

FIXING PHYSICS TEACHING



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For many people, their school years pass without them having much of an idea of where they want to go or what they want to do. But for others their educational and career paths are subject to many influences along the way. Often the strongest influence is exerted by a teacher. A good teacher can bring a subject alive, inspire students and instill a deep and lasting understanding of the topics they teach.

There are many factors that make an effective teacher. Personal skills and pedagogical ability are important, as is a strong knowledge of the subject. While that last point may seem obvious, particularly in the later stages of education, there is actually no formal requirement for this to be the case. Many shortage subjects, such as physics, are taught by non-specialists even to GCSE level.

A SHORTFALL IN TEACHERS

In the case of physics, there has been a drastic shortfall in the number of specialist teachers for many years, which inevitably has a major impact on young people's education in the subject. There are 500 maintained schools in England with no specialist physics teacher. It is not necessarily that non-specialists cannot be good physics teachers, but on average specialists have been shown to teach better-quality lessons, and secondary-school departments without any specialist physics teachers tend to have fewer students who go on to study the subject at A-level.

The Institute of Physics is pleased to see that the latest batch of newly qualifying teachers – whose new-teacher conference took place on 14 July, followed by a celebratory event in Parliament – is the

largest cohort for 30 years, with 650 new physics teachers ready to take up their places in instructing the next generation in the most fundamental of the sciences. As encouraging as this news is, the figure is still short of the new Government target of 925 physics teachers recruited annually – a target that the Institute sees as a crucial step towards rectifying the drastic shortfall, in England, of specialists, which we estimate to be between 4000 and 4500 teachers. It is even further behind the more ambitious target identified by the Institute, of 1000 new teachers per year – the level at which 15 years of steady recruitment would finally put the number of physics teachers back on a par with those of chemistry and biology.

The desired target of physics specialists making up one third of all teachers of science subjects begins from a starting point of around 19%. Until recently, only around 400 new teachers began teacher-training courses each year, and 15% of those who start PGCE courses drop out before completing their training. To make matters worse, half left the teaching profession within four and a half years.

POSSIBLE SOLUTIONS

The prospect of graduates with good degrees in physics having their student loan

repayments met by Government is reassuring. But such incentives are required not only to attract the best graduates into teaching generally, but also to ensure that they are using their specialist knowledge most appropriately – a quarter of the physics graduates who do enter teaching end up teaching maths instead of physics. It has been suggested that they are put off becoming science teachers as it will mean offering chemistry and biology as well as their own subject.

If the requirement to teach other sciences besides physics deters physics graduates from teaching physics, it may be more useful for the subject to be decoupled from the other sciences and, if anything, be taught together with maths – this would also encourage greater recruitment of engineering graduates into physics teaching, providing a greater pool of talent from which to draw teachers.

The Institute has recommended that in addition to schools making every reasonable effort to employ enough physics teachers to ensure that all of their students can be taught by a specialist at GCSE level and above, they should also deploy those teachers appropriately. One way this requirement could be introduced is by making it

impossible for a school to get a top grade at their Ofsted inspection without having a specialist physics teacher.

Curiously, given the dramatic shortage, many physics graduates are rejected from teacher-training. The way in which the admissions system is set up makes it difficult to understand why this happens, but it is clearly something that needs urgent attention.

IOP'S ROLE

Given that for the foreseeable future much physics teaching up to GCSE will be carried out by non-specialists, the Institute is also working to improve those teachers' subject-knowledge, confidence and 'pedagogical content knowledge' – the specific ability to teach the subject of physics. The Stimulating Physics Network, managed by IOP in partnership with the Science Learning Centres and funded by the Department for Education, works with non-specialist teachers to deepen their knowledge of physics and skill at physics teaching and restoring the culture of physics. The initiative provides teachers with a programme of workshops, activities and continuing professional development that is intended to be inspiring, coherent and sustainable.

The Network operates by offering every secondary school in England support from a team of physics network coordinators. Meanwhile, in more than 250 targeted schools, a network of teaching-and-learning coaches provides support to whole departments, working in schools to help their non-specialist teachers be more effective. Support will include discussions of, for example, common difficulties that children have with tasks such as wiring up an electrical circuit, typical

misunderstandings that they might have, or explanations of phenomena that are often used by non-specialists but which are incorrect.

And the programme works, too: the pilot project from 2006–09, which ran in 30 English schools, saw an increase of 30% in the number of secondary-school children going on to study A-level physics. Participation in A-level physics among children from those schools went from 4% below the national average to 14% above it. There was also a dramatic increase in the number of students studying triple science.

Further work relates to the Institute's recommendation of more, and better, mentoring for new teachers. Since 2004, the Institute has offered mentoring to those taking six-month, pre-PGCE, subject-knowledge courses, continuing into their first two years working as a teacher. The assignment of a mentor, along with phone and email support and attendance at conferences, are intended to enhance the teacher's professional network. Surveys of those that have taken part in the scheme have shown that they believe it to be beneficial to both the teacher and the school, which can help address the high drop-out rate that has aggravated the shortage of recruited teachers.

To try to attract more physicists into the teaching profession, the Institute has developed a marketing model, based around specific events at

universities. These are in partnership with university physics departments, and the Institute is working with the Royal Academy of Engineering and others to include engineering departments.

Students who express an interest in becoming teachers can sign up to receive frequent updates of news relevant to teacher-training. At the time of writing, this year's events have identified more than 300 prospective teachers.

Although we believe that IOP's activities have helped to reverse the decline in the number of physics teachers and ensure better teaching from non-specialists, further support will be required from Government to remove the shortfall completely. It's important that it is.

WHY PHYSICS TEACHING MATTERS

Benjamin Franklin described education as "the investment with the greatest returns". This is particularly applicable to physics, which underpins so much of science, engineering and medicine. It is crucial for the future of UK science, and therefore the country's economy, that this shortage of physics teachers be resolved. Physics punches well above its weight in the economy, with physics-based businesses accounting for almost half of all manufacturing jobs in 2008 as well as supporting more than £50bn of gross value added in the UK as a whole and £8bn in Scotland alone – figures

comparable to the finance or construction industries.

Similarly, the UK's science base depends on actually having the scientists to do the work, and they all need someone to teach them. With fewer of them around to make the subject seem intuitive and logical, fewer students go on to study physics at 16-19 level or at university. As well as affecting the number of physics graduates coming through the pipeline and into research and academia, potentially harming the UK's standing in the international science community, it also exacerbates the very problem that caused it by reducing further the number of potential physics teachers.

So while the largest batch of new physics teachers for 30 years is certainly an occasion worth celebrating, there is still work to be done.

Naturally, the shortage of physics teachers has strong local variations. In Blackpool in 2008, for example, the constituency's eight schools only sent five students on to do physics A-level – all of them boys. With the greater autonomy of schools in the future, it is important that those schools recognise the importance of having a specialist physics teacher. By keeping aware of who is teaching physics in their constituencies, MPs can play a key role in ensuring that the next generation of physicists receive the best possible education.

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