Impact assessment of STEM initiatives in improving educational outcomes

PALLAVI AMITAVA BANERJEE

THE CONVERSATION

Can schemes to inspire tomorrow's scientists close the poverty attainment gap?

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Pallavi Amitava Banerjee
PhD student at Durham University

Can you help me with my homework, Carol? Chris Radburn/PA Archive

Science and mathematics subjects have **traditionally been seen** as the forte of high-achieving, white, middle-class pupils. And, in an effort to boost the number of scientists and engineers in the UK, over the last decade the government has backed a range of school initiatives aimed at getting more young people to study these subjects at university.

My initial research findings from a national evaluation show that school performances have been improving slowly and steadily. But up to now, efforts have not been able to completely eliminate the attainment gap in maths and science GCSE results. What seems to matter most when it comes to how well a school does in these subjects is not how many visits they have had from science ambassadors or other interventions, but their pre-existing share of disadvantaged or low-attaining pupils.

In 2012, the **Royal Society** expressed serious concern over the insufficient numbers of 16 to 19-year-olds studying science and mathematics at school – and the even smaller percentage of these pupils going on to study these subjects at university.

There has been some debate over where the evidence lies to support claims of a serious skills shortage in science, technology, engineering and maths (STEM) subjects. The number of graduates in these subjects has actually been rising and was at an all-time high in 2014. Yet there is consensus that more and more people studying and working in STEM professions are required at all levels.

Diversity matters

It is important to make sure the scientists of tomorrow do not come from one social background. A diverse intake for science and maths courses in terms of class, ethnicity, gender and background is expected to lead to a more innovative and responsive STEM workforce.

It could help narrow the socio-economic divide as people in scientific occupations earn almost 30% more than those working in other fields. And a more diverse intake would also help boost social justice – the onus on universities to maintain fair access to all, irrespective of socio-economic status, gender or race.

In order to address the STEM skills gaps, schools have been encouraged to retain more students in science and maths. The government has funded a number of STEM-enhancement and enrichment activities over the past decade to inspire, enthuse and motivate young minds to pursue science and maths beyond compulsory education in England.

There have been a huge number of these programmes – 470 science initiatives were found in the 2004 STEM Mapping Review. The variety and number of these schemes has grown substantially over the past decade. In 2006, when analysing 70 ongoing government-funded initiatives, the STEM Cross-Cutting Programme advised: "The need to rationalise government-supported initiatives and build on the best ones so as to achieve better results for the same amount of money."

The student-focused schemes have provided hands-on experience in STEM subjects, as well as enlightening pupils through role models and mentors and suggesting future pathways to help them make informed choices. They also often provide financial motivation in the form of scholarships and bursaries. These schemes often work on the theoretical assumption that pupils who achieve better results in science and maths are more likely to continue to engage in these subjects.

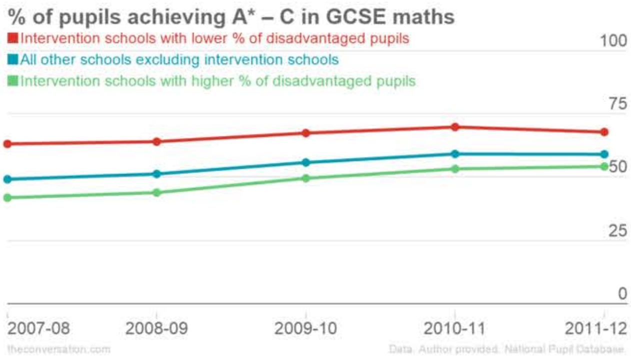
Other activities operate in the form of ambassador visits to schools, hands-on programmes delivered at state-of-the-art laboratories and centres, career guidance and counselling in schools, faculty mentoring programmes and STEM summer schools.

Has it worked?

My continuing research has attempted to understand whether participation in these initiatives has helped reduce gaps in attainment in maths and science between schools with varying shares of disadvantaged pupils.

GCSE science and maths results were tracked between 2007 and 2012 for 300 English state secondary schools known to register pupils for practical science and maths activities, ambassador visits and outreach programmes each year. The common objective shared by all these programmes was to improve an understanding of the subject through hands-on activities and raise attitudes towards science and maths.

Across England, initial analysis of data from the **National Pupil Database** shows that GCSE results in science and maths have been gradually improving between 2007 and 2012 for all schools. The graphic below shows the percentage of pupils achieving A* to C in maths GCSE at the different schools.



It is clear that the schools with a higher proportion of disadvantaged pupils who did a STEM programme, still fall behind. But those who took part in an intervention did have a steeper increase in GCSE maths scores. Intervention schools with a higher proportion of disadvantaged pupils had a 12.4 percentage point increase in GCSE attainment between 2007 and 2012. Those with a lower proportion of disadvantaged pupils experienced a 4.7 percentage point increase in GCSE scores, while the comparator group of all other schools in the country (excluding those who had a STEM intervnention) had a 9.9 percentage point increase in attainment.

Poverty still the biggest driver

Among the various factors considered such as ethnicity, gender and poverty, a school's percentage of disadvantaged pupils still has the most impact on school maths and science achievement. This means that despite participation in STEM activities, the higher the number of pupils eligible for free school meals at a school, the more likely that school is to have poor maths and science GCSE results.

This suggests that the STEM initiatives administered in the schools tracked from 2007 to 2012 have not been able to break free from the effects of socio-economic status. More rigorous evaluations are required to understand what works in order to build on the best initiatives to achieve better results by spending the same amount of money.

Science education
Maths and science education
Education attainment