



National Audit Office

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Department for Education

Educating the next generation
of scientists

Summary

1 A strong supply of people with science, technology, engineering and maths skills is important to promote innovation, exploit new technologies, produce world-class scientists and for the UK to compete internationally.

2 In 2002, a government-commissioned review identified concerns about the future supply of such skills to the UK economy. Two years later, the ten-year *Science and Innovation Investment Framework* set out a strategy to improve the UK's standing as a centre of research, increase investment in research and development, and support a strong supply of scientists, engineers and technologists. A key aim was to increase the skills of young people coming through the school system by improving the quality and quantity of science teachers, improving results for pupils studying maths and science, and increasing the numbers taking related subjects in post-16 and higher education.

3 This report evaluates progress by the Department for Education¹ in increasing take-up and achievement in maths and science up to age 18, and the extent to which specific programmes to raise the quality of school science facilities, recruit and retain science and maths teachers, and improve the appeal of science to young people have contributed to any increase.

4 A summary of our methodology can be found in the Appendix.

Main findings

Trends in take-up and achievement

5 GCSE science entries have been stable over the last five years at around 1.1 million per year. There has been an increase in pupils taking A-level chemistry and maths over the same period, though physics has increased more slowly. Numbers of pupils achieving A-C in A-level biology, chemistry, physics and maths have also increased.

Critical success factors in improving take-up and achievement

6 Our literature review and survey of 1,274 children and young people suggest that the following are critical success factors in improving take-up and achievement in science and maths:

- careers information and guidance
- quality and quantity of school science facilities
- quality and quantity of science teachers
- image and interest
- availability of separate GCSE sciences ('Triple Science')

Careers information and guidance

7 The Department acknowledges that careers information and guidance in schools has been patchy. Only 18 per cent of young people we surveyed were satisfied with the careers advice they had received relevant to science, technology, engineering and maths. The Department launched a new strategy on information, advice and guidance in October 2009, and until March 2011 is running a career awareness pilot in 30 schools to establish a more coherent structure for young people to learn about careers relevant to science and maths.

Quality and quantity of school science facilities

8 The Department has not collected routine data to measure progress against a target set in 2004 to bring all school laboratories up to a satisfactory standard by 2005-06, and to a good or excellent standard by 2010. A 2005 research report suggested that science accommodation remained either unsafe or unsatisfactory in around a quarter of secondary schools, while a 2006 follow-up study estimated that, at the rate of progress at the time, the 2010 target would not be met until at least 2021.

9 Schools with a specialism in science, technology, engineering or maths and computing are effective in bringing together the programmes and resources that support good take-up and achievement in science and maths. The availability of schools with these specialisms varies widely between local authorities, with higher numbers in areas of lower deprivation.

Quality and quantity of science teachers

10 Teaching is of better quality where teachers hold qualifications in the subjects they teach. The Department has sought to increase teaching by specialists in maths, chemistry and physics. It anticipates that targets set by the previous Government for numbers of specialist chemistry teachers will be met, but that those for physics and maths will not.

11 The 'Transition to Teaching' programme aims to promote a teaching career to people in other professions with relevant degrees who are considering a career change. Although take-up has been limited to date, the economic climate presents an opportunity to recruit skilled employees who may be facing redundancy from industry into teaching.

12 Science Learning Centres are a network of ten facilities across England providing specialist continuing professional development to science teachers. There is evidence that participation by teachers in Learning Centre programmes is associated with improved teaching and learning, and higher take-up and achievement in science at their schools, but take-up by teachers varies between areas.

Image and interest

13 The UK generally compares favourably in international comparisons of young people's attitudes towards science and maths, particularly in the value they place on maths, their confidence learning maths, and the extent to which they recognise the usefulness of science. However, in recent years the UK has lost ground in areas such as enjoyment, interest, and motivation to pursue science and maths further.

Availability of GCSE Triple Science

14 Pupils studying 'Triple Science' (separate biology, chemistry and physics) are more likely than those studying combined science to continue science study at A-level and to achieve higher grades having done so. While starting from a low base, pupil take-up of the individual sciences has increased by almost 150 per cent in the last five years. The number of secondary schools offering Triple Science has increased rapidly, although by June 2009 just under half still did not do so.

15 Recent research shows that, compared with other pupils, pupils from more deprived backgrounds achieve relatively larger improvements in their future A-level science and maths outcomes when offered Triple Science at GCSE than when offered only combined science. However, Triple Science is less widely available in areas of higher deprivation, where it could potentially have the greatest impact on take-up and achievement.

Effectiveness of programmes to increase take-up and achievement in maths and science

16 In 2004 there were over 470 initiatives aimed at improving take-up and achievement in school science and maths, run by a wide range of organisations. Some two thirds had no evaluation or none was planned. From 2006, a national programme has had the aim of rationalizing programmes for schools that receive national funding and endorsement.

17 We examined a number of the larger recent programmes, covering around £35 million of expenditure per year, and found that they were widely available to schools and take-up was high, although a small number of schools did not access any. There are considerable regional variations, indicating that further targeted incentives to manage take-up are required.

18 Schools using the programmes have a greater proportion of pupils studying these subjects, and several programmes are associated with increases in take-up and achievement of separate sciences at GCSE, and maths and science at A-level. However, it is difficult to establish whether this is a direct consequence of participating in the programmes, or whether schools with an existing focus on science tend to access more such programmes as a result.

19 Up to a point, take-up and achievement in GCSE sciences is proportionally associated with the number of different programmes in which schools participate. However, there may be diminishing returns when schools access larger numbers of interventions with similar objectives. More generally, our analysis suggests that participation in these programmes has less influence on take-up and achievement than other factors, such as pupil intake.

Value for money conclusion

20 The Department has focused resources on the appropriate critical success factors to improve take-up and achievement in school science and maths, and has made good progress in areas such as A-level maths and availability of GCSE Triple Science. It has been less successful in aspects such as teacher recruitment and take-up of A-level physics.

21 Increased take-up and achievement in school science and maths is, as this report shows, dependent on a number of key factors. These need to be brought together in coherent pathways to maximise successful results and efficient use of public resources in pursuit of this objective. The Department has made progress in doing so, for example by rationalizing the previous plethora of initiatives within a national programme. However, gaps and inconsistencies in availability and uptake remain, creating a shortfall in value for money which the Department could and should address in developing its future programme for science and maths in schools.

Recommendations

22 In taking forward the policy priorities of the new Government, the Department should develop an overarching programme with a clear logic, based on evidence of cause and effect. The programme should provide a framework with clear priorities, a well-defined critical path and appropriate measures of progress. It should provide a basis for engaging with local authorities, schools and colleges on the actions required in the following key areas:

- a systematic approach which gives assurance that there will be sufficient teachers with a specialism in maths, chemistry or physics;
- more even take-up of continuous professional development opportunities for teachers, particularly in local authority areas where fewer schools are currently using Science Learning Centres;
- a realistic assessment of what progress can be made to bring school laboratories up to a good or excellent standard, since the previous target was neither informed by robust data nor achieved within the specified timeframe;
- actions at local level to give all young people access to:
 - a curriculum that includes the study of separate sciences; and
 - a school or college that performs well in science and maths, whether through a relevant specialism or by other effective means;
- further development of the analysis presented in this report with a view to:
 - evaluating more coherently and consistently the efficacy and cost-effectiveness of individual programmes in increasing take-up and achievement; and
 - providing information on local use of programmes to support reviews of whether take-up is sufficient and appropriate.