Science, Technology, Engineering and Mathematics (STEM) in Education and Training

A delivery plan for Wales

Contents

1. Introduction and Strategic Vision

Education changes lives, it provides opportunity, it enables individuals to shape their futures, it builds stronger, more tolerant and cohesive societies, it is the foundation of a strong economy. In short, education matters. Our vision for education is that:

> *Learners in Wales will enjoy teaching and learning that inspires them to succeed, in an education community that works cooperatively and aspires to be great, where the potential of every child and young person is actively developed.*
>
> *Qualified for Life: an education improvement plan, 2014*

This is no more relevant than in the development of Science, Technology, Engineering and Mathematics (STEM) skills and knowledge from our Foundation Phase through to post-graduate study and beyond into the workplace. These skills enhance our young people's ability to access and succeed in rewarding careers at all levels of employment, and provide the level of understanding necessary for all our young people to succeed in an increasingly science and technology driven world.

The importance of our children and young people developing (STEM) skills and knowledge at all levels is widely acknowledged. These skills are essential to the development of a prosperous and sustainable knowledge economy in Wales.

> *Science, technology, mathematics and engineering are the bedrock for innovation in business and industry and the Welsh Government will continue to push forward links between these and education, helping young people get a real grasp of the real world of work.*
>
> *Carwyn Jones, First Minister*

STEM subjects, along with other quantitative disciplines, are highly valued across a range of occupations, offering students varied and highly rewarding career opportunities. These subjects also support the Welsh Government's commitment to jobs, growth and developing a highly skilled workforce for the future[1]. Our ambition set out in the *Policy Statement on Skills* and in the subsequent *Skills Implementation Plan* is to develop a skills system in Wales that supports our future competitiveness, helps us evolve into a highly skilled society as well as tackle poverty, and is sustainable against the backdrop of ever scarcer resources. Our focus is on raising productivity, reducing barriers into work and supporting people into sustainable employment.

[1] Welsh Government Policy Statement on Skills, January 2014

In our *Science for Wales*[2] strategy, we highlight the importance of STEM skills at all levels. The strategy's *Increasing the Science and Engineering Talent Pool* chapter notes the essential nature of these skills in developing a prosperous and sustainable knowledge economy.

> *A central ambition of the Welsh Government is to build a stronger economy. A sound and vibrant scientific and technological base has substantial potential to boost the economy, through advanced ideas, skills and developments and an effective translation through innovation to more high quality jobs.* *Science for Wales, 2012*

The National Assembly for Wales' Enterprise and Business Committee[3] (EBC) follow-up inquiry into STEM skills (2014) called for "a more strategic and joined-up approach to interventions in the different STEM subjects, based on greater understanding and evaluation of their impact". It recognised the scale of the challenge across education settings and society to bring about the cultural change necessary for positive, gender-neutral perceptions of STEM.

> *Wales needs to strive for excellence in STEM right through the pipeline – from the curriculum and qualifications offered in primary and secondary schools, in colleges and universities, through careers advice and work experience, and into meaningful and sustainable employment.*
> *STEM Skills, Enterprise and Business Committee, 2014*

The Committee called for a coherent plan for the promotion, monitoring and evaluation of STEM enrichment activity through the National Science Academy (NSA), the Department for Education and Skills (DfES), and Department for Economy, Science and Transport (DEST). This Plan sets out how EBC recommendations are being driven forward, while capturing work on the development of STEM skills through curriculum and qualifications change, practitioner professional learning and support programmes. It remains focused on actions that relate to STEM skills development, while recognising the essential nature of literacy and numeracy as key to successful STEM skills attainment.

Access to robust STEM performance data and impact analysis is critical to informing programme development and system monitoring. This is even more so at a time of increasing budgetary pressure. Section 2, therefore, sets out upfront how this will be developed over the year ahead and communicated with stakeholders.

[2] http://gov.wales/topics/businessandeconomy/csaw/publications/130319sfw/?lang=en
[3] http://www.senedd.assembly.wales/mgIssueHistoryHome.aspx?IId=2225

Our priority is for the collation, analysis and reporting of progress against key indicators over time. This will provide the information essential for STEM policy and programme development, and system-wide monitoring, including the earlier identification of potential barriers to the flow of STEM skills.

In Section 3, we detail actions to deliver increased uptake and development of STEM skills through the evolution of teaching and learning across education and training settings. Major curriculum and qualifications reforms are key elements of this, supported through our revised strategic approach to supporting curriculum enrichment activity. However, the essential underlying support to develop practitioner skills, knowledge and access to fit-for-purpose bilingual teaching resources is given equal prominence.

Our priority is to evolve the teaching and learning undertaken in our schools, colleges and universities in a way that supports the development of STEM skills by our young people to meet their, and employer, needs in the 21st century.

Our priority is for our STEM related qualifications in Wales be of a standard comparable with the rest of the UK and the best in the world.

Our priority is for the long-term, self-sustaining, system-wide development of an education workforce in Wales capable of delivering a new and challenging STEM curriculum.

The impact of putting the building blocks in place to deliver excellence in STEM skills will be restricted unless this is matched by a notable shift in the perception of STEM. Attitudes towards STEM are often based in deep-rooted societal stereotypes, which become a barrier to progression into rewarding careers and further learning. Section 4 recognises the need for sustained effort in this area, and sets out measures targeted at practitioners, pupils and their parents.

Our priority is to increase interest and participation in STEM learning, particularly with girls.

Our priority is to equip our young people with career management skills and knowledge of the options available to them in the STEM sector, so they are able to make better informed decisions on their futures.

2. Building the evidence base

This section sets out actions to track, understand and report STEM in education and training, analysis of trends, and impacts of intervention and support programmes.

> **Our priority is for the collation, analysis and reporting of progress against key indicators over time. This will provide the information essential for STEM policy and programme development, and system-wide monitoring, including the earlier identification of potential barriers to the flow of STEM skills.**

Activities set out in the subsequent sections of this Plan rely on the results of robust analytical and reporting work. Work in this area informs the delivery of meaningful STEM learning and enrichment opportunities through the more effective allocation of finite resources. It will also ensure that all STEM stakeholders have access to the same information base to inform their planning processes in support of STEM skills.

Work on the systematic collation, analysis and reporting of STEM progress also highlights areas in our intelligence base that may require further investigative work. Plans to plug such potential 'gaps' are also set out in this section, alongside measures to more routinely communicate progress and key issues / findings.

Labour Market Intelligence (LMI) is being increasingly used as part of the evidence base, drawing on a range of analysis including some of the key outputs by the UK Commission for Employment and Skills (UKCES). This includes the Employer Skills Survey and the Working Futures series of employment projections. This information is being better communicated to learners through CareersWales online, as set out in Section 4.2 of this Plan.

The EBC's report highlights high levels of STEM education and training activity, but notes that progress in STEM skills attainment has remained too slow. Analysis of Wales' STEM-related performance in the international 3-yearly PISA comparisons, for example, shows that challenges remain for the development of the mathematical and scientific literacy abilities of our 15 year-olds. As set out in this Plan, these indicators have been analysed in depth, with the results of that informing curriculum and qualifications change (plus support and teacher development programmes) to ensure the flow of STEM skills improves.

The Committee's report also references the change in focus necessary to ensure the STEM needs of our young people are met through curriculum and qualifications change, as opposed to what might be seen as in the short- term interests of schools. We need to ensure that appropriate balance is maintained in the nature of qualifications offered our young people, and that no artificial barriers are introduced to their progression in STEM subjects. As set out in this Plan, measures to track and report information on school level Key Stage 4 local curriculum offers, linked to the new science suite of qualifications in particular, are being introduced. Local authorities and our education Consortia will, consequently, be better placed to work with schools to ensure learners have access to what they need to progress in STEM.

2.1 Collation and reporting of data

There is strong evidence of growing demand from employers for STEM graduates and skills. Data published by the CBI suggests that 72% of all UK businesses rely on people with STEM skills and that 53% of employers expect problems recruiting STEM technicians and graduates in the next three years (CBI, 2014). It is estimated that by 2022, one in five new jobs in the UK will be STEM jobs (Working Futures 2012-2022).

Demand for STEM-related skills in Wales is being assessed through Regional Learning Partnership skills plans. A timeline is also in place for developing Supply and Demand plans for September 2015, working with the Regional Learning Partnerships.

At present, school-related high level indicators are routinely published, including teacher assessment data at the end of key stages and qualifications attainment. In analysing performance, our emphasis will be on ensuring that no artificial barriers exist for learner progression in STEM, so that our education system better meets the demand for STEM skills summarised above. This requires a more detailed analysis of performance by STEM-related qualification type (and any potential gender-related imbalances) to ensure any 'over-application' of qualifications that do not facilitate progression is avoided. To reinforce our emphasis in this area, communication will take place direct with key stakeholders, the publication of data, and through annual Ministerial statements on progress.

IN SUMMARY: OUR ACTIONS

WE HAVE

- Published annually key science and mathematics data, covering, for example, teacher assessment of learner progress at the end of the Foundation Phase, Key Stages 2 and 3, and attainment at Key Stage 4 and AS / A levels.
- Ensured that attainment and progression data at key stages is available on the basis of gender and eligibility for Free School Meals (eFSM).[4]
- Initiated work on accessing and collating relevant Labour Market Intelligence and employer skills needs to inform policy, alongside key educational attainment data.[5]
- Worked with UKCES to disseminate the employment projections included in the Working Futures series of reports, and commissioned a summary report for Wales from Working Futures 2012-22.[6]
- Implemented a range of Skills Performance Measures which provide the basis for delivering our ambition for skills in Wales and the changes needed in response to the Policy Statement on Skills. Specifically, the measure on equality and equity will be used to monitor equality of opportunity for individuals in accessing post-19 employment and skills support.[7]

[4] Relates to Recommendation 11 of the EBC STEM Inquiry Report
[5] Relates to Recommendation 10 of the EBC STEM Inquiry Report
[6] Relates to Recommendation 10 of the EBC STEM Inquiry Report
[7] Relates to Recommendations 10 and 11 of the EBC STEM Inquiry Report

WE WILL

- Develop with stakeholders the details of an annual data report for first publication in 2016, so that all stakeholders have access to a single reference source for STEM in education progress in Wales to inform planning and monitoring arrangements.[8]
- From 2016, alongside the data report, publish an annual Ministerial statement on developments in STEM education and training in Wales. This will highlight the sustained emphasis on STEM skills development, areas of progress, and key issues for stakeholders as the focus of future work.[9]
- Monitor trends and projections on future employment levels in STEM occupations and skills needs through Working Futures and the Employer Skills Survey, so that the data can be used to inform both STEM education and training provision, and robust careers information to learners system-wide.[10]
- Improve the availability and use of STEM-related Labour Market Intelligence in Wales (such as through the Skills Gateway, the Learning and Skills Observatory website, and CareersWales online) to enable key decision makers, and all young people, access to appropriately presented information in STEM employment opportunities.[11]

2.2 Further research and analysis

In addition to the development and production of national STEM skills data, research or other analytical work will need to be undertaken to better understand specific issues regarding the teaching and learning of STEM skills. Such analysis will directly inform future support, guidance, and delivery programmes.

In many respects, specific actions in this area will flow from changes in STEM performance over time. Whether data is showing progress (or the lack thereof) the information below sets the framework through which additional analysis work will be reviewed and managed. It also includes specific actions we have already identified to help decision-makers and wider stakeholders better understand issues behind performance. In addition to specific commissioning, work will also continue to take place through engagement with key STEM stakeholder organisations operating in Wales, and the capturing of their views on performance issues.

To oversee the day-to-day work in this area, and the Plan as a whole, we have established an internal Welsh Government cross-Departmental STEM in Education and Training Group, with the Chief Scientific Adviser for Wales as Chair.[12] The Group will report progress to Ministers.

[8] Relates to Recommendations 7, 10 and 11 of the EBC STEM Inquiry Report
[9] Relates to Recommendations 7, 10 and 11 of the EBC STEM Inquiry Report
[10] Relates to Recommendation 10 of the EBC STEM Inquiry Report
[11] Relates to Recommendation 6 and 10 of the EBC STEM Inquiry Report
[12] Relates to Recommendation 1 of the EBC STEM Inquiry Report

IN SUMMARY: OUR ACTIONS

WE HAVE

- Undertaken an evaluation of the Numeracy Employer Engagement Programme, to capture lessons learned on the management of school-employer links and inform the development of the Enhanced Employer Engagement project.[13]
- Ensured that Wales' PISA mathematics and scientific literacy results have been analysed to capture trends in areas of content, context or assessment approaches that Welsh 15 year-olds do well in, or have shown difficulty in accessing correctly. This is already informing the content of classroom resources in support of the new GCSE qualifications, and advisory support being delivered by regional Consortia for these new qualifications.
- Analysed science Key Stage 4 qualification take-up on the basis of qualification type, including the impact of BTEC science in recent years, against other science qualification options so that informed decisions could be made on revisions to KS4 performance measures and negative impact on progression in science could be better tracked.
- Undertaken in 2014 a survey of science practitioners on curriculum, assessment and teacher support issues to inform further support development.[14]
- Established a termly networking group between Welsh Government officials and the three science Learned Societies and Association of Science Education, to formalise dialogue on school science curriculum and qualifications development.
- Undertaken and distributed to schools via education Consortia a detailed analysis of the 2015 OECD Scientific Literacy framework against the current suite of Key Stage 4 science qualifications. Schools need to better understand the differences between current science learning and the PISA assessment so they can minimise exposing pupils to uncovered assessment content.
- Introduced a network of three Regional Skills Partnerships, tasked with identifying and responding to their regional economic priorities.

WE WILL

- Over the year ahead, engage and consult with Welsh-medium stakeholder organisations on the progress of this Plan, so their views can better inform support programmes.[15]
- Introduce measures to assess the performance of sixth forms, colleges and work-based learning providers in relation to the qualifications achieved by their learners.
- Undertake a follow-up survey with science practitioners, including increased input from Welsh-medium schools, to inform future support programmes following the introduction of the new GCSE science suite in September 2016.[16]

[13] Relates to Recommendation 4 of the EBC STEM Inquiry Report
[14] Relates, in part, to Recommendation 13 of the EBC Inquiry Report
[15] Relates to Recommendation 13 of the EBC STEM Inquiry Report
[16] Relates to Recommendation 13 of the EBC STEM Inquiry Report

- Commission a detailed analysis of PISA 2015 attainment in science and mathematics (with scientific literacy being the major domain), following publication of the headline results in December 2016. This will identify areas of context and content where Welsh learners do not perform as well consequently informing future curriculum development and application in schools.
- Undertake by December 2015 further analysis of the apparent disparity in gender performance in mathematics between current GCSE and PISA assessments, as recommended by Estyn. Better understanding of possible gender-based impact from different assessment types will inform future assessment arrangements in Wales.[17]
- Explore over the year ahead whether future skills projections can be meaningfully matched against existing post-16 learning provision, to ensure that we have people in the right pipeline to meet future demand.[18]
- Task the three Regional Skills Partnerships to publish annual plans detailing the supply / demand conditions for skills locally to correspond with their regional economic priorities.[19]
- Consider by December 2015 options for a review of student numbers by subject and occupational area in the FE sector, so we can better understand the balance of FE provision against national priorities.[20]

[17] Relates to Recommendation 11 of the EBC STEM Inquiry Report
[18] Relates to Recommendation 10 of the EBC STEM Inquiry Report
[19] Relates to Recommendation 10 of the EBC STEM Inquiry Report
[20] Relates to Recommendation 10 of the EBC STEM Inquiry Report

3. Supporting teaching and learning

We know that the need for STEM skills in Wales, and the exciting career opportunities they unlock for our young people, will continue as our economy continues to grow. We also know how important those skills are in underpinning our future economic growth.

> **Our priority is to evolve the teaching and learning undertaken in our schools, colleges and universities in a way that supports the development of STEM skills by our young people to meet their, and employer, needs in the 21st century.**

Already in 2015, we have seen publication of key documents setting out radical new proposals for changes to our education system in Wales. Professor Graham Donaldson's report, *Successful Futures*[21], suggests a vision for the future of education in our schools. It is telling that it sets the development of STEM skills from age 3 to 16 front and centre, recognising their importance in an increasingly science and technology driven world. From the proposed Purposes of the Curriculum, the cross-curricula Digital Competency Framework, through to the six Areas of Learning and Experience (two of which specifically relate to STEM), areas around science, technology, ICT/computing and mathematical and numerical development are clearly recognised. Critically, it also captures the findings of the ICT Steering Group[22], reflecting how important work in this area is in equipping our young people with the skills they need to succeed in a lifetime we can only imagine. A point also clearly communicated by the EBC in its 2014 report.

Successful Futures also highlights the essential nature of pedagogical development and that Wales' education practitioners need the skills and knowledge necessary to be able to deliver a new curriculum. This is nowhere more important than in the STEM field, where we know from global research that the subject knowledge of teachers (in areas such as mathematics and science) is a direct factor in learner attainment. Professor John Furlong's report, *Teaching Tomorrow's Teachers*[23], presents the Welsh Government with a series of options to better prepare our new teachers for a 21st century curriculum through changes to Initial Teacher Training. When read alongside the Minister for Education and Skills' statement on the *New deal for the education workforce*[24] (16 March 2015), a coherent approach emerges.

> **Our priority is for the long-term, self-sustaining, system-wide development of an education workforce in Wales capable of delivering a new and challenging STEM curriculum.**

[21] http://gov.wales/topics/educationandskills/schoolshome/curriculuminwales/curriculum-for-wales/?lang=en

[22] http://learning.wales.gov.uk/resources/browse-all/ict-steering-groups-report/?lang=en

[23] http://gov.wales/topics/educationandskills/publications/wagreviews/teaching-tomorrows-teachers/?lang=en

[24] http://gov.wales/about/cabinet/cabinetstatements/2015/newdealeducation/?lang=en

A new approach to curriculum, assessment, professional learning and initial teacher training will take time to consider and implement. We need to get it right, while continuing to drive improvements through existing curriculum arrangements (such as recent revisions to the mathematics programmes of study). Rapid progress in introducing a new STEM-related curriculum, without the essential underpinning teacher development to ensure their readiness to deliver, would be counter-productive.

Practitioners and key stakeholders are being engaged both formally (through the Great Debate on Welsh Education[25]) and informally to develop Government thinking on the way forward. Their sustained engagement and support is as critical now as it will be throughout the process of reform. It is they who will deliver the STEM skills we need for the future.

STEM qualifications gained in Wales also need to reflect our approach to the teaching and learning of STEM set above, while remaining portable for the learner. Through STEM qualifications gained in Wales, our young people should be able to study and work wherever is best for them.

> **Our priority is for our STEM related qualifications in Wales be of a standard comparable with the rest of the UK and the best in the world.**

In taking this priority forward, we have retained and are in the process of strengthening our STEM-related GCSEs and A levels in Wales, in addition to a more rigorous Welsh Baccalaureate. The introduction of two new mathematics GCSEs for first teaching from September this year, for example, has signalled clearly the emphasis we place on fit for purpose STEM related qualifications.

For vocational qualifications, we are ensuring the relevance, value and rigour of qualifications in receipt of public funding. The Review of Qualifications[26] highlighted that assessment must be robust, valid, appropriate and proportionate, with the value and currency of qualifications being largely dependent on the extent to which they are recognised and understood. We are now engaged in a programme of UK-wide communication to explain and raise the profile of qualifications in Wales, particularly with Higher Education Institutions.

The actions to support the teaching and learning of STEM skills set out in this section are the core focus of this Plan. They are wide-ranging, covering issues such as curriculum design, qualifications development, STEM enrichment, and support to enhance the skills and knowledge of practitioners.

[Drafting Note: *Successful Futures, Teaching Tomorrow's Teachers* and the *New deal for the education workforce* present proposals for unprecedented change across the education landscape in Wales. It is essential that individuals at every level of our education system have the opportunity to reflect on what these proposals mean for them – and for those views to be captured and considered. That process is underway.

[25] http://gov.wales/topics/educationandskills/great-debate/?lang=en
[26] http://gov.wales/topics/educationandskills/qualificationsinwales/revofqualen/?lang=en

The Welsh Government's responses to proposals set out in the two reports will take place before the finalisation of this draft Plan (and may happen during the EBC's consideration, depending on when that is scheduled). This section, including relevant sub-sections below, will be amended to reflect those responses and decisions during this period.

At this point, the priority for enhancing digital skills development in schools (as expressed by the ICT Steering Group, stressed by the EBC, and reinforced by *Successful Futures*) is very much recognised by the Welsh Government].

3.1 Developing fit-for-purpose STEM curricula

An engaging and inspirational curriculum in STEM subjects is the essential core to STEM skills and knowledge development in schools.

Our priority for the evolution of 21st century STEM teaching and learning is embedded in our emphasis on ensuring we have the right STEM curricula in Wales. It is the curriculum followed by schools and colleges that provides our young people with the subject knowledge they need to attain STEM qualifications for their progression into further learning and the world of work. It is also the curriculum, delivered through great teaching, which provides the space and guidance necessary for the development of the enquiry, reasoning and practical skills essential to STEM. In instances where a young person does not intend to go on to further STEM-related learning or work, the skills they develop through a well-taught STEM curriculum are still widely recognised as applicable in preparing them for employment opportunities and the life ahead.

Our work prioritising numerical skills in Wales is, encouragingly, resulting in a growing sense of value around mathematics. However, it is also essential that all our young people leave school with stronger *scientific literacy*[27] if they are to succeed in their lives.

IN SUMMARY: OUR ACTIONS

WE HAVE

- Introduced on a statutory basis revised Areas of Learning and programmes of study for mathematics, so that our expectations for literacy and numeracy, as expressed through the Literacy and Numeracy Framework (LNF), better align to our mathematics curriculum.
- Undertaken an independent review of the curriculum and assessment arrangements for Wales – which takes STEM skills development into account.[28]
- Engaged all stakeholders in the Great Debate on Welsh Education to enable STEM practitioners and stakeholders to respond to the curriculum and assessment review's report, *Successful Futures*.[29]

[27] OECD PISA Draft Scientific Literacy Framework, 2015

[28] Relates to Recommendations 2 and 3 of the EBC STEM Inquiry Report

- Maintained ICT as a statutory subject in Welsh schools at Key Stages 2 and 3 and as part of the non-statutory Skills Framework for 3-19 year olds.
- Introduced Learning Programmes for 16 to 19 year-olds which provide greater focus on courses that employers and universities value, such as STEM subjects, and which offer industry-relevant curriculum and work experience.[30]

WE WILL

- Respond by July 2015 to the recommendations in *Successful Futures*, following practitioner and wider stakeholder feedback through the Great Debate on Welsh Education.[31]
- Work closely with STEM practitioners and key organisations over the year(s) ahead, such as the Learned Societies and Association for Science Education, in developing a fit for the 21st century STEM related curriculum across primary and secondary settings in Wales.[32]
- Consider closely practitioner and stakeholder views on the need for a digital competency framework and the proposed ICT/computing elements of the Science and Technology Area of Learning and Experience (as recommended in *Successful Futures*), and move swiftly this year on resulting decisions.[33]
- Refresh our National Literacy and Numeracy Programmes in the autumn to ensure continued cross-curricula development (including through the provision of science, technology and mathematics).[34]

3.2 Enhancing and enriching the STEM curriculum

Global research suggests that the STEM skills and knowledge developed through formal education is enhanced through the provision of STEM enrichment activities for young people. It is difficult to unpack the direct impact of a particular intervention on knowledge attainment or attitudinal change (leading to STEM career choices). However, as a consequence of wider understanding and our priority on the teaching and learning of STEM skills (page 11), support must continue for high-quality and relevant STEM enrichment opportunities. And in a time of challenging budgetary pressures (as referenced on page 6) provision must be targeted in a more strategic way, in line with identified priorities.

Our emphasis on girls in STEM is explored in more detail in Section 4, and our key educational priority to narrow the gap in educational attainment based on socio-economic status clearly feeds through in our support for STEM enrichment. For example, we know that young people from disadvantaged communities are less likely to engage in extra-curricula activities, or participate in experiences likely to inspire them into further STEM related study or work.

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[29] Relates to Recommendation 3 of the EBC STEM Inquiry Report
[30] Relates to recommendation 5 of the EBC STEM Inquiry Report
[31] Relates to Recommendation 3 of the EBC STEM Inquiry Report
[32] Relates to Recommendations 2 and 3 of the EBC STEM Inquiry Report
[33] Relates to Recommendation 3 of the EBC STEM Inquiry Report
[34] Relates to Recommendation 2 of the EBC STEM Inquiry Report

Last year the Chief Scientific Adviser for Wales commissioned a strategic review of the NSA and STEM enrichment and inspirational learning. The review aimed to build on our strengths with the intention of examining long-term stable support for programmes.[35] A key element of the emerging strategy is a focus on achieving our defined aims. These include work to positively influence our young people between the ages of 9 to 14, recognising this period as crucial to when they decide to pursue STEM subjects and a future career in STEM. The strategy will also build on the successes reaped from commendable, high-performance NSA projects, with the most successful projects in terms of impact being invited to apply for further longer-term funding.[36] NSA funding has resulted, for example, in a higher percentage being awarded a CREST Award, compared to the rest of the UK.

[Drafting Note: As with curriculum reform, NSA review announcements and related future funding will likely take place during the period of the Committee's reflection on this draft. The narrative and actions in this sub-section will be updated to reflect those decisions, prior to finalising the Plan]

IN SUMMARY: OUR ACTIONS

WE HAVE

- Continued grant funding for the successful Further Mathematics Support Programme Wales, to better support the flow of higher order mathematics skills with increasing emphasis on girls' progression and teacher professional learning support.[37]
- Grant funded £1.755 million to Techniquest and Techniquest Glyndŵr to provide science and mathematics enrichment for primary and secondary pupils and charged the organisations with priorities to enhance girls' progression in physics and mathematics, and target provision at disadvantaged communities.[38]
- Agreed with the European Commission that the new ESF programme in West Wales and the Valleys has a Specific Objective for the development of STEM skills amongst 11-19 year olds, to reflect the need for greater funding for activities in these areas.[39]
- Provided NSA grant funding to support a number of universities in Wales to enhance STEM provision in schools – for example: GCSE science revision courses; support for year 10 and 12 students in bioscience, computing, geography, mathematics and physics; and enhancing the provision of computer science teaching for 3 to 19-year-olds.[40]
- Through the NSA, grant funded the three science Learned Societies to provide a range of projects focused both on primary and secondary schools.[41]
- Provided NSA grant funding for a range of projects with wider STEM organisations, including work with young people at risk of becoming NEET;

[35] Relates to Recommendations 1, 2 and 11 of the EBC STEM Inquiry Report
[36] Relates to recommendations 2 and 11 of the EBC STEM Inquiry Report
[37] Relates to Recommendations 7 and 11 of the EBC STEM Inquiry Report
[38] Relates to Recommendations 2, 7 and 11 of the EBC STEM Inquiry Report
[39] Relates to Recommendations 2 and 11 of the EBC STEM Inquiry Report
[40] Relates to Recommendations 2, 4 and 7 of the EBC STEM inquiry Report
[41] Relates to Recommendations 2, 4 and 7 of the EBC STEM inquiry Report

theatre performances to children and parents; and STEM workshops and teacher professional development.[42]

- Involved STEM enrichment partners, including See Science, Techniquest and EESW, in supporting the Schools Challenge Cymru Pupil Offer.[43]
- Grant funded the Innovation Awards scheme for students studying WJEC Design and Technology at GCSE, AS and A level to promote a culture of innovation linked to STEM skills development. Over 2,500 teachers and learners attend the events.[44]

WE WILL

- Over the next three years, continue grant funding through the NSA ensuring activities are targeted on the priorities agreed through the NSA review [dn - details to be added], and a longer-term view is taken on funding strategically aligned project activity.[45]
- Continue to grant fund Techniquest and Techniquest Glyndŵr, with specific strategic objectives to enhance girls' progression and target disadvantaged communities.[46]
- Consider, by December 2015, options for the development of the Further Mathematics Support Programme Wales, and how this can be rolled out for coverage Wales-wide from April 2016 ensuring more learners are supported to develop their higher order maths skills.[47]

3.3 Introducing fit-for-the future STEM qualifications

The Review of Qualifications for 14 to 19-year-olds in Wales ensured that we have qualifications that are understood and valued and meet the needs of our young people and the Welsh economy. Following wide consultation, the recommendations accepted in January 2013 inform the development of STEM-related qualifications, such as revised mathematics GCSEs.

The two new GCSEs in Mathematics-Numeracy and Mathematics will be introduced for first teaching from September 20115, at the same time as the revised maths Areas of Learning and programmes of study become statutory. This links with our work in aligning the revised curriculum and qualifications with the Literacy and Numeracy Framework (LNF). It also reflects our commitment to equip learners with the skills they need for functioning effectively in everyday life and employment; skills that will meet the needs of our young people and the economy.

[42] Relates to Recommendations 2, 4, 7 and 11 of the EBC STEM Inquiry Report
[43] Relates to Recommendations 2, 4 and 11 of the EBC STEM inquiry Report
[44] Relates to Recommendations 2 and 4 of the EBC STEM inquiry Report
[45] Relates to Recommendations 2, 4, 7 and 11 of the EBC STEM Inquiry Report
[46] Relates to Recommendations 2, 7 and 11 of the EBC STEM Inquiry Report
[47] Relates to Recommendations 7 and 11 of the EBC STEM Inquiry Report

IN SUMMARY: OUR ACTIONS

WE HAVE

- Introduced, for teaching from September 2015, two new mathematics GCSEs, one covering numeracy and the other covering aspects of mathematics techniques, in line with the Review of Qualifications recommendations.
- Reformed the Welsh Baccalaureate for first teaching from September 2015, which gives the opportunity to develop skills through Challenges and an Individual Project. We have also overseen publication of related Specifications, SAMs, and guidance for practitioners; which highlight how STEM can be pivotal to the Challenges and the Individual Project.[48]
- Consulted closely with stakeholders on the composition and content for changes to the science GCSEs suite, and issued guidance to WJEC for the development of this suite of qualifications.
- Accredited revised GCE AS and A level science qualifications for Wales, as well as revised GCE AS and A Level qualifications in Computer Science, to maintain qualifications comparability and portability, while responding to the needs of Higher Education.
- Categorised all vocational qualifications as IVET (Initial Vocational Education and Training) or CVET (Continuing Vocational Education and Training) to determine their appropriateness for teaching pre-16.
- Invested in Higher Apprenticeships to support frameworks associated with STEM subjects.

WE WILL

- Strengthen the vocational gateway with the introduction of Sector Qualifications Advisory Panels (SQAPs) to ensure that only those vocational qualifications which are valued by employers in the sector are accredited for use in Wales.
- Accredit the revised GCSE science suite of qualifications in Autumn 2015, for first teaching from September 2016, to take into account scientific literacy principles and better facilitate progression to the revised A level science suite.
- Reform GCE AS and A levels in mathematics and Further Mathematics in Wales for first teaching from 2017, to facilitate progression from the new mathematics GCSEs and retain the portability of our A levels.
- Review responses to the consultation on *Aligning the apprenticeship model to the needs of the Welsh economy* in seeking to build a strong STEM offer within the context of apprenticeship delivery, and ensure that apprenticeships have market relevance.

3.4 Advice, guidance and teacher support

Practitioners across all educational settings value fit-for-purpose advice, guidance and professional learning support which positively impacts their teaching and learning in the classroom. Effective teachers ensure good learning outcomes for their pupils and students.

[48] Relates to Recommendations 4 and 5 of the EBC STEM Inquiry Report

As noted on page 11, our priority to support our education workforce in their professional development is linked to the capacity of delivering the new and challenging STEM curriculum and qualifications arrangements set out in Sections 3.1 and 3.3.

Global studies[49] into what makes great teaching highlight six components which have a demonstrable benefit on learner outcomes. Within these, the content knowledge of teachers is clearly highlighted as a strong factor. We are, therefore, emphasising measures to address the STEM subject specific knowledge of our practitioners, particularly in areas such as physics, ICT/computing and mathematics.

Alongside this, the quality of instruction provided has been highlighted as the other strong factor which impacts on learner outcomes. Effective questioning skills and techniques are a key element; an issue which has featured in the support now available in Wales (for example) on the development of numerical reasoning skills in primary and secondary settings. Other areas of great teaching cited in the report include classroom management and teacher behavioural approaches, all of which are captured in the focus on pedagogy in wider professional learning development.

In taking forward our priority to support STEM practitioners' skills and knowledge, the *New deal for the education workforce* is a critical. Through career-long reflection and development of practice, STEM teachers will access a structured entitlement to high-quality programmes and development opportunities. A number of STEM stakeholder organisations in Wales already provide a high level of professional learning support, and we will work with those organisations to enhance emphasis on access and availability, linked to agreed standards.

The Welsh Government has also provided a range of guidance to schools in STEM related areas, including on forward changes to KS4 performance measures. Linked to our priority to increase the flow of STEM skills, from 2017 performance measures will place greater emphasis on a revised capped points score, including an increased requirement for mathematics and science study. These changes will reduce the focus on the C/D borderline and create greater incentive for schools to stretch all pupils to achieve their full potential, including the more able and talented.

In Wales the term 'more able and talented' (MAT) is used to describe learners who display abilities in one or more areas beyond normal expectations, and require enriched and extended opportunities across the curriculum in order to develop and build on those abilities. In our priority to increase the flow of STEM skills in Wales, it is essential that we nurture and inform our MAT learners.

Our guidance *Meeting the Challenge - Quality Standards in Education for More Able and Talented Pupils* encourages schools to discuss their interpretation of MAT and to come to an agreed definition within the context of their own setting. Guidance is focused on building approaches on a whole-school basis, with consequent links to school development plans. The need to stretch, enthuse and respond to the learning needs of our more able and talent learners is directly relevant to STEM skills acquisition.

[49] What makes great teaching?, Sutton Trust, 2014

One of the outcomes of the Oxbridge Ambassador's report[50] into under-representation of Welsh students in leading universities has been the establishment of the Seren Network. The Seren Network is being established to support high achieving students reach their academic potential and progress to the most competitive universities in the UK. Each partnership hub will introduce a programme of super-curricular academic support, designed to stretch and challenge high achieving students with increased emphasis on higher order STEM skills.

IN SUMMARY: OUR ACTIONS

WE HAVE

- Published a guide on the OECD 2015 scientific literacy framework, and an online bilingual INSET module including filmed classroom content, so teachers better understand scientific literacy and its relevance to all learners.[51]
- Introduced a specific education Consortia-based advisory function for schools in science and mathematics, to support GCSE qualifications change and understanding the teaching and learning of PISA skills.[52]
- Published for primary and secondary schools, science infographics and curriculum planners, and a *Spotlight on STEM* Guide for careers, so teachers and learners have better access to up to date facts about STEM career opportunities and support programmes.[53]
- Funded a pilot of the Institute of Physics Stimulating Physics Network in Wales, providing mentoring support for non-specialist teachers of physics to improve their skills and knowledge, and girls' progression to A level study.[54]
- Charged Techniquest and Techniquest Glyndŵr to enhance their teacher professional learning offer in science and mathematics, through the agreement of a specific objective for their DfES grant funding, so practitioners can access relevant, high quality, professional learning locally.[55]
- Facilitated fully-funded professional learning for Welsh physics teachers at CERN in Switzerland, so teachers experience cutting-edge global research, and learn how to use that in their science teaching.[56]
- Enhanced the delivery of ICT and computer coding in schools through funding workshops for pupils and teachers in every secondary school in Wales.[57]
- Delivered a national conference for secondary Heads of Mathematics to share good practice and effective approaches for mathematics pedagogy.[58]
- Charged the Mathematics Task and Finish Group to consider how the quality and quantity of maths teachers can be enhanced and develop an Action Plan.[59]

[50] http://gov.wales/topics/educationandskills/learningproviders/oxbridge-project/oxbridge-final-report/?lang=en
[51] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[52] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[53] Relates to Recommendation 4 of the EBC STEM Inquiry Report
[54] Relates to Recommendations 7 and 11 of the EBC STEM Inquiry Report
[55] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[56] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[57] Relates to Recommendations 3 and 7 of the EBC STEM Inquiry Report
[58] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[59] Relates to Recommendation 7 of the EBC STEM Inquiry Report

- Introduced Regulations to ensure the professional development needs of the school workforce form part of the school's strategic development plan.[60]
- Continued to offer teacher training incentives for STEM graduates and career changers with a background in industry undertaking post-graduate initial teacher education and training courses.[61]
- Placed more emphasis on the capped points score for monitoring KS4 performance (requiring 2 mathematics and 2 science qualifications from 2017), impacting on work to develop the more able and talented (MAT) pupils.
- Introduced standards and guidance to support schools to further develop provision for MAT pupils, as part of a whole-school improvement agenda.
- Undertaken a review of provision for MAT learners aged 3-19 (including for STEM) to understand how they are identified, supported and challenged to inform future guidance and support arrangements.
- Introduced three regional partnership hubs in the pilot phase of the Seren Network, to better support learner progression to top universities.

WE WILL

- Update our current STEM guidance document for teachers in Spring 2016, in the light of Welsh Government decisions regarding *Successful Futures*. This to include content on unconscious gender bias in STEM, building on findings of global research and work in Wales on 'gender lensing'.[62]
- Publish throughout 2015/16, termly easy-access infographics on STEM, and expand the range of content on support available in primary and secondary settings to teachers are better able to access available programmes.
- Increase advisory support for science through the regional education Consortia from September 2015, so they are better able to support schools' introduction of the new science GCSE suite for first teaching from September 2016.[63]
- Continue to promote the use of STEM Ambassadors in primary and secondary settings to the benefit of both teachers and learners.[64]
- Review and update guidance on delivery of Careers and the World of Work Curriculum framework, as part of enhancing school-employer links.[65]
- Expand from September 2015 the IoP's Stimulating Physics Network programme in Wales to the same (pro-rata) level as England, so that more non-specialist physics teachers have access to mentoring support, and we encourage more girls into A level physics study.[66]
- Through 2015/16 grant funding, require Techniquest and Techniquest Glyndŵr to increase professional learning support to primary and secondary science and mathematics teachers so that Welsh teachers have access to quality professional learning opportunities locally.[67]

[60] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[61] Relates to Recommendations 3, 7 and 8 of the EBC STEM Inquiry Report
[62] Relates to Recommendation 11 of the EBC STEM Inquiry Report
[63] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[64] Relates to Recommendations 2, 7 and 8 of the EBC STEM Inquiry Report
[65] Relates to Recommendation 8 of the EBC STEM Inquiry Report
[66] Relates to Recommendations 7 and 11 of the EBC STEM Inquiry Report
[67] Relates to Recommendations 7 and 11 of the EBC STEM Inquiry Report

- Through the funding of workshops for pupils and teachers, ensure that every secondary school has one or more teacher with direct experience of working with code by 31 March 2016.[68]
- Continue to actively promote physics teacher professional development through fully funding opportunities at CERN, Switzerland so that more teachers have access to cutting edge research, and the impact on their teaching of science.[69]
- Organise events in 2015 for primary mathematics teachers to share good practice and effective approaches for mathematics.
- Develop a range of provision that will underpin the New Deal for the Education Workforce (including a new Masters programme) to provide practitioners with access to the highest quality STEM professional learning opportunities.[70]
- Consider implementing recommendations contained in *Teaching Tomorrow's Teachers*: *Options for the future of Initial Teacher Education in Wales*, including how the availability of training incentives supports STEM teacher recruitment.[71]
- Publish the findings of the Review to Identify *Provision of More Able and Talented Learners in Wales* in 2015, and revise current guidance and develop resources to support provision by practitioners and schools.
- Create further Seren Network hubs in 2015/16 to ensure support is available to all students in Wales, facilitating the flow of Welsh learners into the UK's best universities. And, through building links with partner STEM organisations (such as the Further Maths Support Programme Wales and the Engineering Education Scheme Wales) ensure that all students involved in Seren are aware of opportunities for higher STEM skills development at A level and beyond.

3.5 Provision of bilingual resources

Practitioners in all education settings need good quality teaching resources that they can access easily and have confidence in. It is essential, therefore, that in taking forward our priority to support STEM teachers, that our Welsh medium and bilingual schools are also well equipped to deliver STEM skills through the medium of Welsh, and that such resources are readily and easily available. A point the EBC notes clearly in its 2014 report. It is also important that the supply of Welsh-medium STEM-related teaching resources is maintained in line with practitioner demand. We will, therefore, regularly test with practitioners the availability of resources and their evolving needs going forward.

IN SUMMARY: OUR ACTIONS

WE HAVE[72]

- Published bilingual sample PISA scientific literacy and mathematics questions in .pdf format and as an interactive online resource for schools and colleges.

[68] Relates to Recommendations 3 and 7 of the EBC STEM Inquiry Report
[69] Relates to Recommendations 4, 7 and 8 of the EBC STEM Inquiry Report
[70] Relates to Recommendation 7 of the EBC STEM Inquiry Report
[71] Relates to Recommendations 7 and 9 of the EBC STEM Inquiry Report
[72] Relates to Recommendation 14 of the EBC STEM Inquiry Report

- Through the WJEC, published additional bilingual Specimen Assessment Materials (SAMs) for the new mathematics GCSEs.
- Produced new bilingual teaching resources (Teaching Assessment Materials – TAMs) in support of the new mathematics GCSEs, together with an audit of existing resources relevant to the new qualifications, so that teachers have access to new materials in advance of teaching the new GCSE maths suite.
- Quality assured the bilingual science teaching materials available to schools online through Hwb across key stages, with a new category being created to simplify access.
- Commissioned Techniquest and Techniquest Glyndŵr to produce KS4 science modules for outreach delivery targeted at the key areas (such as forces and motion, cells) identified through the analysis of existing KS4 qualifications and the OECD Scientific Literacy framework.
- Uploaded OPAL Project surveys on Hwb to download bilingual resources.
- Grant funded, through the NSA, a number of projects which include the development of bilingual STEM enrichment resource materials.

WE WILL

- Commission in June 2015 further Welsh-medium resources for mathematics at KS3/4, for publication on Hwb, which will be appropriate for use in class or the home learning environment.
- Produce, via the WJEC, additional bilingual SAMs in support of the new science GCSE suite, in advance of first teaching from September 2016.
- Publish bilingual TAMs in advance of new science GCSE suite being introduced for first teaching in September 2016.
- Facilitate by September 2015 the establishment of Hwb Networks between education consortia to better capture, quality assure, and subsequently publish bilingually online (through Hwb) science and mathematics KS3/4 resources developed through local school-to-school working.
- Continue to commission relevant Welsh-medium print and digital resources to support STEM subjects, and to consult with teachers and other practitioners to identify the resources required. A Needs Identification Panel for Science, Engineering and Design and Technology will be held in June 2015, and a Panel for Mathematics will be held in Autumn 2015.
- Where appropriate, as an ongoing condition of grant, require future NSA grant recipients involved in the development of online materials/resources to also make those available through Hwb.

3.6 Wider ICT support

In addition to the specific actions highlighted above, we have brought forward wider measures which support STEM in education delivery, particularly around the use and application of digital technology. This work has built on the findings of the Digital Classroom Teaching Task and Finish Group (March 2012). For example, the all-Wales learning platform Hwb+ was launched in 2012, and has now been rolled out to over 99% of schools in Wales. Hwb+ has been further complemented by an extensive suite of digital content resources and a wide range of e-Safety support

materials and tools which have been made available through Hwb, the National Digital Content Repository.

One of the major benefits of the Hwb+ platform is the integration of online tools; most notably Microsoft Office 365. Providing online tools via the national Hwb+ platform allows for a consistent approach across all schools and ensures that there is not a proliferation of different systems and protocols in place. Microsoft Office 365 provides a suite of free web applications, including Microsoft Word, Excel, PowerPoint and OneNote. While a large number of schools all over the world are already using Microsoft Office 365, we understand that Wales' approach provides the first instance of an all-country tenancy. This approach facilitates national collaboration in a way that has previously been unfeasible.

These Welsh Government centrally-funded initiatives provide a wide range of financial and pedagogical benefits consistently across all schools in Wales. Importantly in a STEM context, through access and use of such tools teachers will develop new approaches to STEM teaching and learning as their own understanding and application of digital technology grows. In support of this, we have already provided hands-on Hwb+ training to over 2,000 teachers through the extensive Hwb+ Digital Leader training programme.

IN SUMMARY: OUR ACTIONS

WE HAVE[73]

- Invested around £40 million to improve Wales' digital infrastructure through the Learning in Digital Wales grant programme, providing improved broadband services for schools in Wales, so that all primary, special and secondary schools will have improved in-school and Internet connectivity.
- Developed the Hwb platform as a single resource, providing access to high-quality digital resources for schools (including some very high-quality STEM material), and a single point of entry to a range of centrally-licenced tools. These tools provide schools with access to some of the latest in-classroom digital aides to support teaching and learning.
- Developed additional functionality for inclusion in Hwb, in conjunction with feedback from stakeholders. This includes:
  - Hwb Networks – the facility to create online professional learning communities which exploit the collaboration technology built into Hwb.
  - Hwb Community – an area on Hwb where practitioners can upload and share their digital resources with the wider Hwb community.
  - An e-Safety zone hosted on Hwb which promotes safe and responsible use of all digital technology across Wales.
  - Playlists – tools to sequence digital learning materials to support classroom activities in an engaging and interactive way.

[73] Relates to Recommendation 3 of the EBC STEM Inquiry Report

WE WILL

- From April 2015 as part of an all-Wales implementation, use technology to link educators digitally in a way that has not previously been possible through areas such as Hwb Networks.
- Ensure computing remains a focus for STEM activities by HEFCW and universities in Wales, including work on employer accreditation.
- Continue to support the adoption of the digital tools and resources provided through the Learning in Digital Wales programme, building on the Ministerial commitment to the Hwb+ project until August 2018.

3.7 Developments in Higher Education

The *Higher Education Policy Statement* (2013) and annual HEFCW remit letters make it clear that the science research agenda remains a high priority for the Welsh Government. HEFCW has a key role in building core research capacity and research excellence through its QR funding, and works with HE institutions in Wales to increase competitively won research and its exploitation. The 2015-16 remit letter requires the Funding Council to build upon its own research and that of others to address the shortfall in research scientists in Wales, especially in the areas of clinical medicine, engineering and other STEM subjects.

Building on the excellent outcomes of the 2014 Research Excellence Framework (REF) assessment, HEFCW has been charged with promoting continued improvement in research performance through the development of stronger research environments, greater critical mass, and research excellence. Funding may also support the greater involvement of women in science and support for enhanced co-operation between HEIs and schools to facilitate teacher and pupil understanding of STEM. STEM engagement will be co-ordinated with the activities of the NSA to achieve complementarity.

The REF results confirm that there are very significant research strengths in Wales, but they also provide further evidence that Welsh universities suffer from a shortfall of researchers, particularly in the STEM disciplines. HEFCW will continue to support initiatives to increase Wales' research capacity in key areas of science, most critically the next phase of the Welsh Government's Sêr Cymru programme.

In addition to evidence of higher demand from employers for STEM-related skills, there is evidence also of growing demand for STEM subjects from undergraduate applicants. UCAS figures show that the number of Welsh undergraduates accepted onto STEM-related courses has grown steadily from just under 7,000 students in 2007 to over 8,700 students in 2014.

IN SUMMARY: OUR ACTIONS

WE HAVE[74]

- Through the 2014-15 remit letter to the Higher Education Funding Council for Wales (HEFCW), required it to take a whole-sector view of Welsh universities' financial position, as well as each individual university.
- Asked HEFCW to review the funding support for subjects within universities, and the effect of the new tuition fee and student support arrangements introduced in 2012 on HEIs' approaches to resource allocation.
- For 2015-16, required HEFCW to review its current funding formula. In doing so, the Funding Council has been asked to recognise the importance of part-time HE, supporting Quality Research, and the funding of subjects that are expensive to operate (for example, medicine and dentistry).
- Set up an independent review of HE funding and student finance chaired by Professor Sir Ian Diamond, Vice-Chancellor of Aberdeen University. Support for STEM subjects is one of the issues being considered by the review, which will report in autumn 2016.

WE WILL[75]

- During 2015-16, consider the views of HEFCW on what encouragement it should provide to the HE sector to ensure STEM provision in Wales is able to keep up with demand. This in the light of the growing demand for highly-skilled graduates, and the potential returns for individuals in terms of future career prospects and earnings, which is fuelling a growth in demand for STEM provision.
- Consider the views of Professor Diamond, who is likely to make recommendations in his report about higher-level STEM skills funding and provision, and respond accordingly, in autumn 2016.

[74] Relates to Recommendation 9 of the EBC STEM Inquiry Report
[75] Relates to Recommendation 9 of the EBC STEM Inquiry Report

4. Changing perceptions

Changing a person's perception of STEM as an appropriate route for study, or field in which a career can be sought, is widely recognised as challenging. Perceptions often involve outdated understanding of what study and work in STEM-related employment might involve. This is influenced by a view of engineering, for example, based on out-dated heavy industry; or science and mathematics as appropriate only for the "bright geeky kids". Changing perceptions to recognise the reality of contemporary STEM often, therefore, involves attitudinal change from deeply embedded societal stereotypes.

This is most certainly the case regarding the relevance of STEM to girls. Despite some progress in gender-equity in some areas of STEM, emphasis needs to remain in areas such as physics, technology/computing and engineering.

> **Our priority is to increase interest and participation in STEM learning, particularly with girls.**

As highlighted by the EBC through its Inquiry, this will require a sustained effort over time; plus the support and contribution of a wide range of STEM practitioners, stakeholders and civic society. Those working in Wales' education and training system have a key role to play in contributing to this necessary attitudinal change. If we are to meet future demands for the STEM skills we know Wales needs for sustained economic growth, we need to increase the supply of STEM skills through greater numbers of young people pursuing STEM as an option. To achieve that, we simply cannot ignore half the population.

The provision of professional, impartial careers information advice and guidance (CIAG) is a key element in the development of young people's education and future career choices over their lifetime.

> **Our priority is to equip our young people with career management skills and knowledge of the options available to them in the STEM sector, so they are able to make better informed decisions on their futures.**

The need also exists to disseminate and raise awareness of the wide range of career opportunities in different sectors, such as STEM, among parents and teachers, as key individuals who influence and guide young people on their journey into adulthood.

This section, therefore, is concerned with changing perceptions and attitudes about STEM skills, careers and further learning with education leaders, teachers, children, young people and their parents – indeed, society at large.

4.1 Reinforcing the importance of STEM

There is evidence to suggest that some STEM subjects have received less priority in curriculum planning in some maintained schools in recent years. The rapid increase in the application of certain vocational science qualifications, at the expense of more traditional GCSEs, has arguably been a factor in Wales' declining performance in PISA scientific literacy. This also impacts on the preparedness of young people for life in an increasingly science and technology driven world, and their ability to access the exciting and rewarding career opportunities afforded through STEM study.

The essential emphasis on literacy, numeracy and narrowing the gap between attainment and socio-economic status as key priorities for schools, has to be maintained. Emphasis on and development in these three areas is the key to unlocking greater progression and take-up in STEM. However, as reflected on in *Successful Futures*, the increasing importance of STEM skills and knowledge as a means to accessing rewarding careers needs to be more widely recognised across the education landscape.

The ongoing *Making numbers count* campaign is one of our key means of reducing people's negative attitude towards mathematics. All too often, people are heard saying "I can't do maths", to the extent that it is often socially acceptable. Although people in Wales recognise they use mathematics on a daily basis, many express negative views about mathematics in front of their children. Having a negative attitude towards number can readily transfer to children, resulting in poor numerical skills development. The messages within this campaign focus on the need for all adults to be more confident when dealing and talking about mathematics.

Launched by the Minister for Education and Skills in October last year, our *Focus on Science* campaign is targeted at practitioners, learners and their parents. It was developed in response to calls for greater emphasis on science in schools. Although still in its early stages, the campaign is building momentum and a growing body of resources, information, case studies and role models, with the key themes that: science is valued, science is fun, and science is just as important for girls.

IN SUMMARY: OUR ACTIONS

WE HAVE

- Linked the *What you say counts* and *Focus on Science* campaigns to the parent-focused *Education begins at home* campaign and Facebook page, promoting key messages about the importance of science and mathematics to learners, teachers and parents, via television, radio, and social media, and roadshows in Communities First areas.[76]
- Ensured that *Focus on Science* materials have been 'gender lensed', with an emphasis on girls in STEM, and worked closely with EESW in relation to promoting girls' study of science (including case studies with Sony).[77]

[76] Relates to Recommendations 2, 4 and 11 of the EBC STEM Inquiry Report
[77] Relates to Recommendation 11 of the EBC STEM Inquiry Report

- Produced a range of narrative and video-based *Focus on Science* case studies, including with role models who have careers in science (*Science takes you places*) linked to key STEM enrichment activities and the campaign themes.[78]
- Promoted to all Welsh secondary schools via various media the 2015 CERN three-week summer school for physics teachers, and produced a video case study on the Welsh teacher group course at CERN in February 2015.[79]
- Developed (and funded), in conjunction with Pearson, a new category of 'Science Teacher of the Year' for the UK national teacher awards, and sponsored the 'best application of science' award at the 2015 Big Bang events organised by EESW.[80]

WE WILL

- Drive forward *What you say counts, Focus on Science* and *Education begins at home* actively promoting their key themes over the year ahead in support of attitudinal change towards STEM.[81]
- By December 2015 publish further resources for parents, linked to the *Education begins at home* campaign, so they better understand the importance of STEM learning for their children.[82]
- Support science activity at local science festivals, Skills Cymru, and Big Bang events in Wales, over the year ahead so that key campaign messages can be communicated and learners better access STEM careers information.[83]
- As part of *Focus on Science* activity in 2015-16, produce further case studies with a focus on role models and career options, targeting enhancement of girls' engagement with STEM subjects, and disseminate widely.[84]
- Over the next two years, work with the UK-wide *Your Life* KS4 mathematics and science campaign to ensure synergies between the campaigns are maximised, and that young people in Wales (and notably girls) have access to *Your Life* opportunities.[85]

4.2 Careers advice and guidance

As noted in Section 2, the advice and guidance provided through the Careers Wales website and other channels, including face-to-face where appropriate, is informed by professional bodies including Sector Skills Councils, employers, Labour Market Information (LMI) data, and research. As a result of these links, Careers Wales is developing a series of features for its website, one of which, *Spotlight on STEM* is highlighting the opportunities and careers in this area. Such year-round guidance is enhanced at key points - for example, young people receiving their GCSE and A level results each summer.

[78] Relates to Recommendation 11 of the EBC STEM Inquiry Report
[79] Relates to Recommendations 7 and 11 of the EBC STEM Inquiry Report
[80] Relates to Recommendation 4 of the EBC STEM Inquiry Report
[81] Relates to Recommendations 2, 4 and 11 of the EBC STEM Inquiry Report
[82] Relates to Recommendations 6 and 11 of the EBC STEM Inquiry Report
[83] Relates to Recommendations 4, 6, 11 of the EBC STEM Inquiry Report
[84] Relates to Recommendations 6 and 11 of the EBC STEM Inquiry Report
[85] Relates to Recommendations 6 and 11 of the EBC STEM Inquiry Report

Building on its role as the all-Wales, all-age, impartial and bilingual CIAG service, Careers Wales has a strategic function facilitating the development of closer links between schools, colleges and employers. The annual remit letter from Welsh Ministers to Careers Wales sets out how in the coming year Careers Wales will support the implementation of a new model for school-employer links, facilitated by the Enhanced Employer Engagement project.

The Wales Strategic Forum for Career Development brings together representative organisations and expertise from public, private and third sector organisations, including education and employer representatives. In February, it considered the different issues affecting individuals' choices of STEM careers, including recognising the challenges females can encounter in pursuing STEM career pathways and entering such occupations. Good careers advice can help an individual overcome barriers, and help tackle gender stereotypes.

IN SUMMARY: OUR ACTIONS

WE HAVE

- Targeted careers advice and guidance support through Careers Wales to ensure accurate and impartial information is available to young people before they make crucial subject choices.[86]
- Prioritised improvements in the universal offer through Careers Wales online to provide updated career tools and job information, and its continued hosting of the portals for Apprenticeship Matching Service and Jobs Growth Wales opportunities.[87]
- Improved the accessibility to Labour Market Information (LMI) through Careers Wales online, particularly for younger users, through a more visual snapshot of key information on potential careers, including those in STEM.[88]
- Ensured that information on STEM average wages, hours, types of work, levels of qualifications needed, and level of demand in Wales is presented online for young people in a more simplified 'icon-based' format.[89]
- Through the Careers Wales website, established the Skills Gateway service to provide a way for adults to get the support they require in order to improve their skills and to move into sustainable employment.
- Charged Careers Wales to support the development of stronger and more sustainable partnerships between schools, colleges and employers to better facilitate school-employer engagement through a brokerage function, and support such as guidance for schools.[90]

[86] Relates to Recommendation 6 of the EBC STEM Inquiry Report
[87] Relates to Recommendation 6 of the EBC STEM Inquiry Report
[88] Relates to Recommendation 6 of the EBC STEM Inquiry Report
[89] Relates to Recommendation 6 of the EBC STEM Inquiry Report
[90] Relates to Recommendation 4 of the EBC STEM Inquiry Report

WE WILL

- Inform the development of the CareersWales.com website in 2015-16 with user feedback and consultation with clients and stakeholders, including examining the use of new technologies, for example social media.[91]
- Launch the Welsh Government's new Enhanced Employer Engagement project in September 2015 to strengthen links between schools and employers and increase the opportunities for young people to gain experience of the world of work and develop skills relevant to employment during their studies.[92]
- Require Careers Wales through the annual remit to deliver a comprehensive impartial universal service offer to all clients, with prioritisation on certain client groups, providing as appropriate, an impartial one-to-one careers guidance interview, group session interactions, and accessible online information.[93]
- Continue to support careers events, such as Skills Cymru in October 2015, ensuring relevant information on STEM careers is available to young people.[94]
- Ensure that Careers Wales addresses the needs of young people with particular challenges, for example, Additional Learning Needs, in line with the annual Remit Letter and relevant Welsh Government guidance, through identification of client need and prioritisation.[95]
- Continue work with Careers Wales on the development of the Common Area Prospectus / Application Process (CAP) and its phased roll-out into schools from September 2015.[96]

4.3 Women in STEM

As noted earlier, girls' take-up of mathematics, ICT/computing, engineering and physics as they progress through their education and into the world of work remains behind that for boys. Girls are, therefore, not fully benefitting from the opportunities that the STEM sector can offer.

Equally, there are issues with the 'leaky pipeline' of women lost to science careers later in life. The Minister for Economy, Science and Transport established a Woman in Science Task and Finish Group with a broad remit to investigate what barriers may exist to women studying STEM subjects in Wales. It is due to report in the autumn this year. This section highlights additional work being undertaken to promote and increase female participation in STEM.

[91] Relates to Recommendation 6 of the EBC STEM Inquiry Report
[92] Relates to Recommendation 4 of the EBC STEM Inquiry Report
[93] Relates to Recommendation 6 of the EBC STEM Inquiry Report
[94] Relates to Recommendations 4, 6 and 11 of the EBC STEM Inquiry Report
[95] Relates to Recommendation 6 of the EBC STEM Inquiry Report
[96] Relates to Recommendation 6 of the EBC STEM Inquiry Report

IN SUMMARY: OUR ACTIONS[97]

WE HAVE

- Prioritised girls' progression in physics and mathematics as key strands of our marketing and communications work.
- Highlighted a gender balance in education progression as a key objective through our grant funding to STEM stakeholders - for example, in NSA funding to Engineering Education Scheme Wales Ltd (EESW) for *Girls into Engineering,* which encourages girls to consider engineering pathways that are accessible, interesting and relevant.
- Agreed with the European Commission that girls' progression should feature as a priority within the STEM Specific Objective of the new ESF programme in West Wales and the Valleys for interventions for 11-19 year olds.

WE WILL

- Continue to prioritise girls' progression in physics and mathematics as key strands of our marketing and communications work.
- Continue to highlight a gender balance in education progression as a key objective, through our grant funding to STEM stakeholders.
- Through the NSA strategy, focus on actively encouraging more girls to take up and study STEM subjects and go on to pursue careers in science and technology.
- Consider the recommendations of the Women in Science Task and Finish Group in the autumn 2015, with particular emphasis on possible impacts for policy and programme development underpinning STEM skills.

[97] Relates to Recommendation 11 of the EBC STEM Inquiry Report

Annex A

Draft set of key indicators – for comment

Measure
In Primary Schools
Percentage of children achieving the expected level of learning or above in science and mathematics at the end of Key Stage 2.
The attainment of learners eligible for free school meals in science and mathematics is rising faster than the average at the end of Key Stage 2.
In Secondary Schools
The percentage of pupils who achieve the Level 2 threshold including a GCSE grade A*-C in Mathematics including by gender.
The percentage of pupils who achieve the Welsh Baccalaureate, including by gender.
The capped points score of pupils at the end of Key Stage 4, including 2 mathematics GCSEs and 2 science qualifications (GCSEs from 2018), including by gender.
GCSE attainment in science, ICT/computing and mathematics, including by gender.
Percentage of triple (three individual) science GCSE entries, including by gender.
The attainment of learners eligible for free school meals in science and mathematics is rising faster than the average at the end of Key Stages 3 and 4.
Attendance in secondary schools.
In schools and colleges – sixth forms
The percentage of learners undertaking STEM A levels, including by gender.
Girls' take up of A level physics and mathematics as a percentage of the total for each subject.
Post 16
The percentage of 19 year olds in Wales attaining level 2 and level 3 STEM qualifications, including by gender.
STEM related university entrants, including by gender.

Annex B

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