2017 cohort

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Can talks by women in STEM increase the number of Year 10 and 11 girls who decide to study Maths or other STEM subjects at A-Level and would consider a career in a scientific subject area?

National results have been consistently showing that girls are underrepresented in scientific disciplines despite their attainment at GCSE being similar and sometimes higher than male students' (Noyes, 2007). This gender gap in Maths and other disciplines starts as early as A-Levels (Noyes, 2009).

Likewise, in 2019 our target school had an equal proportion of boys and girls who completed their Maths GCSE with a grade 5 or higher (50 boys and 48 girls), with slightly more boys than girls for a 6 or above (41 boys and 34 girls). However, such proportion did not transfer to the A-Level Maths cohorts (the intake being mostly from the school itself), where the boys considerably outnumber the girls. The issue is even more dramatic for Further Maths (1 girl in 21 students in the last 4 years) and Physics (1 girl in 19 students in the last 2 years).

Exposing students to a range of positive role models seems to encourage high attaining girls to continue on a STEM career and, even if this does not seem to have an impact on female students who are already disengaged from STEM (Smith, 2014), it helps challenge stereotypes and provide a varied set of images, which are common suggestions for reducing the gender gap in STEM (Hill *et al.*, 2010).

Therefore, we would like to evaluate whether exposing the students in our school to a variety of female professionals and students in higher education with a strong background in Mathematics, Physics, or Engineering, can influence female students' career awareness and choices. Ultimately, we would like to evaluate if this has a secondary effect of encouraging more girls to study Maths and enrol in A-Level Maths and Further Maths, thus increasing female representation in those classes.

The focus of the research was on Year 10 and 11 students as they will make their A-Level choices soon. The intervention plan involved designing two anonymous questionnaires and organising 10 career talks led by women working or studying in STEM fields with the most dramatic gender gap. The goal was to survey the students before and after the cycle of talks to investigate their knowledge of career pathways involving those subjects and their current A-Level choices and to detect any change in these. Ultimately, the project was to compare these results with next year's A-Level enrolment data to check for any lasting effect. The speakers were required to present their life journey, to provide relevant, clear, and useful career information, and to stress the importance of Maths, both as a pivotal subject for science and as an important factor in their pathway. We planned to design and deliver the survey through online surveying software because it is cheaper, allows a very quick collection and analysis of the data, and is more appealing for young people, as it can be completed on the phone. Moreover, by setting the next question to appear once the response to the previous one was given, we could reduce non-response refusal (Denscombe,2014), and by asking only for the gender of the participant at the end, we could prevent any form of *stereotype threat* and unconscious bias in the girls (Smith, 2014). For this reason, we also decided not to disclose our intent to measure the impact on girls until the end of the project.

The target group was also chosen because of their predicted attainment, as students with less than a grade 6 in GCSE Maths are not accepted for A-Level Maths, Physics, or Computing. Moreover, lower attainment in maths at this age is usually associated with disengagement with the subject (Archer Ker & Tomei, 2013). The other age groups were also left out as they can benefit from similar interventions in the future if their efficacy can be shown. Therefore, focusing on the chosen group created no significant disadvantage for the other students. We planned to collect quantitative data in various forms ("yes"/"no" answers, multiple-choice, and answers on a Likert scale) as it is a quick and efficient method to collect anonymous information from the whole cohort. Moreover, such surveys provide ordinal data in the form of frequencies that can show a change in students' knowledge and decisions, thus allowing the use of non-parametric statistics (Jamieson, 2004), and it can easily be compared with A-Level enrolment data for next year (when available). We decided not to use a mixed-method approach because it would have been too time-consuming, but we are aware that it could have shed light upon the possible motivations of any change, or lack thereof.

Findings and next steps

All plans had to be altered for the closure of all the schools in the United Kingdom due to the outbreak of the Covid19 pandemic, but the school is keen to implement it as soon as possible. In the meantime, we completed a literature review of the effectiveness of the chosen intervention.

In-school career advice through consistent use of talks by external professionals has been documented to work for several subjects (Kashefpakdel & Percy, 2016) and to have lasting positive effects, even on the future salary of the students. This is confirmed to work well for Maths and Science in a report by the National Audit Office, where a large-scale mixed-method approach analysed several initiatives to increase participation in STEM. And among such initiatives, the STEM Ambassador programme appeared to help increase not only the number of pupils that choose STEM subjects, but also their GCSE results (NAO, 2010), and have a proven track record of increasing girls' participation in Physics and Maths (STEM Learning, 2016).

But such interventions alone may not suffice. In fact, when girls have already low STEM aspirations, which is usually the case by the time they reach Year 11, this kind of talks may have a limited impact (CaSE, 2014); also, the higher the volume of career talks the students are exposed to, the higher the chance they receive advice that is relevant for them, so these are not interventions that can be done occasionally if we want to see a considerable change (Kashefpakdel & Percy, 2016).

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