IOP Institute of Physics

The future of higher education in England

Institute of Physics response to an IPPR call for evidence

A full list of the Institute's submissions to consultations and inquiries can be viewed at www.iop.org

28 September 2012

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Annika Olsen
Commission on the Future of Higher Education Secretariat
IPPR
4th Floor
14 Buckingham Street
London WC2N 6DF

IOP Institute of Physics

Dear Ms Olsen,

The future of higher education in England

The Institute of Physics is a leading scientific society promoting physics and bringing physicists together for the benefit of all. It has a worldwide membership of around 40,000 comprising physicists from all sectors, as well as those with an interest in physics. It works to advance physics research, application and education; and engages with policy makers and the public to develop awareness and understanding of physics. Its publishing company, IOP Publishing, is a world leader in professional scientific communications.

The Institute is pleased to submit its views to inform the Institute of Public Policy and Research's inquiry into the future of higher education in England. The attached annex details our response to the questions listed in the call for evidence.

If you need any further information on the points raised, please do not hesitate to contact me.

Yours sincerely,

Professor Peter Main
Director, Education and Science

IOP Institute of Physics

The future of higher education in England

How should our HE sector be organised to achieve the best outcomes for individuals, institutions and society?

1. From our perspective, the HE sector needs to produce adequate numbers of well-trained STEM graduates, particularly physicists. Physics in its totality contributes enormously to our economic and social prosperity and the provision of resources to maintain existing physics courses is vital. Access to the study of physics courses should be irrespective of the ability to pay, and barriers that limit the opportunities to study physics, particularly for students from lower socio-economic groups and those constrained in their choice of where to study, need to be removed.

2. At present, only 36 English HEIs have physics departments offering undergraduate provision in the subject, which is a relatively small amount when taking into account the number of HEIs across England (131 according to Universities UK). This means that there are large areas in England where potential students and industry have no convenient access to a local physics department. As the proportion of students living at home increases, and as industry becomes more dependent upon high-tech knowledge, these regions will suffer from a lack of proximity to university physics. The government and the HE sector, rightly, are keen to increase the number of women, ethnic minorities, and lower socio-economic classes in STEM subjects; among these groups there is a greater likelihood of students choosing to live at home.

3. The reason for the limited number of physics departments is due to funding, as between the early 1990s to the high profile closure of the last major physics department at the University of Reading in 2006, many physics departments disappeared due to either merger or closure. A number of factors contributed to these closures, not least the abolition of the binary divide, which led to a change of mission for many of the former polytechnics plunging them into direct competition with the more research-led universities. The subsequent introduction of the Research Assessment Exercise then sounded the death knell for many of these departments, which had the effect of reducing the number of physics departments that had a strong applied bias, such as Brunel, Bradford, Aston, etc. Another major factor that was instrumental in causing closures was the general decrease in the unit of teaching resource in the 1990s. Contrary to popular belief, the number of entrants to physics degrees had not altered greatly around that time. However, the fall in the unit of resource encouraged the larger, more popular departments to take increasing numbers of students, squeezing the smaller ones, making many of them financially unviable.

4. However, due to recent increases in the uptake of accepted applicants to physics degrees, some HEIs are in the process of reintroducing physics programmes of a more applied nature, which is something to be encouraged and welcomed.

5. Historically, not every HEI in England has had a tradition of offering physics provision, and nor do we wish to impose such a position. But those that were forced to close, due to external factors beyond their control especially in the 'deserts', where

possible, should be encouraged and supported to reintroduce courses, especially in the current financial climate, where in the medium- to long-term, the nation will rely upon a diverse pool of well-trained physics graduates to help re-balance the economy.

6. In addition, there is an inextricable link between undergraduate teaching and research. Policies adopted by the research councils are likely to have the effect of concentrating research which would lead to serious problems in teaching. There is a 'broad' breadth of research quality throughout the UK, and the research councils should seek to fund the best quality projects across all departments on a fair, open and equitable basis without applying minimum mass considerations. Critical mass can be appropriate to some large international collaborative projects, but it is not appropriate to much theoretical and applied laboratory-based physics research which can be both excellent in its own domain and which underpins undergraduate education and provides mutually beneficial links with industry. The possibility of condensing research into a smaller number of universities has important repercussions for teaching; if the number of universities undertaking leading-edge research is reduced, how will the demand for undergraduate teaching be satisfied? The financial models for supporting teaching within a physics department should not be dependent on research income. Undergraduates, particularly in the their final years, should be taught by research-active staff and this requires a diversity of research funding support, including access to project funding, across a range of universities. The supply of graduates needs to be sustained by provision across the HE sector.

7. Another issue relating to finances is how well the UK continues to recruit overseas students, many of whom are a significant source of teaching income for undergraduate and postgraduate courses. Concerns relating to the Bologna Process have never truly been addressed (i.e. many UK STEM graduates will not be seen to be competitive with their mainland European counterparts thus their career opportunities outside of the UK could be restricted), and now with tighter entry requirements, the future offers much doubt and uncertainty for certain parts of the sector. In addition, it is not clear whether the government is sufficiently concerned that EU students could cease to come to UK universities, and our HEIs will no doubt suffer when overseas students head for the Netherlands, Germany and Italy where BSc degrees taught in English are increasingly available, at up to €8,000 rather than £9,000 tuition fees and in many cases where the local living costs are significantly lower.

To what extent should the overall structure of higher education be determined by market forces and to what extent should government play a strategic role?

8. Any system that relies entirely on student-led 'market forces' runs a risk of perverse outcomes and a mismatch between graduates and the job market, where market forces have the potential to either lower standards or concentrate students in larger HEIs.

9. The HE reforms implemented from the 2012/13 academic year have been justified on the grounds of market forces, where university income, primarily tuition fees, will follow student choices. Whilst students have the free will to choose a degree that matches their interests and abilities, the notion that undertaking any degree will enable them to secure gainful employment has more or less proven to be false. It is

hard to understand a market that is driven solely by the choices of students who have little or no information about career prospects and employers' needs.

10. Indeed, the policy target to have 50% of 18-30 year olds in HE by 2010 had a negative impact on the sector. Even though this policy led to an increase in participation levels, it did so in degree courses unable to equip students with the necessary skills to compete in a highly competitive job market.

11. As a consequence, HEFCE had to allocate a larger proportion of its teaching funding grant to HEIs that run such courses. This resulted in high-cost STEM subjects such as physics, whose undergraduate numbers have been steadily increasing in absolute numbers, but decreasing in proportion to the total cohort of undergraduates, being underfunded in the teaching funding resource in the previous funding model. In the new funding regime, direct student funding will make this more of a problem.

12. Thus, it is imperative that university departments receive the full costs associated with teaching resource-intensive subjects, such as physics, in the new HE funding regime. However, we are concerned that the new regime will make it more attractive for HEIs to attract more students in the arts and humanities than in STEM subjects; charging £9,000 tuition fees, an HEI will make a 'profit' on every arts and humanities student but will arguably lose money on every STEM student. The government has stated that it will monitor the impact the HE reforms will have on the take-up of high-cost subjects, but it is not at all clear how it will intervene if certain courses and departments struggle to attract sufficient student numbers; indeed, as has been widely reported, the new regime has led to a reduction in the number of undergraduates entering HE, so far, mainly due to changes in student number controls which we discuss in subsequent paragraphs.

13. The teaching of most STEM subjects, such as physics, is expensive compared with the arts and humanities, because of the need to impart practical laboratory-based skills that require adequate floor space, consumables, often expensive modern equipment, and dedicated technical staff to support the laboratory programme. It is important that HEFCE provides adequate funding, in addition to tuition fees, covering the entire cost of teaching high-cost subjects. Sufficient capital funding must also be available from HEFCE to invest in teaching facilities and laboratories to ensure that they provide an experience that prepares and encourages students to enter the modern research and industry environment.

14. Furthermore, for the 2012/13 academic year, the government allocated 65,000 places for students achieving AAB grades or above at A-level or equivalent (here termed AAB+ equivalent), along with 20,000 places to HEIs whose average charge is at or below £7,500 (following waivers). (In the 2013/14 academic year, it has been announced that the removal of the student number controls will be broadened to include students with grades at ABB or above and equivalent qualifications.)

15. The core quotas for HEIs were lowered according to the existing numbers of students achieving the AAB+ equivalent, following which an HEI can freely recruit as many students at this level as it is able to attract. In addition, as it is understood, the 20,000 places allocated to HEIs whose average charge is at or below £7,500 were made available by reducing the core quota (i.e. the non-AAB+ equivalent quota), which will benefit HEIs 'lower down' in the sector that do not have the capacity to teach laboratory-based subjects, nor will have the ambition to do so, as fees of £7,500 will not be sufficient to teach subjects such as physics.

16. The implication of this policy is that middle-ranked HEIs will struggle to offer provision in STEM courses, and it is these HEIs that have a critical role to play in achieving the widening participation agenda.

How can we fund an expanded HE sector in a way that is fair to graduates, universities and the taxpayer?

17. It is essential that there is a system of charging that is not financially disadvantageous to those who study subjects like medicine, engineering and the laboratory-based sciences such as physics. In addition, for subjects like physics, chemistry and engineering a significant fraction of the undergraduate cohort is enrolled on four-year courses, so further financial pressures exist.

18. Looking back at the introduction of variable tuition fees, despite concerns at the time, as far as we can tell, the introduction of the reforms in 2006 did not appear to have had any adverse effect on either applications or entry to physics undergraduate degree courses. In fact, the number of students admitted to physics (and astronomy) degree courses in England, according to UCAS figures, had risen each year from 2006 (2216) to 2008 (2597). This reflects the general pattern of undergraduate enrolments by English HEIs between 2005-06 and 2007-08. In addition, the participation rates for different groups of students (i.e. state schools/colleges; lower socio-economic; low participation neighbourhoods; black and minority ethnic, etc.) also appeared to change very little as a result of those financial reforms.

19. The major drawback of that system was, as mentioned in response to the previous question, an artefact of then government policy to increase the number of students in the HE sector, which led to HEFCE invariably spreading its funding too thinly; more students opted for arts and humanities subjects which are cheaper to teach than subjects such as physics.

20. The IOP will shortly be launching a new report, “Gravitating towards physics: How will higher fees affect the choices of prospective physics students”, which shows that while higher fees in the new HE regime are unlikely to have a significant impact on the overall number of applicants choosing to study physics, they are quite likely to have a disproportionately negative impact on people from ‘non-traditional’ physics backgrounds, such as women, those from ethnic minority backgrounds and lower socio-economic groups. This situation is something that the IOP will closely monitor.

What role can higher education play in promoting a rebalanced economy across England and safeguarding our position in the global economy?

21. Science and innovation have a key role to play in providing a much needed boost to the UK’s economy: science with its ability to attract the brightest students into HE which will lead to highly skilled graduates that make significant contributions to many sectors within the UK’s economy; academics who will undertake internationally leading research, which is the foundation for new discoveries and applications; and innovation, which is the ability to transform great ideas and concepts into products and services, creating jobs, and contributing to the nation’s GDP. All of this stems from the HE sector, which helps to produce trained graduates in strategically important subjects, such as physics.

22. A report shortly to be published by the IOP, “Physics and the UK economy”, reveals that physics-trained people and physics knowledge can be found having an impact across a large number of economic sectors across the UK, which includes manufacturing which is the largest sector. Beyond manufacturing, physicists can be found working in engineering and related technical consultancy services, the oil and gas sector, and on numerous other technical activities.

23. In addition, a report published by the Science Council has revealed that 20% of the UK’s workforce – 5.8 million people – is dependent upon scientific skills in order to do their jobs, and that this is projected to rise to 7.1 million people by 2030. In addition, the Confederation of British Industry, based on a survey of employers, has reported that there is growing demand for STEM skills, particularly in the low carbon, and digital media sectors, but employers report some difficulty in hiring such staff. This message has been echoed in the report “Employability Skills Review”, published by the National HE STEM Programme, of which the IOP is a partner organisation, where it was stated that:

“*The hi-tech, science and IT sectors are all reporting difficulties in recruiting STEM graduates and predicting even greater difficulty in future years. These employers rate STEM graduates highly, not only for their technical competency but also because of the analytical, problem-solving, numeracy and intellectual rigour skills that they bring with them.”*

24. One important factor in increasing applications to STEM subjects has been the increased emphasis given to STEM by successive governments, beginning in 2006 with the then chancellor’s statements regarding the importance of STEM graduates to the economy. Statements such as these from senior government ministers in reports and public statements, especially in the current financial climate, can only help potential students to consider a STEM subject at university, which will lead to an increased pool of graduate talent which will help satisfy the demands of employers and help to rebuild the economy.

What role should higher education play in providing skills for the job market?

25. The HE sector has its role to play, but one should not be too specific about the needs and requirements of the business sector which can change quickly in response to certain developments. Thus, it is more important to develop key skills at the HE level, something which most companies do accept and for them to take personal responsibility for training on the specifics.

26. Perhaps the greatest contribution that physics departments make to the UK’s economy is the annual production of highly skilled physics graduates that are employed in many nationally important areas, including the IT sector, financial analysis, engineering, environmental science, energy technology, intellectual property law and medical physics. Physics departments train numerate people who are experts at problem solving; the ability to produce detailed, analytic and numerical descriptions of both simple and complex systems is a skill that has a wide range of applications. This ability runs beyond mathematics; it embodies notions of how things work, why things work and predicting how they will work under different conditions. These abstract problem solving skills are also coupled with very real understanding

of technologically useful systems such as materials, electronics and mechanics, so there are clear, direct benefits to engineering and industry.

27. The current MPhys/MSci and BSc degrees produce high-quality mathematically-competent graduates who are eagerly sought by employers, who value the following attributes of physics graduates:

- flexibility and versatility to tackle a wide range of technical and non-technical subjects;
- good analytical and problem-solving skills;
- good mathematical and IT skills;
- a good breadth of technical interest and ability;
- a good understanding of fundamentals from which to approach new situations where traditional approaches do not work;
- analytical problem-solving capabilities;
- an ability to grasp concepts quickly and in a quantitative way (more important than knowledge of a particular specialism); and
- an ability ‘to argue on one’s feet’.

28. This list, essentially, sums up the range of transferable and softer skills that employers demand from physics graduates in addition to the technical skills acquired from physics degrees; on the issue of course content, a disconnect exists between the demands of the job market, i.e. employers, and HEIs, which set the course content and train and teach undergraduates. The HE sector produces people with good skills in communication, mathematics, IT, problem solving, and teamwork. But a narrow training base will produce useful people in the very short term only, and one should resist the temptation to concentrate HE on training in current technology as opposed to more general skills in strategically important areas such as physics.

What contribution should HE make to improving social mobility and building a more just nation?

29. HE is often criticised for being narrow, particularly in socio-economic terms. For many subjects, sciences, mathematics and the modern foreign languages, specific knowledge and skills are required on entry to courses and potential alone on its own is not enough. If the schools and colleges only supply people with these specific qualifications from the higher socio-economic classes it is difficult for the HEIs to do much about it. The solution is not to admit students that cannot cope or to lower standards in order to accommodate them, but to address such issues at the school level, with HEIs playing their role in terms of outreach activities. In addition, league tables have perverse outcomes, in the sense that HEIs are rated in terms of their A-level entry points and low drop-out rates, both of which encourages them to play safe with traditional entrants.

30. In terms of what the HE could do to improve social mobility, one train of thought is that technological advancements in the online delivery of HE courses could make it more possible for more people to study for an undergraduate degree. Of course, there will be resource and time issues which will still act as a barrier for some, but technology has the potential to democratise the HE sector and address the delivery and access issues that prevent those from disadvantaged backgrounds embarking on HE study. However, what is important in terms of online delivery is having

adequate support systems and networks in place that allow students to progress at a sufficient rate allowing them to benefit from remote learning.

Does HE have a role to play in shaping our national culture and strengthening ties of common citizenship?

31. No comment.

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