Raising Aspirations in Physics

Recommendations from a review of research into barriers to STEM participation for students from disadvantaged backgrounds
The Institute of Physics is a leading scientific society. We are a charitable organisation with a worldwide membership of more than 50,000, working together to advance physics education, research and application. We engage with policymakers and the general public to develop awareness and understanding of the value of physics and, through IOP Publishing, we are world leaders in professional scientific communications.

In September 2013, we launched our first fundraising campaign. Our campaign, Opportunity Physics, offers you the chance to support the work that we do.

Visit us at [www.iop.org/fundraising](http://www.iop.org/fundraising).

**Acknowledgement**

We would like to thank Sarah Watt for her generous funding of the Raising Aspirations in Physics project, without which this work would not have been possible.
Executive summary

Three major demographic factors are correlated with the likelihood of a young person choosing a physics course beyond the compulsory phase of education:

- Gender: girls are much less likely to take physics than boys.
- Socioeconomic status (SES): children from more disadvantaged families are less likely to take physics.
- Ethnicity: people from certain ethnic backgrounds are more (e.g. Chinese) or less (e.g. Black Caribbean) likely to take physics.

The Institute of Physics aims to actively promote physics to all, regardless of their background. To date, most of the emphasis of its work has been on gender and, to a lesser extent, on ethnic minorities. This review set out to determine what previous research and surveys reveal in relation to the barriers preventing young people from disadvantaged backgrounds choosing science, technology, engineering and mathematics (STEM) subjects post-16. Of those subjects, physics has the largest disadvantage gap, with high achievers from disadvantaged backgrounds (as measured by free school meals) much less likely to enter physics A-level and less likely to gain top grades than their contemporaries from more privileged backgrounds, but with similar achievement at GCSE (Department for Education, 2011)\(^1\).

This finding is supported by the Social Mobility and Child Poverty Commission who report that, although the socioeconomic differences in the likelihood of attending an elite HE institution are relatively small once prior attainment is accounted for, many more children from poorer backgrounds fall behind during their progress through school, compared with those from richer backgrounds (Crawford, Macmillan and Vignoles, 2014)\(^2\).

The overriding message from the evidence is that economic inequality affects educational outcomes in myriad ways. This makes it difficult to counter them all with remedial measures. The evidence points to deep-rooted differences, indicating that it would be most effective to address the underlying issue of economic inequality, rather than attempting to combat inequality of opportunity piecemeal across many independent issues. While this is a political statement, all of the major political parties agree on the need to broaden the range of socioeconomic backgrounds of people entering the professions (Milburn, 2012)\(^3\), which, for physics, means increasing the range for those progressing to A-level.

These recommendations are aimed at policymakers, practitioners in secondary schools, organisations that provide support for schools and researchers who are interested in the topic.

Despite the deep-seated nature of the issue, there are a number of measures that can and should be taken to increase the number of students from lower SES backgrounds entering STEM subjects and some of these are presented in section 2.

---

There is no easy solution to increasing the number of students from disadvantaged backgrounds taking physics. The Joseph Rowntree Foundation asserts that a lack of robustness and evaluation, and questionable assumptions about low aspirations in poorer children and parents, has led to a proliferation of interventions with unknown effectiveness in enabling disadvantaged children to realise their ambitions (Carter-Wall and Whitfield, 2012)\(^4\).

The recommendations below are based on the best evidence from the review and indicate the approaches that are most likely to make an impact. Each area is discussed in more detail, with full references, in the main body of the report, available from: [www.iop.org/publications](http://www.iop.org/publications).

### 2.1. Raise attainment with effective in-school measures

Physics (and many other STEM) courses at A-level and beyond require a high level of previous attainment. Prior attainment in science and mathematics is the strongest indicator of whether or not a student will go on to study physics. As prior attainment is strongly linked to SES, students from lower SES backgrounds are at a disadvantage when it comes to taking physics post-16.

The evidence shows that a number of measures may be effective. Schools should implement evidence-based strategies that improve attainment, such as:

- Use feedback from students effectively.
- Provide targeted homework (at secondary school).
- Engage pupils with the issues surrounding SES and their own learning.
- Instigate peer-learning programmes for pupils to help increase attainment, build self-confidence and give students opportunities to develop presentation skills.
- Recruit specialist physics teachers where possible.
- Provide training to improve teaching, which can help to break the cycle of poor attainment in schools in deprived areas. Interventions such as the Stimulating Physics Network (SPN)\(^5\) have been shown to be effective.
- Avoid setting; if that is not possible, take into account that prior attainment may be heavily dependent on social background.
- Select students for Gifted and Talented programmes based on potential and interest rather than solely on past attainment.

### 2.2. Develop home–school partnerships

Involving parents with school and their child’s education can help to increase a child’s attainment and aspirations. Developing a successful programme of parental engagement takes time and trust between all parties concerned.

Schools should:

- Consult the whole school community to create and implement a meaningful “Home School Agreement”, which can be recognised on all sides.
- Integrate parental engagement into a whole school approach, rather than as a “bolt-on” activity.
- Provide well structured programmes (e.g. homework clubs) with high-level support to reduce drop-out rates.
- Train all school staff about the best ways to engage parents with their child’s education and give teachers adequate time to undertake this work.
- Provide advice on how parents can help their children with homework and generally improve educational achievement.

---

\(^4\) The role of aspirations, attitudes and behaviour in closing the educational attainment gap by Charlotte Carter-Wall and Graeme Whitfield, Joseph Rowntree Foundation, 2012.

\(^5\) More information about the SPN can be found at [http://stimulatingphysics.org/](http://stimulatingphysics.org/).
Working with parents:
• Recognise parental needs and have the improvement of pupils’ learning as a clear goal.
• Use flexible models of working in partnership in different contexts and maintain a genuine two-way exchange.
• Tap into parents’ needs and interests by creating comfortable environments and involve other members of the community.

2.3. Provide appropriate advice on routes through education
Many students and families from disadvantaged backgrounds are not aware of the range of careers that exist in STEM areas and, equally important, in areas where STEM skills offer a significant advantage. Consequently, subject choices are made without proper information as to where they might lead and the economic consequences of particular choices are not made visible. The evidence indicates that it is not sufficient simply to offer examples of STEM jobs; such an approach is unlikely to succeed and may be counter-productive.

Schools should:
• Integrate awareness of skills development into mainstream teaching; students should realise that STEM skills are applicable across a wide range of careers.
• Ensure careers advice and guidance: starts early enough (before year 9) to be effective; is bespoke to the student and their current aspirations; concentrates on the next stage of choice; and includes parents.
• Implement a proactive approach in matching work placements with pupils.
• Provide information on how to access higher education and which subjects are desired by universities.

2.4. Increase science capital
Science capital refers to having science-related qualifications, understanding, knowledge (about science and “how it works”), interest and social contacts (e.g. knowing someone who works in a science-related job). Students from under-represented groups will have few role models, people who are “like them”, visible in STEM careers. Parents who have not been to university themselves may not be familiar with the routes into higher education and may not see this as an option for their children. For such children, inspiration and information from other adults, including teachers, can be important and influential. Girls especially are more likely to take a subject post-16 if they think the teacher is interested in their education as an individual, yet conversely girls are much less likely to think this is true compared with boys.

Schools should:
• Raise the overall profile of science in school. This requires support from senior leadership and the science department as a whole. Any strategies need to be embedded and should foster a general culture among adults in the school and the surrounding community of being positive about physics and STEM.
• Endeavour to build long-term relationships between pupils and role models (who could be ex-pupils) with a similar background in terms of geography and SES. One-off visits are much less likely to be effective than establishing a successful STEM club.
• Make sure all teachers are aware of the influence they can have on children’s future careers, that they are informed about current entry routes to different careers and they do not discourage pupils from pursuing STEM careers based on their personal opinions and stereotypes.
• Explore socio-scientific issues in lessons: this has a positive effect on encouraging young people (especially females) to choose post-compulsory STEM education.

2: Recommendations
2: Recommendations

Professional bodies, employers and other organisations should:

- Assist schools in running events by providing resources, including staff, that can engage parents and pupils about different career routes.
- Provide and support appropriate role models with similar social backgrounds so students can see and get to know people “like them” in STEM roles;
- Assist schools in implementing long-term programmes to highlight the many careers and opportunities available in and from science.
- Use media in a positive way to provide examples of different career paths and to counteract stereotypical images of scientists.

2.5. Improve awareness of further and higher education

There appears to be a number of barriers that make it difficult for students from low SES backgrounds to study STEM subjects at university. Some of these may be practical, such as the costs involved with moving away from home and tuition fees. Others are linked to a lack of information or aspiration.

Further and higher education providers should:

- Provide schools with information about the appropriate subjects and courses to study at school that are required to apply for their HE STEM courses.
- Provide information about bursaries and other financial help available at their institution.
- Be aware of the impact of partner-school agreements especially if certain STEM courses (e.g. physics) are not offered widely in the region.
- Ensure there is a collaborative outreach/ambassador approach across the different STEM-related departments within the university so best practice can be shared.
- Provide opportunities for families to increase their science capital.
For further information contact:
Clare Thomson
IOP Institute of Physics
76 Portland Place, London W1B 1NT
Tel +44 (0)20 7470 4981
E-mail clare.thomson@iop.org
www.iop.org
Charity registration number 293851
Scottish Charity Register number SC040092

The report is available to download from our website and if you require an alternative format please contact us to discuss your requirements.

The Kitemark is a symbol of certification by BSI and has been awarded to the Institute of Physics for exceptional practice in environmental management systems.
Certificate number: EMS 573735