

Higher Education in Science, Technology, Engineering and Mathematics (STEM) subjects

Report: published 24 July 2012

“The Government in their Plan for Growth attach great importance to education and hi-tech industry in order to create jobs and prosperity. The jobs of the future will increasingly require people with the capabilities and skills that a STEM education provides. However, there appears to be a mismatch between the STEM graduates and postgraduates that higher education institutes (HEIs) supply and the demand from employers, both in terms of the number of students and the skills and knowledge they acquire.”

In December 2011, The House of Lords Science and Technology Sub-Committee, under the chairmanship of Lord Willis of Knaresborough, opened an inquiry into higher education in STEM subjects (science, technology, engineering and mathematics). **Lord Broers**, one of EPC’s Patrons sits on the Committee and another, **Professor Dame Julia King** was quoted in the report. **The EPC’s written evidence was cited 11 times (see Appendix) in the final report** which was published on 24 July 2012.

The recommendations have been summarised here, together with some recommended actions for EPC. It is also worth emphasising that the report highlights specifically the currently unquantifiable risks arising from the recent HE reforms on postgraduate provision in STEM subjects, together with the damaging impact of the immigration reforms and urges Government to heed the concerns of employers, HEIs and the professional bodies. These are both issues on which EPC has lobbied hard.

Recommendations	Issues for EPC
1. The Government should work together with HESA, the Research Councils, HEIs and professional bodies to formulate and apply a standard definition of STEM. The definition should derive from a statement of the competencies and skills that a STEM graduate should possess and the characteristics that a STEM course should contain, including direct STEM content.	To engage with HESA in ensuring that all engineering programmes are included.
2. The number of students taking maths post-16 is insufficient to meet the level of numeracy needed and often fails to meet the requirements for studying STEM subjects at undergraduate level. As part of their National Curriculum review, it is recommended that the Government make studying maths in some form compulsory for all students post-16, appropriate to the programmes they want to study at higher level e.g. prospective engineering students would require mechanics as part of their post-16 maths. It is recommended also that maths to A2 level should be a requirement for students intending to study STEM subjects in HE.	We will be feeding this in to the consultation (currently live)
3. HEIs are urged to engage fully to smooth the transition from school to HE, particularly in maths and to work with Schools to establish where the skills gaps are and which areas of the maths syllabus are essential for STEM undergraduate study. Work expected to be completed by July 2014. The report supports the recommendation by the House of Commons Education Committee that there should be a single comprehensive national syllabus, accredited by Ofqual, to offset the risk that competing examination boards will tend to drive down standards and says that the proposed national subject committees will be critical to the success of the new scheme. The Committee seeks assurance that the HEIs would have a significant role within the committees and that the committees would be given the capacity to be fully effective in ensuring that standards, particularly at A2, are maintained.	We will be feeding this in to the consultation (currently live)
4. The Education Committee recommended that the Government should pilot a national syllabus in one large entry subject as part of the forthcoming A level reforms. This report recommends that maths should	We will be feeding this in to the consultation (currently live)

be the subject of such a pilot.	
5. The Government should increase its efforts to boost specialist STEM teacher recruitment and should assess which existing initiatives have yielded positive results and which have not worked, so that resources can be concentrated on those schemes that produce the best outcomes.	N/A
6. The Government should direct the new National Careers Service to ensure that appropriate advice is given to young people about the following: STEM subject choice at school and its possible consequences for future study and careers; the choices available within STEM subjects at HE level and beyond and the advantages of pursuing a STEM degree; and, relevant careers advice that highlights the jobs available to STEM graduates both within STEM and in other industries. In order to make STEM careers and subject choices more accessible to students, parents and teachers, the Government is encouraged to use new technologies by, for example, commissioning a STEM careers App.	Do we have members who have developed anything useful in this regard with their Careers Services for example which could be highlighted?
7. Schools should ensure that support for careers education through continuing professional development (CPD) is provided to those offering careers advice to students.	N/A
8. The lack, or low level, of maths requirements for admission to HEIs, particularly for programmes in STEM subjects, acts as a disincentive for students to take maths and high level maths at A level. We urge HEIs to introduce more demanding maths requirements at entry for STEM courses. It is also recommended that HEIs should work together to ensure that entry requirements for the same course are consistent across different HEIs.	Not sure we would necessarily support this given the diversity of the sector
9. The lack of reliable data on the supply and demand for STEM graduates and postgraduates makes it very difficult to assess whether there is a shortage of STEM graduates and postgraduates, and in which sectors. More needs to be done to identify areas of shortage so that remedial action can be taken and to enable students to make informed choices about whether the courses they are considering will equip them with the skills needed by employers. The Government should appoint a single body (or amalgamates the efforts of existing bodies such as HESA, UCAS, UKCES, CIHE, the Higher Education Careers Services Unit (HECSU) or the new National Centre for Universities and Business) to be a repository of relevant information currently collected by different agencies on the supply and demand for STEM graduates with a view to providing comprehensive, real time data analysis and a commentary with market intelligence of where STEM shortages exist, broken down by sector. This body should provide yearly updates to HEFCE, Government and other stakeholders on skills shortages so that remedial action could be taken to protect, or grow, those STEM areas which are needed to support economic growth and where market failure means that supply does not meet demand. All these data should be accessible to all stakeholders in order, amongst other things, to inform student choice.	Monitor
10. The same body should also be responsible for holding, monitoring and analysing data for postgraduate education, including the employment of qualifiers from postgraduate courses on an ongoing basis—disaggregated into PhD, research Masters and taught Masters, and by subject areas. HEIs are urged to contribute to the provision of data to this body by putting in place a robust, long-term tracking system for postgraduate provision and destination data.	Lobby for the extension of DLHE, otherwise the different methodologies put in place by different HEIs (as well as the cost) will be problematic.
11. The Government should commission a study to find out the first destination of STEM graduates with a first degree (by degree class) as well as postgraduates. The study should also attempt to find out the reasons that lie behind students' career choices. This information would help to	Again – lobby for extension of DLHE to meet this need.

<p>explain what makes STEM graduates and postgraduates choose non-STEM jobs and allow STEM employers to take action to attract the best and brightest into STEM careers, particularly research.</p>	
<p>12. Given the significant number of students choosing to study “softer” science courses, HEFCE and HEIs should collaborate in conducting a study into the career progression of students of new STEM courses (such as some sports science and forensic science courses) to enable those undertaking these courses to decide whether they are being equipped with the skills graduates need to succeed in the STEM job market.</p>	<p>EPC to extend work on employability of engineering graduates to examine this?</p>
<p>13. It appears that SIVS policy has had a positive impact on STEM and the report recommends that the Government should therefore continue to support the initiative. There are concerns that the recent HE reforms may erode STEM provision in favour of “cheaper” subjects. The SIVS policy is an important tool to help counteract that. The new approach to SIVS proposed by HEFCE is to be welcomed in that it will allow other subjects, such as computer science, to be offered support if they are deemed vulnerable. It is recommended that the body in charge of collecting and analysing data should, by providing evidence and analysis to HEFCE and the Government, contribute to the process of establishing which subjects should be given SIVS status.</p>	<p>EPC to develop evidence base?</p>
<p>14. While HEFCE has a legitimate role in determining which subjects are vulnerable and should be supported as part of the SIVS programme, the report recommends that the Government should decide which subjects are strategic and should therefore be given SIVS status. The Government’s decision could be included in the Secretary of State’s annual letter to HEFCE.</p>	<p>EPC to work with EC and RAEng to establish a definition of “strategic”?</p>
<p>15. It is clear that STEM postgraduates are valued and in demand amongst employers, and that they play a significant role in driving innovation, undertaking research and development, and providing leadership and entrepreneurship. It appears to us that, although the Government recognise the central role that STEM plays in their strategy for growth, they fail to articulate how they intend to highlight to students the benefits of postgraduate study, to reduce the decline in STEM qualifiers in some STEM subjects, or to improve our understanding about the demand for postgraduates and the value they offer to the economy. They also fail to make clear what support they will give to postgraduate STEM provision in order to realise their vision. It is therefore recommended that the Government set up an expert group to consider the supply and demand of STEM postgraduate provision in the UK and to identify weaknesses and areas of skills shortage. The Government, as the strategic leader, should agree the terms of reference of this group with a view to formulating a strategy for STEM postgraduate education in the UK which will underpin their strategies for growth. As part of the expert group, employers are urged to spell out their needs to Government and to identify skills shortages at STEM postgraduate level.</p>	<p>EPC to put forward a representative for this Committee</p>
<p>16. The Government’s response to the Higher Education White Paper consultation stated that they will “not at this stage be seeking to introduce changes to primary legislation” but they would move their reform agenda forward “primarily through non-legislative means”. It is not clear if Parliament will be given the opportunity to scrutinise the proposed changes to quality assurance and HEFCE’s power. It is recommended that the Government clarify in their response to this report what opportunity Parliament will be given to scrutinise further the proposed changes to quality assurance, as set out in the Higher Education White Paper. The Government should also set out a</p>	<p>N/A</p>

<p>timetable for when the changes will take place and outline the form they will take.</p>	
<p>17. Given the skills gaps that exist in key areas across the graduate pool, the QAA has a long way to go in ensuring that industry is sufficiently involved in setting standards and benchmarks. It is recommended that the QAA should do more to recruit employers, SMEs in particular, to engage with HEIs and take part in setting QAA standards and benchmark statements. The QAA should be in a position to report back on how it plans take this recommendation forward by July 2013.</p>	<p>N/A</p>
<p>18. Further, the remit of the QAA should be reviewed with a view to introducing a system to assure quality, standards and benchmarks in HEIs that is fit for purpose. This should include the development (and achievement) of objectives for the inclusion of employers in the setting of standards and benchmarks, and a yearly list of thematic problem areas, accompanied by an action plan, where consistent skills gaps occur.</p>	<p>N/A</p>
<p>19. The Research Councils should monitor the impact of embedding Roberts' Money into the standard funding mechanisms.</p>	<p>Monitor</p>
<p>20. HEFCE is urged to take steps to ensure that the REF does not act as a disincentive to HEIs to promote quality in teaching and it is recommended that the number of lecturers that have received teacher training during the course of their careers should be set out in the Key Information Set (KIS), along with information about the training received. HEIs are urged to offer an accredited course on teaching which all academic staff would be required to complete.</p>	<p>EPC to poll members on promotion criteria to review weight attached to teaching quality across different parts of sector.</p>
<p>21. Student assessment of staff performance and teaching quality should be applied across all HEIs. HEIs should have a robust system in place for assessing the quality of teaching including an anonymised and standardised assessment by students. The anonymised results of such assessments should be published in the KIS at a departmental level. QAA should be charged with reviewing whether HEIs have appropriate systems in place to achieve this and that the assessment of teaching quality is fit for purpose.</p>	<p>As part of same survey, EPC to poll members on whether and how anonymised student feedback is used in performance management and promotion criteria.</p>
<p>22. The KIS is a good starting point to help to ensure that students have the information they need to make an informed decision about their courses. However, the value of some of the information offered is not clear or sufficient to enable a student to make an informed choice about the quality of provision delivered by their course. The Government should ensure that the information provided in the KIS gives students the information they need to make an informed choice about the quality of their course. KIS should contain more detailed information on destination data beyond six months, as well as career paths; other measures of quality (including teaching); and more information on outcomes (that is, the skills that students will acquire during their studies). A similar KIS should also be available to postgraduate students with equivalent information on postgraduate provision.</p>	<p>Need to have evidence on use and robustness of KIS for UG courses first...</p>
<p>23. Given the limitations on the role that the QAA plays in sign-posting high quality provision, the report states that accreditation of courses by professional bodies would "be a sensible way forward". Accreditation may not be possible for courses in areas where there are no professional bodies. However, for those that have professional bodies and do not already have an accreditation scheme, they should consider setting up such a scheme. Rather than kite-marking individually hundreds of courses a better approach might be to involve industry through the accrediting bodies and for companies to state whether they supported the</p>	<p>Monitor</p>

accreditation. Given the tension between accreditation and kite-marking, the Government is invited to explain the aim of kite-marking and what it is expected to achieve beyond that which accreditation by professional bodies already provides.	
24. It is recommended that professional bodies, such as the Institute of Physics or the Institute of Mechanical Engineers, should make further efforts to provide accreditation of different STEM subject areas to ensure that students have confidence in the quality of their chosen course and that they will achieve high quality outcomes in terms of skills and knowledge. For those courses where there is less of a clear link with a profession, it is recommended that the Science Council consider whether it would be possible to develop a broader system of accreditation to ensure that graduates have the core skill set required of a STEM graduate. It is further recommended that the Government should provide support for such activities in the early stages of development until they are fully established.	Re-examine and potentially re-highlight our output standards
25. Government, employers and HEIs should find a way to incentivise employers, particularly SMEs, to offer more work placements, and encourage more students to take them up.	Do we have any good examples of best practice we can share amongst our members?
26. In order to assist HEIs in engaging with employers and in securing placements for their undergraduate and postgraduate students, the establishment of a central database is recommended to post opportunities for placements for undergraduates and postgraduates. Government should extend the remit of the Graduate Talent Pool service to include undergraduates and postgraduate placement opportunities.	N/A – other than to promote with membership should it come to fruition. If it doesn't, is this something we could do as a collaborative project across the membership?
27. The expert group established to look at postgraduate provision should examine how the quality of postgraduate teaching provision is assessed to ensure quality and consistency of approach across funding bodies, and consider how measures of quality of postgraduate education that go beyond research excellence might be developed. In particular, Research Councils and other postgraduate funding bodies are urged to expand the quality principles that underpin the DTC model to other types of postgraduate funding provision.	See recommendation 15.
28. Government should encourage the Research Councils to preserve a variety of PhD delivery models to ensure that the UK's current breadth of expertise in science is maintained and that new areas of science are able to grow. It is also recommended that the expert group set up to consider the supply and demand for STEM postgraduate provision considers whether the current provision of funding for doctoral study across funding bodies is sufficient to cover the breadth of excellent research across the UK.	See recommendation 15.
29. The recent adjustments to the core and margin system may allay some of the concerns about the effect of the HE reforms on STEM provision. However, Government is urged to explain in its reply to this report on what evidence this change of policy was based and the timescale in which it was implemented. HEFCE should publish the quantitative evidence on which they base their funding model for public subsidies of STEM subjects with a view to reassuring stakeholders that these subsidies in conjunction with students' fees are sufficient to cover the cost of STEM provision. It is too early to assess the impact of HE reforms on the sector. Government is urged to have particular regard to the effect of the reforms on STEM provision and to ensure that HEFCE will have the necessary resources to intervene in appropriate circumstances.	Monitor.
30. Changes to the immigration rules may reduce the number of overseas	Monitor.

<p>students coming to study to the UK and, therefore, the income that HEIs derive from these students to support other activities. This may result in a general reduction of provision of STEM courses that rely on this income to make them viable. The Government have replaced the PSW route with more selective arrangements under Tier 2, notably making a job offer paying more than £20,000 a year a requirement for a visa. The UK Border Agency (UKBA) told us that the limit was set following guidance from the Migration Advisory Committee. It is not, however, clear if this guidance was intended specifically for graduates. The Migration Advisory Committee is asked to reconsider its advice and to monitor the impact of the changes on both the number of graduates who stay on to work in the UK and on the number who decide not to study here, due to the real or perceived barriers created by the closure of the PSW route.</p>	
<p>31. HE is a global market and the UK has to compete with other countries that are positioning themselves to attract international students. The perception that the UK does not welcome students may be having a detrimental effect on recruitment from some countries. The UK must be seen to welcome the brightest and the best and the Government is urged to increase efforts to dispel perceptions that the UK does not welcome students by sending out a more positive message through the UKBA website, immigration agencies and the British Council.</p>	<p>Monitor.</p>
<p>32. The lack of reliable statistical data is a concern because the Government is not able to identify problems with its visa system soon enough to put in place a mitigation plan. Data from HESA is more accurate but by the time it is published it is 18 months out of date. This problem is particularly acute for the HEIs. It is therefore recommended that the Government working with HEIs, as a matter of urgency, make further efforts to co-ordinate data collection and ensure that data is shared between UKBA and HEIs. In addition, the Government should collect real-time data on the effects of changes to immigration policies in HEIs with a view to setting up a mitigation plan, if necessary, and to enable policy decisions to be based on the latest information. This should be achieved by September 2014.</p>	<p>Monitor and ensure information is analysed and circulated amongst membership.</p>
<p>33. Given the significant contribution that overseas students make to the economy and that the majority leave the UK following their studies and do not therefore contribute significantly to net migration, the Government should make a distinction in the immigration statistics between HE students and other immigrants and uses only the latter category to calculate net migration for policy-making purposes.</p>	<p>Monitor and ensure information is analysed and circulated amongst membership.</p>

EPC evidence referenced 11 times

1. In addition to the skills gap at the school-HEI interface, we also received evidence that graduates were often found to lack the numeracy skills needed to succeed in the workplace...(p.15)
2. A number of Vice-Chancellors told us that not only had their HEIs had to offer remedial maths to those who had not taken A level maths,³⁴ but such courses were also needed for students who had performed well at A level maths. (p.18)
3. The Engineering Professors' Council also warned that "it will be important to ensure that funds provided for SIVS and STEM initiatives are not used for other purposes. STEM subjects generally need more funding than many others—despite typical student fees being the same for all subjects". (p. 37)
4. As a result, the Research Councils created a specific funding stream (Roberts' Money) of over £120 million between 2003–11173 to address these issues in all research disciplines. The Roberts' Money was used to fund new training schemes or activities aimed at improving the employability skills of postgraduate students. A number of submissions were supportive of the scheme and the impact it has had on improving the employability skills of postgraduates. (p. 48)
5. There is considerable debate about the relationship between teaching and research.¹⁸⁸ We recognise that research is an important factor in determining the quality of provision within STEM when students wish to go on to conduct their own research, but we agree with HEA that it should not be the only factor. HEA said that "we are seeing a rebalancing" of promotions criteria away from research and towards recognition of good teaching. However, we received little evidence of this rebalancing. From 2014, it is proposed that data on the professional accreditation of teaching staff, which is collected by HESA, could be used to trigger an out-of-cycle review by the QAA if the numbers were considered to be lower than the average.¹⁸⁹ Whilst welcoming this development, it is not, in our view, enough. (p.50)
6. Alternative mechanisms for exposing students to the work environment need to be explored. The businesses to which we spoke emphasised the benefits of building better relationships and collaborations between HEIs and employers as a way of encouraging employers to take part. The Royal Society and the Wilson Review made similar points. We are aware, however, that this issue is a particular challenging for SMEs. Semta noted that "whilst the majority of large companies in the sector actively engage with universities, provide placements and employ undergraduates, graduate and postgraduates, this is not the case for the majority of SMEs who make up 99% of the sector. The problem for SMEs is one of perception in terms of barriers: e.g. relevance of HE engagement to an SME; value and return on investment by SMEs in recruiting a graduate; resources to support an undergraduate, work placement, internship, graduate training and post-graduate support". They were currently looking at mechanisms to encourage SMEs to engage. (p.59)
7. There are also other forms of high quality doctoral provision²⁴⁹ ABPI told us, for example, that DTCs are valued by employers and by the students who undertake PhDs through them because they provide a critical mass of students who learn from each other and benefit from access to different disciplines in a general area of science and technology.²⁵⁰ The Engineering and Physical Sciences Research Council (EPSRC) mid-term review of their DTCs concluded that the DTC approach was an effective way of training a cohort of students, and leveraging substantial industrial funding. RCUK noted that the Economic and Social Research Council (ESRC) centres have provided clear evidence that they can deliver the highest quality training provision. (p.61)
8. There is concern, therefore, that DTCs will have a negative impact on the breadth of research that takes place outside of the centres, given that PhD students are often involved in new areas of research through project studentships on grants. (p.63)
9. It has been suggested that DTCs should be just one element of PhD provision, because there are high quality PhDs in universities that do not have DTCs (those, for example, funded through CASE Studentships). (p.63)
10. Within the discipline of engineering, where the UK is particularly reliant on overseas students, Professor Wark said that 40% of their students were non-EEA students and that if they were to lose them "it would have a severe impact on our ability to perform research that keeps Imperial College as a world-leading institution".³¹¹ In 2009–10, 34% of engineering first degree qualifiers and 64% of engineering postgraduate qualifiers were from overseas (including other EU countries).(p.70)
11. The Engineering Professors' Council told us that "almost all engineering departments in the UK would be running at a loss if it were not for overseas students' fees",³¹³ and that, in a poll they had conducted, 16 out of 27 HEIs reported a reduction in overseas applications to Masters courses. (p.70).