THE ROYAL SOCIETY

Review of Post-18 Education and Funding
Department for Education
20 Great Smith St
Westminster
London
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Re: Review of Post-18 Education and Funding

The Royal Society welcomes the Government's commitment to review Post-18 Education and Funding. All young people should have access to, and be aware of their opportunities within, the post-18 education sector. This will be vital for the UK to deliver the skills needed to achieve the ambitions set out in the Government's Industrial Strategy ambitions.

The demand for science, technology, engineering, and mathematics (STEM) skills, and for competency in mathematics, computing, data analysis and machine learning in particular, is growing, and the nation's economy depends on its delivery. At the same time, young people will have to respond to continuous change and a broad curriculum, encompassing this knowledge and skills set, will enable them to do so.
We have identified four main principles that are required to equip the next generations with the skills that will be required for the future:

- Post-18 education choices cannot be considered in isolation when addressing the skills gap; it will be essential to attract and retain pupil's interest in STEM subjects from primary school onwards, to develop new qualifications to engage students at later stages, and to support life-long learning.
- Signalling and career advice must be established at all levels of education to allow young people to understand where their education pathway can take them.
- Quality technical education and advanced and higher apprenticeships must be offered, and valued, alongside traditional academic routes.
- Barriers must be removed to enable people from all regions, ethnicities, socio-economic statuses and genders to enter post-18 education routes.

Detailed comments on these principles can be found in the supporting appendix.

Appendix

1. Introduction

1.1 The UK has significant skills gaps, and UK industry has consistently identified lack of STEM skills as the biggest barrier preventing scale-up. Skills that are particularly in demand include:

- **Computing skills.** The current digital revolution has significant implications for the computing skills that today's young people will require.[1]
- **Data skills.** As many as 58,000 data science jobs are being created each year in the UK and demand is outstripping supply.[2]
- **Mathematics and quantitative skills.** Mathematics has been demonstrated to be one of the best ways to improve computational and data skills.[3]
- **Machine-learning skills.** Advanced machine-learning skills are in increasing demand in this rapidly developing area. New mechanisms are needed to increase the pool of people who have advanced machine learning skills.[4]

1.2 Young people will need to develop a broad skill set including creative, communication, scientific, quantitative and digital skills, in order to respond well to the continuous change they are likely to experience throughout their careers.

1.3 Post-18 education choices will be influenced by previous decisions. It is important that efforts to increase post-18 education in the areas mentioned in 1.1 go hand in hand with efforts to improve the progression of pupils in these areas at earlier stages of their education.

- The development of rigorous new post-16 courses and qualifications in STEM to engage students who are studying non-STEM subjects at school or who are training in the workplace, are needed, ensuring these meet the changing needs of employers.
- Post-16 vocational and technical education and training is central to meeting the demand in the future UK workforce for STEM qualified people. However, the status of vocational education should be raised to meet its potential.

2. Making choices in the post-18 education and training sector

2.1 Schools should provide high quality advice about career options, and ensure pupils have experience in prospective work places, to help students make informed decisions on their post-18 education. It is important to consider that in order to make decisions on their education, young people consider the most useful sources of careers information to be family, followed by careers advisers and teachers.[5]

- Increasing parents' understanding of how STEM offers many and varied employment opportunities for their children should be prioritised by the Department of Education.
- In a report by the Wellcome Trust, that presents findings from the 2016 Science Education Tracker, a third of young people indicated that they had not received career advice from their

[1] The Royal Society 2017 *After the reboot: computing education in UK schools.*

[2] The Royal Society 2017 *Response to Building our Industrial Strategy Green Paper.*

[3] https://royalsociety.org/topics-policy/education-skills/mathematics-education/

[4] The Royal Society 2017 *Machine learning: the power and promise of computers that learn by example.*

[5] The Royal Society 2014 *Vision for science and mathematics education.*

school or college.[6] A decrease in this fraction would be a measurable indicator of success for the Government's new careers strategy.

- A third of the UK science workforce is non-graduate, and by 2020 the UK will need approximately 450,000 new STEM technicians.[7] In order to meet this demand teachers and careers advisers should raise awareness of the range of vocational options in STEM.

2.2 The Higher Education sector has a role to play in providing parents, schools, teachers and careers advisers with guidance on the value of STEM options. For example, the role that employers and universities play in signalling the value of studying mathematics requires urgent action and we look forward to working with the Department for Education and the British Academy to explore how the right messages from these sectors can encourage young people to study and excel in mathematics.

2.3 There are now more PhD students in the UK than at any time in the past, of whom only a small fraction are likely to pursue traditional academic careers. Higher Education Institutions must be supported in the provision of careers information, advice and guidance to graduates. The Royal Society has developed a document on 'Doctoral students' career expectations'[8] to this end.

3. Delivering the skills our country needs

3.1 Course provision according to needs

3.1.1 An increasing proportion of graduates will need quantitative, data and computational skills, and education and training course provision should reflect this. For example, several measures can be taken to increase provision of machine-learning skills[9]:

- Government, mathematics and computing communities, businesses, and education professionals should help ensure that relevant insights into machine learning are built into current education curricula.
- In the short term, the most effective mechanism to support a strong pipeline of practitioners is likely to be government support for (advanced) courses in machine learning.
- In considering the allocation of additional PhD places and new fellowships across subject areas, as announced in the Spring 2017 Budget, machine learning should be considered a priority area for investment.

3.1.2 The Department may wish to consider how Higher Education Institutions' accountability measures support or hinder a more responsive approach to course design. Other features of the system that may inhibit the Higher Education sector being responsive to changes in demand for STEM courses may include limitations on laboratories, and participation post-16 STEM education as mentioned in 1.3.

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[6] Wellcome Trust 2017 *Young people's views on science education.* London: Wellcome Trust, The Royal Society, Department for Business, Energy & Industrial Strategy

[7] Royal Academy of Engineering 2012 *Jobs and growth: the importance of engineering skills in the economy.*

[8] https://royalsociety.org/~/media/policy/projects/doctoral-students/doctoral-students-career-expectations-principles-responsibilities.pdf

[9] *Op. cit.* note 4

3.2 Offering diverse career routes

3.2.1 Quality technical education, alongside traditional academic routes, is essential to ensure that people have the skills required in our changing economy.

3.2.2 The Department should ensure that employers and educators provide advice on the mathematical and computational skills components of the new technical education pathways in England.

3.2.3 To ensure skills exchange between industry, academia and the public sector, movement of people and ideas should be stimulated. The Royal Society is now carrying out work to look at the landscape and dynamics of data scientists as they move between roles and sectors, which is expected to give more insights into skills exchange in data science. We would welcome discussion with the Department about this project and its implications for individuals, organisations and skills needs.

3.2.4 Ongoing educational opportunities to support lifelong learning and career development will become increasingly important in a changing work environment.

3.2.5 Efforts should be undertaken to engage people in STEM at later career stages. Various career paths can lead to becoming a scientist, and to this end the Royal Society has a video series available: 'I wasn't always a scientist'[10], that reveals the stories of scientists who did not take traditional routes into their scientific careers.

3.3 Attracting international talent: To remain a world-leading destination for science, research and business, the UK needs to invest in its own workforce while continuing to attract the best international talent.

3.4 Higher education that is accessible to all. Removing the barriers to accessing STEM and computing education faced by disadvantaged and underrepresented groups will be essential to meet the skills needs of the UK economy. It should be possible for every student to access post-18 education independent of gender, ethnicity, location and socio-economic status.

- Lack of gender diversity is a longstanding issue in STEM disciplines. In a report by the Wellcome Trust, that presents findings from the 2016 Science Education Tracker, one in ten students agreed science-related careers are 'more suited to men than women'.[11] In order to meet the current and future skills needs in computing, the Government, employers and schools must prioritise changing the gender balance.
- Regional differences in provision of pre-18 education will impact on post-18 participation. To deliver an industrial strategy that champions science and innovation throughout the UK, we need to ensure that young people in all areas of the country have the same opportunities to pursue STEM and computing education.
- Existing research on pupils' attainment in science has shown lower participation and attainment of pupils with lower socio-economic status. New policies have been introduced to widen participation, but these did not proportionally increase the participation of students from lower SES backgrounds in school science. In the Royal Society and EEF's *Review of SES and Science Learning in Formal Educational Settings*, a number of promising educational approaches were revealed to support low-SES students' progression. Schools taking forward these kind of approaches could increase STEM participation post-18, and we await the result of the Wellcome Trust and EEF's Improving Science Education projects with interest.[12]

[10] https://royalsociety.org/topics-policy/diversity-in-science/i-wasnt-always-a-scientist/

[11] *Op. cit.* note 6

[12] The EEF and the Royal Society 2017 *Review of SES and Science Learning in Formal Educational Settings.*