

How can we increase girls' uptake of maths and physics A-level?

Introduction and background

For some time there has been a significant gender gap in the proportion of pupils pursuing maths and physics to A-level. Of students taking A-levels in 2017, 18 per cent of girls compared to 33 per cent per cent of boys took maths A-level, and a mere 4 per cent of girls compared to 17 per cent of boys took physics A-level. In other subjects, the gap is much smaller. For example, 13 per cent of girls and 15 per cent of boys took chemistry A-level in 2017 and the numbers taking biology were slightly higher for girls than boys (19% of girls compared to 14% of boys).

These gender differences are not linked to prior attainment at GCSE. Attainment in maths and physics at GCSE is very similar for girls and boys: in 2017, 19.4 per cent of girls taking maths GCSE achieved grades 7-9 (equivalent to A/A*), compared to 20.7 per cent of boys, whilst 41.8 per cent of girls taking physics at GCSE achieved grades 7-9, compared to 42.3 per cent of boys. The gap in taking maths and physics to A-level is also present among students who achieve grades 7-9 (A/A*) at GCSE. Among pupils who achieved grade A or A* in GCSE maths in 2010, 36.5 per cent of girls compared to 51.1 per cent per cent of boys took maths A-level. Among those who achieved grade A or A* in GCSE physics, just 13.2 per cent of girls compared to 39.3 per cent of boys took physics A-level.

This report from the Institute for Fiscal Studies (IFS) looks at some of the possible reasons for these gender gaps. It also reports on the results of a small pilot trial, funded by the STEM (Science, Technology, Engineering and Maths) Skills Fund, which aimed to explore whether financial incentives might help to reduce the gaps.

Key findings

The pilot scholarship scheme

- In partnership with the STEM Skills Fund, the IFS conducted a small-scale randomised control trial in which girls in Year 11 who were predicted to achieve at least grade 7 (equivalent to at least grade A) in maths, physics or combined science GCSE were offered financial support in return for applying to study physics or maths A-level.
- The scholarship consisted of an upfront payment made to all eligible girls shortly before A-level subject choices were finalised (in January of Year 11) and an additional weekly payment for 12 weeks during the summer term of Year 11 to those eligible girls who applied to study physics and/or maths at A-level. The amount of upfront and weekly payments across schools was varied to provide evidence as to whether the amount and/or timing of the scholarship had an impact on its success. Schools were randomised into either a control group (in which no scholarships were provided) or one of six treatment arms.
- Schools were informed that participation in the pilot would require completing a Memorandum of Understanding, filling out an online school questionnaire and encouraging the eligible girls in their school to answer a pupil questionnaire and possibly participate in a focus group. A total of 36 schools completed a Memorandum of Understanding and were included in the pilot.
- It must be noted that sample sizes were small and that a disproportionately large number of schools in the control group did not respond to the invitation to participate in the trial. This means means that it is not possible to use a simple comparison of average outcomes across the treatment and control groups to produce an unbiased estimate of the effect of offering scholarships.
- As part of the pilot, a total of 266 girls, as well as a senior staff member across 40 schools, were surveyed about girls' A-level subject choices and what drives them. Four focus groups took place with 6-8 girls in schools in Bolton, Hull, Birmingham and Portsmouth to discuss reasons in more detail.
- Participation in the questionnaire was voluntary, so it is important to note that the girls who answered it may not be representative of the sample of eligible girls involved in the study. The girls who answered the pupil questionnaire are much more likely to have applied for maths or physics A-level than those who did not respond.

Key messages from the research

- The schools in the research sample were generally well-resourced with 97 per cent offering A-level maths and 95 per cent offering - level physics. Eighty-one and 85 per cent of schools reported that all maths and physics teaching respectively is done by specialist teachers with at least an undergraduate degree in their subject.

- Most of the girls in the survey reported that they had received good maths teaching to GCSE; 76 per cent said that the teaching was good or outstanding.
- With regard to physics, just 38 per cent reported that their teaching was very good or outstanding and 30 per cent reporting that it was satisfactory or weak.
- In the focus groups, there were comments from the girls about teaching in both maths and physics being too focused on exam preparation and too boring and repetitive. A lack of opportunity for debate and discussion was also highlighted in the focus groups.
- In the survey 77 per cent of girls reported that they find maths interesting, and 83 per cent reported enjoying it. The figures for physics were lower, with 61 per cent saying they find it interesting and 57 per cent saying that they enjoy it.
- By far the most important reason cited by girls for their choice of A-level subjects is enjoyment of a subject: 51 per cent cite it as the most important reason. Other factors cited as most important in subject choice were believing they will perform well (17%) and the fact that the subject is a requirement for their chosen university course (17%).
- Girls in the focus groups expressed the view that maths and physics were content heavy subjects. Not only did this render the subjects difficult, but it also meant that they were not able to go into enough depth.
- Other issues cited by the girls in the focus group were the perception that maths and physics would entail a lot of homework.
- The survey highlighted a lack of confidence on the part of girls in their ability to do well in physics. Fifty per cent agreed or strongly agreed with the statement that 'I often worry that it will be difficult for me in physics classes'. Fifty-two per cent agreed or strongly agreed that 'I worry I will get poor grades in physics'. Just 29 per cent agreed or strongly agreed that 'physics is one of my best subjects' and just 36 per cent agreed or strongly agreed that 'I learn physics quickly'.
- The above concerns are perhaps linked to the predicted grades in the sample, with 60 per cent of the girls predicted to achieve a higher grade in maths than in physics.
- Teachers also cite lack of confidence as a key reason why girls do not opt for physics A level. Eighty per cent agreed or strongly agreed with the statement that 'these girls are just as able, but not as confident in their ability to learn STEM subjects as boys'.
- In the focus groups, girls cited boys' behaviour in maths and physics lessons as a reason why they do not enjoy learning these subjects and would not want to pursue them further. They talked of boys chanting or making noises to intimidate them when they were asked a question by the teacher or laughing if they gave an incorrect answer. Girls were particularly concerned that they would be in a class of mostly boys both at A-level and university.
- In the focus groups some girls expressed the view that boys were better at maths and physics than they were.
- Teachers felt that the decision not to take maths or physics to A-level was self-perpetuating. Sixty-eight per cent agreed or strongly agreed that 'these girls don't want to/feel discouraged from pursuing STEM subjects at A-level because many of their female peers do not'.
- The girls in the focus groups were clearly aware of the value of maths and physics partly because of their perceived difficulty and partly because of the number of doors which they could open. However, most girls in the sample had already decided on the university courses which they wanted to follow and only 4 per cent had opted for engineering or technology and 1 one per cent for computer science, both of which require physics.

Perceptions of STEM careers

- Girls have generally favourable attitudes to STEM careers. Eighty-seven per cent agreed or strongly agreed that 'working in a STEM job would enable me to make a positive contribution to society'. Ninety-two per cent agreed or strongly agreed that 'working in a STEM job would enable me to make a good living'.
- However, there is a more mixed picture in terms of girls' confidence to do well in a STEM job. Thirty-eight per cent agreed or strongly agreed that 'I am not good enough at maths or science to work in a STEM job'.
- Girls believe that it is difficult to get a job in STEM. Forty-nine per cent agreed or strongly agreed that 'STEM jobs are hard to get, especially for women' and 67 per cent agreed or strongly agreed that 'STEM jobs are male dominated'. Testimony from the focus groups mirrored these perceptions.
- Teachers feel that the gender gap in STEM A-level is partly driven by girls not aspiring to work in STEM because of male dominance. 75 per cent agree or strongly agree that 'these girls don't aspire to work in STEM occupations and so don't need to take A-levels in STEM subjects' and 80 per cent of those agreeing or strongly agreeing say this is because 'STEM occupations tend to be male-dominated'.
- Lack of STEM role models also appears to be a factor. Eighty-seven per cent of those teachers who believe that girls do not aspire to work in STEM occupations say that this is because 'they lack female role models working in STEM'. There is also the fact that girls tend to have a larger number of male than female teachers, particularly in physics.

The STEM scholarship

- At first sight, the scholarship seems to have had a sizeable impact on the number of girls opting for maths and physics A-level. In treated schools, 13.2 per cent of girls reported taking these subjects as a result of the scholarship. However, these estimates are based on the girls who responded to the survey who are in any case far more likely to have opted for maths and physics. This, together with the small sample size, means that results must be treated with caution.
- A substantial proportion of girls in the survey felt that no amount of money would induce them to choose maths or physics A-level.
- They did, however, feel that talks from female role models in STEM could be effective. Thirty-three per cent of the girls who are not going to study STEM subjects at A-level say that meeting women who work in STEM could make them more interested in pursuing STEM subjects at A-level. Ninety-eight per cent of teachers felt that helping girls to access female role models would be effective or very effective in closing the gender gap.
- Ninety-eight per cent of teachers felt that offering girls work experience in STEM occupations would be effective or very effective. However, just 43 per cent of schools currently have links to businesses in STEM, suggesting that it might be necessary to form relationships with new businesses or to deepen the existing relationships.
- Interventions to boost confidence could play a role. The girls in the focus groups emphasised the importance of supportive teachers. Another idea might be to provide girls with tailored statistics on the proportion of girls like them who do go on to achieve an A/A* at A-level.

The full document can be downloaded from:

<https://www.ifs.org.uk/publications/13277>