IOP Institute of Physics

New Horizons: responding to the challenges of the 21st century

Institute of Physics response to the Interim Report of the Joint Future Thinking Taskforce on Universities

A full list of the Institute's responses and submissions to consultations can be found at http://www.iop.org

2 September 2008

2 September 2008

Higher Education and Learners Support Division
Enterprise, Transport and Lifelong Learning Department
Europa Building
450 Argyle Street
Glasgow
G2 8LG

IOP Institute of Physics

Dear Sir/Madam

The Interim Report of the Joint Future Thinking Taskforce on Universities

The Institute of Physics is a scientific membership organisation devoted to increasing the understanding and application of physics. It has an extensive worldwide membership (currently over 34,000) and is a leading communicator of physics with all audiences from specialists through government to the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

The Institute welcomes the opportunity to respond to the Interim Report of the Joint Future Thinking Taskforce on Universities.

The attached annex highlights the key issues of concern to the Institute.

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

Yours faithfully

Alison McLure
National Officer (Scotland)

IOP Institute of Physics

A response to the Interim Report of the *Joint Future Thinking Taskforce on Universities*

Research

A key priority for optimising the Scottish university sector should be to ensure that Scotland remains one of the best places in the world for science, research and innovation. This priority ties in with the Scottish Government's National Outcome for research and innovation[1]. One proven method of achieving excellence in research and innovation is to encourage and finance collaboration between university research groups, such as the successful Scottish Universities Physics Alliance (SUPA). SUPA should continue to be supported with sufficient funding to carry out its excellent work.

Knowledge Transfer

The Institute agrees that knowledge transfer is very important to the successful delivery of a knowledge-led, science-based economy, alongside a vibrant science base which is well funded. Science research in higher education institutions has recently been the subject of a range of reviews including the RCUK report on Economic Impact[2]. Lord Sainsbury's Review[3] follows a similar line to that of RCUK's, suggesting that funding should be readily available for research which is going to have early economic impact. While it is important that the economic impact of science research can be considered during funding applications, there is a danger that basic research in more speculative areas could be neglected.

Applications of 'curiosity-driven' research are difficult to foresee, but can see huge benefits in the long term. There is no shortage of examples illustrating the significant contributions that have been made to the UK's economy by fundamental research in physics. In terms of innovation, physics is more likely to produce new paradigms, whilst engineers are more likely to perfect existing ones. A combination of the two approaches is clearly vital to wealth creation in any developed economy.

One aspect of physics is often the time taken between the essential breakthrough in the science and the application. It is not so long ago that the laser was dismissed as a physicist's toy and not many people thought that atomic clocks would lead to the ability to navigate to within a metre at any point on the Earth's surface. The following examples help to illustrate how fundamental research feeds technology, the vast majority of which is physics based:

<u>Fibre optics</u>: In 1870, the physicist John Tyndall demonstrated that light follows the curve of a stream of water pouring from a container. This simple principle led to the study and development of the application of fibre optics, which over the last 50 years have had many uses in communication, medical imaging, traffic management, television and CCTV. Today, researchers at Heriot-Watt University are using fibre-optic technology enabling optical measurements to be made in real engineering

---

1 http://openscotland.gov.uk/About/scotPerforms/outcomes/research

2 Excellence with Impact. (2007) RCUK http://www.rcuk.ac.uk/cmsweb/downloads/rcuk/economicimpact/excellenceimpact.pdf

3 The Race to the Top, A Review of Government's Science and Innovation Policies. (2007) Lord Sainsbury of Turville. http://www.hm-treasury.gov.uk/independent_reviews/sainsbury_review/sainsbury_index.cfm

environments, providing shape, vibration, velocity and acoustic measurements for applications in industry and mechanical engineering research.

LCD technology: Research that made LCDs possible was undertaken by interdisciplinary teams in the UK, including physicists and organic chemists, based in government research laboratories, universities and industry. Highlights include the first stable room temperature liquid crystal material, and two independent device developments (the amorphous silicon thin-film transistor and the supertwist display) which allowed LCDs to make the transition from simple displays for watches and calculators into complex displays for mobile phones, computer monitors and TVs. They have resulted in substantial revenue to the UK through sales of materials and royalty income from device patents.

Medical Resonance Imaging: The ability of MRI scanners to produce images of the human body is due to a fundamental property of nuclei: that they respond to magnetic fields. Isidor Rabi first observed the phenomenon in the 1940s in work that won him a Nobel Prize for Physics. In the 1970s, Sir Peter Mansfield working at the department of physics at University of Nottingham, carried out research to develop rapid imaging techniques, allowing different types of tissue to be distinguished, leading to detailed images of organs such as the brain and the ability to distinguish between healthy and cancerous tissue.

It is important to achieve a balance between early economic impact research and curiosity-driven research. This was also one of the conclusions from the Report on the Consultation of the Science and Innovation Strategy for Scotland[4].

Teaching and learning

In terms of teaching and learning at universities, the reason education at the higher education level is better than training is because the primary need is for flexible people with good skills in communication, mathematics, IT, problem solving, and teamwork. Every effort should be made to improve these already high standards. One should resist the temptation to concentrate higher education on training in current technology as opposed to more general skills. There needs to be a balance between developing the individual learner and producing workers for the economy.

The Institute agrees with the report's assertion that the higher education sector should develop more flexibility in its teaching programmes in order to accommodate the changing demography of learners. In particular, there is likely to be more demand for part-time learning, as mature students return to education. Allowing entrance and exit points at different SCQF levels is welcomed by the Institute. Degrees with progression routes and emphasis on graduate skills are also welcomed, particularly in terms of increasing participation in higher education. We are aware that there is a shortage of qualified technicians in the university sector and industry, and more flexibility could help to increase supply. However, in a sector where all those who attend university aspire to become honours graduates, the marketing of SCQF levels to attract sufficient numbers of students presents a challenge. Further to this, we note that flexible qualifications will only succeed if there is an employment market.

The Institute agrees with the Joint Future Thinking Taskforce that universities should continue to combine teaching and research. As an example, physics is a dynamic subject that continually develops into new areas. It is difficult to imagine how undergraduate teaching could maintain contact with these advances unless a

---

[4] Science and Innovation Strategy for Scotland. Report on the Consultation. (2007). The Scottish Government. http://www.scotland.gov.uk/Resource/Doc/981/0052726.doc

substantial fraction of the people who taught them were active in research. The Institute believes that teaching and research are intertwined and there is a danger of undermining the quality of physics education if changes in the higher education system lead to significant number of universities teaching physics in a teaching only environment.

Funding

The Institute does not favour a funding system that in any way discourages students from families of modest means participating in higher education if they have the ability to benefit from it. The Institute is in favour of grants for poorer students.

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

Also, laboratory-based sciences are intensive in both teaching staff and laboratory facilities, and require the greatest injection of funds in order to provide adequate infrastructure. As industry's demands for graduates with a high degree of technical knowledge and expertise increases, it is incumbent upon universities to have modern instruments and equipment. Allowing for increasingly rapid depreciation, the cost of providing modern equipment has risen at a faster rate than inflation. Funding for these subjects should take these factors into account.

Strategically important and vulnerable subjects

The strategically important and vulnerable subjects (SIVs), such as physics, should be monitored to evaluate undergraduate trends across all subjects. This would provide data to support measures to encourage students to take such subjects.

In the Institute's experience, personal incentives, such as grants and bursaries to students, are of limited influence. A better strategy would be to give extra UCAS points for strategically important and vulnerable subjects. Also, more funding could be allocated to schools and colleges that recruit into SIVs, and to incentivise universities to increase undergraduate numbers. *Stimulating Physics* is a new project set up by the Institute in England, following a £1.8m award from the Higher Education Funding Council for England in March 2006. The project aims to increase participation and broaden the pool of entrants to physics-based courses in higher education. This is a model which has been successful in England and should be followed in Scotland to ensure that SIVs maintain a sufficient supply of entrants.

The Institute is pleased to note that from 2007-08, the Scottish Funding Council[5] has decided to remove the limit in recruiting full-time undergraduate students in science, engineering, computing and mathematics subjects, which will allow universities flexibility to meet demand for SIVs.

Funding decisions should take into account the contribution to the economy from graduates of the subjects. For example, while physics looks like an expensive subject to teach, the return on the government's investment is much higher for the UK economy but this is not reflected in university funding.

---

[5] http://www.sfc.ac.uk/news/sfc/2007/sfcpr0507/sfcpr0507.html

The Institute and the Royal Society of Chemistry published the report, *The economic benefits of higher education qualifications*, in January 2005[6], which revealed that physics and chemistry graduates in the UK earn more than graduates from most other disciplines. According to the report commissioned from PricewaterhouseCoopers, a graduate in physics or chemistry earns between £185,000-190,000 (compared with the average of £129,000) more during their career than someone with A-levels but no degree, whereas history and English graduates earn only £89,000-92,000 more. The report also demonstrated that physics and chemistry graduates pay approximately £135,000 more in tax than those with A-levels and £40,000 more than the average graduate during their working lives.

The report also assessed the costs associated with undertaking a degree, trading them off against the economic benefits. It concluded that the individual rate of return to the average degree holder is about 12% per annum. This compares with an individual rate of return for graduates in physics and chemistry of 15% per annum.

International perspectives
The *Second International Review: International Perceptions of UK Research in physics and Astronomy*[7], undertaken by a panel of internationally renowned physicists and astronomers, drawn from many countries, highlighted that overseas postgraduate students should be seen as an investment to the UK. The UK is currently profiting less than other EU countries from attracting talent from beyond the EU at postgraduate level, due to the policy of charging higher fees to these students.

Summary
In summary, the Institute agrees with much of the content of the Interim Report of the Joint Futures Taskforce and hopes that the suggestions and ideas in this paper will contribute positively to the debate about the future of Scotland's universities.

[6] www.iop.org/activity/policy/Publications/file_4149.pdf
[7] see page 30, http://www.iop.org/activity/policy/Projects/International_Review/file_6364.pdf

The Institute of Physics is a scientific membership organisation devoted to increasing the understanding and application of physics. It has an extensive worldwide membership (currently over 34,000) and is a leading communicator of physics with all audiences from specialists through government to the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics

IOP Institute of Physics
76 Portland Place
London W1B 1NT

Tel: +44 (0) 20 7470 4800
Fax: +44 (0) 20 7470 4848
Email: physics@iop.org
Website: http://www.iop.org