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.