National Assembly for Wales Consultation

Follow-up inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills

Response from Techniquest

Techniquest is an educational charity based in Cardiff with a Wales-wide mission to engage people in science and motivate them to learn more. It operates a busy science centre in Cardiff Bay, provides a major schools' outreach service to all areas of Wales and employs experts in all aspects of STEM enrichment to achieve this. Techniquest is well respected internationally, and provides consultancy and other services to a range of countries world-wide.

In 2013/14 Techniquest reached 338,000 people with high quality 'live' STEM enrichment experiences. Of these, some 175,000 were Welsh school-age children and 50% were girls. Services are provided in every unitary authority of Wales, and are targeted on disadvantaged areas where possible.

Techniquest welcomes the opportunity to respond to the National Assembly for Wales' consultation on STEM skills, and comments here in relation to the terms of reference.

What impact has the Welsh Government's strategy *Science for Wales* and Delivery Plan had on STEM skills in Wales?

For this question, Techniquest will comment specifically on the section within the *Science for Wales* agenda and delivery plan that most closely aligns to its mission: Increasing the science and engineering talent pool.

Techniquest has noted the specific actions outlined in section 5.4 relating to the promotion of STEM, and the progress on these actions outlined in the *Delivering Science for Wales 2012-13 annual report*[1]. With regard to actions 1, 2 and 4:

1. *We will develop our STEM strategy, building on a survey of existing activity to engage and develop children and young people and increase the proportion of the cohort studying sciences and pursuing STEM-related careers, including more girls and women*

The National Science Academy (NSA) appointed Dateb Ltd to map STEM enrichment activities in Wales. Techniquest has not seen the final report but sent its comments on the draft final report in April 2012 to the NSA. In summary, Techniquest viewed the analysis as incomplete, with no clear definition of the term 'activity', no information about of the quality or impact of activities and minimal information about gaps in provision in terms of geography and content.

Techniquest recommends that the analysis is carried out again, and if necessary updated, to provide a full picture of the STEM enrichment activities in Wales.

Other important facets of this work will be the monitoring and evaluation of these activities.

At present, there is no facility for monitoring Wales-wide work in this area. Techniquest's vision is to reach every school-aged student once per year, and 7-11 year olds three times

[1] *Delivering Science for Wales 2012-13. Annual report on our strategic agenda for science and*

per year, which will amount to over 750,000 enrichment engagements per year. It would be useful if information about the uptake of this activity plus that of other enrichment providers could be collected on a central database showing individual students' interactions. This would help to identify those who have not engaged and help target and prioritise intervention, as well as identify any geographical or subject areas that are not covered by enrichment activity.

With respect to evaluation, organisations use a range of methods to measure the effectiveness of their work. Many organisations, including Techniquest, use the Generic Learning Outcomes, which measure affective rather than cognitive learning, including knowledge and understanding, skills, attitudes and values, enjoyment, inspiration and progression[2].

The measurement of the impact of science enrichment activity is a long-term goal of many enrichment providers. AHRC funded Techniquest and Salford University a three-year PhD to study the long-term impact of Techniquest's secondary programmes.

Techniquest works closely on evaluation with a range of practitioners and academics, and a number of studies have been completed world-wide that represent an increasingly strong body of evidence of the effectiveness of STEM enrichment activity. However, more remains to be done.

More recently, the Wellcome Trust has announced a new funding stream to improve the knowledge base and practice of science enrichment activities, called Science Learning+[3]. Techniquest recommends that the NSA looks into how a Welsh bid to this fund could support some of its strategy; Techniquest would be keen to work with the NSA on this.

Regarding the development of a STEM enrichment strategy, Techniquest has been invited to a meeting in mid-May 2014 by the NSA (date to be confirmed) to contribute to this.

As part of this development, Techniquest recommends that the NSA also seeks input from partners with whom science enrichment experts routinely work, including universities and STEM industry. These partners are key to the success of STEM enrichment, offering advice and expert STEM knowledge, and supporting enrichment initiatives as mentors or role models. With support from these partners, any resulting STEM enrichment strategy will have adherents from the whole STEM community in Wales, not just those who develop and deliver STEM enrichment activity directly.

To consolidate working relationships between STEM enrichment specialists and STEM specialists in universities and industry, strong links between the Department for Education and Skills and the Department for Economy, Science and Transport will be important. The development of the STEM enrichment strategy, which will be led by the Department of Economy, Science and Transport (through NSA) would benefit from strategic support from DfES.

2. *Set direction and coordinate STEM activities through the NSA, including appointment of an NSA-STEM Coordinator*

Techniquest is not aware of the appointment of an NSA-STEM Coordinator, though the NSA's recent grant round (to end in March 2015) set guidelines that show its initial priorities for Wales. Again, the completion of the STEM mapping exercise will be informative in helping to set direction.

4. *Examine ways to raise the standard of science and maths teaching….including how improved or specialist teaching can be encouraged…through initial and through Continuous Professional Development (CPD)…to provide effective learning for all pupils, including those who want to study sciences as single A levels*

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[2] http://www.inspiringlearningforall.gov.uk/toolstemplates/genericlearning
[3] http://www.wellcome.ac.uk/Funding/Public-engagement/Funding-schemes/Science-Learning/index.htm

NAfW recommended in its 2011 report into the STEM agenda that the Welsh Government, through Estyn should research *why science in primary schools may be experiencing a decline*[4]. With regard to teacher support, Estyn's report[5] recommended that local authorities should provide primary and secondary schools with more opportunities for CPD on science teaching and learning, and that primary schools should provide training for teachers with weak science subject knowledge.

It is difficult to see how this action can be achieved given that the provision for science CPD in Wales has reduced in recent years due to changes in the main organisations that provided this form of teacher support: the local education authorities (LEAs) and the General Teaching Council for Wales (GTCW).

The number of Science Advisors in the 22 LEAs of Wales has been reducing over a number of years, and in the academic year 2012/2013 this role ceased to exist. LEAs now work through four regional consortia, whose main remit is school improvement. System Leaders visit schools to challenge and support them on standards, in line with Welsh Government priorities, including literacy, numeracy and the reduction of the impact of poverty on attainment. It seems that science has reduced in priority in the last few years, especially at Key Stage 4. At this key stage, greater emphasis is placed on mathematics and language, with the main performance indicator being the *Threshold Level 2 inclusive of English or Welsh and mathematics*. Consequently, System Leaders do not routinely support science teachers in the teaching of the subject.

Techniquest would be interested to know how many teachers have accessed science CPD since September 2013, particularly in the light of the decline in science teaching identified by NAfW (footnote 2) and corroborated by Estyn (footnote 3).

GTCW no longer funds or runs CPD in Wales.

Techniquest runs science CPD for primary and secondary teachers across Wales on behalf of the National Science Learning Centre[6], offering over 500 fully-funded teacher-days per year. Whilst well-received, these reach a small number of science teachers in Wales.

On another note, the Welsh Government has been consulting on Key Stage 4 performance measures[7]. It notes that there has been a sharp increase in the number of students not taking science GCSE and that in England proportionally 50% more students take triple science than in Wales. This makes the case stronger still for focused and prioritised science CPD for teachers. The consultation looked at which measures should be used at Key Stage 4 in relation to qualifications. It will be important for science education in Wales that whatever is chosen as the main indicator (threshold measures or capped points scores), it should include science alongside mathematics and a language. The elevation of science as one of the subjects to be counted in this way would be important for raising the profile of science within a school and, ultimately, helping to increase the 'science and engineering talent pool'.

What progress has been made in addressing the issues identified in the Enterprise and Learning Committee's 2011 inquiry into the STEM agenda?

Techniquest would like to comment on the Welsh Government's response to recommendations 6, 10 and 12[8]

Recommendation 6
We recommend that the Chief Scientific Advisor, through the NSA, should evaluate initiatives aimed at addressing negative perceptions and gender stereotypes of STEM

[4] *The science, technology, engineering and mathematics (STEM) agenda*. Enterprise and Learning Committee, National Assembly for Wales (January 2011)
[5] *Science in key stages 2 and 3*. Estyn (June 2013)
[6] https://www.sciencelearningcentres.org.uk/consortia/national
[7] Key Stage 4 performance measures: stakeholder survey, Welsh Government (March 2014)
[8] http://www.assemblywales.org/bus-home/bus-third-assembly/bus-guide-docs-pub/bus-business-documents/bus-business-documents-doc-laid.htm?act=dis&id=212251&ds=3/2011

subjects and should promote good practice within the school system, starting at the earliest possible age.

In 2013/2014 Techniquest worked with Chwarae Teg with funding from Welsh Government to ensure that all its programmes and exhibits do not favour or exclude any gender. In addition, it is currently developing videos and associated hands-on activities for Key Stage 4 students (14 – 16 years old) as part of its *Getting Girls into Physics* project. This initiative, run in partnership with the Institute of Physics, aims to address the deficit in number of girls who choose to study physics[9], by highlighting the many and varied roles carried out by women in physics. Techniquest is keen to support the CSA in this work.

In addressing this recommendation, it will also be important for the NSA to work with parents. A recent 5-year study by Kings College London[10] showed that being aware of a variety of jobs available in STEM, either because parents of other known adults are employed in the STEM sector, greatly increases the likelihood of young people aspiring to pursue a career in science themselves.

Finally, in relation to this recommendation, it should be noted that the *Science for Wales* policy document contains photographs of eight named scientists in its pages (not including the CSA), and of these just one is female.

Recommendation 10
We recommend that the WG should publish a CPD plan for teachers in Wales……aimed at improving in-service training and updating STEM teachers and heads of departments, not only to enhance STEM teachers' subject knowledge but also their understanding of how to teach specific subject topics up to GSCE at least.

In its response the Welsh Government states it wants to focus 'on the national priorities of literacy, numeracy and tackling priorities set out in the School Development Plan'.

Techniquest is concerned that if science CPD is not referred to specifically as a priority by Welsh Government, then it may not be addressed given the competing and, rightly, important areas that are identified as priority at present. This is of particular concern given Wales' poor performance in the PISA tests for Science in 2009, and the imminence of the next test in 2015.[11]

Recommendation 12
We recommend that the WG should contract the EBPs (Careers Wales) to develop strategic partnerships between schools and industry in order to increase the opportunities for teachers and lecturer placements…with STEM employers as part of teachers' CPD.

Techniquest suggests that this is another area in which it is imperative that DfES and DEST work together closely.

Techniquest
2 May 2014

[9] *It's Different for Girls,* Institute of Physics (2012)
[10] http://www.kcl.ac.uk/sspp/departments/education/research/aspires/ASPIRES-final-report-December-2013.pdf
[11] http://www.oecd.org/pisa/keyfindings/pisa2009keyfindings.htm