THE ROYAL SOCIETY
CELEBRATING 350 YEARS

# A summary of 'A higher degree of concern'

**A report on the final phase of a project considering the future supply and demand for science, technology and mathematics graduates**

The Higher Education (HE) system underpins the UK's ability to do well as a nation. In the context of an increasingly competitive and inter-connected global economy, this means that HE must equip students individually with the knowledge, skills and aptitudes to hold their own with the best in the world. At the same time HE must provide the basis for a skilled workforce that meets the UK's needs quantitatively and qualitatively. This report highlights important recent trends in the teaching and research training functions of HE and steps we must take, urgently, to ensure that it delivers these requirements over the next decade.

Students are mobile, especially at graduate level. There is global competition to attract the best students onto masters and doctoral courses. The UK competes successfully: numbers of non-UK masters students at UK universities have nearly quadrupled in the last ten years and now account for over half of all masters students, while numbers of non-UK doctoral students have more than doubled. These non-UK students contribute hugely to the quality of the UK HE experience, and constitute a remarkable opportunity for long-lived UK influence.

In order to remain attractive in this market, the UK must align itself more closely to the Bologna vision, to which 46 European countries (including the UK) have now subscribed. Bologna sets an internationally recognised benchmark for HE qualifications. The UK cannot be perceived as offering something less. That means increasing the period of study from the start of first degree to completion of PhD from the current 6 or (more commonly) 7+ years to 8 years. This extended period is much needed also because of changes in standards at undergraduate entry and the increasing breadth required of successful PhDs.

For the 8-year approach to work, three things are vital. First, it must be implemented with sufficient flexibility to retain the advantages of the wide variety of degrees that we currently have at each level. Second, there must be an effective strategy at national level for funding the additional year or years. Third, the intermediate steps must meet the needs of the large majority of students who leave HE after an undergraduate or masters degree without proceeding to the doctorate.

Our detailed analysis of the statistics confirms a decline in numbers of UK students taking core science and engineering subjects at postgraduate levels. In order to avoid serious shortages of these vital skills, we urge both individual universities and central Government to encourage study in core STEM subjects at all levels, for example by the introduction of bursaries or reduced fees for students undertaking these courses and by promoting wider awareness of the career options that such courses open up.

**Policy document 03/08**
**January 2008**
**ISBN 978-0-85403-674-5**

**This report can be found at royalsociety.org**

## Introduction

The Higher Education (HE) system is the engine of the UK's efforts to generate, store and transmit knowledge. We see today that knowledge underpins all aspects of our national well-being. A healthy HE system is now a prerequisite for a healthy society. If we are to do well in the future, we must ensure that our HE system is fit and competitive in the more challenging circumstances that we will undoubtedly face then. So this report looks forward ten years and examines some of the steps we need to take now to secure the long-term fitness of our HE system.

This is the second of two reports on the future of higher education. Our first report, *A degree of concern?*, was published in 2006. It provided a detailed statistical analysis over a ten-year timeframe of what had been happening at first degree level. We documented outputs, highlighted the importance of putting UK developments in a European and global context, and stressed the need for flexibility and breadth throughout the HE system. We emphasised the need to see the formal HE process as a start to lifelong learning, equipping graduates with the skills to adapt and flourish in changing circumstances.

In this second report the focus is on postgraduates. We concentrate on the teaching and research training functions of universities – the education of those who will use the skills, knowledge and experience gained in both their working lives and their personal lives. We describe recent trends in numbers and course structures, engagement with employers' needs, and the significance of the increasing international dimension in UK HE. We examine where the HE system needs to be in ten years time, and identify important implications for current policy.

## Recent trends in postgraduate subject choices

The most immediately striking finding from our detailed statistical analysis is the impressive rate of growth over the past ten years in the number of stand-alone masters degrees[1] and doctorates awarded to students of any nationality: up by 133% (to 103,500) and 79% (to 16,000), respectively, between 1994/95 and 2004/05. The corresponding rate of growth for first degrees over this period is just 29%. For UK students only, the growth rates are more modest but still strong: 65% for masters degrees and 63% for doctorates (compared to 23% for first degrees). More and more UK students are staying on to further their studies, or are returning after a spell away from university. The traditional 3-year undergraduate degree is less and less a direct route to employment.

Of masters degrees taken by UK-domiciled students, the proportion in science subjects broadly interpreted has been constant over the last ten years at about 30% of the total. Science has thus generally held its own in the expansion of the masters sector. Within that, there has been spectacular growth in the biological sciences category (driven mainly by psychology, microbiology and sports science) and in subjects allied to medicine. The physical and mathematical sciences categories have grown at slightly below-average rates, and both chemistry and physics themselves have declined significantly. The engineering and technology category has been static, thus shrinking from 9.3% to 5.7% of the total.

At doctorate level, science has not held its own so well, dropping from 65% to 57% of degrees awarded to UK students. The disciplinary pattern is similar to that of masters degrees, with relative as well as absolute growth in biological sciences and subjects allied to medicine, some relative decline in mathematical and physical sciences, and engineering and technology again virtually static in absolute terms.

There is reason, then, to be concerned about the falling popularity of courses in some core sciences and in engineering and technology. Moreover, it would be rash to argue that even holding market share in comparison with ten years ago was enough. The future is going to need a more highly scientifically trained workforce. So we urge both individual universities and central Government to encourage study in core science subjects at all levels, for example by the introduction of bursaries or reduced fees for students undertaking these courses and by promoting wider awareness of the career options that such courses open up. The core subjects provide the essential foundation for later developments.

The financial and other hurdles associated with providing STEM courses have been extensively aired, as have the dangers of parts of the country being bereft of such courses and students unable to travel far thus being unable to study significant aspects of science. This could in turn have a significant impact on numbers of graduates staying on to take PGCE courses in STEM subjects, thus creating further pressures on STEM at school level within the region. We therefore welcome initiatives already being taken by individual institutions to collaborate regionally in the provision of key courses, and urge both institutions and Government to adopt an imaginative approach to facilitating such collaborations.

## Proposed changes in course structure

For students considering a career where a PhD is relevant, we strongly support the Bologna vision of an 8-year

[1] This does not include 4-year courses like the MMath or MPhys, which are classified as first degrees.

span from starting as an undergraduate to completing the PhD. There are several cogent reasons for this.

- Where Bologna sets the benchmark, students with only 6 or 7 years of university work behind them are likely to be disadvantaged in seeking postdoctoral positions.
- If shorter courses thus become less portable in the international market, it will become more difficult to attract overseas students to the UK.
- Changes in the background knowledge of students at entry to undergraduate courses mean that it can take them longer to reach the required standard.
- A longer masters phase can provide a very effective way of providing multidisciplinary skills and experience.
- A longer first degree or masters phase can also provide opportunity to carry out original research, either in anticipation of embarking on a PhD or to develop skills useful in other career trajectories.

There are several possible approaches to structuring the proposed 8 years. For example, the mainstream Bologna approach is 3:2:3, with a 3-year first degree followed by a 2-year masters and a 3-year doctorate. A 4:1:3 approach would retain the advantages of the 4-year integrated masters that is rapidly gaining ground within STEM subjects. It could also allow for broader first years and conversion courses for those with A levels not immediately suited to their desired degree subjects. The 1-year masters would then allow an element of specialisation as a prelude either to a PhD or to employment. A 4:4 approach would combine the integrated masters with a longer doctorate that could include a larger taught component or allow extra time for writing up. In advocating the 8-year cycle we strongly stress:

- the need for flexibility in the exact structure of the 8 years, so as to suit the circumstances of individual students, institutions and disciplines – the emphasis must be on the quality of the education provided and not just its duration;
- the prerequisite of effective funding mechanisms to cover the full 8 years, including both the costs incurred by the institution and the costs incurred by the student; and
- the importance of ensuring that the structure also meets the needs of those who will leave before the final, doctorate, stage.

It will be important to monitor the impact of changes in course structure on demand from both UK and non-UK students.

## The employer perspective

In recent years a tremendous emphasis has been placed on knowledge transfer between universities and businesses and on commercialising research. A matching emphasis needs to be placed on a collaborative approach to learning provision that ensures that businesses and other employers are engaged in curriculum development, course design and delivery.

While attempts to quantify future labour demands are unlikely to be fruitful, there would be value in carrying out a large-scale qualitative study of the changing demands of employers. This would enable us to understand what skills, knowledge and experience they seek in the STEM graduates they employ and how that is changing. What is already clear is that employers are increasingly working with the HE sector, for example by taking on students for practical experience and by sponsoring actual or potential employees through courses.

Postgraduate education and training designed or sponsored by employers meets a very real need and should be viewed as an integral part of the educational framework. These programmes offer benefits to all three parties involved: students, employers and universities. We recommend that any future official review of STEM HE should examine such education and training to help ensure its continuation. We believe there should be more emphasis on a collaborative approach to learning between universities and industrial researchers, matching the emphasis that has been placed on knowledge transfer and commercialisation of research.

## The international dimension: non-UK domiciled students studying in the UK

In proportional terms, the strongest driver for the growth in postgraduate degrees awarded is the influx into the UK of students from other parts of the EU and from outside the EU. By 2004/05 students from outside the UK accounted for 52% of all masters degrees awarded (up from 32% in 1994/95), and 39% of all doctorates (up from 33% in 1994/95). The proportion of all first degrees awarded to non-UK students, by contrast, was 11.8% in 2004/05 (up from 7.5% in 1994/95). At masters level, the rate of growth has been even stronger for non-EU students (from 9,200 to 40,400) than for other-EU students (from 5,100 to 13,600); at doctorate level it is the other-EU cohort that has grown most dramatically (from 600 to 2,100).

The subject choices of the non-UK students differ from those of UK students, though they show similar trends. Engineering and technology, and computer science, are particularly popular. The non-UK students make a major contribution to higher education in the UK. Their financial contribution is obvious, both to the university and to the

locality, and it is likely that in many instances they make a crucial difference to the viability of their courses. They also enrich the cultural experience of their colleagues. The fact that so many come to the UK for part of their education must serve to strengthen the UK's influence around the world. Those who work in research, especially those remaining in the UK for postdoctoral work, constitute an important element of the UK's total research effort.

One key policy issue is the extent to which the rapid growth of non-UK students in the past ten years can be sustained in the face of the increasing global competition for talent. The quality of the experience offered to the non-UK students – many of them paying high fees – will be a major factor. Both individual institutions and policy-makers at national level must review the extent to which the HE system currently depends on its non-UK students. They need to develop strategies both for maintaining the inflow and for adapting to the eventuality of the inflow slowing down. To inform strategy at the national level it will be important to collect clear data on what non-UK students do in the years after completion of their formal studies.

## Vision for the next decade

In ten years time, even more than now, the HE system needs to deliver in a context where there is increasing global competition for the best students, where we need a higher level of skill throughout the workforce, where the growing complexity of the employment market demands a corresponding diversity and flexibility in our approach to education, and where we will need a more scientifically literate citizenry. This has to be accomplished by a set of independent institutions supported by a mix of public and private funding. While we have made major investments in our HE system in the last ten years, many competitor countries have been investing even more rapidly in their own HE systems. The stakes get higher with each passing year.

And so do the opportunities. There are many signs of a population eager for knowledge. Increasing numbers at all levels of HE, particularly the increasing numbers engaging at the postgraduate stages, point to the possibility of continued expansion. We have to ensure that a sufficient proportion of these numbers is attracted into science.

The key is flexibility and a willingness to experiment. In order to flourish in the circumstances prevailing in ten years time, the HE system needs now to find ways of developing several trends already in evidence. In particular, universities and Government need to:

- encourage more students into HE and into science courses and work to impart the general scientific aptitudes that will be most useful in subsequent careers;
- develop the eight-year model for those intending to pursue careers in science, and ensure that it is properly funded so that neither universities nor potential students are discouraged;
- work more closely and imaginatively with employers at all stages of planning and delivering learning opportunities;
- recognise the range of benefits that non-UK students can provide and take steps to ensure that the UK remains effective in the international competition for mobile talent.

Higher education must remain a high political priority with strong, visible Government support. The UK has to go on demonstrating that it is really committed not just to maintaining but to improving its track record. HE is globally recognised as something in which the UK excels. We must work energetically and imaginatively to ensure that we remain at the forefront internationally if the UK is to do well in the coming decade.

This is a summary of a report which considers the future supply and demand for science, technology and mathematics graduates. This report is the second and final phase of the project, chaired by Professor Judith Howard FRS.

Copies of the report can be obtained from:
Science Policy Section, The Royal Society,
6–9 Carlton House Terrace, London, SW1Y 5AG.
Tel: +44 (0)20 7451 2500
Email: science.policy@royalsociety.org
The full report is available on the Royal Society's website at royalsociety.org.
Issued January 2008 RS1070