

Enterprise and Business Committee

Meeting Venue:

Committee Room 3 – Senedd

Meeting date:

14 May 2014

Meeting time:

09.15

Cynulliad
Cenedlaethol
Cymru

National
Assembly for
Wales



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Agenda

Pre-meeting in private (09:15–09.30)

Formal public meeting (09.30)

1 Introductions, apologies and substitutions

2 Follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (session 1) (09.30–10.15) (Pages 1 – 9)

Witnesses:

Dr Anita Shaw, Deputy CEO, Techniquest

Prof. Niels Jacob, Head of the Mathematics Department, Swansea University, Wales
Institute of Mathematical and Computational Sciences (WIMCS)

Jane Richmond, Head of Learning and Interpretation, The National Botanic Garden of
Wales

Attached Documents:

Research Brief

EBC(4)-13-14 (p.1) – Techniquest

EBC(4)-13-14 (p.2) – Cardiff University, Wales Institute of Mathematical and Computational Sciences (WIMCS)

Break (10.15–10.25)

3 Follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (session 2) (10.25–11.10) (Pages 10 – 15)

Witnesses:

Joy Kent, Chief Executive, Chwarae Teg

Emma Richards, Project Development Manager – Education, Chwarae Teg

Alice Gray, STEM Ambassador

Attached Documents:

EBC(4)-13-14 (p.3) – Chwarae Teg

Break (11.10–11.20)

4 Follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (session 3) (11.20–12.05) (Pages 16 – 18)

Witnesses:

Donna Griffiths, Skills Strategy Manager Wales, CITB

Attached Documents:

EBC(4)-13-14 (p.4) – CITB

5 Papers to note (Pages 19 – 20)

Attached Documents:

Minutes of Previous Meeting

EBC(4)-13-14 (p.5) – Letter from the Minister for Economy, Science and Transport regarding Car Parking Charges Research

EBC(4)-13-14 (p.6) – Letter from the Minister for Economy, Science and Transport

regarding travel patterns in South East Wales

De-brief in private (12.05–12.25)

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 progression².

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*

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 report⁵ 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.

Techniquet 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.

Techniquet runs science CPD for primary and secondary teachers across Wales on behalf of the National Science Learning Centre⁶, 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 measures⁷. 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?

Techniquet would like to comment on the Welsh Government's response to recommendations 6, 10 and 12⁸

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 Techniquiest 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 physics⁹, by highlighting the many and varied roles carried out by women in physics. Techniquiest 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 London¹⁰ 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 GCSE 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'.

Techniquiest 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.

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

Techniquiest
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>



Wales Institute of Mathematical and Computational Sciences

Sefydliad Gwyddorau Mathemategol a Chyfrifiannol Cymru

The National Assembly for Wales' Enterprise and Business Committee follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills

Written Submission from Wales Institute of Mathematical and Computational Sciences

Background

The Wales Institute of Mathematical and Computational Sciences (WIMCS) was given WG approval in October 2006, and £5 million financial support by HEFCW. Originally a collaborative partnership of the Universities of Aberystwyth, Bangor, Cardiff, Swansea, it now also includes the University of South Wales. The proposal advised that:

The formation of The Wales Institute of Mathematical and Computational Sciences (WIMCS) will bring together individuals and groups in mathematical and computational sciences in Wales to provide the critical mass of high quality researchers who will achieve international recognition for mathematical research excellence. The aim of the Institute is to enhance the standing of mathematics and computation in Wales, to foster links with industry, commerce and business, to generate substantial research funding and to provide a forum for education and public awareness of the mathematical sciences. Furthermore, it will provide the foundation for a mathematical sciences base to support inter-disciplinary research projects.

Ref 1. What impact has the Welsh Government's strategy *Science for Wales* and Delivery Plan had on science, technology, engineering and mathematics (STEM) skills in Wales?

As part of the strategy of Science for Wales the NSA was set up and WIMCS is one of the hub members.

Part of the original WIMCS remit was to:

Establish Outreach activities aimed to enhance the interaction between the universities and the schools to help invigorate the study of mathematical and computational sciences and other disciplines.

Examples of our work are:

1. WIMCS initiated a Spring Term Programme of Maths Masterclasses at Swansea for Year 9s in 2010. These have now become an annual event.
2. WIMCS has provided financial support to similar Masterclasses at the Universities of Bangor and South Wales.



3. WIMCS supported a Maths Club at Aberystwyth University.
4. WIMCS secured EPSRC funding against competition for two Maths Roadshows (£140k). Its main partner was, and is, Science Made Simple, Cardiff.
5. WIMCS initiated in 2010 the Further Maths Support Programme Wales funded by the WG (initially £440k for the period 2010-13). The pilot started in South West Wales and has since been expanded to North West Wales and RCT and parts of Cardiff area. It supports schools and teachers as well as individual pupils at schools and colleges who have insufficient access to staff in all or some of Further Maths modules. It also provides enrichment for KS4 and Post 16 students in Mathematics. The Programme in Wales works closely with the similar initiative in England.
<http://www.furthermaths.org.uk/?page=wales>

See also <http://www.wimcs.ac.uk/outreach.html>

WIMCS has applied for NSA Grant Funding and has been successful three times.

- 1) NSA Funding to provide CPD training for secondary teachers in Maths, Physics and Chemistry. Its partners were the Institute of Physics and the Royal Society of Chemistry.
- 2) NSA Funding to take its 'Maths Apps' Careers Roadshow to 24 secondary schools in 2013. Approximately 7000 students from years 7 to 9 saw the show.
- 3) NSA Funding to take the Maths Apps Roadshow to a further 32 secondary schools in 2014.

WIMCS believes that there is a clear need to engage with students in the years prior to GCSEs to encourage them in the take up of STEM subjects. The challenge has been underscored by the relatively poor PISA results in Wales particularly in Maths. The positive feedback received encourages us to believe that these activities have and are having an impact.

We would also like to add that Swansea has more than trebled its mathematics UG-intake from 2003/04 to 2008/09. Without the additional posts coming through WIMCS it would not have been able to deal with such an increase, and perhaps it should be observed that a 'Science for Wales' policy began before the appointment of Prof. John Harries.

Ref 2 a) The adequacy of provision of STEM skills in schools, further education colleges, higher education and work-based learning (including apprenticeships)

In 2011/12 WIMCS managed the Wales hub (c£1m) in the £21M 3 year UK wide HE STEM programme run by Birmingham on behalf of HEFCE and HEFCW to enhance the skills and knowledge base of the workforce in these areas. The WIMCS Outreach Coordinator Alison Braddock was appointed HE STEM Regional Director Wales and coordinated the Wales element. WIMCS Professor Ken Morgan, Swansea University and others also played significant roles in the project.

<http://www.hestem.ac.uk/partners/wales>



The Project has now ended but it is believed to have made considerable impact in these areas:

- Making graduates more effective in terms of the skills they bring to employers
- Making employers better appreciate the value our graduates can offer
- Using HEI expertise to up-skill better the existing workforce
- Making the transition from school to university as effective as possible

It is our belief that that the impact should continue to be monitored within the 'Science for Wales' strategy. It may well be cost effective to sustain and continue some of the sub projects.

Ref 2 b) Value for money from the additional funding to support and promote STEM skills and whether the current supply of STEM skills is meeting the needs of the Welsh labour market

WIMCS is not in a position to assess Ref 2(b) but believes strongly that STEM skills must continue to be supported and promoted within Wales.

Ref 2 c) The supply of education professionals able to teach STEM subjects and the impact of Initial Teacher Training Grants and the Graduate Teacher Programme on recruiting STEM teachers and education professionals

WIMCS would like to comment on the possible shortage of secondary school teachers with the skills required to teach Further Maths. Although the take up of Maths at A Level is broadly similar in England and Wales, it is 25% lower in Further Maths.

Maths	2013	England	Wales
Male		13.8	13.8
Female		7.5	7.6
Overall		10.4	10.4

Further Maths 2013

Male	2.6	1.8
Female	0.9	0.7
Overall	1.7	1.2

<http://www.jcq.org.uk/examination-results/a-levels/a-as-and-aea-results-summer-2013>

Factors contributing to the shortfall may be a lack of suitably skilled teachers and the level of encouragement given to students wishing to take Further Maths which is recognised as being a relatively 'difficult' A Level Choice. WIMCS staff presented their views to the WG on the importance of up-skilling teachers in Further Mathematics. As a consequence limited CPD in Further Mathematics supported by the WG will be offered in the pilot area from September 2014.

WIMCS staff have also presented the view at meetings attended by WG officials that the WG should not be encouraging schools and colleges to pressurise students wanting to take Further Maths to also take the Welsh Baccalaureate. Further Maths is often taken as a fourth A level (in combination with Maths, Physics and Chemistry) and taking the Welsh Baccalaureate as a fifth is a big ask!



Ref 2 d) The effectiveness of education and business links between education institutions and STEM employers.

Part of WIMCS's remit is to foster links.

WIMCS would point to the following initiatives it has nurtured:

1. HMC2 – The Health Modelling Centre Cymru was set up to provide an access route to mathematical and computational modelling expertise for health professionals to help solve clinical, epidemiological and health service delivery problems. <http://hmc2.cf.ac.uk/about.html>
2. MSc courses in MSc in Operational Research and Applied Statistics/ MSc in Operational Research, Applied Statistics and Risk at Cardiff. These qualifications include placements in industry, business and the public sector.

WIMCS believes that both provide valuable means for the skills of mathematicians to be accessed by the wider community, and that if, as part of the Grand Challenge of Life Sciences and Health, resources were channelled into and through HMC2 where appropriate, greater engagement to the benefit of both the mathematics and life sciences community would result.

3. At Aberystwyth, three large European FP7 projects (HYDROFRAC, PARM2 and INTERCER2) in the Marie Curie Industry Academy Partnerships and Pathways Scheme have supported several secondments of PhD students to the industry for periods of up to 6 months, as well as a stream of researcher exchanges between academics and industrialists. This is having a clear benefit to STEM areas (particularly applied mathematics and engineering) in Wales.

Ref 3. Whether any progress has been made on addressing negative perceptions and gender stereotypes of STEM and promoting good practice to encourage women to acquire STEM skills and to follow STEM related careers.

WIMCS is conscious of the need to encourage women. Wherever possible it tries to have women speakers as well as men, and in its Outreach work makes a conscious effort to promote female role models.

Stereotyping can start early, and the mathematical sciences in particular need to consciously strive to make themselves attractive as career paths for women from early school years rather than when it is already too late.

NB It may be of interest that there is a relatively new commercial campaigning organisation that operates in UK under the name Little Miss Geek to make careers in technology and video games more accessible and appealing to women http://en.wikipedia.org/wiki/Little_Miss_Geek



Ref 4. What progress has been made on learning STEM skills through Welsh medium education and training?

WIMCS would point to:

a) The help from Coleg Cymraeg Cenedlaethol in establishing Welsh-medium teaching posts at Aberystwyth, Cardiff and Swansea. This has helped in the recruitment of high quality students from Wales who might otherwise have gone elsewhere. This is a major initiative which has proved to be an unqualified success.

b) The work of Dr Tudur Davies of Aberystwyth University's Institute of Mathematics, Physics and Computer Science in translating into Welsh 'Facts and Formulae' leaflets. The project was supported by both the Coleg Cymraeg Cenedlaethol and the MathCentre, and has been published at <http://www.mathcentre.ac.uk/resources/uploaded/ff2ystadegaethweb5.pdf>

NB MathCentre is a project offering students free resources to support the transition from school mathematics to university mathematics in a range of disciplines across the United Kingdom.

c) Dr K. Evans and Prof. N. Jacob (Swansea) have written in the Welsh language a textbook on Calculus (about 360 pages with a Welsh - English vocabulary list and more than 140 solved problems) which covers the first year at University as well as the final years at school. Such a book does not exist, and is much needed. The manuscript is ready for publication, and has already been successfully used in the mathematics education of Welsh speaking engineering students in Swansea. Additionally a complete set of lecture notes for Elementary Geometry in the Welsh language has been produced in Swansea.

Agenda Item 3



Response to the Enterprise and Business Committee's follow up inquiry into:

Science, Technology, Engineering and Mathematics (STEM) skills

April 2014

Chwarae Teg exists to deliver our vision of a Wales where women achieve and prosper. We do this by working with women to broaden horizons and build confidence and skills; working with employers to create modern workplaces that are successful by harnessing everyone's contribution; and working with influencers, educators and decision makers to build a society that values, supports and benefits women and men equally.

Research demonstrates that women are under-represented in STEM industries; there are often very few women on the boards of FTSE STEM companies, large numbers of women are not using their STEM qualifications in their careers and young girls are less likely to feel confident in their abilities in these subject areas. We believe that working with young women could help reduce the apparent gender gap in STEM and improve the economic prospects of STEM industries, by utilising the resource that is women in STEM. We welcome the opportunity to contribute to this inquiry and would be keen to work with the committee and the Welsh Government to take our recommendations forward.

Key points

1. Women are under-represented in STEM and targeted interventions at an early age would help to reduce the gap between males and females.
2. It is important that female role models from STEM industries play an active role in STEM engagement and education, to help encourage girls to achieve their full potential and pursue careers in STEM unhindered.
3. Support structures available to assist working parents or carers in STEM careers are vital in ensuring longevity in their careers and creating a more flexible work environment that is family friendly.

Consultation Questions

1. What impact has the Welsh Government's strategy Science for Wales and Delivery Plan had on science, technology, engineering and mathematics (STEM) skills in Wales?

- 1.1. The Welsh Government's investments into *Increasing the Science and Engineering Talent Pool* through STEM engagement projects are invaluable when encouraging young people to access science. The engagement projects available from Techniquest as part of the National Science Academy and their outreach programmes (such as MathCymru) are vital in making STEM accessible. In a PISA survey in 2012, pupils reported that they felt there were higher levels of support from mathematics teachers in Welsh schools than the OECD average¹. However, the information available does not indicate whether more girls are being encouraged to study STEM subjects.
- 1.2. The 2012 PISA survey showed that Wales scored significantly lower than England, Scotland and Northern Ireland and in the OECD average in mathematics and science. The data available was not disaggregated by gender, it is crucial to monitor the progress of boys and girls respectively, to ensure they are identifying with STEM subjects equally.

Recommendation 1: Ensure data is collected to monitor STEM education and employment. This will provide a benchmark and allow progress to be monitored.

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

- 2.1 It is important that initiatives encourage children to be involved in STEM subjects from the Foundation Phase onwards. Engagement projects, such as STEM Cymru, are working to create a positive image for STEM industries for children. Furthermore, STEM Cymru's project *Girls into Engineering* is vital in allowing girls to pursue careers in Engineering and STEM, which are industries which lack equal female representation.
- 2.2 Estyn reported that the majority of secondary science departments in Wales are led effectively by teachers who are enthusiastic about science¹. However, only about half the primary leaders have a clear vision for developing science in their schools. Thus, children from a younger age need to be engaged in science through utilising STEM specialist teachers or retraining teachers in STEM. Furthermore, young girls would benefit from exposure to a female STEM role model, helping them to identify with a subject that often can be gender-biased.

¹ Estyn Report into Science in Key Stages 2 & 3 in June 2013

2.3 The data available does not indicate whether the changes implemented have led to more young girls becoming interested in science. Our own projects, Get on with Science (delivered in partnership with ContinYou Cymru) and Fair Foundations (part of the Agile Nation project, suggest that Science lessons are often not engaging for girls and 'gender lensing' should be carried out to ensure girls benefit equitably.

Recommendation 2: Teaching materials and STEM engagements initiatives should be 'gender-lensed' to ensure that girls and boys are engaged to an equal measure.

3. The adequacy of provision of STEM skills in schools, further education colleges, higher education based learning (including apprenticeships);

3.1 Currently, women remain underrepresented in STEM careers. It is important to ensure that girls are being encouraged to be involved in STEM and ensure that girls are aware of their potential to succeed in these areas. Research shows that girls' self-confidence in the subjects can affect how well they perform in STEM subjects, and their confidence is affected by their exposure to the stereotype that girls cannot succeed in these subjects².

3.2 Women are especially under-represented in STEM apprenticeships, accounting for just 3% of engineering apprenticeships³ for example.

Recommendation 3: Initiatives need to be in place to encourage more women to study STEM at further education, higher education and undertake STEM apprenticeships.

4. Value for money from the additional funding to support and promote STEM skills and whether the supply of STEM skills is meeting the needs of the Welsh labour market;

4.1 We welcome the Welsh Government's commitment towards promoting STEM skills as STEM industries are deemed crucial for the modern economy and hold great potential for economic growth for Wales. Therefore, investment in STEM skills is invaluable to Wales' future economy.

4.2 There is limited data available on the supply and demand of individuals with STEM skills to the UK workforce and ambiguity over the skills desired by the industry. This is thought to lead to a lack of clarity over what STEM education should be trying to achieve⁶.

4.3 Women are still under-represented in STEM industries and thus skills of women in STEM will not be fully utilised in this area of potential economic growth. It is thought that harnessing the full potential of women could generate economic growth. Thus, it

² Simpkins, S.D. and Davis-Kean, P.E. (2005). The intersection between self-concepts and values: Links between beliefs and choices in high school. *New directions for child and adolescent development*. Pg. 31-47

³ http://www.thedataservice.org.uk/statistics/statisticalfirstrelease/sfr_supplementary_tables/Apprenticeship_sfr_supplementary_tables/

is important that when promoting STEM skills, that all genders are equally targeted, to help women access a career in STEM and fully use their potential.

Recommendation 4: Work with STEM employers to understand skills gaps and identify how they can make sure all skills are being fully utilised.

5.The supply of education professionals able to teach STEM subjects and the impact of Initial Teacher Training Grants and the Graduate Teacher Programme on recruiting STEM teachers and education professionals;

5.1 There is currently limited data available concerning the number of recently STEM graduates becoming teachers. Research indicates that a shortage in STEM teachers leads to a reduced number of students studying STEM subjects at A-level⁴.

5.2 Anecdotal evidence suggests to us that low levels of gender awareness amongst teachers and careers advisers is creating a barrier for girls wanting to engage with STEM occupations. We therefore, urge that PGCE, Master of Education and Careers qualifications include specialist training. CPD should also be available for these professionals to reinforce the learning and ensure it has an impact.

Recommendation 5: Gender awareness should be embedded in PGCE, Master of Education and Careers Service professional training to increase understanding of gender stereotyping and how to encourage more women into STEM⁵.

6.The effectiveness of the education and business links between education institutions and STEM employers.

6.1 There is limited data available concerning the supply and demand of individuals with STEM skills in the UK workforce, which has ultimately led to uncertainty over the skills desired by potential employers and what STEM education should aim to achieve.

Recommendation 6: Stronger links between schools and local businesses are promoted, focusing on offering a broader range of options to girls through positive role models and meaningful work experience⁷.

7. Whether any progress has been made on addressing negative perceptions and gender stereotypes of STEM and promoting good practice to encourage women to acquire STEM skills and to follow STEM related careers.

7.1 Women occupy around 15% of STEM positions and make up 42% of FTSE STEM company boards. Furthermore, a significantly lower number of female STEM graduates go on to work in STEM roles in comparison to male graduates. Thus, there is still work needed to be done to address these gender gaps.

⁴ Nath, C. and Border, P. (2013). STEM education for 14-19 year olds. Parliament.UK

⁵ Chwarae Teg Manifesto (2014). A Wales Where Women Achieve and Prosper. Cardiff, Chwarae Teg

7.2 Chwarae Teg and Continuu Cymru's project *Get On With Science* identified the importance to engage school aged girls in science and provide professional female role models to demonstrate their potential⁶. This reinforces research that showed the positive effect exposure to female role models has on school aged children. This also altered their attitude about science and women in industries⁷.

7.3 Research shows that the largest contributing factor towards the participation of girls in STEM subjects is self-confidence. It is thought that the negative stereotype that girls are less able in STEM subjects worsens their performance in the subjects. Therefore, it is important to actively address the falsehood of this stereotype, to prevent girls from being deterred from this subject. OECD Pisa Test showed that in most countries girls under perform in Maths in comparison to boys. However, in the countries that offer more equal opportunity and resources to men and women (such as Iceland, Norway and Sweden), the STEM gender gap significantly decreases⁸.

7.4 The nature of STEM industries means that work often runs outside of office hours and thus breed an inflexible environment that isn't family friendly, resulting in difficulties for employees with a family (the responsibilities of which often effect females more than males). Furthermore, due to the constantly changing nature of the STEM industries, any break from a career can result in being left behind, this problem largely effects women in STEM, as family responsibilities more often fall on women's shoulders and result in career breaks. It is important that there is a supportive structure in place that allows flexibility and assistance for working parents or carers in STEM industries.

Recommendation 7: Initiatives need to be put in place to encourage girls from a young age to be encouraged into Science, this should include the promotion of female role models. Support structures must also be implemented to help working parents in STEM industries.

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⁶ Chwarae Teg (2012) *Get On With Science*, Cardiff, Chwarae Teg

⁷ Smith, W.S. and Owen, T. (2006) Effect of women in science career role models on early adolescents' attitude toward scientists and women in science. *Journal of Research in Science Teaching*, Pg 667-676.

⁸ OECD Report (2014) *Are boys and girls equally prepared for life?*

Enterprise and Business Committee follow-up inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills: A response by CITB Cymru Wales

CITB Cymru Wales welcomes the opportunity to provide evidence to the Enterprise and Business Committee's follow-up inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills. Adequate STEM provision is essential in laying the foundations for careers in the construction sector, allowing the next generation of Wales' construction workers to progress to apprenticeships and training.

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

- **The adequacy of provision of STEM skills in schools, further education colleges, higher education and work-based learning (including apprenticeships);**

The general impression often expressed anecdotally by employers is that employees, especially younger employees including apprenticeships have low or poorly developed basic skills in literacy and numeracy. This would seem to be the case in England as well as Wales, so may not be considered a Welsh issue only. The concern extends to Graduates as well as those entering work at the lower level. Numeracy and STEM seems to have been overshadowed by issues relating to Literacy and the English GCSE in Wales over recent months.

During discussions with Further Education colleges it is apparent that their intake of students and apprentices require significant remedial work to attempt to bring them to the required standard around C Grade GCSE which is costly in time and resources. Developing students STEM skills Post 16 can be considered as being additionally difficult as learners will have a number of years' experience of failure at Secondary Schools in subjects such as Maths and are at a transitional period from adolescence to adulthood and employments with all the added distractions associated with this.

With regards to the acquisition of the basic STEM skills required for Construction Apprenticeships which are largely basic calculations of quantities, ratios and angles these should be learnt and consolidated by the end of the Primary school phase and built upon and enriched during latter education phases. It is inconceivable that learners 'lose' consolidated learnt skills during the Secondary Education phase and that it is wasteful for employers FE and HE to be 'picking up the pieces' of failure lower down the Education system.

Secondary Schools and FE have been, and continue to be, in the case of Secondary Education held to account for their performance or lack of performance whilst it would seem that Primary schools who are tasked with ensuring the development of basic skills are unaccountable and are not subject to the same scrutiny with regards to STEM subjects or basic skills transition in general. Before progress on these matters is made it is essential that the success of the primary sector is rigorously assessed as it is likely that transition levels are unrealistic causing issues and waste throughout the system. It would seem that ESTYN have been ineffective in their role in scrutinizing this sector and to this end an independent task force led by industry should be formed to lead this enquiry.

An additional factor which affects all stages of Education is the lack of STEM ability amongst teachers and lecturers; this has been acknowledged by ESTYN in a recent report on the Construction Sector in Wales. This situation is highly likely to exist in the Primary sector and is likely to be exasperated with the introduction of an additional

GCSE in Mathematics in the Secondary Sector without sufficient thought or planning with regards to the number or availability of teachers capable of delivering the additional qualification. The reality will probably be that specialist and semi specialist teachers will be taken away from the lower ability student to teach middle and higher ability students making the support for potential apprentices in the lower academic cohort weaker. This needs to be planned effectively.

- **Value for money from the additional funding to support and promote STEM skills and whether the current supply of STEM skills is meeting the needs of the Welsh labour market;**

As noted elsewhere within this report, employers continue to complain about the lack of basic skills amongst employees old and young. Initiatives such as the Basic Skills in the workplace initiative were a positive step but were ineffective in its lack of ability to help sole traders who are the backbone of the Construction Industry.

The cost of remedial work for apprentices and graduates is also a concern as this is increasingly expensive with only the examination bodies profiting if students continue to have to re-sit qualifications they are likely to repeatedly fail.

- **The supply of education professionals able to teach STEM subjects and the impact of Initial Teacher Training Grants and the Graduate Teacher Programme on recruiting STEM teachers and education professionals;**

Whilst it is not possible for us to comment specifically on the success of the specific initiatives without data regarding the numbers successfully recruited and entering teaching, the notes above the comments in the 1st section of this report indicate concern at the current situation on Primary and FE and points to additional potential concern within the Secondary Sector.

This is a key requirement of success for the development of STEM at all levels. Additional up-skilling and assessment of capability needs to be undertaken at all levels for existing staff and especially for FE Construction Craft lecturers.

- **The effectiveness of education and business links between education institutions and STEM employers.**

With the demise of Careers Wales EBP activities seem to have reduced and lack a clear purpose and focus compared to their peak in the 1980's and 1990's through the EBP network. At best they can be said to be responsive to school needs rather than industry needs with an over emphasis on end of year summer activities perceived by employers rightly or wrongly as providing time for teachers to complete end of year tasks.

The sheep dip approach of offering work experience to all students within a narrow time band during the summer term has disengaged many employers from participating in links with schools due to past experiences for a number of reasons.

There is an opportunity for positive and meaningful engagement with industry through the new Welsh Baccalaureate and the Challenges which are a key part of their structure.

The level 2 and potential level 3 WJEC qualifications also provide an opportunity for meaningful employer input as a key part of their design.

Whether any progress has been made on addressing negative perceptions and gender stereotypes of STEM and promoting good practice to encourage women to acquire STEM skills and to follow STEM related careers.

The number of learners within the Russell Group Universities in Wales such as Civil Engineering and Architecture have a roughly 50-50 split male and female. This is not to say that these are Welsh learners or that these learners will chose to live and work in Wales or the UK following graduation as many are overseas students. Numbers are holding up well due to the international reputation of these institutions.

The situation with regards to courses such as Foundation Degrees, HNC's and degrees from institutions who have more recently gained university status is less encouraging with Construction Management etc. showing a residual male dominance.

Craft and Technical courses and Apprenticeships show the highest percentage of male learners compared to female, with apprenticeships showing the lowest number of females entering through this route. This is also true of the recently launched Civil Engineering Pathway at level 3 (technical) with no females applying for places in South East Wales.

CITB have over the years undertaken a number of initiatives from funded work experience for females and positive action events, some of which continue today. Unfortunately little measurable impact against investment can be seen.

The level 2 WJEC design and architecture qualification available from September 2014 is designed to assist in addressing this issue.

What progress has been made on learning STEM skills through Welsh medium education and training?

With regards to construction and education limited progress has been made in the provision of learning through the medium of Welsh. To a large extent this is influenced by a number of factors including demand from learners, availability of bi-lingual lecturers and issues relating to assessment of learners work and additional work and costs imposed by awarding bodies. The lack of bi-lingual external verifiers and examiners is also an issue that needs to be addressed.

On a positive note the development of 3 GCSE sized qualifications for schools delivery with the WJEC will potentially assist in addressing this issue as the qualifications can be delivered by Welsh medium schools who have the teaching staff. The development of a level 3 qualification equivalent to a GCE A level will assist progression and continued Welsh Language provision.

CITB Cymru Wales – April 2014



Eich cyf/Your ref:
Ein cyf/Our ref

William Graham AM
Chair Enterprise and Business Committee

06 May 2014

Dear William

The impact of car parking charges on town centres is an issue that has been of concern to Assembly Members. However, there has been little formal research on this matter.

As you will know, the Enterprise and Business Committee in its enquiry into the Regeneration of Town Centres judged that the evidence presented regarding town centre parking was mostly anecdotal. I have therefore decided to commission a small piece of work to research the impact of varying car parking charges on town centre footfall. The research will consider:

- The existing evidence on car parking charges and town centre footfall
- What approaches to charging have been successful and unsuccessful
- The impact of varying charges on different users
- How car parking charges can be used to influence town centre footfall.

I expect case studies to be identified and based on discussions with a range of stakeholders, including businesses and local authorities, and for examples of good practice from outside of Wales to be reflected in the recommendations.

I hope that you will find the outcome of the research useful, and I will write to you again when it is completed.



Edwina Hart MBE CStJ AC / AM
Gweinidog yr Economi, Gwyddoniaeth a Thrafnidiaeth
Minister for Economy, Science and Transport



Llywodraeth Cymru
Welsh Government

Eich cyf/Your ref
Ein cyf/Our ref

William Graham AM
Chair –Enterprise and Business Committee

08 May 2014

Dear William

I would like to update you on survey work that we will be carrying out over the next two months in relation to travel patterns in South East Wales.

We will be collecting data on the origin and destination of trips and the factors that influence those trips. This data is required to maintain our models of travel patterns in Wales.

We will be undertaking road side interviews and traffic counts at approximately 30 locations in and around Newport and Cardiff, postcard surveys at the Severn crossings, email questionnaires to Severn Crossing TAG customers and number plate recognition surveys along and off the M4.

We are liaising with the relevant police forces to ensure that any potential disruption is kept to a minimum.

A handwritten signature in black ink, appearing to be 'Edwina Hart', written in a cursive style.