



Response to Enterprise and Learning Committee Inquiry:

Science, Technology, Engineering and Mathematics (STEM) Skills

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Introduction

ColegauCymru welcomes the opportunity to provide evidence as part of the Enterprise and Learning Committee's inquiry into STEM skills.

ColegauCymru is the national organisation representing the 19 FE colleges and two further education (FE) institutions in Wales.

In this response the terms 'college' and 'FE College' are used to cover all types of FE colleges and FE institutions.

All colleges with the exception of YMCA Community College teach a combination of STEM subjects.

This paper addresses the questions identified by the Committee in the order set out in the consultation letter.

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

Programmes to engage and enthuse

- 1.0 Colleges are actively engaged in a number of initiatives to engage school pupils in engineering and technology. Most colleges have extensive link programmes with schools to extend the STEM curriculum. Competitions that colleges may engage in include:
- Engineering Education Scheme in Wales (EESW)
 - Micromouse Challenge
 - F1 competition
 - Engineering UK's "Make it Happen"
 - Engineering Year 12 Challenge
- 1.1 In addition, FE colleges in Wales inspired the inception of the Engineering Week Wales (EWW) initiative, which has engaged around 1,000 Year 9 school pupils each year since it began in 2006. Through EWW, colleges invite schools to participate in fun, competitive engineering taster sessions and provide them with a publication that includes lively case studies of role models (successful and up-an-coming young engineers from Wales) as well as a routemap of qualifications entry points and progression routes to help promote engineering as a career choice. An example of an EWW publication – which includes the career routemap – is attached. EWW is coordinated by ColegauCymru and organised locally by around 14 colleges each year with approximately 100 schools participating. The initiative is supported by Semta, the Sector Skills Council covering engineering and by City & Guilds.

Potential actions

- 1.2 There are many initiatives to engage and enthuse young people in STEM. It would be helpful if these were developed into a coherent STEM promotion programme on a national level, linking existing programmes such as EWW and EESW, together with JIVE¹/Women Into Science and Engineering (WISE) initiatives that target girls, in order to improve perceptions from primary school onwards.
- 1.3 Career routemaps for all STEM disciplines would be helpful promotional tools to show that progression from level 2 to level 6 (graduate level) and professional qualifications is possible through a variety of paths. The traditional linear academic route of GCSEs → A levels → undergraduate degree is not the only route to achieving success in engineering or reaching the highly valued Chartered status. To borrow from the independent education foundation Edge, “there are many paths to success”. However, anecdotal evidence suggests that many parents, teachers and others who advise young people on career routes believe that the traditional linear academic route to success at the highest level is the only path to follow.

Entry to vocational FE qualifications

- 1.4 For vocational educational routes the key indicators/pre-requisites are normally taken from GCSE qualifications, specifically in Maths and Science and English/Welsh. Vocational routes include entry at level 2 and level 3. Educational pathways leading to employment and progression need learners with different levels of ability in the three key indicator subjects.
- 1.5 There are two issues:
- learners arriving at FE colleges with none or insufficient of the above or
 - learners arriving at FE colleges with all or some of the above but still not being able to cope with the technical requirements of the vocational/ General Education programme of study.
- 1.6 Colleges often report that a significant gap exists in the mathematical ability of many learners who access FE to study STEM subjects. This could be a result of local competition for post 16 places with more mathematically competent learners choosing to stay on in school; it could be a misunderstanding on the part of the learner about the kind of knowledge foundation needed in order to study STEM at level 3 and above with ease; or it could be that the pre-16 curriculum is not a sufficiently robust preparation for progression onto a level 3 vocational course in certain STEM subjects.

¹ JIVE is a five year project funded by the European Social Fund that has addressed occupational segregation in the Science, Engineering, Construction and Technology (SECT) sectors. It is a UK national partnership led by the [UK Resource Centre for Women in Science Engineering and Technology](#) at Bradford College.

- 1.7 The content of a common curriculum for 11-16 year olds may not be appropriate or sufficient to follow some occupational paths. It is usual for 16 year olds starting at college with level 2 entry qualifications (GCSEs) to continue to study at level 2 for the first year of college. This is because they need to develop level 2 specialist vocational skills before they can move on to level 3.
- 1.8 In some occupational/vocational routes (including certain engineering and construction pathways) it would be helpful to have an advancement programme for the three key areas.

Challenges: pre-entry

- 1.9 Each learner has different needs, but this can be accommodated through collaboration and modularisation of programmes. The WBQ is a helpful development in this respect.
- 1.10 GCSE results are published so close to the start of the new term that it is difficult to plan or deliver additional support that individual learners might require to be able to embark on a new vocational course with confidence.
- 1.11 Study programmes must be delivered with an applied learning philosophy supported by practical sessions in true/simulated working environments.

Potential actions: pre-entry

- 1.12 Researching and mapping the support necessary for learners to succeed in each vocational pathway needs to be planned. The result of the mapping exercise could be an offer of summer school placements to prepare learners for their vocational studies at FE college before term begins.
- 1.13 Earlier publication of GCSE results (say, in July) would enable colleges to offer summer courses to potential learners interested in STEM subjects to prepare them for the challenges of a specialist vocational course.
- 1.14 Additional qualifications could be offered as part of 14-16 year old curriculum to support/nurture the learner in their initial considerations of educational/vocational pathways, for example through the Principal Learning Programme of study that forms part of the Welsh Baccalaureate Qualification (WBQ).
- 1.15 An advancement programme would provide opportunities to gain the skills necessary for occupational/vocational routes - thus allowing progression. It needs also to be recognised that such skills are needed at all levels and provide a solid foundation for the world of work.

Further education provision

- 1.16 Science, Maths, ICT and Computing are taught at A/AS levels and BTEC National Certificate/Diploma and Higher National Diploma courses are available in Computing and Information Technology. Engineering may be divided into Agricultural; Electrical and Electronic; Mechanical and Manufacturing; Motor Vehicle; and Welding and Fabrication. The main awarding bodies for these courses are Edexcel, City & Guilds, IMI and EAL.
- 1.17 In some colleges, the demand for GCSE/AS/A levels in STEM subjects (particularly AS/A level Chemistry and Biology and GCSE Human Health and Physiology) has risen since 2007/08, possibly due to other educational institutions no longer offering these subjects.
- 1.18 FE colleges deliver the skills and knowledge that their Sector Skills Councils (SSCs) communicate to them via their labour market intelligence (LMI) surveys. Curriculum planning takes into account progression from college to work and from college to HE.
- 1.19 Colleges are effective in responding to the changes in technology that industry demands and provide an effective conduit between higher education (HE) and industry as well as at the lower entry points. Some colleges have a high number of learners who progress to HE institutions from college, whilst some colleges also have a high number of learners who study HE level subjects at their local college. Colleges also liaise closely with blue chip STEM employers and support individual companies' training needs.

Potential actions

- 1.20 It will be important to build on the success of the Work Based Learning Pathway to develop the Principal Learning Qualification (PLQ) to broaden 14-16 STEM curriculum at a higher level. The PLQ is based on the diploma that is offered in England. It is aimed at high achieving school pupils and differs from the traditional focus of school link engineering programmes. It is delivered in partnership with college/school/industry and is "applied" rather than academic.
- 1.21 Pathways to Apprenticeships (PtAs) could be enhanced and further developed to prepare learners for apprenticeships and encourage employers to engage with training.
- 1.22 The curriculum could continue to be developed, including an expansion of Foundation Degrees, in partnership with employers to address identified needs.
- 1.23 The introduction of the Qualifications and Credit Framework (QCF) should be supported. This is introducing accreditation for small bits-sized chunks of

learning (units), which enable a qualification to be built up of credits achieved over time to suit a learner's/employer's needs.

2 the additional funding to support and promote STEM skills and whether current supply of STEM skills is meeting the needs of the Welsh labour market, including international comparison with selected relevant countries and regions

- 2.0 The UK Government is prioritising STEM subjects at HE level by protecting funding for STEM subjects. At the time of writing, the Welsh Assembly's draft budget has not yet been laid and comparisons cannot be made.
- 2.1 ColegauCymru recognises the current public spending challenges and notes that FE colleges have been commended for their response to the WAG's Transformation agenda. Mergers, strategic alliances and collaborations have been and continue to be developed. They involve college-college, college-higher education institution, college-local authority and college-WBL providers. Partnerships are not only structural but also curricular (see Case Study 2 below for an example).
- 2.2 There is a concern, however, that work-based learning (WBL) contracts might be reduced in the next tender round.
- 2.3 Capital funding is a particular issue. The Networks of Excellence programme that was introduced a number of years ago (similar to CoVE in England) has long since stopped. It is understood that capital funding is going to be further squeezed over the current Comprehensive Spending Review period.
- 2.4 Within the National and Planning Funding System (NPFS) that is used to allocate funding to post-16 education and training, the delivery of vocational STEM courses attracts additional funding in recognition of the additional costs incurred in meeting their practical requirements.
- 2.5 The WAG has recently announced additional funding for the promotion of STEM under the leadership of EESW. It is not yet clear how that funding will be channelled. ColegauCymru suggests that coherence across the range of programmes and initiatives would be helpful, together with efforts to raise awareness and the esteem of vocational routes through the use of routemaps and promotion of campaigns such as EEW and Vocational Qualifications (VQ) Day. Further comment on this issue is provided in paras 1.2 and 1.3 above.

3 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

- 3.1 Potential STEM teachers are recruited either directly from those who have taken STEM qualifications followed by a professional teaching qualification or by those with experience from industry who can apply their knowledge through teaching.
- 3.2 FE has a tradition of appointing lecturers with experience of the world of work. These lecturers bring with them a tremendous amount of expertise. Potential lecturers from industry can be attracted into teaching through opportunities to visit local colleges and become a guest lecturer - under the supervision of lecturing staff.
- 3.3 The current economic downturn is an important opportunity to recruit those who may be released from employment in industry, who have the ability and aptitude to move into a teaching career.
- 3.4 A significant issue for FE colleges in Wales currently is the lack of an up-to-date post-16 Teachers Qualifications Framework. A new Framework was adopted in England in a number of years ago. In Wales however, a draft Framework was submitted by the Sector Skills Council LLUK under contract to the WAG in 2008 but the WAG has yet to issue a final Framework. The updated Framework is expected to include training on cross-cutting teaching and learning issues including key/basic skills and bilingual teaching. It is also expected to introduce registration for all new FE teachers/lecturers, and to include specific requirements to participate in continuous professional development (CPD) in order to retain registered status.

Continuous professional development (CPD): opportunities

- 3.5 CPD is fundamentally important in order to ensure that STEM teachers/lecturers are able to retain links with industry, are abreast of the latest technological developments, and are competent to teach the new and future skills required.
- 3.6 A number of CPD opportunities exist, for example:
 - school link programmes are used to develop school resources (at school): both staff and physical resources
 - in-company training that is delivered by college teaching staff helps to maintain staff/college links with industry developments

- The New Engineering Foundation is a UK-wide CPD programme that supports lecturers to have six-week placements in industry to upskill. This is an opportunity that could be exploited to a greater degree, but colleges face real challenges in planning to release staff for placements of such length. Placements in new technology industries could be targeted, e.g. renewable energies, aerospace, electronics.
- international opportunities also exist, such as the British Council's LIPD and Leonardo programmes, which are available to a wide range of teaching disciplines.

4 the effectiveness of education and business links between education institutions and STEM employers

- 4.0 Labour market research and projections for the next decade have identified that there will be a significant shortfall of STEM skilled individuals available to meet the demand created by the developments envisaged within the energy sector. This includes the proposed growth in the nuclear sector as well as the growth in the sustainable energy sector required to meet the targets set for reducing the output of CO₂.
- 4.1 Colleges have developed (and continue to develop) effective links with key employers and specific industries in their areas, including the aerospace industry, energy (especially oil/gas/nuclear/marine) industries, and agriculture. The curriculum is being developed to ensure that learners are developing the correct skills to enter the labour market.
- 4.2 A number of WAG initiatives have helped provide opportunities for employers to engage with colleges, including:
- Pathways to Apprenticeships (PtAs)
 - ProAct – which has resulted in bespoke training developed for individual companies
 - Shared apprenticeships scheme – which provides good additionality programmes and a progression route from PtAs.

Opportunities

- 4.3 A number of opportunities exist to further develop links with employers, for example:
- Skills Growth Wales (ProAct successor)
 - The demand for business improvement techniques is increasing

- The new Sector Priority Funds provide opportunities for FE colleges to engage with certain sectors, particularly the electronics/phototonics sector and the renewable energy industries (e.g. manufacture of photovoltaic cells, wind turbine maintenance) to develop sector-specific courses
- The development of the QCF responds directly to the demands of employers for bite-sized chunks of learning. Employers find it a challenge to release employees for training. Training in bite-sized chunks enables the employer to receive onsite specific training on its own equipment with minimum downtime.

An example of the QCF in practice: Deeside College has credit-rated all the internal courses provided by Airbus in Broughton, and the college is continuing with work to map advanced materials programmes onto the QCF, which will eventually enable the courses to be opened up to others, outside Airbus.

Challenges

- 4.4 Whilst many solid links have been established between colleges and business, the challenge of coordinated and coherent communication of the plethora of initiatives could be improved upon for the benefit of all parties.
- 4.5 A number of good initiatives have been introduced but care needs to be taken not to overcomplicate the initiatives. One suggestion might be to channel the communication of all initiatives through the relevant Sector Skills Councils.

Responding to specific industry demands

4.6 Case study 1: the nuclear industry

Coleg Menai has developed a Foundation Degree (in partnership with a HEI) in Engineering (Nuclear) in response to a request from local employers. The college has also started delivering training and assessment on site in radiation protection at both the local nuclear installations.

The Ynys Môn Ynys Ynni initiative developed by the local authority has provided a focus on the skills gaps relating to the energy sector. The college, in partnership with Ynys Môn, is developing a range of programmes to support this initiative. Significant investment has been made into developing an Energy and Fabrication Centre on the Llangefni campus which will deliver the skills training required to support the Ynys Ynni initiative. An example of the resources being provided is the development of a Flow Loop Simulator which will allow training in a variety of disciplines relating to human performance and engineering installation.

4.7 Case study 2: the aerospace industry

An Advanced Materials Centre was recently opened on the new aerospace park in Broughton as a collaboration venture between Deeside College, Glyndwr University and Airbus. The key purpose of the Centre is to service the training requirements for Airbus A350 and the next generation composite wings. It will also service the needs of other sectors for advanced materials training.

A Foundation Degree in aircraft manufacture and a Foundation Degree in aircraft maintenance is being delivered by Deeside College and Glyndwr University in a HE/FE collaboration. The college delivers the first year of training and the onsite work-based learning delivery whilst the university delivers the university-based second year teaching. The Foundation Degrees are currently being delivered for Airbus, Thomas Cook and Hawker Beechcraft.

5 the implementation and impact of strategic policies and government initiatives to foster STEM skills including the role of the Chief Scientific Adviser, the National Science Academy and the Welsh Government's *Skills That Work for Wales* and *For Our Future* (higher education strategies and A Science Policy for Wales (November 2006)

- 5.0 The recent launch of the National Science Academy to improve the supply of scientists, technologists, engineers and mathematicians in Wales is a very positive move. Publicising its work will be important, making sure that its profile is kept high by associating with the right companies. It is an opportunity to converge the STEM subjects and drive through the message that STEM has a significant impact on developing the economy in Wales. The title 'Science Academy' perhaps is misleading as it decouples 'TEM' subjects which Science increasingly relies on to move its own understanding forward.
- 5.1 Regular reviews and communications to the FE sector on progress against the agenda would be useful. Data about progress on STEM subjects in schools, FE colleges and universities would help inform curriculum planning. Curriculum planners often lack current data on which to base judgements. This may be reflected in a lack of innovativeness in the curriculum offer.
- 5.2 *Skills That Work for Wales* and *For Our Future* illustrate the increasing interest in STEM subjects. The former draws attention to the increase in the number of young people taking A-level in STEM subjects (up from 9,534 in 2003/04 to 10,066 in 2006/07). It draws attention to the fact that STEM graduates offer skills and knowledge that are highly valued in the labour market.

- 5.3 Employers have suggested that the demand for STEM graduates is likely to grow significantly over the next few years. However, *Skills That Work for Wales* was published just as the economic downturn took place and some of its forecasts and predictions need to be re-examined in the light of the current context.
- 5.4 The Welsh Assembly Government's national priorities for research match funding, which reflect the importance of STEM subjects, are listed in *For Our Future* as follows:
- Digital economy (ICT)
 - Low carbon economy (including climate change mitigation / adaptation issues)
 - Health and biosciences
 - Advanced engineering and manufacturing.
- 5.5 The April 2009 announcement also recognised the expertise and capacity Wales has in key cross-cutting especially optoelectronics, engineering, printing technologies, product design and rapid prototyping, visualisation, advanced materials and information communication technology. These technologies are important as they impact on a wide number of sectors.
- 5.6 In spite of the praiseworthy statements above, both *Skills That Work for Wales* and *For Our Future* devote only one or two paragraphs to STEM subjects. A more detailed examination of the WAG policy on STEM would be welcome. The WAG document *Economic Renewal: a New Direction* emphasises the importance of developing an innovation culture in Wales and recognises the need to 'educate, attract and retain able scientists, engineers, technologists and mathematicians'.
- 5.7 It is too early to say whether the appointment of a Chief Scientific Adviser will make a difference. However such an appointment is to be welcomed and it is hoped that the post will cover a brief wider than science – to encompass STEM as a whole.

Conclusion

- 6.0 Colleges are actively engaged in a number of initiatives to engage school pupils in engineering and technology. Career routemaps for all STEM disciplines would be helpful promotional tools to show that progression from level 2 to level 6 (graduate level) and professional qualifications is possible through a variety of paths.

Colleges' strong vocational focus and their close links with industry underline the key contribution of colleges to raising the profile of STEM subjects.