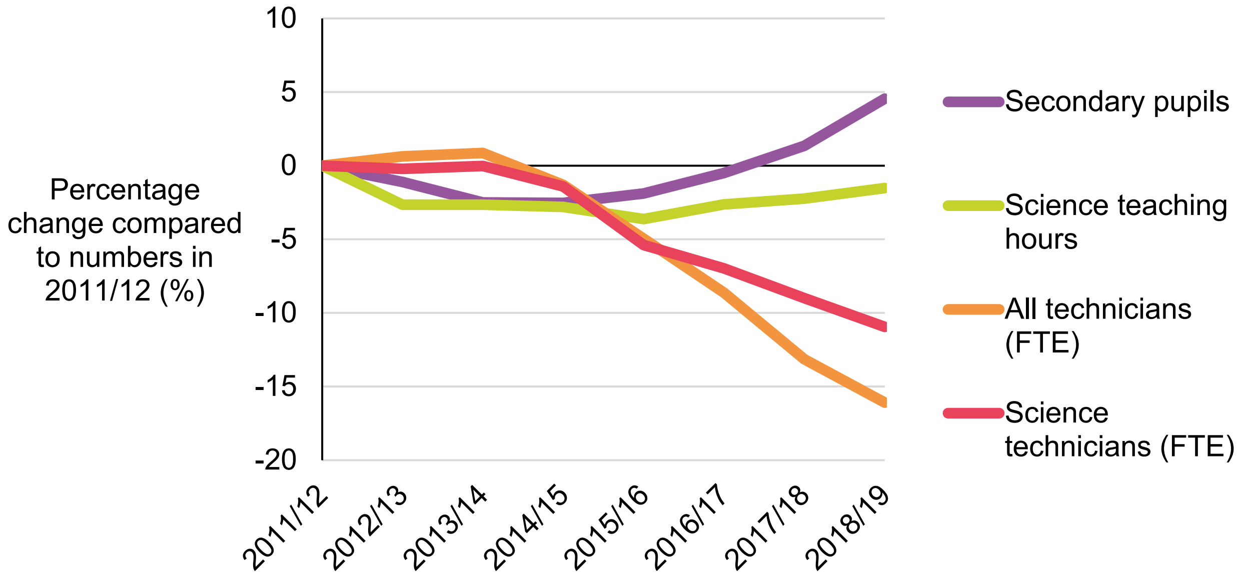


Source: NFER analysis of SWC data and School Census data.

Figure 4 compares this trend in total science technician numbers with a variety of other relevant measures, relative to their level in 2011/12. The number of pupils in secondary schools fell between 2011/12 and 2013/14, but has been rising since then as larger cohorts have come through the education system. Secondary cohort sizes are forecast to continue rising until 2024. The overall number of science teaching hours in secondary schools have followed a similar pattern to pupil numbers, although have not risen quite as fast as pupil numbers since 2013/14. This would suggest that, all else equal, the demand for school science technician support has grown over time.

However, in contrast, the number of FTE school science technicians has fallen between 2011/12 and 2018/19 by around 11 per cent. Nonetheless, the fall has not been as steep as the fall in the overall FTE number of all types of school technician (including IT and art technicians, for example, as well as science technicians) in secondary schools, which has fallen by around 16 per cent over the same period. This implies that the number of non-science technicians has fallen by more than 16 per cent, suggesting that science technician numbers have fallen by less compared to other types of school technicians.

Figure 4 Percentage change over time in science technicians, all technicians, science teaching hours, and secondary pupils compared to level in 2011/12



Source: NFER analysis of SWC data and School Census data.

There are a range of possible explanations for why the number of science technicians has fallen at a greater rate in the last five years than secondary pupil numbers and science teaching hours. A key potential reason is a squeeze on school finances, leading to science technician redundancies or schools not replacing technicians who leave. The Institute for Fiscal Studies estimate that real-terms secondary school expenditure per pupil fell by 6.9 per cent between 2011/12 and 2018/19, due to funding not keeping pace with increases in costs (Britton *et al*., 2019).

In the Durham practical science study, Heads of Science who reported a change in technician provision were asked to select the reasons for the change (Cramman *et al.*, 2019). Among the respondents from state schools in England who reported a decrease in the number of technicians, 46 per said the reasons were 'financial' and 21 per cent said they had decided 'not to recruit after the position became vacant'. This supports the hypothesis that reduced school funding is the main reason for the fall in the size of the technician workforce.

Two other potential reasons are staff shortages and reduced demand. First, schools may have wanted to employ more technicians but failed to attract suitable applicants, so had unfilled vacancies. The Durham study reported that 'across the three years of the study, between 9 and 11 per cent of respondents from English state schools indicated that there was at least one technician position unfilled within their school' (Cramman *et al.*, 2019). We have no available evidence on whether this was higher than in earlier years, and therefore a potential explanation of the downward trend in technician numbers. It is also unclear whether these were positions where attempts to fill it had failed or that were in the process of being filled. However, qualitative interviews with Heads of Science in the Gatsby study of practical science 'reveal unease at the difficulty in recruiting qualified and experienced technicians, the main reason being given as the low salary on offer' (Gatsby, 2017).

Second, changes to the science curriculum and/ or exam specifications may have affected the amount of practical science in science lessons, and therefore the amount of science technician support required. Ofqual and awarding organisations hoped that new science GCSEs and A levels, which were introduced from September 2016, would increase the amount and variety of practical science occurring in science lessons. However, others had concerns that the removal of controlled practical assessments from exam specifications would lead to a reduction in practical work in schools. The Durham practical science study found 'little evidence of systemic change in the amount of practical work occurring in school science lessons' between 2015 and 2017 (Cramman *et al.*, 2019). This explanation therefore seems not to be able to explain the fall in technician numbers during this period.

Overall, the reduction in real-terms school funding seems to be the most plausible explanation for why the number of science technicians in English state secondary schools has fallen steadily between 2011/12 and 2018/19. However, we do not have sufficient evidence to rule out other explanations.

2.5 Science technician support in schools

Measuring the extent of the support school science technicians provide to science teachers is challenging because effective technician support comes in a variety of forms that are impossible to capture in measures derived from administrative data. These include, but are not limited to, technician's subject knowledge, expertise, experience, communication skills and motivation. Using the amount of contracted science technician time relative to proxies of the demand for technician support is therefore very much an approximation for the richness of support that science technicians may or may not offer in individual schools. Nonetheless, the use of such metrics to make a broad assessments and comparisons of the extent of science technician support is well established in schools and in policy.

We present data on several metrics of school science technician support estimated from the SWC, which are set out in Table 1. We analyse how their averages and distributions have changed over time between 2011/12 and 2018/19 and how they vary by region, school deprivation[2], Ofsted rating and school type (academies or local authority maintained schools).

[2] Measured by quintiles of the proportion of pupils eligible for free school meals.

Table 1 Definitions of school science technician support ratios

Metric	Definition	Source/ notes
Science technicians per school	FTE science technicians in the school	Source: SWC.
Science technicians per 100 pupils	FTE science technicians in the school / headcount of pupils age 11-18	Source: SWC, School Census.
Science technicians per science teacher	FTE science technicians in the school / FTE science teachers in the school	Source: SWC. Only includes schools that provided timetable data on teachers' subjects taught
Service factor	Total science technician hours per week in the school / Total science teaching hours per week in the school	Source: SWC. Only includes schools that provided timetable data on teachers' subjects taught See ASE (2019) for details on how the service factor is calculated.
Service factor threshold	Is the service factor (as defined above) at or higher than 0.65?	As above. Thresholds set out in Royal Society and ASE (2002).

Each measure has strengths and limitations for measuring science technician support, which should be considered when interpreting the findings:

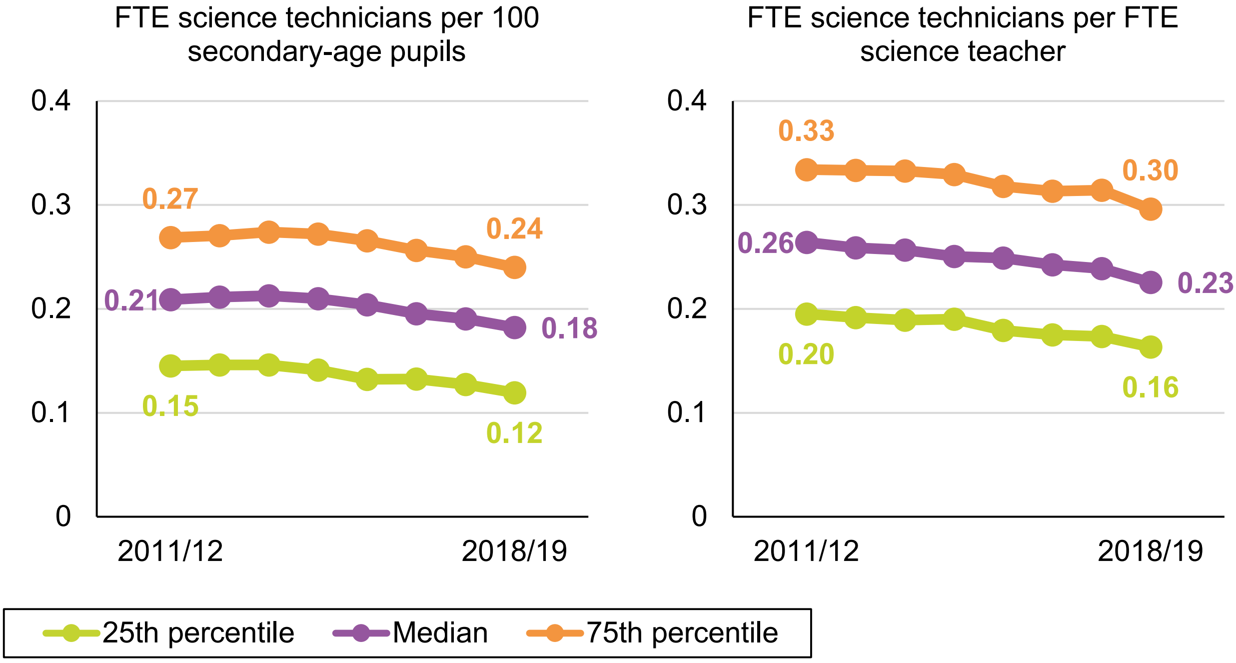
- The number of FTE science technicians per 100 pupils was established as a ratio for benchmarking by the National Science Advisers' and Inspectors' Group (Royal Society and ASE, 2001). While relatively straightforward to calculate, it does not account for differences in the amount of science teaching across schools, due to timetabled instruction time for science and/or science curriculum options at key stages 4 and 5.
- The number of FTE science technicians per science teacher is a preferable ratio as it better reflects the amount of science teaching technicians are supporting. However, it may not be comparable across schools if the teaching load per teacher differs across schools.
- The service factor was established as a ratio for benchmarking by the ASE. While it is more complex to calculate, it is the best approximation of the required technician support. It is a recognised benchmark used by schools, so is our preferred measure.
- The minimum service factor threshold of 0.65 was suggested by the Royal Society and ASE (2002) as representing 'the minimum necessary to provide adequate technical support to a science department'. Like any threshold it is somewhat arbitrary, but is taken to represent a rough indicator of a level of effective support.

2.5.1 Overall technician support ratios

2.5.1.1 Science technicians per 100 pupils and per science teacher

Figure 5 shows how the first two ratios – number of FTE science technicians per 100 pupils and number of FTE science technicians per science teacher – have changed over time. We present data on the median school, which is the middle school in the distribution, and the 25th and 75th percentiles (quartiles), which are the schools at the top and bottom quarters in the distribution. We present the median and quartiles as they are less sensitive to extreme values, which are likely to be influenced by measurement error.

Figure 5 Number of science technicians per 100 pupils and science technicians per science teacher



Source: NFER analysis of SWC data and School Census data.

The data shows that, as for the number of FTE technicians per school, both these support ratios have fallen steadily over time between 2011/12 and 2018/19. The median number of FTE science technicians per 100 pupils has fallen by 13 per cent, from 0.21 in 2011/12 to 0.18 in 2018/19. The Durham practical science study reported that the average number of FTE science technicians per 100 pupils was 0.24 in 2015, 0.26 in 2016 and 0.23 in 2017. This is again higher than indicated by the SWC data, which could be due to a number of different reasons.

The Royal Society and ASE science technician survey report (2001) cites that a 1994 NSAIG report had calculated that average number of FTE science technicians per 100 pupils to be 0.29 in 11-16 comprehensive schools (i.e. all state schools, except grammars) and 0.30 in 11-18 comprehensive schools. The SWC data suggests that the level is substantially lower than that now.

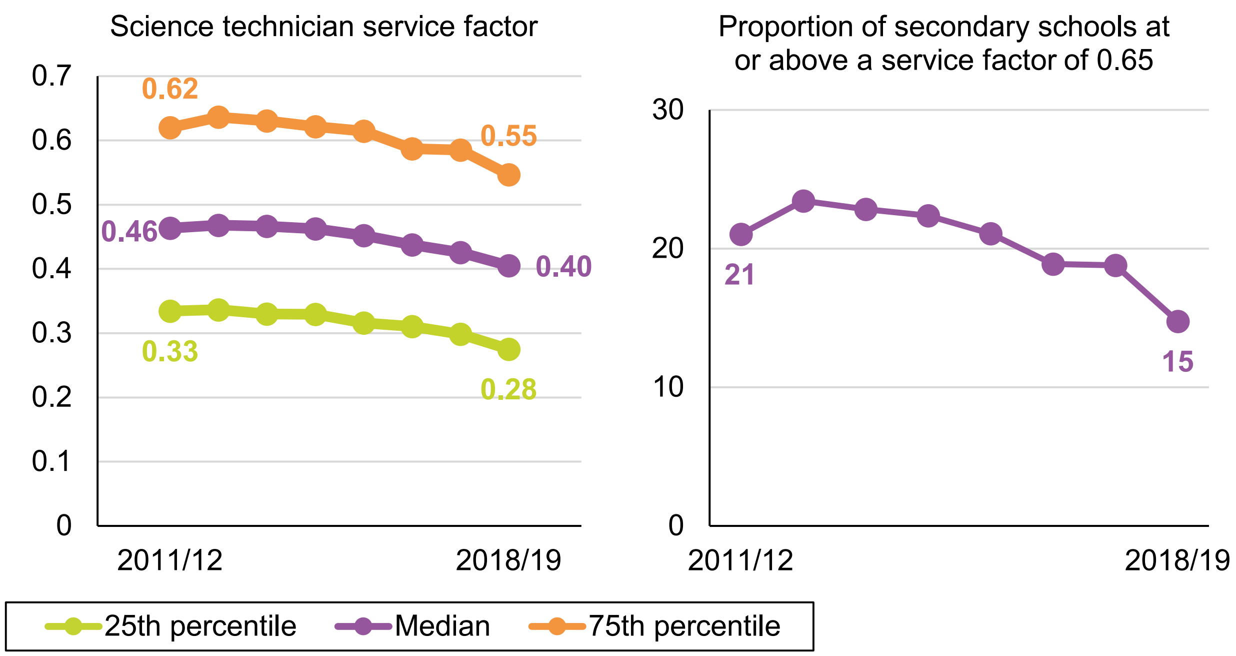
The Royal Society and ASE report (2001) also shows data from its own 2000 survey showing that the number of pupils per FTE science technician (the inverse of the ratios presented here) was 470 in comprehensive schools in England and Wales. The SWC data implies that the number of pupils per FTE technician in 2011/12 was around 480, which is a similar level to the 2000 survey, rising to 550 pupils per FTE technician in 2018/19. The ten years between 2000 and 2010 were characterised by substantial increases to secondary school budgets, which may have enabled schools to maintain their levels of science technician provision throughout that period.

The SWC data shows that the median number of FTE science technicians per science teacher has fallen by 15 per cent, from 0.26 in 2011/12 to 0.23 in 2018/19.

2.5.1.2 Science technician service factor

Figure 6 shows how the science technician service factor and the proportion of schools with a service factor of 0.65 or above have changed over time. The data shows that the median service factor has also fallen by 13 per cent between 2011/12 and 2018/19, from 0.46 to 0.40.

Figure 6 Science technician service factor and proportion of schools meeting service factor minimum threshold of 0.65



Source: NFER analysis of SWC data.

This fall has translated into fewer schools meeting the ASE's suggested minimum service factor threshold level of 0.65. The SWC data suggests that while 21 per cent of secondary schools were at or above the threshold in 2011/12, the proportion has fallen to 15 per cent in 2018/19.

The Royal Society and ASE science technician survey report (2001) estimates that the median service factor in comprehensives schools in England in 2000 was 0.49, with lower and upper quartile values of 0.39 and 0.58 respectively. The SWC data suggests that the service factor has fallen a little since that survey, but not substantially. Again, rising secondary school budgets between 2000 and 2010 may have enabled schools to maintain their science technician service factor throughout that period.

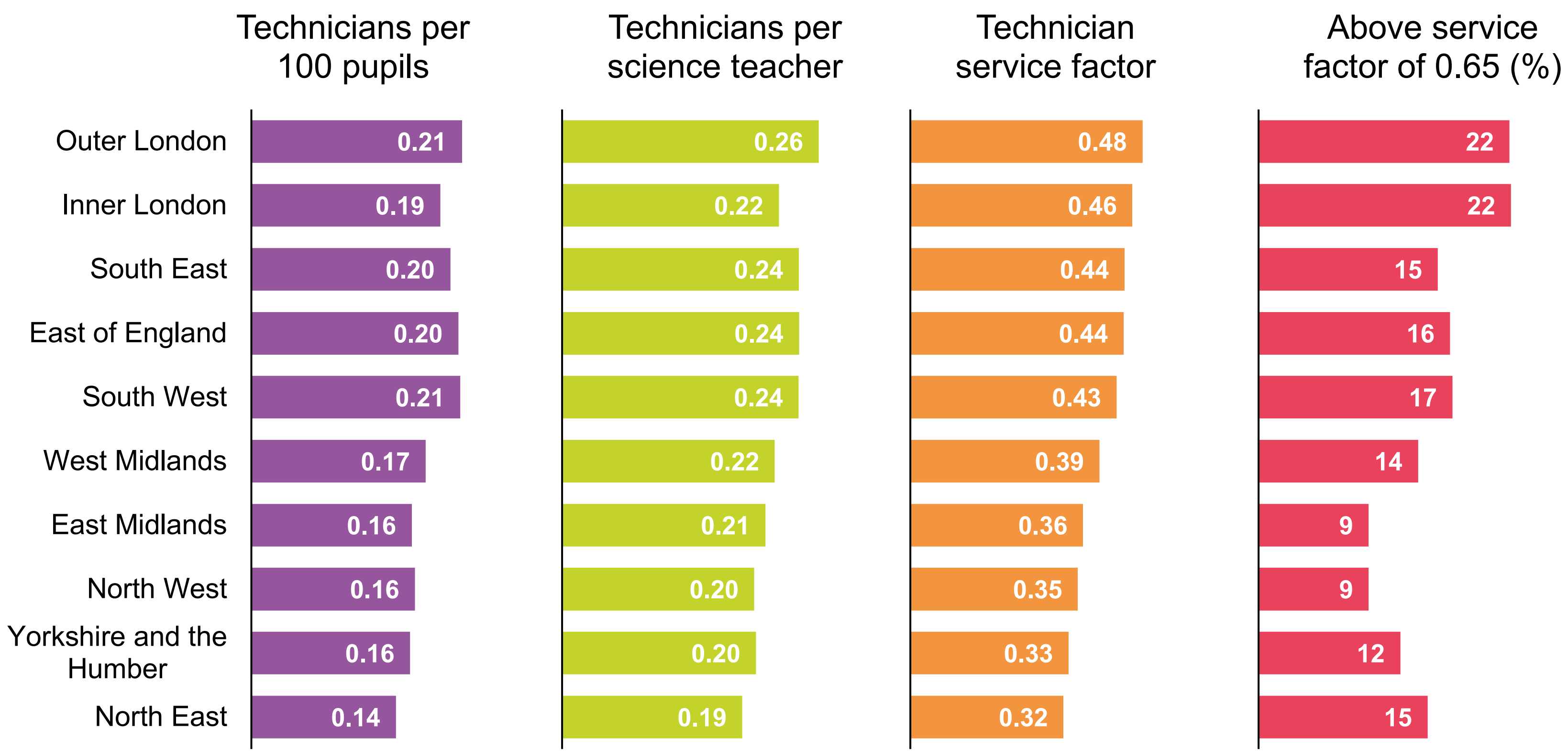
2.5.2 Variation between schools

As suggested by the large gaps between the 25th and 75th percentiles in the ratio figures above, there is considerable variation in support ratios between schools. At least some of this variation is likely to be explained by specific school characteristics. We explore the variation by three key characteristics: region, school deprivation level and school type.

Figure 7 shows the median values of the three technician support ratios, plus the proportion of schools above a service factor of 0.65, for schools in different regions of England in 2018/19. The data shows that there is considerable variation by region and that, while there are some slight variations in the pattern for different measures, the variation is primarily on a north-south axis. London and regions in the south have higher support ratios on average than schools in the midlands, which in turn have higher average ratios than schools in northern regions. The data does not explain why this might be the case, but one possible explanation is that there may be a greater availability of people with the necessary qualifications and skills in London and the south of England. Another speculative explanation is that science teachers in higher-wage areas, such as London and the south of England, have more financially attractive options outside of being a science teacher and greater levels of science technician support could be being used to help retain them.

Figure 8 shows the variation in the same technician support metrics by school deprivation level (measured by quintiles of the proportion of pupils eligible for free school meals (FSM)) and school type. The data shows that schools with less-deprived pupil intakes tend to have a higher average level of technician support than schools with more-deprived pupil intakes. It also shows that academies tend to have a slightly higher average level of technician support compared to local authority (LA) maintained schools. The data cannot explain why these differences exist, but could be due to the relative attractiveness of working in these different schools and/or the financial situation these different schools are in.

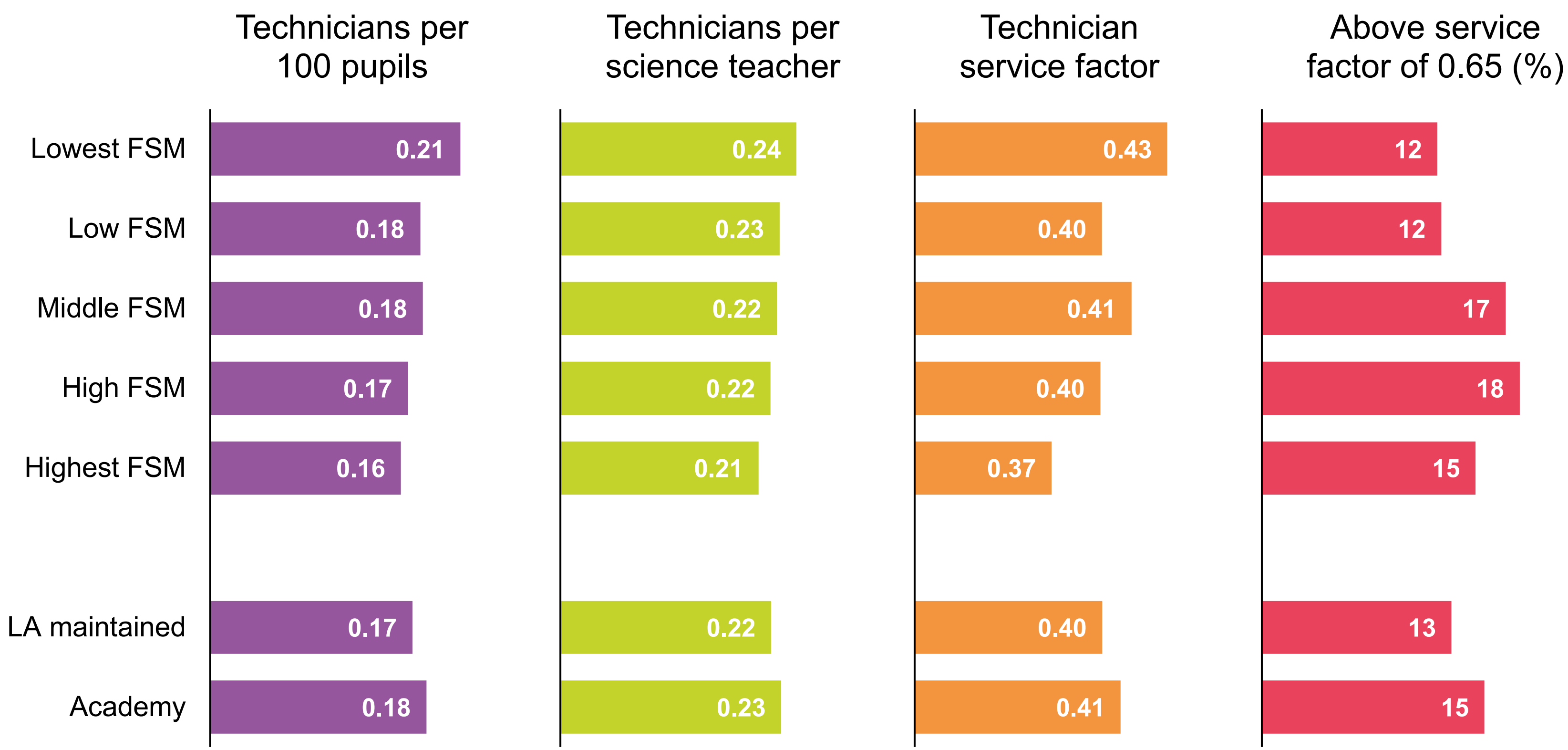
Figure 7 Regional variation in science technician support ratios, 2018/19



Source: NFER analysis of SWC data and School Census data.

Note: regions ordered by their level of science technician service factor.

Figure 8 Variation in science technician support ratios by level of pupil disadvantage and school type, 2018/19



Source: NFER analysis of SWC data and School Census data.

3 Characteristics of the science technician workforce

Key findings

The SWC data confirms findings from other surveys that the school science technician workforce is around three-quarters female and three-quarters aged over 40 in 2018/19. Around half of school science technicians work part-time, although nearly half of those who work part-time work at least four days per week. Most of the school science technician workforce is employed on a term-time only basis, which comes with a significantly lower salary compared to a full-year contract. This salary difference by contract period is larger than that due to a science technician's experience level.

School science technician pay has been flat in real-terms – in other words pay has risen at roughly the same rate as the rate of inflation. The starting salary of a newly-qualified teacher is 40 per cent higher than the salary of the average science technician of around £17,000. Technician pay is higher in London than in the rest of the country, as it is for teachers, but unlike for teachers, technician pay is not regulated to be higher in London.

In 2011, the House of Commons Science and Technology Committee described the pay and conditions of science technicians as 'appalling' and called for the creation of 'a career structure that will attract skilled and dedicated people to work as technicians'. Our findings suggest there has been no significant improvement in the pay and employment conditions of school science technicians in the nine years since this report was published.

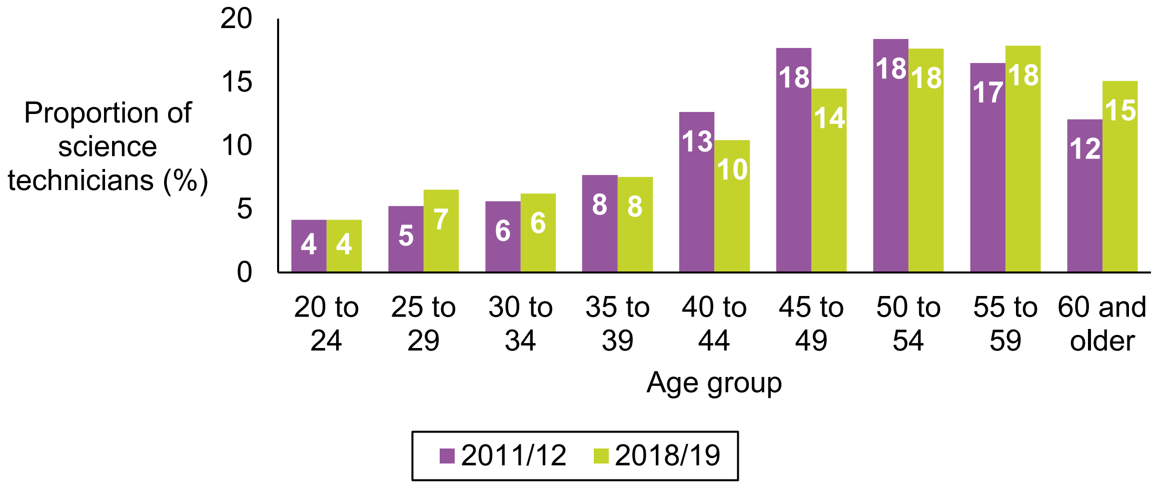
This section describes the characteristics of the school science technician workforce in state-funded secondary schools in England, and how they have changed over time. It includes analysis of science technicians' personal characteristics, such as age and gender, contract characteristics and their pay.

3.1 Age and gender

Figure 9 shows the age distribution of school science technicians in 2011/12 and 2018/19. The science technician workforce is skewed towards older age groups, with only around 10 per cent aged under 30 and around three quarters aged over 40 and around half aged over 50. This is in stark contrast to the age profile of teachers, 21 per cent of whom are under 30 and just under half over 40 and 18 per cent over 50.

Between 2011/12 and 2018/19, the proportion of science technicians older than 50 and older than 60 has increased slightly, while the proportion in their 40s has fallen. This may be due schools downsizing their technician staffing through natural turnover, while the technicians who are retained get older. These patterns represent a continuation of a previous trend: the Royal Society and ASE science technician survey (2001) reports that only four per cent of respondents were age over 60. The same report also reported a lower proportion of technicians aged in their 50s (30 per cent) and a higher proportion of technicians in their 40s (39 per cent).

Figure 9 Age distribution of science technicians, 2011/12 and 2018/19

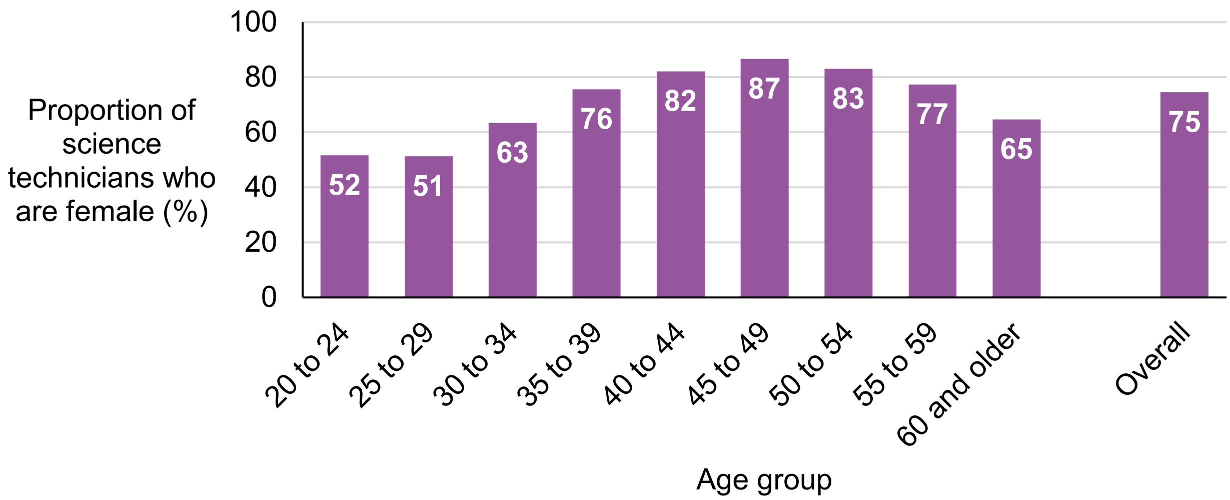


Source: NFER analysis of SWC data.

The school science technician workforce has been majority-female for a long time. The Royal Society and ASE science technician survey (2001) reports that respondents to the 2000 survey were 75 per cent female. The SWC data indicates that 75 per cent of science technicians in both 2011/12 and 2018/19, showing that there has been no change in the gender balance in at least two decades.

Figure 10 shows how the proportion of science technicians who are female varies by age. There is an even gender balance among technicians in their twenties, while in older age groups the proportion is skewed towards more female technicians.

Figure 10 Gender distribution of science technicians by age group, 2018/19



Source: NFER analysis of SWC data.

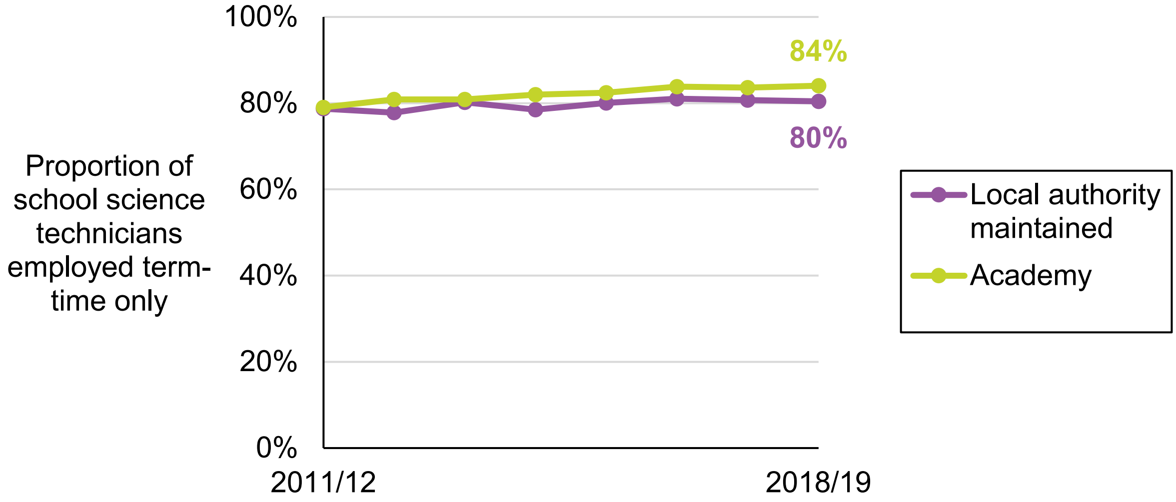
3.2 Contract status

3.2.1 Contract type (permanent/ temporary) and contract period (full-year/ term-time only)

The SWC data shows that most school science technicians are employed on a permanent contract, and only around three to four per cent are employed on a temporary basis (e.g. fixed term contract).

However, a high proportion of school science technicians are employed on a term-time only contract (defined in our analysis as 51 weeks or less per year), as opposed to a full-year contract (52 or 53 weeks per year). Figure 11 shows the proportion employed on a term-time only contract in local authority maintained schools and academies. In 2011/12, around 80 per cent of science technicians were employed on a term-time only contract in both local authority maintained schools and academies. Over time the proportion has remained similar in maintained schools, but has risen slightly to 84 per cent in 2018/19 in academies.

Figure 11: Around four in five science technicians are employed on a term-time only contract



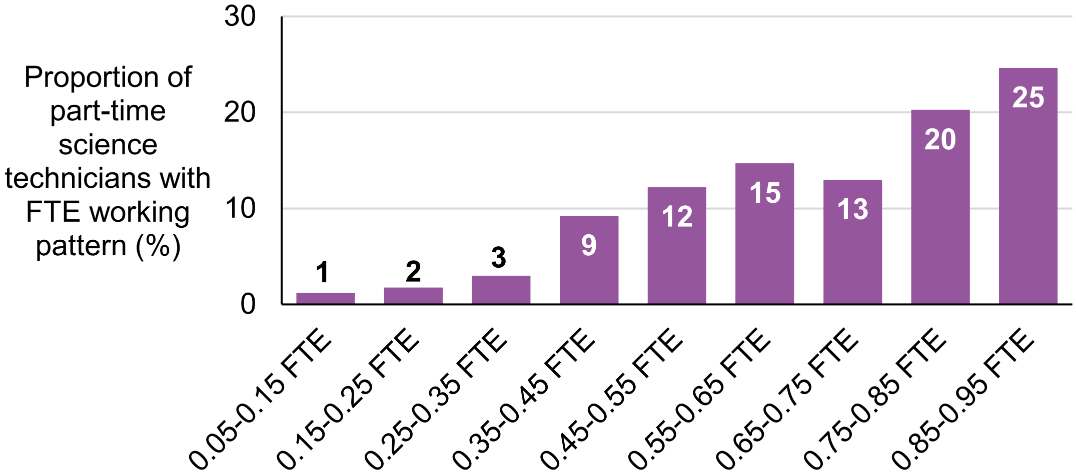
Source: NFER analysis of SWC data.

3.2.2 Contracted hours per week

Just over half of science technicians are employed full time and just under half are employed part time. Among those employed part time, there is a range of working patterns, as measured by FTE.

Figure 12 shows the distribution of FTEs worked by part-time science technicians in 2018/19. Most science technicians work quite a high FTE, with around three quarters of part-time science technicians working between 0.55 and 0.95 FTE. The proportion of science technicians working part time has increased slightly over time, from 51 per cent in 2011/12 to 54 per cent in 2018/19. There has been little change in the distribution of hours worked by part-time technicians during this period.

Figure 12: Around three quarters of part-time science technicians work between 0.55 and 0.95 FTE

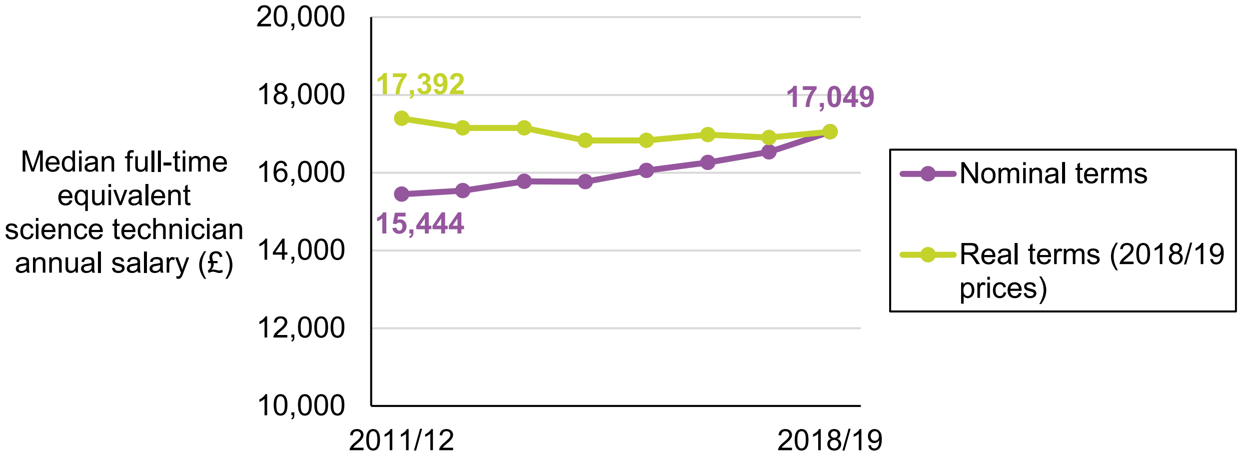


Source: NFER analysis of SWC data.

3.3 Pay

Figure 13 shows the median FTE salary of a school science technician, in both nominal terms (the actual value it was paid in) and real terms (after the effect inflation has on the purchasing power has been taken into account). We report the median because it is a better measure of typical science technician pay, and is not sensitive to outlier values, which are disproportionately likely to be affected by measurement error.

Figure 13: Median science technician annual salary has been broadly stable in real terms since 2011/12 at around £17,000



Source: NFER analysis of SWC data.

While median nominal FTE pay has increased steadily since 2011/12, it has risen at roughly the same rate as the rate of inflation over the same period. In real-terms, median science technician pay has therefore been broadly stable between 2011/12 and 2018/19 at around £17,000 per year.

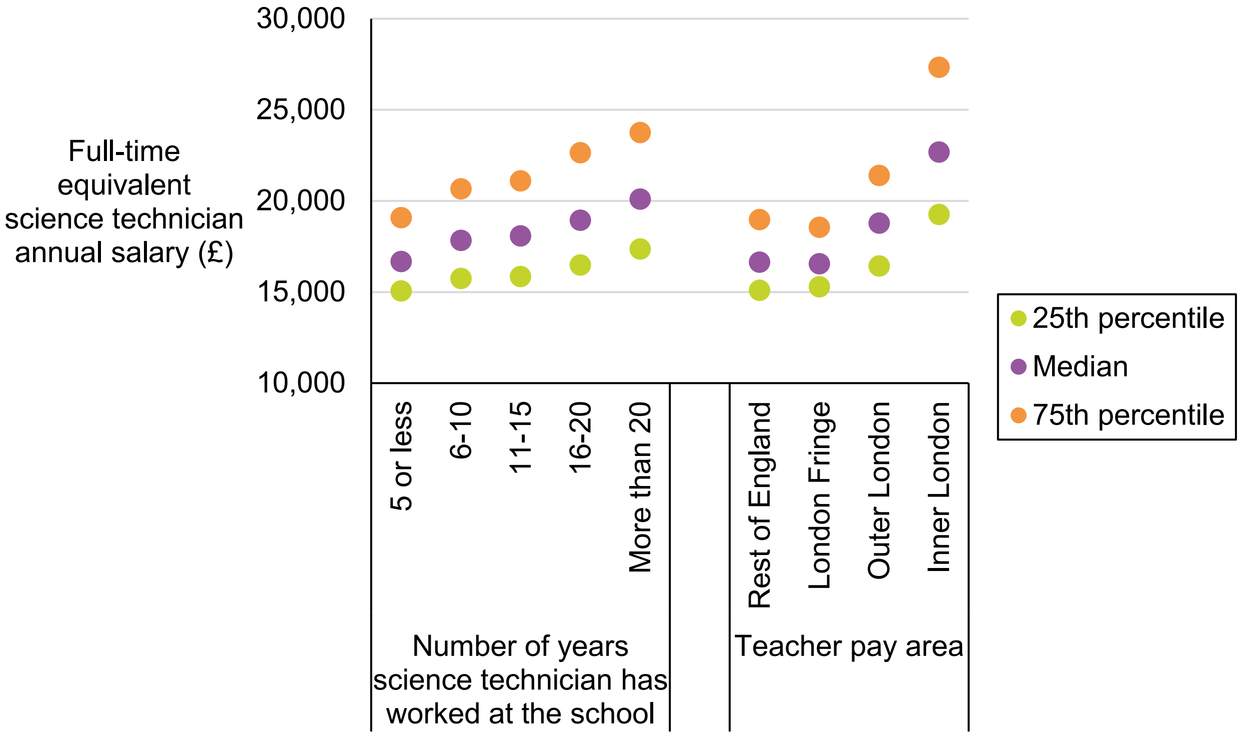
In comparison, the starting salary for a newly-qualified teacher (NQT) in England in 2018/19 (outside of London) was £23,720, which has increase from a nominal value of £21,588 in 2011/12. The average teacher salary was £40,554 in 2018/19, which increased from £37,900 in 2011/12. The ratio between average science technician pay and outside-London NQT pay is the same in 2018/19 as it was in 2011/12 (around 40 per cent higher), as is the ratio between average science technician pay and average teacher pay (around 140 per cent higher).

Technician pay varies between individual science technicians according to a number of factors, including geography, experience and contract period. Figure 14 shows a clear relationship between a school science technician's pay and how long they have worked as a science technician in their current school[3].

Figure 14 also shows that the school's geography is related to technician pay. We present average technician pay data for different teacher pay areas. While these areas have teacher pay scales that are regulated to have higher pay (for LA maintained schools at least), technician pay is not regulated in the same way. Nonetheless, it is an indication of the differences driven by wage rates in the local economy. Technician pay is clearly higher in London compared to in other areas, but there is little difference between the London Fringe area and the rest of England.

[3] This is not a precise measure of experience, as they may have worked as a science technician at another school before their current role, which is not measured in the SWC.

Figure 14: Science technician salaries vary by experience and geography

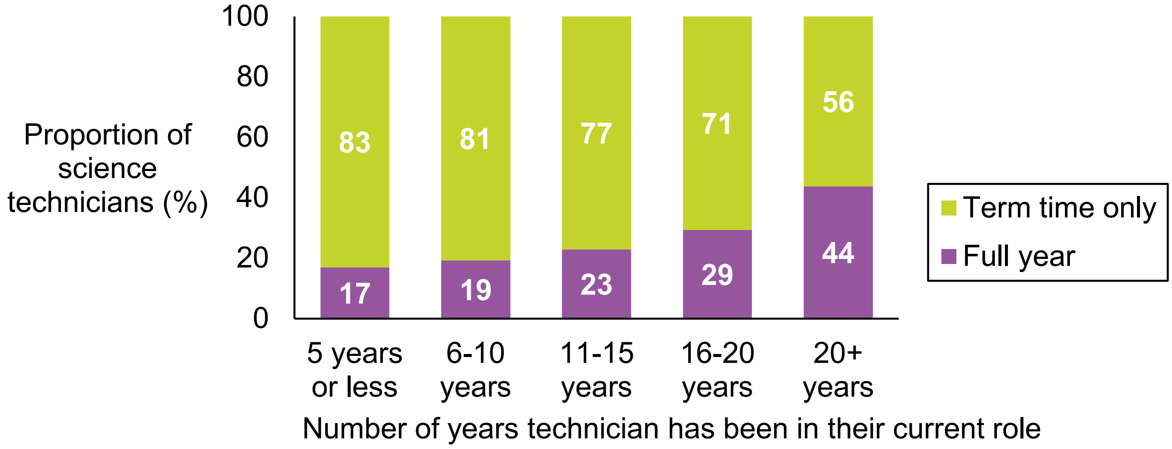


Source: NFER analysis of SWC data.

Some of the relationship between technicians' years of experience and pay is driven by the number of weeks per year they are contracted (referred to here as contract period). Figure 15 shows that technicians who have been employed at the school for more years are more likely to be employed on a full-year contract, while a greater proportion of newer technicians are employed on a term-time only basis.

This could be for two possible reasons, the relative importance of which the data cannot distinguish. First, longer-serving technicians may be rewarded with a full-year contract and take on more responsibility as a senior technician (a role that is not coded separately in the SWC). Second, it is possible that longer-serving technicians may be employed on a legacy full-year contract, while newly-hired technicians are employed on a new term-time only contract.

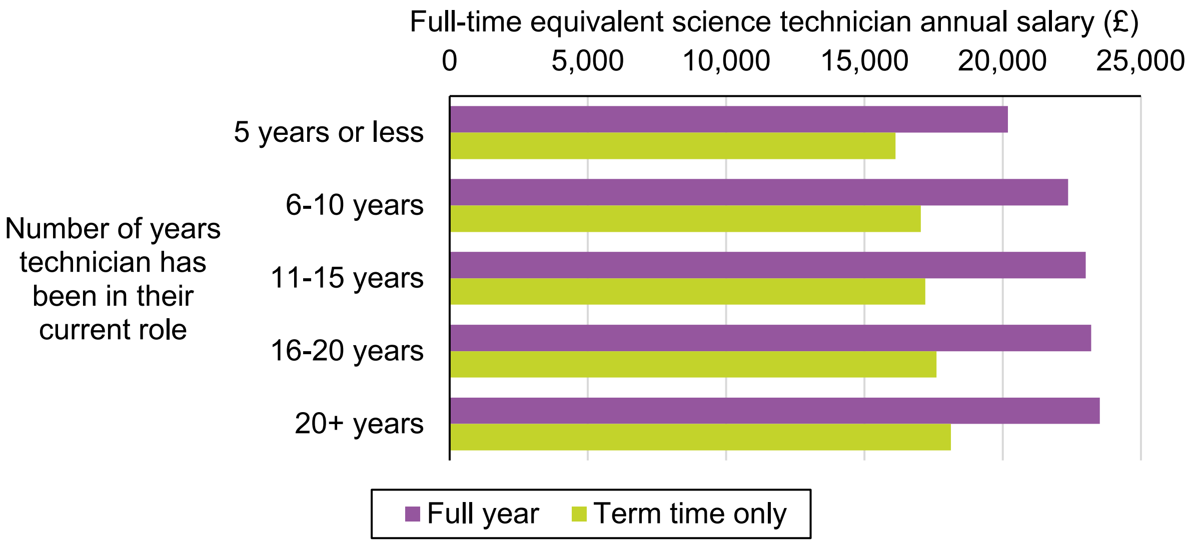
Figure 15: Longer-serving science technicians are more likely to be employed on a full-year contract



Source: NFER analysis of SWC data.

Figure 16 shows the average FTE pay of science technicians, split by contract period and the number of years they have been employed in their current school. The data shows that the differences in pay by contract period (comparing the purple bars with the green bars) are greater than the differences in pay by experience level (comparing bars of the same colour). It suggests that contract period is a more important factor for explaining a science technician's salary level than their years of experience.

Figure 16: Differences in pay due to contract period are greater than the differences in pay due to how many years the science technician has been at the school



Source: NFER analysis of SWC data.

4 Retention and turnover of science technicians

Key findings

The turnover rate of school science technicians has been around 20 per cent between 2014/15 and 2018/19, having risen from around 15 per cent in 2011/12. High turnover means that school leaders experience staffing uncertainty and, if replacements are made, incur recruitment costs of hiring new staff. However, many schools may have chosen not to replace science technicians who have left, reducing the overall workforce size, as shown in section 2 above.

The overall turnover level for school science technicians is about the same level as for teachers (Worth *et al.*, 2018). However, the proportion of science technicians leaving the system is a lot higher and the proportion moving schools is a lot lower compared to teachers, for whom the rates are around ten per cent for both.

Younger school science technicians and those approaching, or at, retirement age are more likely to leave the state-funded school sector than those in their 40s and 50s. Younger technicians are more likely to move school than older technicians. There is higher turnover among science technicians in schools with lower Ofsted ratings, which may relate to a lower quality of working environment in those schools.

This section presents data on the retention and turnover of school science technicians, using longitudinally-linked SWC data. The analysis explores how school science technician retention and turnover have changed over time and how it varies by technician and school characteristics.

4.1 Retention and turnover

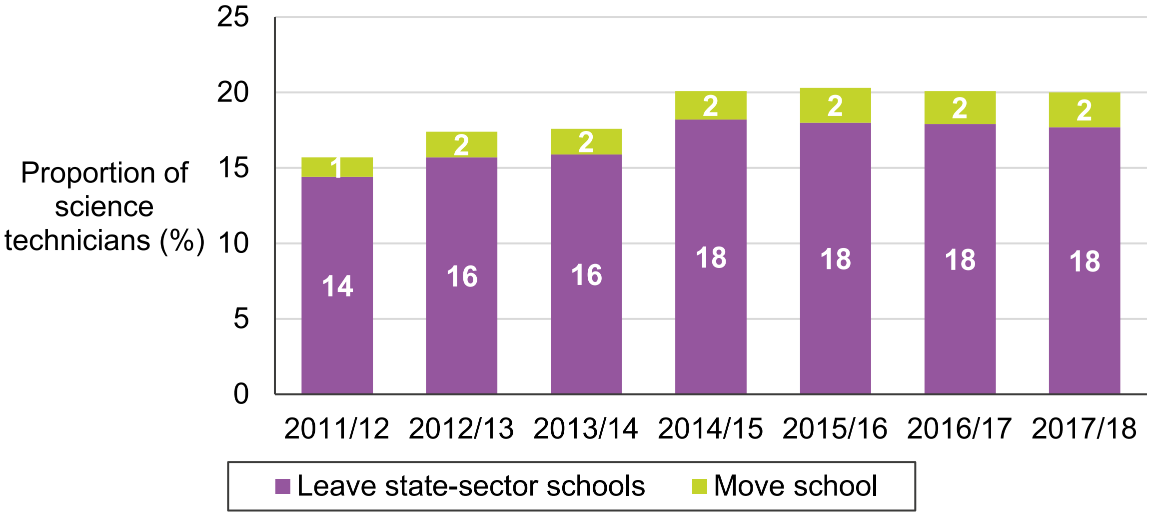
Figure 17 shows the proportion of school science technicians who left their role between one year and the next, split by year (with the year representing the last year they were employed in their school). The purple bars highlight the proportion of technicians who were no longer present in the SWC (and therefore not employed by a state-sector school) in the following year, while the green bars show the proportion who were present in a different school the following year. The total of the two bars represents the average turnover rate of science technicians.

The science technician turnover rate has been around 20 per cent since 2014/15, which had risen from around 15 per cent in 2011/12. High turnover means that school leaders experience staffing uncertainty and, if replacements are made, incur recruitment costs of hiring new staff. However, many schools may have chosen not to replace science technicians who have left, reducing the overall workforce size, as shown in section 2 above.

The overall turnover level for school science technicians is about the same level as for teachers (Worth *et al.*, 2018). However, the proportion of school science technicians leaving the system is a lot higher and the proportion moving schools is a lot lower compared to teachers, for whom the rates are around ten per cent for both. It is important to note that school science technicians who left employment in the state-funded sector, as measured in this data, may have moved into a new job still working as a technician; for example, as a school science technician in another country (including Wales or Scotland) or as a technician in an independent school, or in a college, higher education or in industry.

The low rate of school science technicians moving school may be due to the quality of the longitudinal linking within the SWC data: a technician could move school but their records be treated as if they are two separate individuals within the data. However, as the longitudinal data linking uses name, date of birth and national insurance number it should pick up most genuine cases of school-to-school moves.

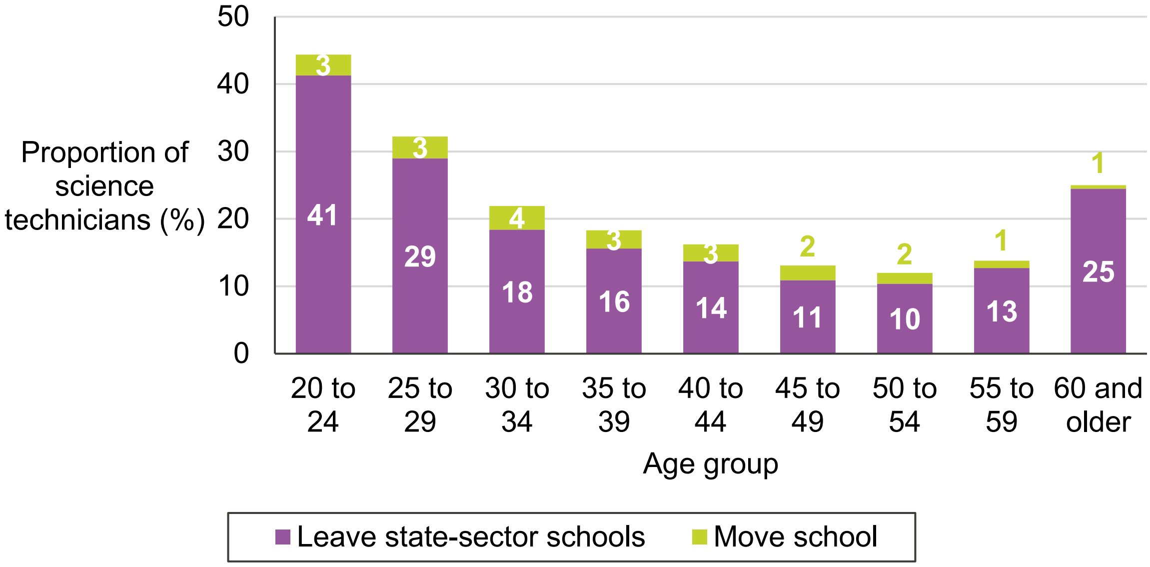
Figure 17: School science technician turnover has risen between 2011/12 and 2018/19



Source: NFER analysis of SWC data.

Figure 18 shows the retention and turnover of school science technicians by age group. The data shows that younger science technicians and those approaching, or at, retirement age are more likely to leave the state-funded school sector than those in their 40s and 50s. It also shows that younger science technicians are more likely to move school and older technicians less likely to move school. This is likely to be due to older technicians being more settled and less footloose. A very similar pattern is seen for teachers (Worth *et al.*, 2018).

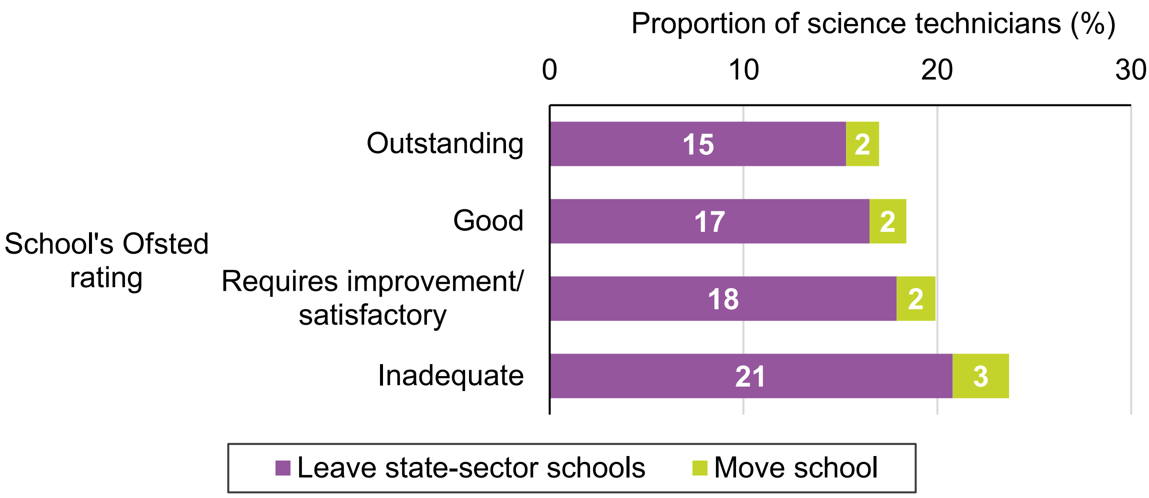
Figure 18: Younger and older school science technicians are more likely to leave



Source: NFER analysis of SWC data.

Figure 19 shows that, as for teachers, there is higher turnover among school science technicians in schools with lower Ofsted ratings (Worth *et al*., 2018). This may relate to the lower quality of working environment in those schools. For example, teachers in schools rated as inadequate or requires improvement are more likely than teachers in schools rated as good or outstanding to report that their workload is unmanageable (Walker *et al*., 2019; Jerrim and Sims, 2019).

Figure 19: Science technicians in schools with a low Ofsted rating are more likely to leave



Source: NFER analysis of SWC data.

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5 Conclusions and recommendations

The findings from this new research lead to a number of key overall conclusions about the current state of the school science technician workforce in England. In this section we draw these together and make a number of recommendations for policy, practice and further research.

The level of school science technician support in England's secondary schools has fallen between 2011/12 and 2018/19

All the measures that we have explored of the extent of science technician support available within school science departments, many of which are based on long-established metrics, show that science technician support has fallen between 2011/12 and 2018/19. Given the reduction in real-terms per pupil school funding over this period, the most likely explanation is that the fall is due to schools reducing their expenditure on science technicians as their budgets have been squeezed (Cramman *et al.*, 2019; Britton *et al.*, 2019). However, we cannot definitively rule out other explanations, such as increasing science technician shortages, also playing a part.

Schools in the North of England have the lowest level of technician support, while schools in London and the South of England have the highest levels. Schools with more deprived pupil intakes and local authority maintained schools also have slightly lower levels of science technician support.

Most schools are, as a result, operating with a science technician workforce that is smaller than the minimum support threshold recommended by the ASE. This could be having a detrimental impact on the workload of science teachers. However, relatively little robust quantitative research has been conducted to demonstrate the relationship between science technician support and science teacher workload.

Recommendation 1: The Government should consider what policy measures might encourage schools to increase the level of science technician provision and support

Recommendation 2: More research should be conducted to understand better the relationship between science technician support and science teacher workload

The pay and conditions of school science technicians have not improved since the House of Commons Science and Technology Committee described them as 'appalling'

In 2011, the House of Commons Science and Technology Committee described the pay and conditions of science technicians as 'appalling' and called for the creation of 'a career structure that will attract skilled and dedicated people to work as technicians' (GB. Parliament. HoC. Science and Technology Committee, 2011). Since then, the average pay of school science technicians has been flat in real terms up until 2018/19; in other words, pay has risen at roughly the same rate as the rate of inflation.

Most school science technicians are employed on a term-time only contract, and the proportion of technicians employed term-time only (which comes with a lower salary) has increased slightly in academies since 2011/12, but remained the same in local authority maintained schools. The turnover rate of school science technicians is around 20 per cent in 2017/18, having risen by five percentage points since 2011/12.

It is therefore clear that there has been no significant improvement in the pay and employment conditions of school science technicians since the Science and Technology Committee's most recent report covering the science technician workforce.

Recommendation 3: The Government should review science technician pay and conditions, considering what policy measures might help to attract and retain science technicians in the future

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Appendix A: methodology

This report is based on findings from analysis of data from the DfE's SWC. The SWC is an annual snapshot data collection covering the employment records of all teaching and non-teaching staff employed in state-sector schools in England. The data has been collected every November since 2010.

The main focus of our research is data on school science technicians, which are classified in the SWC as school support staff. The SWC includes data on each staff member's role, which enables science technicians to be identified as distinct from other support staff, particularly from other technicians (e.g. IT technicians, art technicians). The SWC also includes data on each individual's school, contract and personal characteristics.

SWC records for the same individual are linked from one year to the next using their name, date of birth and national insurance number (and teacher reference number, but only for teachers). This enables analysis of science technicians moving school and leaving employment in the state-funded education system. We found a high rate of school science technicians leaving employment in state-sector schools, but a low rate of technicians moving school. This may be due to the quality of the longitudinal linking within the SWC: a technician could move school but their records be treated as if they are two separate individuals within the data due to mismatched linking. However, as the longitudinal data linking uses name, date of birth and national insurance number it should pick up most genuine cases of school moves.

We combine the data on science technicians with data on the numbers of science teachers, the number of pupils enrolled in the school and school characteristics. The data on science teachers also comes from the SWC, combining contract information and data on which subject each teacher teaches from the SWC curriculum module. Subject data is not collected from around one-third of secondary schools due to the particular data collection methods that are used, so any analysis using the number of science teachers is based on a subset of all secondary schools. Data on the number of pupils enrolled in the school comes from the DfE's School Census and school characteristics come from DfE's Get Information About Schools database and Ofsted school inspection outcomes data releases.

SWC returns are made by schools and not all schools submit returns that are based on complete and up-to-date employment records. This is an issue for teacher data as well, which the DfE partially solves by filling in gaps from cross-checking against the Database of Teacher Records (a separate database relating to teacher pension contributions). This is done for around one per cent of teacher records per year. There is no such process for filling in missing data for science technicians, so the data we have analysed may undercount technicians. It is also possible that some technicians who have left their post are erroneously included in a census return, thereby *overcounting* the number of science technicians. It is not possible for us to verify records, but these possibilities exist and we base our analysis on what is recorded in the data.

Indeed, we find a number of schools with no records for science technicians, despite having records for other types of staff. In some cases this appears to be plausible – for example where there are also no science teachers – but not in others. For our analysis we assume that a school is likely to genuinely have no science technicians where there are fewer than five science teachers, but they have been incorrectly omitted where the school has more than five science teachers. However, we cannot perform this adjustment where there is no data on the number of science teachers.

A range of other assumptions are also technically plausible, so we explore the sensitivity of our findings to two assumptions at opposite ends of plausibility:

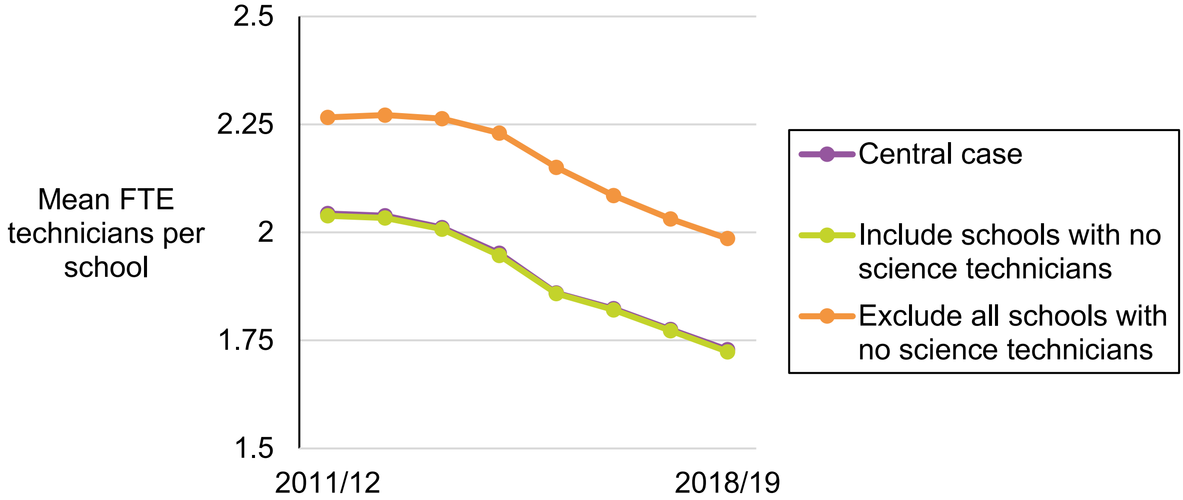
1. all schools with no science technician records genuinely have no science technicians
2. all schools with no science technician records have incorrectly omitted their science technician records, and the school actually has an average number of technicians

Anything between these assumptions is likely to be plausible and therefore bounds our estimates. Further, if the same trends that appear in our main estimates are also evident across different assumptions, then it suggests that the *trends* are likely to be accurate, even if there remains uncertainty about the exact *level* of each ratio.

Figures 20-23 present the sensitivity analysis. We present the central case that we report in the main body, as well as data estimated using the two assumptions above that test the sensitivity of the results to alternative assumptions. The sensitivity analysis shows that while there is uncertainty about the level of each ratio due to missing data, the extent of the uncertainty is not large. Furthermore, the downward time trends in all of the ratios are evident across all assumptions and all measures, suggesting that whatever the true level of the technician support ratios, they are very likely to have declined between 2011/12 and 2018/19.

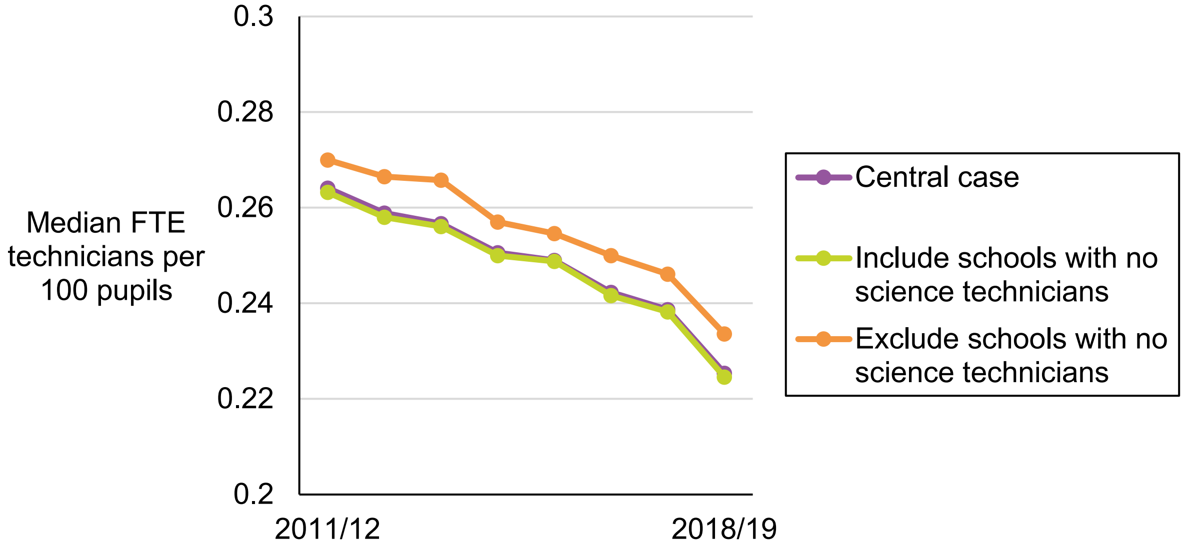
In section 2.2 we compare our estimates of the FTE number of science technicians per school with those estimated in the Durham study for 2015-2017, finding that the Durham estimates are higher than ours for the corresponding years. Figure 20 below shows that even if we make an extreme assumption that all the schools in the SWC that have no records for science technicians have missing data (and actually do have technicians), our estimates remain lower than those in the Durham study. Therefore, potential data quality issues with the SWC are unlikely to entirely explain the differences between the estimates.

Figure 20: Sensitivity of the FTE technicians per 100 pupils measure to different assumptions where a school has no science technician records



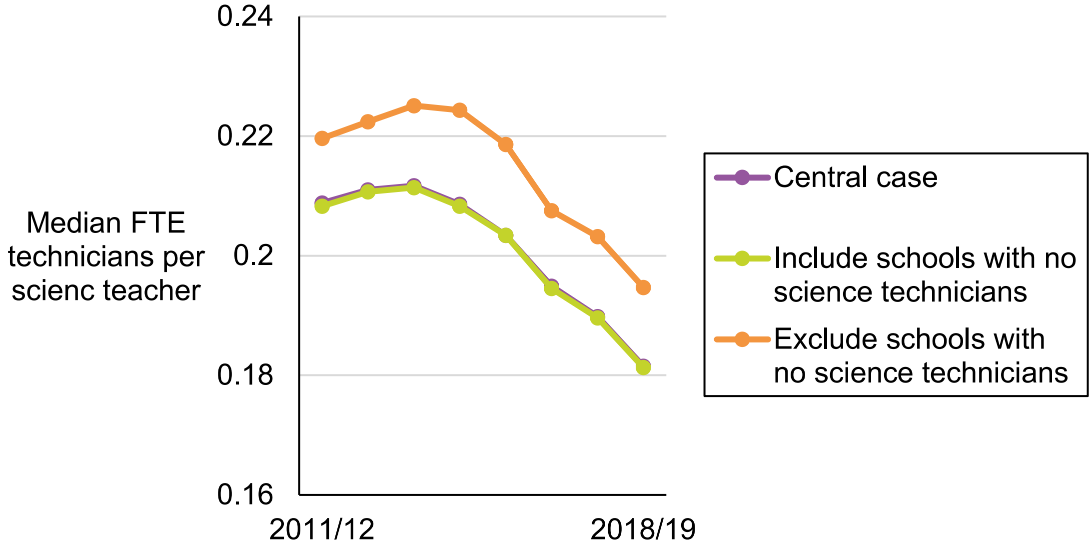
Source: NFER analysis of SWC data.

Figure 21: Sensitivity of the FTE technicians per science teacher measure to different assumptions where a school has no science technician records



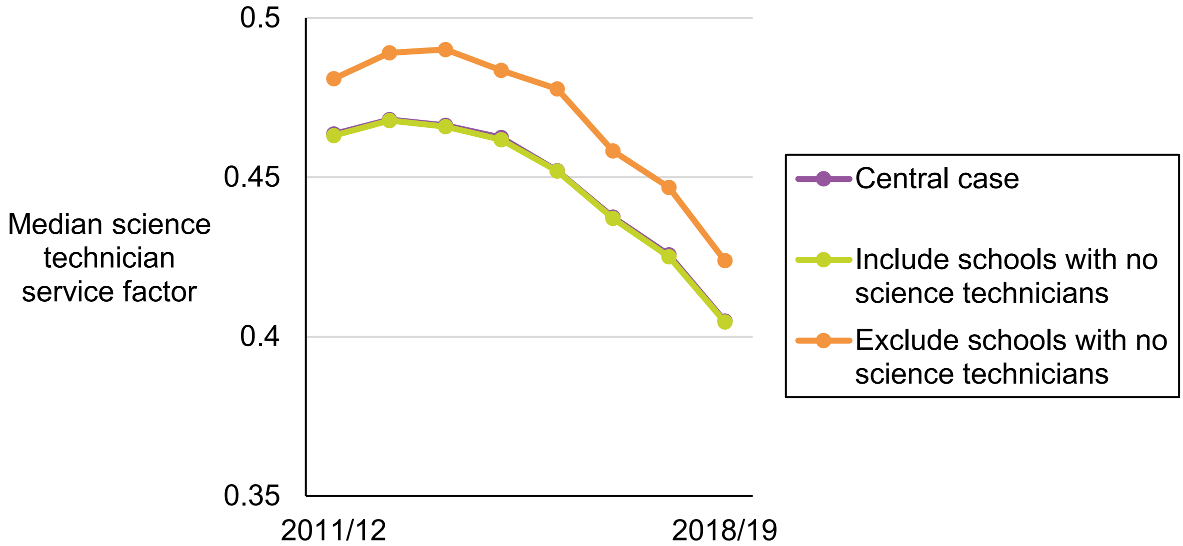
Source: NFER analysis of SWC data.

Figure 22: Sensitivity of the FTE technicians per science teacher measure to different assumptions where a school has no science technician records



Source: NFER analysis of SWC and School Census data.

Figure 23: Sensitivity of the science technician service factor measure to different assumptions where a school has no science technician records



Source: NFER analysis of SWC and School Census data.

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National Foundation for Educational Research

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The Mere, Upton Park, Slough, Berks SL1 2DQ

T: +44 (0)1753 574123 • **F:** +44 (0)1753 691632 • enquiries@nfer.ac.uk

www.nfer.ac.uk

NFER ref. RSST

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