IOP Institute of Physics

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Trends in physics education

A summary by the Institute of Physics

A record year for teacher recruitment

In September 2010, the Institute of Physics (IOP) calculated that 1,000 new physics teachers needed to be recruited every year for 15 consecutive years in order to overcome the devastating shortage of specialist physics teachers in English schools.

In 2010, however, only 590 would-be physics teachers began their teacher training course on their path to Qualified Teacher Status and parity between the sciences in school science departments seemed as distant as ever. Only 19% of the science teaching workforce were specialist physics teachers.

Often, biologists and chemists with little knowledge or even enthusiasm for physics are left to carry the torch for physics in schools across the country. In 2010, at least 500 schools in England had no specialist physics teacher.

At a time when businesses are demanding greater scientific literacy from incoming generations of potential employees, students are being denied their entitlement to a good physics education from a suitably qualified physics teacher.

As Professor Peter Main, director of education and science at the IOP, explains: "When the subject 'science' was introduced to school timetables in 1989, it replaced biology, chemistry and physics. Physics lost its identity and a massive decline in the workforce was masked by the recruitment of 'science' teachers, who were predominantly biologists.

"We are only now starting to turn the situation around and bring physics back to the fore."

Positive effects

While there is no magic bullet to remedy the chronic shortage of physics teachers, the situation is starting to improve as steps have been taken by both the IOP and the Department for Education (DFE). The actions taken are starting to have positive effects and drive teacher recruitment numbers up.

Indeed, in 2011, we enjoyed a record year of teacher recruitment with a total of 889 new trainee physics teachers, either starting their PGCE or embarking on an employment-based route into teaching (see table, right), and, in 2012 all indicators suggest that we are going to see an increase on 2011's numbers with at least 900 entering training.

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What's changed? One significant development occurred in February 2011 when the Secretary of State for Education, Michael Gove, instructed the Training and Development Agency for Schools (now the Teaching Agency) to allocate a separate specific target for the recruitment of physics teachers.

In previous years there had been only one overall allocation for the training of "science" teachers and this led to sustained recruitment of disproportionate numbers of biologists and chemists over physicists, and allowed the shortage of physics teachers to perpetuate.

The new allocation for physics teacher recruitment – a target of 925 new trainee physics teachers each year – fired the starting gun.

Following the target's introduction in the 2010–11 academic year, 2011–12 saw other important developments. The introduction of "Physics with Maths" teacher training courses at more than 30 training centres is now catering for would-be physics teachers who might have been deterred from teaching by the prospect of having to teach either chemistry or biology. To physicists and engineers, maths is far more familiar territory.

In addition, the DFE and the IOP formed a partnership to offer 100 IOP Teacher Training Scholarships – worth £20,000 each – to attract the best graduates to become physics teachers.

Following a successful year of running a rigorous selection process to award the scholarships to suitable candidates, 115 of this year's trainee physics teachers will be IOP Scholars. Having been assessed by the IOP for both subject knowledge and teaching aptitude, there is confidence that the inaugural scholars will bring a burst of physics excellence to science departments across England.

Physics excellence

There is still a long way to go before physics can boast a healthy teaching workforce. The problem has been compounded in recent years by 15% of potential teachers not making it to the end of their training course and, of those that complete their training, half leave the teaching profession within four-and-a-half years.

As Chris Shepherd, the IOP's teacher support manager, has said, the current state of teacher recruitment is "like a bath with the plug out and the taps only half on".

However, through the enhancement of IOP-facilitated networks, comprising peer groups of physics teachers, it is believed that teachers in training and those in their first few years will benefit from the support and mentoring that has previously been scarce or non-existent and be encouraged to remain in the profession.

Number of students entering a teacher training course for physics

Year	PGCE	Other routes into teaching*	Total
2009–10	518	72	590
2010–11	581	92	673
2011–12	709	180	889

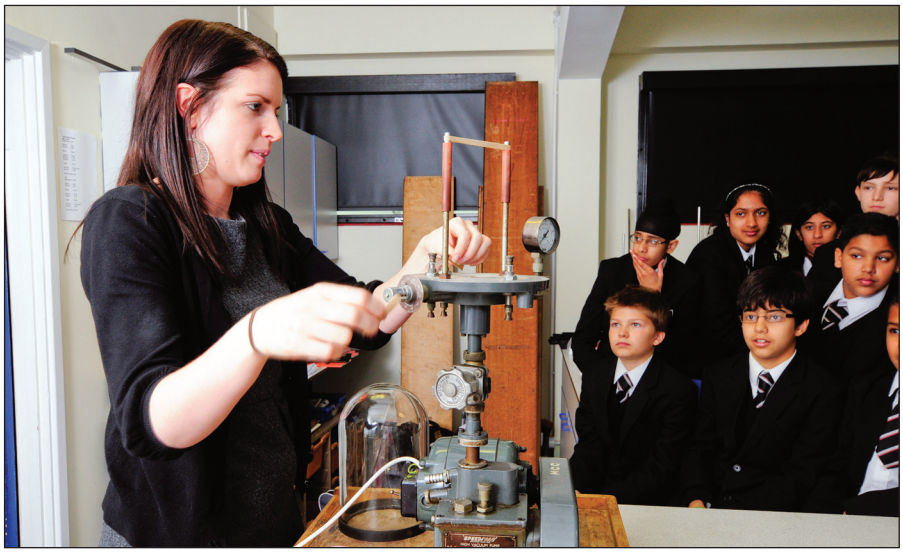
*School-Centred Initial Teacher Training, Employment-Based Initial Teacher Training, undergraduate degrees in education and those attending non-HESA higher education institutions.

Successful steps already taken

Recognising that the teacher shortage will take more than a decade to rectify, steps have been taken to improve the situation now to ensure that past mistakes result in as few students as possible being deprived of a good physics education.

One successful solution has been the introduction of a dedicated national network of expert physics teachers. The Stimulating Physics Network (SPN) works with non-specialist teachers of physics to equip them with the know-how, confidence and enthusiasm necessary to become inspirational teachers.

Government-funded, and run in partnership with the National Network of Science Learning Centres, SPN's partner schools are already reporting very significant increases in uptake of physics at AS and A-level.



A survey of SPN's 276 partner schools (which comprises just under a tenth of all state schools in England) indicates that there has been a 30% increase in uptake of AS level physics over the past few years in these schools.

The numbers of AS and A-levels entered by students across the country provide an important measure for the health of physics in schools across England.

Until 2006, the number of students choosing to study physics at A-level had been declining for more than a decade. For the sixth consecutive year, however, we have now seen steady increases in participation (see table below).

As Professor Sir Peter Knight, president of the IOP, commented, placing these developments into wider context after 2011's A-level results were announced: "The incremental increases each year have led to a significant long-term trend. Over the last five years, the number of A-level exams taken across all subjects has risen 7.7% but the growth in the number entering for physics is far stronger – a 19.6% increase."

Popular culture – from the "Brian Cox effect" to the prominence of physics during, for example, 2012's Paralympics opening ceremony – plays an important part in raising the profile of physics, but it is the work of teachers, translating nascent enthusiasm into A-level results, that has delivered the change that continues apace.

The statistics from SPN's partner schools show that a significant proportion of 2012's increase in AS physics entrants is due to the work undertaken by them to improve the provision of physics by non-specialists.

Although every student is entitled to be taught physics by a qualified physics teacher, the in-house, bespoke training that SPN offers to non-specialists recognises that, for the foreseeable future, much physics teaching will be done by non-specialists.

After class...

If A-levels offer the first opportunity to drop or continue studying physics, degree choice is the next stopping point.

As with A-levels, the past few years have seen a significant increase in the number of students applying to study physics at university. In 2012, there was an 8.3% increase in applications to physics courses. This is in stark contrast to the 8.7% decline in university applications to all courses across the UK.

An important factor in this development has been wide public acknowledgement of the value of a physics degree. As Prof. Main describes: "The lifetime value of a degree in physics is enormous. The subject knowledge gained on the degree is, of course, fascinating but also leaves the graduate with computing skills, a high level of sophistication in mathematics, analytical and problem-solving skills, and the ability to grasp and apply complex ideas."

Similar sentiments are shared with the business community, who bemoan a lack of suitably qualified people. A recent survey of the Confederation of British Industry's membership stated that 42% of firms struggle to find the scientific, technological, engineering or mathematical talent that they require.

At a time when students are well aware of how perilous the job market is, physics is increasingly recognised as a positive and exciting degree choice.

A gender divide

However, while we see improvements in schools and at degree level, a very significant hurdle still remains across both stages of education – the problem of the shortage of girls in physics.

The stark under-representation of girls in physics remains a significant and persistent concern. In 2012, 27,148 boys entered for physics A-level (making physics the third most popular subject among boys); however, only 7,361 girls chose to study physics (making physics the 19th most popular subject among girls) (see table, left).

As Charles Tracy, head of education pre-19 at the IOP, says: "Many very able, potential female physicists are being denied opportunities because of discouraging stereotypes and anachronistic assumptions about physics."

Recognising that the gender difference remains a significant obstacle to ensuring all students receive their entitlement to a solid education in physics, the IOP will be publishing further findings on the issue of girls in physics in the autumn and making recommendations on how this persistent problem might be addressed.

Number of students entered to physics A-level

A-level	2007	2008	2009	2010	2011	2012
Total	27,466	28,096	29,436	30,976	32,860	34,509
Girls	6,109	6,155	6,538	6,668	6,849	7,361
Boys	21,357	21,941	22,898	24,308	26,011	27,148
Girl/Boy ratio	22.2%/ 77.8%	21.9%/ 78.1%	22.2%/ 77.8%	21.5%/ 78.5%	20.8%/ 79.2%	21.3%/ 78.7%