Scottish Science Advisory Council (SSAC) response to the Scottish Government's
STEM Education and Training Strategy for Scotland

January 2017

In November 2016, the Scottish Government published its draft *STEM Education and Training Strategy for Scotland* for consultation, outlining its future plans for the subjects and the steps to be taken to encourage uptake of the specialist skills necessary to work in the STEM sectors of the economy. Views were sought from all those with an interest in the promotion of STEM on how they think STEM skills and education could be improved and developed. Shirley-Anne Somerville, the Minister for Further, Higher Education and Science, asked the SSAC to contribute.

The SSAC provided the following response.

Consultation Question – Definition

1. **Do you agree with the definition provided of STEM for the purposes of this Strategy?**

    a. The definition of 'Science' seems a bit convoluted and couched in terms of 'interest and understanding….'. It does not convey the axiom of the scientific process, which is to collect and structure data and knowledge about the natural world - producing explanations that are testable and predictions that can be made and tested. The scientific process is framed around 'testable hypotheses', which move forward as our knowledge advances. We can use that knowledge to innovate and it is this innovation that is key to the improvement of our economic performance and status as a leader in the knowledge economy. STEM is fundamental to that aspiration and delivery of it.

    b. The consultation is very focused on education and training in the STEM area: i.e. STEM as a vocation. It should also recognise the wider roles of STEM. For example, the UK now has close to 80% of the economy as service sector, for which various skills are required, including STEM-related. There are strengths and capabilities in other sectors, on which the growth of the Scottish Economy will also be critically dependent. By emphasising STEM skills more (rather than only STEM disciplines) – the impact of STEM will be wider. Maths (numeracy) and IT skills are highly relevant in many parts of social science, economics and other disciplines. Q-Step recognises the importance of these (quantitative) skills outside the classical STEM disciplines. This needs to be nurtured and supported. http://www.nuffieldfoundation.org/q-step-centres-and-affiliates

    c. While Digital Skills are important, does it warrant a separate section of STEM (now STEM + Digital Skills). The examples cited would seem to fall within the 'S' of STEM. Digital Skills are now seen as a universal requirement, within and outwith STEM. Perhaps it is worth emphasising the need for computing skills as a priority within the 'S' of STEM to better balance them with other skills requirements (e.g. see b).

Consultation Question – Aims and Priorities

2. **Do you think the aims of this Strategy and the four priority themes are the right ones to address the challenges identified?**

a. The aims are written with STEM employment in mind. However, knowledge and appreciation of STEM are important for the rest of the population too. All of Society needs to appreciate STEM, its role and issues. Future Society is going to have to take difficult decisions on STEM-related issues such as: healthcare in an aging population; genetic intervention at many levels. Our entire population needs to be 'STEM-savvy' to participate in these decisions in an informed way. A key aim should be informed citizens equipped to engage with STEM issues. Thus, it is important not to limit STEM aims to employment-related opportunities but address the identified problem with learners choosing not to take STEM subjects past primary school.

b. In priority theme 'Excellence', literacy and communication within STEM are as important as numeracy and digital skills. Perhaps they should be mentioned?

c. In priority theme 'Inspiration', and referring to (a), it important that STEM is disseminated to the entire population, including those who do not aspire to STEM-related employment. [STEM-informed societal choices]. 'Inspiration' should be a top priority and, as a result, innovation will ensue.

d. The fundamental wider issue to be addressed is providing Scottish students with the STEM skills and role models at all stages of their careers to develop the skills of the pipeline of well-informed talent to satisfy the needs of Scotland's future innovation economy. This argues for a joined up, collaborative approach across all sectors (HE, FE, industry, agencies…..), informed by the opportunities created by, and requirements, of Scotland's STEM R + D base

Consultation Question – Outcomes

3. **Are these success criteria right? If not, tell us what criteria we should use instead.**

a. Outcomes should be measurable. It's not clear how points 1 and 2 might be measured.

b. Point 3 - would it be better to phrase in terms of 'gender equality', rather than 'gender balance'?

Consultation Question – Scope

4. **Do you think the scope of the Strategy is right? Tell us if you think it should exclude something or include anything else. For example, should it include training and development that employers provide for their workforce?**

a. The text seems to exemplify just the extreme points of the scope from 'early years' (para 1) to vocational training at school or adult level (para 2). Perhaps the age group that is currently most critical to the STEM community is aged 8-13, where we know that young people's engagement and appetite for STEM wanes. Would this become a priority in the Strategy?

b. Training within a workforce is often bespoke and at a level of detail that is specific to that employer. For that reason is should not be included in this STEM appraisal –

which should be about knowledge and attributes that are transferrable across employment platforms.

  c. Broad public engagement in STEM is key for the future. How do we ensure a two-way dialogue between science and society?

Consultation Questions – Current actions

  5. Give us your views on whether you think the actions already underway across the sectors on STEM fit well with the Strategy and will contribute positively to it.

  a. The size of Appendix A pays testament to the substantial activity and its diversity that is already directed towards STEM. The activities fit and contribute but, perhaps, suboptimal impact is gained from the activities due to the ad hoc way that it has evolved. The challenge is to enhance impact from this resource.

  6. Tell us about activity currently ongoing – either included in this document or not – that you think could be adapted or stopped and why.

  a. Appendix A demonstrates that there is a substantial ongoing effort in STEM. However, it seems diffuse and not interconnected. If the time, money and enthusiasm could be gathered and operated on a more strategic way, there would be enormous benefit.

  b. The LUMA project in Finland is cited later in the document and is an excellent example to follow. STEM activity under LUMA is broad-reaching in its delivery – involving social media and discussion groups and even running to summer camps. Emulating such activity will require resource.

  c. Linking to Q4, there is an identified need to focus on the age 8-13 client group to capitalise on the earlier years and exploit their innate enthusiasm for STEM learning. It is at this point that many young learners lose their appetite for STEM. However the potential for a further loss of appetite after 13 should also be considered in addressing this need.

  d. UNESCO has an excellent website on Science and Gender. It hosts data, analysis and metrics.

Consultation Questions – Implementation

  7. Do you agree with the principles set out for implementation?

  a. The principles are good and the adoption of a KPI approach will ensure that targets can be set and that progress to achieving them can be quantified. The current House of Commons Science and Technology Select Committee inquiry on 'Closing the STEM Skills Gap' will, when it reports, provide useful input. The challenge in a Scottish landscape will be to review its recommendations in the context of the Scottish Education system. Responses from industry are being published and should be monitored to input in a Scottish context.

  8. What else should Government do to ensure a more coherent approach and maximise impact?

  a. SG should be continually challenging its own agencies for validated data that report progress in the delivery of enhanced performance. It also has the opportunity to

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incorporate this into external contracts that it places. At present, reporting of STEM activity is only in binary, whereas there will be increasing pressure to quantify impact in terms of value for money. Given the wider impact of STEM teaching and training and the long timescales for cultural change, reporting metrics and benchmarks will need to be smart.

Consultation Questions – Proposed Actions

9. **Overall, do you think this Strategy is clear and action focused? Do you think that the actions that we propose to take nationally will achieve the aims and intended outcomes?**

a. Subject benchmarks were promised by end of 2016 under CfE (including STEM) but have yet to appear. The delay is because 'The Depute First Minister wishes to undertake more stakeholder dialogue before launching the Benchmarks'. This provides an excellent opportunity to consider and agree the role of STEM within these Benchmarks.

10. **Will this Strategy improve equity of outcomes? If not, tell us what else it should include, in particular for women and girls and other groups of people – disabled people, care leavers and minority ethnic communities.**

a. Again, this is a matter of directing funding to expand successful pilots. For example, the EQUATE activity involved 15 women returning to work experience in the energy and power sector, over 6 months and at a total cost of £15k. It's important to scope what size of budget would be required to deliver significant impact. Important to decide which of these many initiatives quoted will give best value for money.

b. Distance learning (of both staff and students) may provide opportunities to address inequity due to geographic isolation.

11. **What could schools, colleges, universities, community learning and development, the voluntary sector, science engagement providers and museums do to support the areas for action?**

a. These participants work hard to deliver on STEM, essentially at no cost except to the organisation involved. More coordination amongst them would be beneficial to the STEM agenda and delivery.

12. **What could professional organisations and bodies and third sector organisations do to support the areas for action? This includes, in particular, the General Teaching Council for Scotland, the CLD Standards Council, the teaching unions and representatives and the Learned Societies.**

a. Some learned societies have long advocated for a minimum qualification in STEM as essential for entry to primary training. Recognising that CfE promotes diversity of learning pathways at school, perhaps there is now a need to consider elective study in STEM during training of primary teachers for those deemed to be underqualified in that respect. Reciprocally, students well-qualified in STEM could broaden their curriculum in non-STEM topics.

13. **What more could science centres and festivals do to complement and enhance STEM formal education, to inspire scientists of the future, and to ensure their activities support those of the Scottish Government and its agencies?**

a. Science Centres and museums engage well with schools from the more deprived

communities (visits to the centre) but the majority of elective visits are from the higher social demographics. Funding of visits is always an issue. Science Festivals can provide an opportunity for two-way dialogue between science and society (in addition to one-way communication of science to an audience that is more typical of the Science Centres and museums). Can more priority be put on positive discrimination for more deprived communities: funding for visits, backfill teaching to release teaching staff, reciprocal visit of centre staff to these schools and perhaps free family membership of the Centres?

14. **Should this Strategy identify more actions for particular sectors, for example in relation to workplace and work-based training and development? Please make suggestions on what these actions could be.**

a. Workplace training is probably best driven by the employer, as there will be bespoke aspects of the training. However, linkage to companies so that learners, teachers, etc. can interface with these companies should be encouraged.

Consultation Question – STEM Improvement Framework

15. **Tell us what you think about this Improvement Framework. How can we best ensure uptake of this Framework in early years learning settings, schools and clusters?**

a. The Improvement Framework, as detailed in Appendix B, is very comprehensive. Understandably it does not have a prescriptive timeline, but individual schools/clusters should be challenged to evaluate and declare their own timeline – and then be held to account for its delivery.

16. **Tell us what you think of our proposal for developing a model of collaboration between schools, colleges, universities and employers. How should we now take this forward?**

a. The LUMA Project in Finland is cited in the document. As noted in the response to Q6, LUMA is broad-reaching in its delivery – involving social media and discussion groups and even running to summer camps. Emulating such activity will require substantial resource.

Consultation Question – STEM ambassadors:

17. **Tell us what you think of our proposals for a Scottish STEM ambassador network. How should we now take that forward?**

a. The STEM Ambassador Programme in Scotland has been active and laudable but prone to geographic isolation, which led to each node operating as a silo. The recent restructuring into only 3 nodes with central coordination (at SSERC) will do a lot to rectify this. Geographic reach to all communities in Scotland is a particular challenge. It will be important that this new 'Ambassador Network' which is termed 'an addition' is not separate from existing activity (which is almost exclusively pro bono) and is tightly integrated with the Ambassador Programme. Linkage to individual champions will be vitally important.

b. The logistics in assigning a STEM Ambassador to each school are challenging. Of course, there is a need to expand the numbers of Ambassadors, further challenged as the population of Ambassadors is continually turning over. However, quality of Ambassadors will also be important for effective delivery, which may need enhanced levels of training.

c. STEM Ambassadors play a key role in sparking interest in STEM. There is perhaps further scope to coordinate and showcase a number of key STEM advances which have emerged from Scottish Universities, research institutes and companies as case studies.

Consultation Questions: Partnerships

18. **What other groups, organisations or people need to be involved in delivery of this strategy?**

a. This list is comprehensive. As SSERC will have a pivotal role in coordination Science Ambassadors, they should also be included.

19. **Tell us about what you are doing in your organisation, establishment or community that supports the aims and priorities of this Strategy.**

a. The Scottish Science Advisory Council fully supports the STEM agenda, both in committee and in the field. Members are also active on behalf of their university. The most important role of SSAC is in advice and support of the Chief Scientific Adviser in her role of deliver of the STEM Strategy.

20. **What could employers do to attract and retain more diverse STEM talent?**

a. Many employers already promote STEM externally, providing case studies and exemplars of how important STEM is to their business model, and the good opportunities for jobs, job satisfaction and successful careers. It is important to get more employers on board. Retention of STEM talent within Scotland is a particular challenge. Sad to say, it is often better terms and conditions elsewhere that stimulates this mobility while lifestyle and environment act as drivers for retention. Employers are often not good at finding their median point in these two opposing drivers.