Cynulliad Cenedlaethol Cymru
The National Assembly for Wales

Y Pwyllgor Menter a Busnes
The Enterprise and Business Committee

Dydd Iau, 4 Mehefin 2014
Thursday, 4 June 2014

Cynnwys
Contents

Cofnodir y trafodion hyn yn yr iaith y llefarwyd hwy ynddi yn y pwyllgor. Yn ogystal, cynhwysir trawsgrifiad o'r cyfieithu ar y pryd.

These proceedings are reported in the language in which they were spoken in the committee. In addition, a transcription of the simultaneous interpretation is included.

Aelodau'r pwyllgor yn bresennol
Committee members in attendance

Mick Antoniw	Llafur Labour
Keith Davies	Llafur Labour
Yr Arglwydd/Lord Elis-Thomas	Plaid Cymru The Party of Wales
William Graham	Ceidwadwyr Cymreig (Cadeirydd y Pwyllgor) Welsh Conservatives (Committee Chair)
Julie James	Llafur Labour
Eluned Parrott	Democratiaid Rhyddfrydol Cymru Welsh Liberal Democrats
Joyce Watson	Llafur Labour

Eraill yn bresennol
Others in attendance

Dr Tom Crick	Uwch Ddarllithydd mewn Cyfrifiadureg, Prifysgol Metropolitan Caerdydd Senior Lecturer in Computing Science, Cardiff Metropolitan University
Yr Athro / Professor Richard B. Davies	Is-ganghellor, Prifysgol Abertawe, Addysg Uwch Cymru Vice-Chancellor, Swansea University, Higher Education Wales
Yr Athro / Professor Andy Evans	Pennaeth Adran Mathemateg a Ffiseg, Prifysgol Aberystwyth Head of the Department of Mathematics and Physics, Aberystwyth University
Barry Liles	Pennaeth, Coleg Sir Gâr Principal, Coleg Sir Gâr
Wendy Sadler	Swyddog Cyswllt ag Ysgolion, Ysgol Ffiseg a Seryddiaeth, Prifysgol Caerdydd Schools Liaison Officer, School of Physics and Astronomy, Cardiff University
Richard Spear	Prif Weithredwr, Gyrfa Cymru Chief Executive, Careers Wales
Dr Greg Walker	Dirprwy Brif Weithredwr, ColegauCymru Deputy Chief Executive, CollegesWales

Swyddogion Cynulliad Cenedlaethol Cymru yn bresennol
National Assembly for Wales officials in attendance

Siân Hughes	Ymchwilydd Researcher
Mike Lewis	Dirprwy Glerc Deputy Clerk

Siân Phipps	Clerc Clerk

Dechreuodd y cyfarfod am 09:13.
The meeting began at 09:13.

Cyflwyniadau, Ymddiheuriadau a Dirprwyon
Introductions, Apologies and Substitutions

[1] **William Graham:** I welcome Members to our meeting this morning, and any members of the public. The meeting is bilingual and headphones can be used for simultaneous translation from Welsh to English on channel 1, or for amplification of the sound on channel 0. The meeting will be broadcast and a transcript of the proceedings will be published later. May I remind people to turn off their mobile phones? Members and witnesses, there is no need to touch the microphones; they will come on automatically. In the event of a fire alarm, we ask people to follow directions from the ushers. I have apologies from David Rees, Byron Davies and Rhun ap Iorwerth, and there are no substitutions today.

09:14

Ymchwiliad Dilynol i Sgiliau Gwyddoniaeth, Technoleg, Peirianneg a Mathemateg (STEM) (Sesiwn 4)
Follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (Session 4)

[2] **William Graham:** I welcome our witnesses—thank you very much for your attendance. Could I ask you, for the record, to give your name and title?

[3] **Ms Sadler:** I am Wendy Sadler, from Cardiff University, schools liaison.

[4] **Professor Davies:** I am Richard Davies, vice-chancellor at Swansea University and today representing Higher Education Wales.

[5] **Yr Athro Evans:** Andrew Evans ydw i, o Brifysgol Aberystwyth; pennaeth mathemateg a ffiseg.

Professor Evans: I am Andrew Evans from the Aberystwyth University; head of mathematics and physics.

[6] **William Graham:** This is the last of our evidence sessions before we scrutinise the various Ministers. We will go straight into questions, and I invite the first of our Members to ask questions. Today, that is Dafydd Elis-Thomas.

09:15

[7] **Yr Arglwydd Elis-Thomas:** Diolch yn fawr, Gadeirydd. Mae'n bleser eich cael chi i gyd yma'r bore yma ac mae'n bleser cael y fraint o ofyn cwestiynau i chi. Ein bwriad ni gyda'r ymchwiliad hwn yw gwneud cyfraniad creadigol ond beirniadol i'r hyn sydd yn digwydd ym maes addysg uwch yn benodol yn y pynciau rydym yn edrych arnynt. Carwn ofyn yn gyntaf, felly, ynglŷn â'r ddogfen 'Gwyddoniaeth i Gymru'. Mae pwyslais ynddi ar wella trefniadau

Lord Elis-Thomas: Thank you, Chair. It is a pleasure to have you all here this morning, and it is a pleasure to have the privilege of asking questions to you. Our intention with this inquiry is to make a creative, but critical, contribution to what is happening in the higher education sector, specifically in the subjects that we are looking at. I would like to ask, first of all, about the 'Science for Wales' document. There is an emphasis in that document on improving communication

cyfathrebu a chydlynu adnoddau. A fyddech yn dweud bod hynny wedi dechrau digwydd yn barod o fewn y sector addysg uwch? Pa fath o gydweithio sy'n digwydd a beth yw'r rhwystrau i gydweithio ymhellach?

arrangements and co-ordinating resources. Would you say that that has started to happen already within the higher education sector? What type of collaboration is happening and what are the barriers to further collaboration?

[8] **Professor Davies:** Perhaps I could begin by responding—I apologise for responding in English—

[9] **Lord Elis-Thomas:** No, no; we are a bilingual country, as you know, Richard.

[10] **Professor Davies:** After 60 years, I still do not have the confidence to respond in Welsh.

[11] There are considerable things going on within the higher education sector in response to the Government's agenda here in Wales, but also internationally. The science and technology agendas are very powerful across the globe. As far as interacting with the Government goes, we have the Sêr Cymru initiative, which we applaud tremendously. It was bold, it was big, it challenged us to do things that we would not be doing on our own, from our own resources, and it was a well-funded opportunity for us. We believe that we have risen to the challenge, recruited some brilliant *sêr* to Wales, and that will have a big impact.

[12] However, we have mixed messages. At the same time—you may want to explore this later—we have a situation where our funding council is withdrawing all additional funding for most high-cost subject areas. So, in a sense, we are being incentivised to switch away from high-cost subjects—in other words, laboratory-based and engineering subjects—to lower-cost subjects. I think that it is testament to the resilience and independence of universities that we are all taking a longer-term view, and we are not reacting to this incentivisation. We are doing the opposite. We are growing and developing STEM subjects, and that is very evident. I am very proud of my own university, where we have doubled engineering over the last five years and, over the next five years, we will double it again. We are determined, and if we cannot get the funding and support from the Higher Education Funding Council for Wales, we get it from other Government streams and we get it from other sources—the private sector, et cetera. All the other universities can tell very strong, powerful stories about investing in modernising and growing STEM subjects as well. So, I see really substantial change. When I came to Wales, 10 years ago, I was saying again and again, 'We've got a huge deficit in Wales. We don't have enough STEM in our universities. For historic reasons, we are dominated by the arts and humanities and non-STEM areas.' That is being changed, and I am delighted that that is happening.

[13] **Keith Davies:** Bore da i chi i gyd. Mae pobl eraill wedi dweud wrthym eu bod yn pryderu bod y ffaith bod HEFCW wedi newid y rheolau cyn belled ag y bo ffioedd yn y cwestiwn yn mynd i ddylanwadu yn y tymor hir ar y pynciau STEM. Ni fydd gan y colegau'r adnoddau i gynnig cymaint ag y maen nhw'n ei gynnig yn awr.

Keith Davies: Good morning to you all. Other people have said that they are concerned that the fact that HEFCW has changed the rules as far as fees are concerned will have a long-term impact on STEM subjects. The colleges will not have the resources to offer as many courses as they offer at the present time.

[14] **Professor Davies:** I must allow my colleagues to respond as well, but I have to say that it is a policy that we just cannot understand and cannot believe. It runs counter to other Government policies in Wales and round the globe. We find it quite extraordinary. However, at least in the medium term, we do not see any signs that universities are reacting in a way that would be financially sensible. We are having to take risks, we are bold and, as I say, we have independence. We can go along our own line, which I think that we are all pursuing in

various ways, and we have to look at the long-term requirements of Wales and the long-term strategy, which is important in providing these skills for young people and for industry and for growing a different type of industry in Wales—a modern, hi-tech industry. So, we will not be put off course, but that does not mean that, in a few years' time, we will not have some financial crises.

[15] **Lord Elis-Thomas:** May I ask you, then, the obvious question? What is the funding council for, if it is pursuing an agenda that is obverse in relation to the real needs of universities?

[16] **Professor Davies:** I do not think that that is a question that I should be answering. In defence of the funding council, it has a difficult situation with the unintended consequences, which it is managing, of the fee support system in Wales. It would probably be saying that it is forced into making some unpalatable decisions.

[17] **Mick Antoniw:** If I could jump in on that funding situation, of course there are things like Horizon 2020 and European specific funding in respect of innovation, research, and so on; does any of that fill the gap, or has that enabled you to accommodate the change?

[18] **Professor Davies:** No. The research funding does not support teaching and skills development. Funding of research is challenging in its own right, and there is never any leakage out of that into teaching. The crude reality is that we all depend on a large number of overseas students, who pay higher levels of fees, to help cover some of the fixed costs in these areas, and therefore we have to move towards a structure where the fee level in the high-cost subjects of £9,000 is covering marginal costs, rather than a lot of the fixed costs.

[19] Could I just clear up one great misunderstanding here? We do not have £9,000 for each student to spend on their education. We are required by HEFCW, under the fee plan regime, to spend at least £1,500 of that money on widening access and promoting higher education. I do not say that those are bad things—marketing is very important in any business—but we only have £7,500 to spend on the education of each student on the ground. No-one can deliver that in high-cost subjects adequately and in a competitive way. We have to get money from elsewhere. It comes from the private sector, it comes from European structural funds—we are getting a lot of support from structural funds—and other sources.

[20] **Eluned Parrott:** I wonder if I could jump in there and ask a question of Professor Davies. Could you tell me: what is the size of the gap that you are talking about in terms of your own university, and for universities that are not able to access structural funds? How are they filling the gap?

[21] **Professor Davies:** Everyone is being very creative. There is no question that the overseas students and their higher fees are a significant component of this. We are talking about millions of pounds. Swansea is a relatively small university, but it takes well over £20 million in fees from overseas students. Business and industry are willing to pay because they are desperately concerned about high-level skills in STEM subjects. They talk about talent flow. We are getting considerable support from major companies to support developments in those areas. So, there are creative ways. How much does it cost? The English funding council does a regular review of the costs of delivery in different academic areas, and their costing structure is something over £10,000 to teach engineering and laboratory science. However, you must not compare that with £9,000; you have to compare that with the £7,500 that we have. There will be a degree of error in that. it is an approximate figure, and you could say that the cost base here is lower than in some of the English cities, so we may be able to do it for a bit less, but there is still a big gap between what it costs and what we get.

[22] **Yr Arglwydd Elis-Thomas:** Diolch **Lord Elis-Thomas:** I thank Andy Evans for

i Andy Evans am ei bapur hynod o ddefnyddiol. Mae'n gwneud y pwynt yn glir iawn ei fod yn ystyried swyddogaeth y Coleg Cymraeg Cenedlaethol a'r bartneriaeth gyda phrifysgolion megis Aberystwyth yn y pynciau yr ydym yn eu hastudio yn benodol yn y pwyllgor hwn yn un allweddol. Sut wyt ti'n rhagweld y bydd hyn yn datblygu at y dyfodol, yn wyneb y sefyllfa y bydd adolygiad o gyllid y Coleg Cymraeg Cenedlaethol a'r modd y mae'n gweithio?

his paper, which was very useful. It makes the point very clearly that he considers the function of the Coleg Cymraeg Cenedlaethol and the partnerships with universities such as Aberystwyth in the subjects that we are studying specifically in this committee to be key. How do you foresee this developing in future, in the light of the review that will be undertaken into the funding of the Coleg Cymraeg Cenedlaethol and the way in which it works?

[23] **Yr Athro Evans:** Mae yna gysylltiad, wrth gwrs, rhwng yr hyn yr ydym yn ei wneud o ran darpariaeth cyfrwng Cymraeg a'r pwnc cyntaf, sef yr hyn sy'n cael ei wneud drwy'r rhwydweithiau cenedlaethol a Sêr Cymru. Mae pwyslais ar gydweithio. Hefyd, yn y rhannau eraill, mae cydweithio rhwng prifysgolion ac ysgolion, a rhwng prifysgolion a diwydiant a busnes. Felly, mae'r pwyslais ar gydweithio yn bwysig. Teimlais, wrth roi'r ddogfen at ei gilydd, fod un peth yn dod yn glir, sef mai'r hyn y mae'r Coleg Cymraeg, yn fy nhyb i, wedi llwyddo i'w wneud yw cael pobl i weithio'n effeithiol, i roi strwythur ar gydweithio ac i sicrhau nad yw pethau'n digwydd yn achlysurol yn unig—fel y byddem yn ei wneud yn naturiol—gan roi strwythur hirdymor ar y datblygiad.

Professor Evans: There is a link, of course, between what we are doing with regard to Welsh-medium provision and the first subject, namely what has been done through the national networks and Sêr Cymru. The emphasis is on collaboration. Also, in the other areas, there is collaboration between universities and schools, and between universities and industry and business. So, the emphasis on collaboration is important. I felt, as I was putting the document together, that one thing became clear, namely that what the Coleg Cymraeg, in my view, has succeeded in doing is to get everybody to collaborate, to structure that collaboration and to ensure that things do not happen only in an ad hoc fashion, as would be the case normally, thereby giving a long-term structure to that development.

[24] Yn benodol, rydym wedi cychwyn drwy weithio gyda Chyngor Cyllido Addysg Uwch Cymru, ac yna gyda'r Coleg Cymraeg Cenedlaethol i sicrhau bod y pynciau craidd STEM yn cael yr un sylw a'r un pwysigrwydd o ran darpariaeth cyfrwng Cymraeg â'r pynciau y tu allan i'r gwyddorau. Teimlaf ein bod wedi cael rhyw fath o lwyddiant o ran hynny, ac rydym wedi gweld twf sylweddol. Mae gennym dros 50 o fyfyrwyr erbyn hyn yn cymryd rhannau o'u cyrsiau gradd mewn ffiseg, mathemateg a chyfrifiadureg drwy gyfrwng y Gymraeg. Mae'n braf i weld hynny'n ehangu ym mhellach i Abertawe, sydd newydd benodi rhywun i swydd ffiseg cyfrwng Cymraeg, ac mae Caerdydd wedi gwneud hynny ar gyfer mathemateg. Gobeithiaf y byddwn yn parhau i gael strwythur clir sy'n ein galluogi ni i weithio efo'n gilydd er mwyn sicrhau bod y Gymraeg yn flaenllaw yn y pynciau craidd.

Specifically, we have worked from the outset with the Higher Education Funding Council for Wales initially and then with the Coleg Cymraeg Cenedlaethol to ensure that the STEM core subjects are given the same attention and importance with regard to Welsh-medium provision as the subjects outside the sciences. I believe that we have had some success in that regard, and we have seen significant growth. We now have more than 50 students taking parts of their degree courses in physics, mathematics and computer science through the medium of Welsh. It is good to see that being extended further to Swansea, which has recently appointed someone to teach physics through the medium of Welsh, and Cardiff has done likewise for mathematics. We hope that we will continue to have a clear structure that enables us to work together in order to ensure that Welsh is prominent in the core subjects.

[25] Roeddwn mewn cyfarfod gyda

I attended a meeting with the heads of

phenaethiaid adran yr wythnos hon. Bu inni edrych ar y data, sy'n dangos bod y myfyrwyr yn Aberystwyth sydd wedi dewis astudio rhan o'u gradd drwy gyfrwng y Gymraeg yn uwch o ran cyflogaeth na'r rhai di-Gymraeg. Mae hynny'n dangos bod rhai o'r pethau y mae Meri Huws wedi bod yn eu dweud yn gywir.

department this week. We looked at the data, which show that the students in Aberystwyth who opted to study part of their degree through the medium of Welsh have higher employment levels than those who did not. That shows that some of the things that Meri Huws has been saying are true.

[26] **Yr Arglwydd Elis-Thomas:** Mae gennyf un cwestiwn olaf am hyn. Yn ystod ein hymchwiliad, rydym wedi bod yn siarad dros y we gyda myfyrwyr a disgyblion ysgol ynglŷn â'r hyn sy'n peri iddynt roi blaenoriaeth i'r pynciau craidd: gwyddoniaeth, mathemateg, peirianneg a thechnoleg. Credaf fod yr hyn yr ydych newydd ei ddweud yn bwysig iawn: mae'n rhaid cael cysylltiad rhwng gweithio'n ddwyieithog gyda gweithio gan roi blaenoriaeth i'r pynciau sydd o ddefnydd yn ehangach o fewn gyfundrefn yr ysgol. Dywedodd yr is-ganghellor John Hughes ar ddechrau ei yrfa ym Mangor na allech chi gael prifysgol nad oedd yn dysgu mathemateg yn effeithiol ar bob lefel. Mae'r ffaith ein bod ni bellach yn gallu gwneud hynny'n ddwyieithog drwy fodiwlau gwahanol yn golygu bod ansawdd y dysgu a'r addysgu wedi gwella. A fyddech yn cytuno â hynny?

Lord Elis-Thomas: I have one final question on this. During our inquiry, we have been having web chats with students and school pupils regarding what leads them to give priority to the core subjects of science, mathematics, engineering and technology. I think that what you have just said is very important: it is necessary to have a link between working bilingually and working to prioritise the subjects that are of wider use within the school. The vice-chancellor John Hughes said at the start of his career in Bangor that you cannot have a university that was not teaching mathematics effectively at every level. The fact that we are now able to do that bilingually through different modules means that the quality of the learning and teaching has improved. Would you agree with that?

[27] **Yr Athro Evans:** Byddwn yn cytuno â hynny. Mae'r twf wedi bod yn anhygoel. Pan gychwynnon ni gydweithio o fewn y brifysgol yn Aberystwyth, roedd gennym un modiwl ar draws y gwyddorau i gyd. Nawr, rwy'n gweld bwrdd o'r maint hwn yn llawn pobl ifanc yn frwdfrydig dros ddysgu drwy gyfrwng y Gymraeg, felly mae pob cyfarfod o'r gangen yn bleser mawr i mi.

Professor Evans: Yes, I would agree with that. The level of growth has been incredible. When we began to work within the university in Aberystwyth, we had one module across all of the sciences. Now, seeing a table of this size full of young people who are enthusiastic about teaching through the medium of Welsh means that every branch meeting is a great delight for me.

[28] **William Graham:** Keith, would you like to ask a supplementary question?

[29] **Keith Davies:** Yn dilyn hynny, mae'r papur yr ydym wedi ei dderbyn gan Aberystwyth yn sôn bod myfyrwyr yn cael £500 y flwyddyn yn ychwanegol. Fodd bynnag, darllenais yn y papur lleol yn Llanelli yr wythnos diwethaf fod rhai disgyblion, os ydynt yn gwneud mwy na 60% o'u pynciau yn y brifysgol drwy gyfrwng y Gymraeg, yn cael £3,000 y flwyddyn yn ychwanegol.

Keith Davies: Following on from that, the paper that we have received from Aberystwyth states that students receive an additional £500 per annum. However, I read in my local paper in Llanelli last week that some students, if they study more than 60% of their subjects at university through the medium of Welsh, receive an additional £3,000 per year.

09:30

[30] **Yr Athro Evans:** Mae gwahanol ysgoloriaethau. Yr ysgoloriaeth yr ydym wedi canolbwyntio arni yw'r un sydd â 40 credyd. O'r cychwyn, rydym wedi sylweddoli mai'r peth pwysig yn y gwyddorau—yn sicr, mewn mathemateg a ffiseg—yw ein bod yn cofio mai Saesneg yw iaith gwyddoniaeth yn rhyngwladol, ond ei bod yn bwysig bod y myfyrwyr yn gallu cyfathrebu'n gyfforddus drwy'r Gymraeg er mwyn mynd i mewn i'r gweithle yn gyfforddus, a mynd i mewn i'r sector ysgolion a gallu dysgu a thrafod y pwnc heb orfod dysgu gwneud hynny wrth wneud y cwrs ymarfer dysgu. Mae wastad wedi bod yn darged gyda ni i gael traean o'r cwrs ar gael drwy gyfrwng y Gymraeg. Mae hynny yn digwydd bod yn fwy perthnasol i ni. Mewn pynciau eraill, efallai ei bod yn fwy naturiol ac yn haws i—

Professor Evans: There are different scholarships. The scholarship that we have focused on is the 40 credit one. From the outset, we realised that the important point in the sciences—particularly in maths and physics—is that we remember that English is the international language of science, but that it is important that the students should be able to communicate comfortably through the medium of Welsh so that they can go into the workplace comfortably, and go into the school sector and be able to teach and discuss the subject without having to learn to do so during the teacher training course. We have always had a target of providing a third of the course through the medium of Welsh. That happens to be more relevant to us. In other subjects, it may be more natural and easier to—

[31] **Keith Davies:** Felly, mae maint yr ysgoloriaeth yn dibynnu ar y canran o gyrsiau sy'n cael eu cymryd drwy gyfrwng y Gymraeg yn y brifysgol.

Keith Davies: So, the size of the scholarship is dependent on the percentage of courses being taken through the medium of Welsh at the university.

[32] **Yr Athro Evans:** Ydy.

Professor Evans: Yes.

[33] **William Graham:** Do you want to ask your other question, Keith?

[34] **Keith Davies:** I asked it earlier, Chair.

[35] **William Graham:** Oh, thank you very much. Mick Antoniw is next.

[36] **Mick Antoniw:** There has been some evidence and some commentary in the media as well about the supply of students coming through schools, and there are a number of threats to it. One is whether we have enough students applying for, seeking and wanting to do the subjects. The second thing is whether they have adequate preparation; that is, when they arrive, are they learning in the first year what you would expect them to come with? I suppose my question is probably for you, Wendy, in terms of the engagement with the schools over this. What are your views on that?

[37] **Ms Sadler:** The feedback we get from colleagues teaching first-year students when they come in is that there is a different type of student. Although students have achieved the requirements to get in to do physics, it is my experience particularly that they lack the mathematical skills. Perhaps they do not understand that physics is inherently a mathematical subject, which seems obvious to physicists, but which may not be coming through in the school system. More importantly, I think that it is a change in the way of thinking in terms of how they are learning. At schools, they are possibly learning about how to pass exams, and not learning critical thinking skills. Part of the teaching in the first year is about learning that they have to find things out for themselves—they are not going to be spoon-fed. So, the feedback has been that it is about the technique—it is not that they do not know their subject, but it is about how the way that they learn can be different for physics particularly. I do not

know whether you want to add anything.

[38] **Yr Athro Evans:** Yr unig beth yr hoffwn ei ychwanegu yw bod ychydig o fyth o ran gallu'r myfyrwyr. Beth rydym yn ei weld yw bod agwedd y myfyrwyr yn bositif iawn; maent yn dod i'r brifysgol ac maent yn gweithio'n galed. Rwy'n credu ein bod ni ychydig bach yn ddilornus weithiau o'n pobl ifanc. Maent yn ymwybodol eu bod mewn byd caled ac maent yn barod i weithio'n galed. Mae'r ffaith ein bod wedi gweld symudiad mawr o'r pynciau celfyddydau ac ieithoedd i wyddoniaeth yn dangos eu bod nhw'n deall y sefyllfa. Rydym wedi ei weld yn Aberystwyth; mae'r niferoedd sydd wedi dod i astudio mathemateg a ffiseg ers 2009 wedi dyblu, ac nid ydym wedi gweld cwymp sylweddol yn safon y myfyrwyr rydym yn eu cynhyrchu ar y pen arall. Rwy'n credu bod eisiau inni roi clod i'r myfyrwyr am y gwaith maent yn ei wneud.

Professor Evans: The only thing I would add to add is that there is slight myth in terms of student ability. What we see is that the students' attitude is very positive; they come to the university and work very hard. I think that we are sometimes quite critical of our young people. They are aware that they are in a difficult world and they are prepared to work hard. The fact that we have seen a great shift from the humanities and languages to the sciences shows that they understand what the situation is. We have seen it in Aberystwyth; the numbers that have come through to study maths and physics since 2009 has doubled, and we have not seen a significant drop in the quality of the students that we create at the other end of the process. I believe that we should congratulate the students for the work that they have done.

[39] **Keith Davies:** Yr hyn sy'n digwydd, rwy'n credu, pan rydym yn darllen am y pethau hyn—. Roeddem yn cael trafodaeth brynhawn ddoe gyda'r Gweinidog, ac roedd un neu ddau o bethau y gofynnais iddi edrych arnynt, er enghraifft y nifer isel o ferched sy'n cymryd ffiseg. Fodd bynnag, os ewch yn ôl i'r ysgol ac edrych ar y strwythur TGAU, fe welwch fod nifer o ysgolion yng Nghymru yn cynnig gwyddoniaeth dwbl—cemeg, ffiseg a bywydeg. Rwy'n credu bod hynny yn mynd i effeithio ar faint o blant, yn enwedig merched, sy'n mynd mewn i'r chweched dosbarth i wneud ffiseg. Y peth arall rydym wedi bod yn darllen amdano yw bod disgyblion yn mynd i mewn i'r brifysgol i wneud mathemateg—mathemateg pellach a ffiseg wnes i yn y chweched dosbarth, gyda llaw—ond nid oes llawer o ysgolion yng Nghymru yn cynnig mathemateg a mathemateg pellach nawr. Bu'n rhaid imi symud fy nghroten o un ysgol yng Nghaerdydd i ysgol arall yng Nghaerdydd achos nid oedd yn cael y cyfle. Yr hyn sy'n digwydd wedyn yn y flwyddyn gyntaf yn y brifysgol, mor bell â bod mathemateg yn y cwestiwn, yw eich bod yn cael plant i mewn sydd wedi cymryd mathemateg a mathemateg pellach a phlant sydd wedi cymryd un pwnc mathemateg yn unig. Mae hynny'n broblem. Beth allwn ni wneud am hynny, nid wyf yn gwybod, ond rwy'n rhoi'r bai am hynny ar y

Keith Davies: What happens, I think, when we read about these things—. We had a discussion yesterday afternoon with the Minister, and there were one or two things that I asked her to look at, for example the low numbers of girls studying physics. However, if you go back to the schools and look at the GCSE structure, you will see that a number of schools in Wales offer double science—chemistry, physics and biology. I think that that will have an impact on how many children, particularly girls, go into the sixth form to study physics. The other thing that we have been reading about is that pupils go into university to study maths—further maths and physics were my subjects in the sixth form, by the way—but there are not many schools in Wales now offering maths and further maths. I had to move my daughter from one school in Cardiff to another school in Cardiff because did not have the opportunity. What happens then in the first year of university, as far as maths is concerned, is that you get children in who have studied maths and further maths and children who have studied the one maths subject only. That is a problem. I do not know what we are going to do about it, but I would put the blame for that on the curriculum in the schools—the fact that the opportunities are not there, perhaps.

cwricwlwm yn yr ysgol—y ffaith nad yw'r cyfleoedd ar gael, efallai.

[40] **Yr Athro Evans:** Mae hwnnw yn bwynt digon dilys. Mae mwy o wahaniaeth rhwng y myfyrwyr gorau a'r myfyrwyr ddim cystal sy'n dod i mewn. Rydym yn cydweithio gyda HE STEM, er enghraifft, sydd wedi ariannu desg gymorth i helpu'r myfyrwyr i godi eu sgiliau mathemateg. Felly, rydym yn ymwybodol o hynny. Rwy'n credu bod yr agwedd o fewn y brifysgol yn dangos ein bod yn deall bod angen dysgu criw mwy eang o fyfyrwyr nawr. Fodd bynnag, rydym hefyd yn gweld eu bod nhw yn dal i fyny a bod y safon yn cynyddu. Wrth gwrs, gyda mwy o fyfyrwyr yn mynd mewn i'r brifysgol i astudio'r pwnc, bydd mwy ohonynt, yn naturiol, yn dod allan gyda'r graddau gorau, ac rydym ni yn annog fwyfwy y rhai gorau i fynd i mewn i'r sector dysgu. Rwy'n credu bod y broses hon yn mynd i helpu fel mae'n mynd ymlaen. Wrth gwrs, os ydynt yn medru'r Gymraeg hefyd, gorau oll.

Professor Evans: That is a valid point. There is a greater difference between the best students and those who are not as good who come in. We are working with HE STEM, for example, which has funded a helpdesk for the students to improve their maths skills. So, we are aware of that. I believe that the attitude within the university demonstrates that we understand that we now need to teach a broader range of students. However, we also see that they are catching up and that the standard is improving. Of course, with more students going into university to study the subject, then, naturally, more of them are coming out with the best degrees, and we are increasingly encouraging the best ones to go into the teaching sector. I think that this process will assist as it goes forward. Of course, if they speak Welsh as well, that is an added bonus.

[41] **Yr Athro Davies:** A gaf fi ddweud fy mod yn cytuno'n llwyr â Keith Davies ar hyn?

Professor Davies: May I say that I agree completely with Keith Davies on this?

[42] There is no question that Keith Davies has put his finger on some critical issues as far as the development of skills in schools is concerned. Universities work very hard with schools on a variety of projects to raise aspirations and interest and to fill in the curriculum and provide some extra attraction by bringing in experienced research staff and so on to discuss what is going on in science and technology. However, we cannot act as a remedial operation completely. This is not happening just in Wales. When I was in England, we used to laugh at the physics department in my university there, where there was a Fellow of the Royal Society—who was paid very well, of course, as a professor of physics—and one of his jobs was to teach mathematics in remedial classes to first-year physics students who did not have the mathematics to do physics properly. This was in a top 10 university in the UK. So, this is universal and I believe that Keith put his finger on two of the critical issues. One is, I think, a poverty of ambition in some schools, where you cannot even do full syllabuses in physics, chemistry and biology for GCSE. That is a total poverty of ambition because if you have only done a double GCSE, you start doing A-levels at a huge disadvantage and you have a huge leap to take in order to catch up with better-prepared students, and in a modular system, you just do not have time to catch up. So, you are handicapping your young people right from the start. Not being able to provide double mathematics at A-level is criminal and many schools in Wales, I am afraid, still cannot do that.

[43] I have to give an example from my own family. One of my children, in a very good school in north Wales, told me that just before doing A-levels he had been told not to bother about one of the modules because it was too difficult and the teachers could not deal with it, and that if he got zero it did not matter because he could do well enough in the other modules. That was because he was doing double maths. Luckily, he had a statistician as a father, who in 24 hours had transformed the situation. [*Laughter.*] However, other children did not have statisticians as fathers. I felt there that something had seriously gone wrong in the education

system and that does need to be looked at. In Swansea—and other universities do this as well—we do support schools that cannot provide enough support by helping children with double maths. However, we do not have the staff and we cannot do it on a big scale, so that has to be looked at.

[44] One thing that I would add to what Keith said is that the other problem that we have in Wales is that a smaller percentage of our young people go to university than in England or Scotland. It is a significantly smaller percentage. So, it is not just in STEM that we are not getting enough people through, and I think that there are very big issues to be addressed.

[45] **Mick Antoniw:** Could I just follow through on that with a question to you, Wendy, because I am interested in your particular role? What is your experience of dealing with this? What it sounds like is that what should be a natural and integrated flow et cetera does not actually happen—that maybe there is a concentration on getting the pass marks and everything else sorted out rather than the actual education side of it. What is your experience and what is the response from schools in terms of the sorts of issues you raise with them?

[46] **Ms Sadler:** Well, I think that a lot of it comes down to the continuing professional development of the teachers. We know that the Institute of Physics has widely reported that the issue of physics teaching in Wales is a big problem. Maths and further maths are not so much my area of expertise, but in terms of the physics teaching, 40% of teachers in Wales teaching physics do not have a physics background themselves. So, that is part of the problem. By the time you get to A-level, you would hope that that was not the case. Most of them are taught by a physics graduate—I do not know the statistics myself; I do not know whether Andy does. So, I think that, partly, it happens earlier on. That would be my viewpoint. The switch off to these subjects and the way they are taught—with physics in particular, which is where my experience is—is not reflective of being taught by people who are connected to current, contemporary physics and who understand the physics process very well. So, biology graduates are having to teach physics. They are following the curriculum, but if the curriculum itself is not very exciting or engaging, it is not going to switch many people on to physics, and the biology teachers are barely managing to cover all their subjects.

[47] I think that one of the things they have tried with some success in England is allowing teachers to specialise in physics and maths, rather than having to teach all three sciences—biology, chemistry and physics. That is showing some success because physics graduates are attracted more to a job where they are teaching both physics and maths, which are more complementary, than they would be to a job where they had to teach biology as a physics graduate. So, I think that we have to start looking a bit earlier at how we recruit and continue to invest in CPD of physics teachers because that is a really core issue.

[48] **William Graham:** Eluned is next and then Julie.

[49] **Eluned Parrott:** Thank you. I want to ask you about the pipeline of talent coming through. If we want to provide higher level science graduates and those sorts of skills for business but also for academia, we have to have a good understanding of where people are dropping out of the process. So, clearly there are issues at GCSE and A-level that need to be addressed, but can you tell us, in terms of universities, where we are losing talented people along the way? Where are we losing people who might perhaps be home-grown Sêr Cymru in the future?

[50] **Ms Sadler:** I am not quite sure about where they drop out after becoming students.

[51] **Professor Davies:** In the universities that have substantial traditional science departments, the dropout rate is very low over the three years—

[52] **Eluned Parrott:** I do not mean in terms of undergraduates. Pardon me; if I may rephrase the question. With the people who are doing undergraduate degrees, are we losing them when they finish their undergraduate degree and they leave the profession, or do they do a taught postgraduate degree and then leave or do they—

[53] **Ms Sadler:** Do you mean leaving Wales or leaving STEM as an area?

[54] **Eluned Parrott:** Leaving STEM careers or, if you like, the academic pipeline.

[55] **Yr Athro Evans:** Mae ychydig bach yn anodd bwrw i lawr at y manylder, ond yn sicr mae tueddiad i'r mwyafrif aros ymlaen i fynd ymlaen i gyrsiau eraill. Nid yw'n bosibl i weld a ydynt yn aros ymlaen i astudio yn union yr un maes—pa un a ydynt yn aros ym maes ffiseg neu a ydynt yn mynd ymlaen i faes cemeg, peirianneg neu fathemateg, neu fynd i ddysgu neu i mewn i fyd busnes neu astudio cyfrifiadureg a thechnoleg gwybodaeth. Maent yn mynd i bedwar ban y byd ac i bynciau eraill. Dyna un o'r pethau sy'n dda am gael gradd mewn pynciau fel ffiseg a mathemateg yw eu bod yn mynd i swyddi ym mhob maes. Maent yn bynciau da—rwy'n rhoi rhyw fath o hysbyseb i chi yn y man hwn. Maent yn eich paratoi ar gyfer pob math o yrfaoedd; rwy'n siŵr y bydd sawl un ohonoch yn gwybod am hynny. Fodd bynnag, mae'r rhan fwyaf yn aros ymlaen i wneud cyrsiau pellach. Yna, cwestiwn arall yw a oes swyddi addas ar eu cyfer yng Nghymru i'w cadw nhw yma.

Professor Evans: It is rather difficult to get down to the detail, but certainly there is a tendency for the majority to stay on to go on to other courses. It is not possible to see whether they are actually staying on to study in exactly the same field—whether they are staying in the field of physics or whether they are going on to the field of chemistry, maths or engineering, or going to teach or into the world of business or to study computers and IT. They actually go all over the world and to other subjects. That is what is good about having a degree in subjects such as physics or maths is that they can go to jobs in every field. They are very good subjects to take—I am giving you a sort of advert here. They prepare you for all sorts of careers, as I am sure that a number of you will know. However, the majority stay on to do further courses. Then the question of whether there are appropriate jobs available for them in Wales, to keep them here, is another matter.

[56] Rwy'n credu mai'r peth arall sydd ynghlwm yn hyn yw cydweithio efo busnes a gwneud yn siŵr ein bod yn cydweithio efo busnes i wneud yn siŵr bod y sgiliau o fewn y cwrs hefyd yn addas i'r gweithle, nid dim ond yr ochr academaidd. Mae'n sicr yn rhywbeth yr ydym yn trio ei ddatblygu ac yn rhywbeth rwy'n gweld yn digwydd yn fwy eang.

I believe that the other thing associated with this is collaboration with business and ensuring that we collaborate with businesses to ensure that the skills included in the course are suitable for the workplace, not just the academic side. It is certainly something that we are trying to develop and something that I see happening on a broader scale.

09:45

[57] **Professor Davies:** I wonder whether I could add to that. We would not look at graduates who go off into non-STEM fields as a loss because they are contributing to the economy in various ways and they have hugely transferrable skills. You can see from the wage levels that these people are in short supply. You do not have to do any research to find out whether there is a demand—you can just see that from the wage levels in these areas. It is a fact, for example, that in Germany many of the leaders of industry are engineers; you do not say that those managers are a loss to engineering, because they are doing rather a good job for Germany. So, I do not think that we should worry too much about people going into other fields; it is just that we have to increase the throughput dramatically.

[58] There is a problem at the postgraduate level across the UK. The new fees structures are making it very difficult to get funding for postgraduate courses. There is nervousness about debt. The numbers doing many postgraduate courses are declining and industry is telling us that it wants far more people, but it is the postgraduate courses that are the big differentiator now and that is going to be a major issue over the next few years. One of the sad things to me is that we are spending so much time worrying about undergraduate fees, when, to me, in terms of the future economy, the real issue is going on to higher level skills through Master's and doctorates of engineering courses and so on.

[59] **Ms Sadler:** If we talk about losing women in STEM subjects, then there is well-known evidence that, after the postgraduate period and the post-doctoral period, that becomes a big problem. There have been a lot of inquiries into this and the House of Commons select committee has been looking at how to change the culture of research to ensure that women can continue with a career in research. I know that the Chief Scientific Adviser for Wales, Julie Williams, is also looking at ways to support that. However, the data did suggest that that is the point in the pipeline, if you like, where you would lose a lot of women from the STEM areas.

[60] **Julie James:** If I may, I will just follow that up, just on that point. It is obvious from this morning's session that right across the developed world, not just in the UK, women drop out of STEM subjects, which is associated with career breaks and maternity leave as much as anything else. Also, we have done some research in this committee, and I have been doing it myself for some time now, in association with many of the fine people at Technocamps and so on at Swansea University, around the way that STEM careers are viewed by young people—young men, as well as young women—and what their expectations look like at the other end and so on. A lot of that is to do with the way that the teachers view it. This is not just about the ability to teach physics; it is about their view of physics as a profession or maths as a profession or whatever. Joyce and I are about to go and talk to some people in the National Botanic Gardens of Wales about the way that primary school teachers take that up. I wonder whether you think that there could be a generic culture shift that we could make about the way that people think about STEM subjects. I personally think that it is exacerbated by the fact that we call them 'STEM subjects' for a start. It makes it sound as if they are some sort of other thing, apart from your normal, day-to-day life. I wanted to ask all three of you the classic magic wand question: if you could get the committee to do one thing, what would it be that would make that difference to the numbers of people coming through, particularly the numbers of women, but generally the numbers of people coming through into those subjects, particularly in Wales?

[61] **Ms Sadler:** I think that you are right that there is a huge cultural shift that is needed and that is why it is a hard thing that perhaps is not easily fixed with a magic wand. The cultural stereotypes are embedded much earlier than a lot of the activity is focused on. I would say that a lot of initiatives on getting girls into STEM subjects come at secondary school level. The educational research suggests that if, by the end of primary school, a girl or boy's self-image does not include a scientist, then that will have an effect. You have probably heard of the 'ASPIRES' report from King's College London, which introduces this idea of science capital, which is beyond the school, although the school culture is part of it, and whether their family culture accepts science and STEM subjects as a valid career. If you are talking about changing that kind of culture, you also have to tackle parents and the whole population really, so that is a big ask, but things such as the media and tv can help with those sorts of images of scientists. I am chairing an event tomorrow evening about science on tv in Wales, why there is not more of it and why we are not promoting role models that way, because there is not this culture of Welsh science that people are seeing, and it would help girls and boys to see those kinds of jobs.

[62] The Institute of Physics has a sort of magic wand, which has had some outstanding

results in England. The stimulating physics network is a project that costs around £4,000 per school for the schools that it engages with. It is about teaching teachers how to be aware of these gender stereotypes. In the schools that it has worked with in England since 2009, something like 200% more girls have gone on to do A-level physics than the average across the UK. The figures they have seen are 200% for £4,000 per school. It is a sustained project; a one-year pilot will not make much difference, but if you can sustain the investment in the teacher support and tackle head on the fact that schools' culture might have a lot of gender stereotypical things going on, it can make a difference. Primary school is where it starts. The stimulating physics network is focused at secondary schools, but I believe that we need to challenge primary schools to think of this—it is at a very young age when girls and boys begin to realise that, in shops, science toys are targeted at boys. Can we pass legislation to say that marketing should not be allowed to market things as boys' toys and girls' toys? I feel strongly about that and the big part that it plays. It translates through to the whole culture of primary schools. My son's primary school, even next week, is having a pirates and princesses dressing-up competition—I am horrified and I do not know what to do about it.

[63] **Julie James:** Send your daughter in as a pirate.

[64] **Ms Sadler:** It is only my son that is at school at the moment—

[65] **Julie James:** Send him as a princess.

[66] **Ms Sadler:** I might send him in as a princess. I am going to be the awkward parent who complains.

[67] There was a suggestion in the Institute of Physics's 'Closing Doors' report. It looked at gender stereotyping within schools and the cultural problem, for the subjects that boys do not take and the subjects that girls do not take, to try to see. It found that it is almost always the culture of the school that affects whether a girl goes on. There are things that you can do to change that. Chwarae Teg has had a funded project—I have forgotten the name of it now—to work with primary school teachers about being aware, first of all, that these stereotypes exist and are embedded and that it is a massive cultural problem. It is everything, as I said, from science on tv, the stereotype of the crazy mad male scientist, the toys that are marketed at our children to the way that our teachers teach. So, sorry, there is not a magic wand, but we have to accept that it is a cultural shift that we need to make. As a specific example, at secondary school level, the stimulating physics network has had a lot of success. The Department for Education in England has just committed another £4.3 million to this, because it has seen the evidence of it working.

[68] **William Graham:** Could we have details of that particular scheme in England? That would be helpful to our committee.

[69] **Ms Sadler:** Certainly.

[70] **Joyce Watson:** I will just follow through on the same theme. In your evidence, Andy, or Professor Evans, you talk about giving bursaries or, in particular, that you cannot give bursaries to discriminate positively, but that you can put positive action in for female graduates. I just wanted to explore whether, in terms of giving bursaries, in all of your institutions, you monitor the ratio between who is getting a bursary or a scholarship and who is not, and whether you disaggregate the data that fall out of that, or even whether in the application form, in the first place, you remove the names and look at a number, so that there is no mindset. If everything you have said is true, and I know that it is, surely you have to start to remove some of those things. So, I would like to know a little more about your process, in terms of those people who get bursaries, and whether you disaggregate the data, but also the systems and processes that lead up to the application.

[71] **Professor Davies:** We do, and the impression that I have is that all universities are monitoring very carefully the students who get bursaries, whether it is in terms of the Welsh language, areas of science, excellence or widening access. The evidence from Wales, so far, and from English universities, which are doing similar sorts of things, is that, actually, the bursary system is not affecting choice very much at all. It should not surprise us too much because we can see that demand is not very price sensitive. We have always known that students pour into London universities in spite of the fact that the cost of living is twice as much, which completely dwarfs any sort of fee issue. If we have money to spend, I think that there are much better ways in terms of culture change and increasing the enthusiasm and commitment, and enhancing ambition, whether it is for girls or—

[72] **Joyce Watson:** With respect, however, money is being spent, and I want to actually get underneath the money that is being spent, where it is being spent, and who it is being spent on. That was my question.

[73] **Professor Davies:** We can tell you that. Each university is different. We do keep those figures. However, as I say, our research is unsettling. We are giving that money because we have to, effectively.

[74] **Joyce Watson:** So, who are you giving to?

[75] **Professor Davies:** We do not necessarily think that it is good value for money, because there is not a lot of evidence that it influences choice. That is what I am saying.

[76] **Joyce Watson:** I accept that, but I want to know where it is going.

[77] **Julie James:** May I just come back on that as well? One of the issues that follows on from both of those topics, really, that we have been looking at, which I have certainly been looking at a lot as well—I do not know whether you saw our short debate, but I think that it is worth looking at, for the Minister's response—is the whole issue about unconscious bias. There has been a lot of research about that recently. Again, I would like to see more about your assisting physics, or whatever it was called. There have been several studies in America that show that where interviewers for post-graduate courses, or for undergraduate courses, or for jobs in universities, go through the unconscious bias test first, the outcome afterwards is considerably more equal, if you like, than it was before. I have to say that I have taken the test myself, and it is quite appalling what assumptions that you make from your cultural background, where you would have thought that you did not make those assumptions at all. So, I, for one, am very keen on getting what is relatively a cheap process through a lot of our stages of decision making for young people going into various occupations to make sure that we are not doing that so that we are not actually favouring women for traditionally women's occupations, and are not favouring men for traditionally male occupations. I think that there are some small cultural things that we can do pretty much straight away that might make those little differences.

[78] The last point that I want to ask you about is whether you see women being put off from your courses because of the gender imbalance that is already there. I have to say that I know of many A-level students who do not want to go on an engineering course where they are one of three girls in a cohort of 280. What efforts do your institutions make to make those women comfortable in that environment?

[79] **Professor Evans:** Could I make the first point specifically on what Joyce raised on this very interesting thing of ensuring that the bursaries are fairly distributed? We think that we do it fairly, and we think that we do it objectively and transparently. However, it is something that I will certainly take back. We have recently—this week—at Aberystwyth

announced the appointment of a new director of ethics and equality.

[80] **Joyce Watson:** I will come to meet him or her.

[81] **Professor Evans:** I will certainly go back to her, because I am sure that she would want to look at this in some more detail. More generally, I think role models are absolutely crucial. I think that the Institute of Physics recognises this. Of course, this is not a quick fix, but at least we are recognising it, and several people are recognising it. One of the things particular to the STEM career path is that, normally, entering an academic position would require a PhD and some years of intensive research work before the first academic position. It is not like that, necessarily, in other subjects. Those two years quite often correspond to the exact period of raising children, and I think that we are losing a lot of very talented female scientists at that point.

10:00

[82] As part of the women in science activities some months ago, we invited one of our former graduates, who is now a professor in Bath, and she made this point very eloquently. What they are doing there is that they are looking at new ways of allowing people to enter the teaching profession to allow for this and, certainly, I know that in our own universities we are now recognising career paths that are not just research. We are allowing people—. In fact, I am going to Swansea this afternoon on one of these. It is about recognising that there are ways right through to professorship grades that are not necessarily purely research. That ought to help, but we have to get into the psychology of making sure that we treat everybody equally.

[83] **Julie James:** Just on that point as well, on the role model—

[84] **William Graham:** It must be a final point; we are running out of time.

[85] **Julie James:** Okay, I just want to make a very brief point on role models, because I go around all the schools in my area. The other issue is that you need role models who are not the chief scientific adviser and the professor of something-or-other in astrophysics; you need people who are doing a normal science job to show normal kids that they can be normal scientists. I think that that is a big issue.

[86] **Ms Sadler:** Yes, Cardiff University—

[87] **Professor Evans:** We are finding that our students are great at this. Our students are organised as the Physics Buskers. The girls have organised into Phys-CHIC at Aberystwyth. Again, we would prefer for them to do it all together, but certainly they are terrific.

[88] **Professor Davies:** There is a huge amount going on in these areas. The trouble is that it is so big that we cannot sit here and list it all, but none of it is really solving the key problem. In terms of where you have got to focus, I think that it is rather good that we have focused on physics, because that probably is the big problem in terms of gender and science. In the biological sciences, at least at the undergraduate or school levels, you get more women coming through. Medicine is dominated by women now. On engineering, I am much more confident about engineering in the future. Already, in the United States, biomedical engineering—what we call medical engineering—is the big subject. We know that job growth there is going to be massive. It is much more attractive for women than men, and we are going to see that surging forward in the UK over the next 10 years or so. Environmental engineering as well is more attractive. So, I see a lot of hope here, but, currently, on providing role models in engineering, I am talking from a university that has just lost, because she has retired, our one female professor of engineering. Ridiculous though that is, that is the situation

that we are in.

[89] **Julie James:** You should take that unconscious bias test. [*Laughter.*]

[90] **William Graham:** Thank you very much. From the depth of our questioning and your excellent answers, we could have gone on very much longer. Thank you very much for your attendance today. I will ask Members to come back in 10 minutes' time. However, I will just tell Richard that the committee had a visit to your new campus a few weeks ago and was incredibly impressed. I wish you every success with that. Thank you very much for coming today.

[91] **Professor Davies:** Thank you very much, and I am sorry that I was out of the country at the time.

[92] **William Graham:** We understand.

Gohiriwyd y cyfarfod rhwng 10:03 a 10:12.
The meeting adjourned between 10:03 and 10:12.

Ymchwiliad Dilynol i Sgiliau Gwyddoniaeth, Technoleg, Peirianneg a Mathemateg (STEM) (Sesiwn 5)
Follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (Session 5)

[93] **William Graham:** We welcome Richard Spear of Careers Wales to our committee today. Thank you very much. For the record, could I ask you to give your name and title?

[94] **Mr Spear:** Yes, certainly. I am Richard Spear, and I am the chief executive of Careers Wales.

[95] **William Graham:** Thank you very much. I am going to ask the first question, if I may. The committee has heard previously that pupils who are particularly disruptive or who have poor attendance levels are often pushed into subjects such as construction craft. Would you be aware of this and do you have a comment?

[96] **Mr Spear:** I know that there is some evidence of that. Certainly, in the most recent Estyn inspection of learner support within schools, I believe that it found evidence to support that sort of conclusion. That is not the position that our staff see within schools, because they have an opportunity often to meet with individuals one-to-one and offer them independent and impartial careers advice and guidance. It was interesting to look at some of these previous transcripts and things such as the recent Estyn inspection. Often, the services that Careers Wales provides and the careers education provided within schools seem to get merged, so I would make a clear distinction between the two. However, I am aware of some evidence to support that proposition.

[97] **William Graham:** Thank you very much. Do you think that STEM careers or further study is an area that is of particular interest or of less interest in the priority groups that your organisation works with?

[98] **Mr Spear:** In terms of the priority groups, our priorities are not determined according to curriculum or subject choice. We do prioritise our services. The first thing to say, I guess, is that our services are available to all—they are all-age services. We do have a list of priority groups that has been set by the Welsh Government, but they are more about the nature of the individual—basically, those individuals who need more support. So, it would be impossible to

comment as to whether individuals who wish to follow a STEM career are within our priorities or outside of them. Our services primarily focus on those who need greater support, and those who need those career management competencies developed to enable them to manage their careers throughout their lives.

[99] **William Graham:** Thank you very much. Keith is next.

[100] **Keith Davies:** Thank you, Chair.

10:15

[101] Byddaf yn gofyn yn Gymraeg. Ar brofiad gwaith, a oes digon o gyfleoedd ystyrlon i bobl ifainc cyn belled ag y mae profiad gwaith yn y cwestiwn? Hefyd, a oes digon o gefnogaeth gan ysgolion i roi'r wybodaeth i'r bobl ifainc?

I am going to ask my questions in Welsh. On work experience, are there enough meaningful opportunities for young people as far as work experience is concerned? Is there enough support for schools to give the information to these young people?

[102] **Mr Spear:** First, just in terms of the role of Careers Wales and how it has changed, this is one area where our role has changed over recent years, so I will explain that change and then come on to the two specific elements of the question, if that is okay, Keith. Previously, Careers Wales used to arrange work placements directly for schools. Over the last couple of years, you may be aware that our organisation has shrunk, and one area that we have had to scale back on is that direct delivery of those sorts of services. What we now do is facilitate links between employers and schools. We also go out and try to encourage employers to offer work placements. Our staff undertake health and safety inspections of their premises and we hold something called the national database for work experience. However, I guess the responsibility has always been with schools, but they need to play a more active role now in using that database, contacting employers and organising the placements for young people. That is just to explain, in terms of background, how things have changed.

[103] Forty thousand young people a year get work experience placements from our database, which is a very significant number. Whether those placements are all adequate is an interesting question. There is some evidence to indicate that that is not the case. There are challenges, certainly in some areas, in gaining appropriate work experience placements for young people, and there are a number of issues related to that and involved in that. It is partly the timing: schools often prefer to send the whole cohort of young people out for a one or two-week period, and that is often extremely difficult for employers to accommodate, so there is that particular issue. That is a significant one. Moving forward, we are working very closely with the Welsh Government at the moment, looking at developing a European social fund project focusing on the delivery of the curriculum and the world of work. That has not been submitted yet, but there is a strong focus in that in looking at how we can improve the adequacy and sufficiency of work experience placements, to make them more meaningful for young people. What we would be very keen to move away from is a sort of sheep-dip approach, where all young people go out to a placement and have a week's experience that is not necessarily going to give them a better understanding of the world of work or help them to make some informed career decisions. It is certainly an area that we need to develop, but again, in terms of responsibilities, currently it is the schools' responsibility to secure the placements, but we do provide that support service.

[104] **Keith Davies:** Roeddech yn sôn eich bod yn cael trafodaethau gyda chyflogwyr. Wrth gwrs, mae'r ymchwil rydym ni'n ei wneud yn awr ar y pynciau STEM. Faint o gyflogwyr a fyddai'n addas i gynnig profiad

Keith Davies: You mentioned there that you have discussions with employers. Of course, the research that we are doing at the moment is on STEM subjects. How many of the employers would be suitable to give work

gwaith i blant sydd yn mo'yn edrych ar bynciau STEM ac a fyddai'n gefnogol iddyn nhw? A yw'n anoddach i gael cyflogwyr fel GE neu rywrai fel hynny i gynnig? A yw'n anoddach i gael profiad gwaith mewn sefyllfaoedd fel hynny nac mewn cwmnïau eraill?

experience to young people who want to look at STEM subjects, and would support them? Is it more difficult to get employers like GE or someone like that to offer? Is it more difficult to get work experience placements in organisations like that than in other companies?

[105] **Mr Spear:** It is difficult to give an immediate answer to that. We have got employers on the database, and often employers will offer a range of opportunities, some of which may relate to STEM, and others will not. We could certainly analyse in more detail the specific placements that we have on our database and provide the committee with a report on that. I am not aware that there are greater difficulties in securing placements within the STEM sector from employers like the ones that you mentioned, Keith. In fact, some of the bigger employers are very good and have very extensive programmes of work experience placements—BT, for example, has a very significant programme going forward to encourage young people to take up work experience placements. It is often smaller firms that struggle and, as you know, Wales is made up primarily of very small companies. It is the smaller firms that seem to struggle most to deal with an individual on work placement. So, I am not aware of any specific issue in relation to the provision of work experience placements from the STEM sector in terms of employers, but we can analyse our database and provide a little bit more detail on the nature of the experience placements that we hold within our database. That is not going to be all of the work experience placements that take place, but the majority of them are on our database.

[106] **Keith Davies:** I mentioned GE because Nantgarw has GE Aviation and Whitchurch has GE Healthcare. They are huge companies and I just wondered whether there are placements there for youngsters from Caerphilly, Pontypridd and Cardiff.

[107] **Mr Spear:** Again, we have a very significant number of employers on the database. There are 36,000, so it is probably best that I go back to speak to colleagues and analyse that. I would not know off the top of my head whether those employers are on there. I would anticipate that they would be, however, just based on some experience of some of the big employers. They seem to be the more proactive organisations in terms of offering work experience placements.

[108] **Keith Davies:** Thank you. Diolch. Thank you, Chair.

[109] **William Graham:** Joyce Watson has a question.

[110] **Joyce Watson:** I just want to ask an additional question. I want to be naughty. You have mentioned, and it is a fact, that very large employers can offer opportunities because of their scale. I do not expect you to answer now, but have you got any evidence that suggests that rural areas—and I cover mostly rural areas—really struggle to give young people opportunities? As I said, I do not expect the answer now, but if you could explore that I would be most grateful.

[111] **Mr Spear:** If your question is specifically in relation to work experience placements, I am aware that rural areas do struggle more to offer opportunities for schools. Particularly in the Powys area, for example, I know that a number of schools are struggling with their work experience placement programme this year. With the limited resources we have, we are trying to work very closely with the local authority and providing additional health and safety vetting for the individual work placements that young people have secured themselves through family contacts. I am not aware of other less rural areas struggling to that degree. On the other hand, if you look at our database and you compare the opportunities available in, for

example, Powys to those in Cardiff, there appears to be adequate provision—if you just look at the database. Talking completely off the top of my head now—we will get the figures for you—there are something like 1,600 work experience placement opportunities available in Powys on our database and just over 2,000 in Cardiff, for example. However, there seems to be an issue in terms of young people wanting to secure placements through family connections for various reasons—whether it is travel or whatever, I am not sure. So, yes, I am aware that there are greater difficulties reported by schools within some rural areas in Wales.

[112] **Joyce Watson:** Thank you.

[113] **William Graham:** Julie is next.

[114] **Julie James:** Just on that point, you know that the inquiry is into STEM-related subjects, and a lot of the companies in Wales that provide STEM-related services are tiny little micro-companies. I have to say that my own experience, just anecdotally, in my own constituency, which is the middle of Swansea, so not rural in any way, is that it is actually quite a big hurdle for some of those little companies to be allowed to offer work experience, because there seem to be a lot of health and safety requirements and form filling-type things. Is there not anything that we can do about that? It does seem a little excessive, I have to say, to expect somebody who is basically a one-person band to have a complete suite of health and safety policies when they work out of their living room.

[115] **Mr Spear:** The responsibility for securing the health and safety of placements primarily lies with schools in terms of their responsibility for young people. However, we undertake—although we have a more limited capacity to do this than we had previously—those health and safety inspections, so there should not be a great burden in that respect on employers because we are not asking them necessarily to undertake any additional inspections themselves.

[116] **Julie James:** I have had several complaints just about the speed of it and what a kerfuffle it was. They were more than happy to take on more than one work experience person in a row, but it seemed to be a huge kerfuffle. I confess that I do not know what the kerfuffle is, but they were definitely objecting to it.

[117] **Mr Spear:** I would certainly welcome any specific feedback that you have from those employers and encourage them to contact me.

[118] **Julie James:** I will find out the specifics and come back to you.

[119] **Mr Spear:** However, health and safety are obviously very important considerations in these placements.

[120] **Julie James:** It depends what you mean though, does it not? Of course it is an important consideration and, of course, the welfare of people is paramount, but on the other hand if you do expect a small micro-company to have a full set of health and safety policies and all the rest of it, we are going to experience difficulty, it seems to me.

[121] **Eluned Parrott:** I was just wondering if you have any evidence as to whether young people who are sent to science-related businesses actually get to have work experience in a science-related role within them. I was interested in being a journalist when I was 15; I was sent to a newspaper where I worked in the accounts department for a week, which was not entirely what I was interested in. So, I wonder whether you have any evidence to show what roles people are actually doing when they go on their work experience.

[122] **Mr Spear:** It is only anecdotal, really, and probably, in many cases, it would support

the particular experience that you had on your work placement. I am aware that a number of young people, particularly in the engineering element of STEM, go out and, because of the very significant health and safety issues with young people in that engineering environment, they do often end up in the office, which is not what they want. This is one of the issues that we are exploring with the Welsh Government in terms of the ESF project that we are trying to develop. I think that we need to be more lateral in our thinking in terms of work experience. Yes, a good work experience placement offers a young person a brilliant insight into the world of work, but are there other ways in which we can give individuals that insight, particularly, perhaps, working with the further education sector, the higher education sector and work-based learning providers, all of which, for example, deliver engineering provision and are often better able to deal with the needs of, and support, a young person in that context than an employer? So, I think that we need to think more laterally, not just about working with employers, but in seeing how we can get young people to gain that very valuable experience by working with learning providers.

[123] **Eluned Parrott:** Thank you.

[124] **William Graham:** I call Joyce Watson.

[125] **Joyce Watson:** The Construction Industry Training Board suggests that work experience should meet the needs of schools, rather than the needs of industry. Do you have any comment to make on that?

[126] **Mr Spear:** From our perspective, a work experience placement should meet the needs of the individual young person, in terms, as I said earlier, of giving them an insight into the world of work, but also enabling them and supporting them to make career decisions. So, I would not say that the work experience placement should suit the schools. I know that schools have their own pressures in terms of the curriculum and the time frame over which they can release young people, so, obviously, the arrangements need to be practical from the perspective of the school and the employer. I think that we probably, collectively, need to get better at selling work experience placements as a benefit to employers as well, particularly in terms of recruitment, but, primarily, I see the function of a work experience placement as being centred on the needs of the young person.

[127] **Eluned Parrott:** I want to ask about how early we should be engaging with young people, to talk to them about future careers. What evidence are you aware of in terms of the benefits of early intervention in getting people thinking in this way?

[128] **Mr Spear:** There is not a great deal of empirical evidence to indicate when, timing-wise, it is best to make an intervention, and resources are another issue. With more significant resources, obviously, the earlier, the better, to a certain degree, in terms of exposing young people to the world of work.

[129] I think that you can start developing an insight into the world of work and the types of skills that individuals need to be successful in the workplace from a very early age. But when you come to specific advice and guidance about the particular career path that individuals want to choose, that is often best delivered at the closest point to making the decisions, which is why a lot of our work focuses, for example, on year 11 students and year 9 students in schools, when they are making important decisions about future learning and employment opportunities. So, I would say that there is a dearth of empirical research to show exactly when the best time is to make an intervention in terms of careers advice and guidance. The sooner, the better is a pretty obvious statement, but, given the limited resources we have, we think that it makes sense to try to target our interventions at those periods when young people are making those important decisions that will affect the rest of their lives.

[130] **Eluned Parrott:** Okay, thank you. Year 9 is obviously a critical stage, because it is the point in time when young people make the first choices that might potentially prevent them from pursuing an academic path in a particular area in the future. So, in choosing which sciences they take at GCSE level, for example, they might prevent themselves from following a certain career if they choose unwisely. How much support is provided at that point to young people? Do we have evidence that suggests that young people are not making mistakes?

10:30

[131] **Mr Spear:** Again, in terms of the evidence, I would cite the recent Estyn inspection on the learner support arrangements within schools, which highlighted some very significant deficiencies in terms of the career education that young people are given at that age. The report also cited examples of individuals who took the wrong decisions, ill-informed decisions, which then prevented their options at a later stage.

[132] In terms of Careers Wales and our input, that primarily comes in in year 11, even though we do as much as we can with year 9, as well. However, I think that what we need to reflect here is that, in the provision of careers advice and guidance, there is a whole family of organisations and individuals that do that, and there is a range of influences on young people, from parents to schools, et cetera.

[133] One of the things that we are keen to do, again, going forward, working with the new strategic forum for career development chaired by the Deputy Minister for Skills and Technology, is to get better at clarifying what our respective roles and responsibilities are across the piece, because they are not entirely clear now. I know that there is a lot of confusion. Even reading, for example, that Estyn report, which is entirely focused on schools' delivery of career education, a lot of people have inferred that some of the recommendations relate to Careers Wales; well, they do not. However, the terms 'careers' and 'careers advice and guidance' are often used quite loosely. We think that we need to tighten up on the roles and responsibilities in that respect, which goes back to the question of whether there is evidence that perhaps more should be done within schools for young people at that age—yes, there is. There is clear evidence from the recent Estyn inspection.

[134] **Eluned Parrott:** In terms of what Careers Wales provides, obviously, a lot of your support services now are responsive, so there is web-based information and there is a telephone advice line. Do you have web pages specifically designed for year 9 pupils with information presented in such a way that someone who is vaguely interested in a career in engineering, or in going into the construction industry at a future stage, will be able to clearly understand what kind of subjects they should be taking at GCSE?

[135] **Mr Spear:** We do. That information is there, but what I would say is that we do need to review our entire online presence. That is an action that we have in our business plan for this year, going forward. You may be aware that Careers Wales is a relatively new organisation, which was formed following the merger of seven different companies. So, probably, over the last couple of years, a lot of the efforts within the organisation have been on establishing the new company. I think that our website was probably more advanced before we went through that process than it is now. A lot of additional features have been added to it and it is now quite clunky. All of the information that you could possibly need is there; finding it is not necessarily straightforward, which is why it is one of the main focuses, in our business plan this year, to try to address.

[136] We are doing that through a number of different means. There are three different actions in our business plan in relation to this. One is to come up with a new online presence and a completely new vision in terms of what our online presence should be. The other two are more technical, so, we are currently going through something called a transformation

project to change the architecture that underpins our website to make it more searchable, user friendly and up-to-date in terms of the technology that is now available to underpin websites. The third area is to gather new information on the career opportunities that are available to young people of any age. By the end of the year, we will have updated information on 1,800 different occupational routes showing things like what is involved, what sort of skills you need, what jobs are available within those particular sectors, how much individuals are likely to earn and what the projections are going forward. We have a lot of that at the moment—we have it for about 1,000 different occupations—but we need to update that.

[137] The other thing that I should mention as well, which is of particular relevance to this committee, is that we do not promote any particular sector; perhaps I should have said that at the outset. We are impartial and independent. What we are extremely keen to do is to raise awareness of the opportunities that are available, whether they are employment or learning opportunities, particularly to young people. So, obviously, we are keen to make young people aware of the opportunities that are available through a STEM route. We have on our website—and I can forward details for the committee to look at it—a spotlight on science, technology, engineering and maths. Again, that covers what is involved, what the future holds and what jobs young people could go into within this sector, which are a lot more extensive than a lot of people might think when they come up with an image of STEM as a sector. So, we have got that type of information on there and all of the information that a young person could possibly need is on there, but we need to present it in a more up-to-date and user-friendly way that better meets the needs of young people.

[138] **Eluned Parrott:** Absolutely. In terms of a proactive strategy that draws young people to actively search out that information if, perhaps, their schools' careers advisers are not as proactive as we would like, what is Careers Wales doing to ensure that young people know that this is there for them?

[139] **Mr Spear:** We highlight the availability of our website to all young people.

[140] **Eluned Parrott:** How do you do that?

[141] **Mr Spear:** Through our careers advisers who work within schools. So, either through individual one-to-one interviews with the young person or through group work. We highlight the availability of our online services to staff as well, so that they can make those available. We have marketing campaigns to underpin the website, which are not just targeted at young people, but are targeted at all individuals who we would like to use the website.

[142] **Keith Davies:** I think that you are in a unique position, to follow on from what Eluned said, because I think that year 9 is so important. I remember a careers officer at some conference I was at, saying that this young lad had decided to take needlework, so that when he went into year 10, people said, 'You are taking needlework?' I asked the careers officer, 'Why did this young lad want to do needlework?' and the reason was that he wanted to go into electronic engineering and he had seen the kind of work that electronic engineers do and had thought that pursuing needlework at GCSE would be a great help to him. Of course, there are plenty of examples like that because if you look at the top chefs in the world, they are not women are they? They are men. [*Laughter*.]

[143] **Julie James:** He is an endangered species.

[144] **Eluned Parrott:** He is getting more endangered by the minute. [*Laughter*.]

[145] **Keith Davies:** No, I support you, Eluned. I think that it in year 9, it is important for youngsters to see the range of opportunities that are available and what subjects fit in to those opportunities, because they are making a decision to get a qualification, which is probably, for

many young people, the only qualification that they have. That experience in years 10 and 11 could be very important for them.

[146] **Mr Spear:** It is extremely important and we are aware that there is a lot of pressure on schools, particularly from the curriculum perspective, and there is a strong focus on literacy and numeracy, which of course, we entirely support, but some of those pressures have led to difficulties for young people in accessing our staff to support them in making informed careers decisions. That is obviously an issue that we are trying to work with; we are trying to be as flexible as we can with schools, because, as I said, we fully appreciate the very significant pressures that they are under. They are often pulled in a number of different directions. Yes, we would obviously completely agree that more needs to be done.

[147] Again, there is evidence of this from a previous Estyn inspection, looking at the way that the careers and the world of work curriculum is delivered; it is extremely variable within schools. We have some schools, according to Estyn, dedicating no time whatsoever to the delivery of careers and the world of work curriculum. Others do very well, obviously, and have a very active programme. We think that the new Welsh baccalaureate model offers some very significant opportunities to strengthen the delivery of the careers and the world of work curriculum and we will be working very closely with schools. As it happens, we are in discussions at the moment with the Construction Industry Training Board on how we can work with it on helping schools to meet some of the enterprise challenges within the Welsh baccalaureate. So, there are opportunities available, but some of our staff do struggle in some instances to gain access to the type of young people who we know need our support. That is an issue that we are concerned about.

[148] **Eluned Parrott:** You talked about talking to young people, providing information about the kind of opportunities that are in the world of work at the moment. How up to date is the labour-market intelligence that you are able to provide to people?

[149] **Mr Spear:** It is as up to date as the information available. We get it from Government sources. I think that the latest set of data goes to around 2012.

[150] **Eluned Parrott:** Okay. So, you are looking at current statistics as opposed to looking to project future trends.

[151] **Mr Spear:** Both.

[152] **Eluned Parrott:** You are doing both. In terms of the STEM labour market in the future, what kind of projections are there for growth in those career opportunities?

[153] **Mr Spear:** Well, very significant ones, as we flag up in our spotlight on STEM on our website. I have some examples here—apologies, but I will read them because there are a lot of figures. With regard to what the future holds, the website says that the demand for STEM graduates and postgraduates will grow much faster than in other subjects by 2017. Just to give you an inkling—and these are figures from across the UK, because we do not just focus on Wales in terms of some of this labour market information—there will be a 122% increase in demand for biological science graduates within the next eight years, a 56% increase for engineering graduates, a 95% increase for mathematical science and computer graduates, a 38% increase for medicine graduates, a 48% increase for physical environment science graduates, and an 80% increase for technology graduates.

[154] We are impartial, so we do not promote any particular sector, but where there are clear growth opportunities available, we do try to raise awareness of those opportunities among young people and people within the labour market as well, so that they have a better insight into some of the opportunities available to them. Obviously, this information is

extremely important for young people in making their decisions. To a certain degree, the future trends stuff is crystal-ball gazing. It is not easy. We do not do it ourselves; we gather information from others who have experience in doing this and we present it in a usable way. Obviously, any prediction about future demand must be taken with appropriate caveats, but we think that it is important to give young people an insight into the best available intelligence on what likely opportunities will be available within the various occupations.

[155] The other thing that we do on our website, and obviously our careers advisers support this sort of stuff in far more detail when they have one-to-one guidance interviews with young people, is list the jobs available within the STEM sector. I am not going to add them up here, but, taking a quick glance, there are certainly about 100 different occupations listed as being within the STEM sector. Again, that is just to increase young people's awareness of exactly what STEM is, what is involved in it and what opportunities it could lead to for them. We also have a section on what skills individuals need and where they could work—and this is particularly focused on Wales, so it flags up Anglesey and the nuclear industry developments and some of the other very significant engineering developments taking place across Wales. It also gives an insight to young people about the type of money that they could earn in the various occupations. So, we give people that information as well. So, it is quite a rounded package, but we buy that in from a firm that supplies these sorts of data on a European basis to most of the careers services. We try to present it then in a meaningful way. However, our staff will help young people to interpret some of these findings and figures.

[156] This is the information element of our organisation. I guess that a lot of organisations provide similar information, but what we feel is our unique role is the advice and guidance that relate to that information. There, what we do—and this is a relatively new model for us—rather than pointing people down a particular route for a particular career, is give them the information that they need to make those decisions. We are more about developing the individual's career management competencies, so that they can make informed decisions and realistic plans and know where to find the information that they need to take those decisions, rather than what was perhaps the old model of careers advice, which was to ask someone what career option they wanted to go for, have a discussion about that to make sure that it was realistic and appropriate and then help them on to that career path. We are now more about providing people with the range of skills and competencies that they need to manage their careers throughout their lives.

[157] **Keith Davies:** You mentioned the new Welsh baccalaureate coming in. As part of the existing Welsh baccalaureate, people had to be involved in an enterprise activity. All youngsters had to be involved in that. At one time, Careers Wales did a lot with the Young Enterprise competition, where employers and schools got together. Are there such competitions now that Careers Wales is involved in?

[158] **Mr Spear:** There still are but we play more of a supporting role now rather than actually co-ordinating those activities ourselves. So, for example, at the Big Bang events that were organised recently by STEM Cymru, our staff were there to support those events and to provide independent and impartial careers advice and guidance. However, that is an example of the type of thing that we no longer deliver ourselves on an extensive basis.

10:45

[159] **William Graham:** Julie, do you have a question?

[160] **Julie James:** No, I just wanted to comment that, having looked desperately for what you were talking about on your website, I could not find it. So, I just wanted to concur that your website is dreadful. When are you expecting to get that project?

[161] **Mr Spear:** There are a number of different projects. With regard to the three that I listed, for the new vision for our website, we have a deadline of September to come up with that; the two technical transformation elements currently have a deadline of December.

[162] **Julie James:** So, it will be done by the time the next cohort get through.

[163] **Mr Spear:** Yes.

[164] **Julie James:** It is very difficult to navigate, is it not?

[165] **Mr Spear:** It is. That is one of the reasons why we are trying to moving the architecture of the site. It is a massive site, and it is therefore a huge undertaking. It is not as straightforward as you might assume. As it happens, I found this when I looked for the previous committee's initial report into STEM. So, I can assure you that it is there. However, that is an issue that has been raised with us on a number of occasions.

[166] **William Graham:** There are no more questions from Members, so thank you very much, Richard, for your evidence today. As you know, the Record will be produced and you will be able to check it in a few days' time. Thank you very much for your attendance today.

[167] **Mr Spear:** Thank you for the opportunity to come along today and answer some of your questions. I will provide some additional analysis on our database of work experience placements, but if the committee needs any more information, if the clerk lets me know, we would be happy to provide that.

[168] **William Graham:** That is helpful; thank you very much.

[169] We will now take a break. I ask Members to come back in 10 minutes.

Gohiriwyd y cyfarfod rhwng 10:46 a 10:55.
The meeting adjourned between 10:46 and 10:55.

Ymchwiliad Dilynol i Sgiliau Gwyddoniaeth, Technoleg, Peirianneg a Mathemateg (STEM) (Sesiwn 6)
Follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (Session 6)

[170] **William Graham:** Welcome back, and welcome to our witnesses, Dr Walker and Mr Liles. For the record, I would like to ask for your names and titles.

[171] **Dr Walker:** I am Greg Walker, deputy chief executive of ColegauCymru/Colleges Wales.

[172] **Mr Liles:** I am Barry Liles, principal of Coleg Sir Gâr, but I am here representing ColegauCymru as well today.

[173] **William Graham:** Thank you very much. Perhaps we could move straight away to the questions. I think that I am starting with the first question. I am sorry; I will ask Mick to ask the first question.

[174] **Mick Antoniw:** One of the areas that we want to—[*Inaudible.*]—between STEM subjects, and obviously with the workplace and the linking of skills and work. I wonder whether you could just set out your thinking on where we are on that.

[175] **Dr Walker:** There are various dimensions to this. First of all, colleges are big providers of work-based learning in its own right, in terms of apprenticeships, other programmes, traineeships, and so on. So, obviously, the learner—or the employee, in fact—is actually in the workplace, and therefore the connection is pretty obvious. In terms of mainstream programmes for 16 to 24-year-olds, the engineering and STEM programmes typically will have a work-related education element and placement element to them. So, that will be an integral part of the STEM programme in terms of a BTEC qualification, for instance. How it is done, of course, will vary from college to college and the extent to which those links are in place will depend on the local level of engagement and the types of firms that are within the catchment area of the college. However, those catchment areas now are much bigger than they were because, as you are aware, transformation has meant that, in most cases now, colleges are reaching a bigger regional area than they have done traditionally. That is the sort of basis of two elements.

[176] Do not forget, as we have said in the paper as well, that higher vocational education—so, levels 4, 5 and 6 courses—are now being done very strongly in colleges with 7,000 higher vocational education students. Around 40% of those will be STEM students. So, that is also an important element. Within higher national certificates, higher national diplomas and foundation degrees, there is usually, again, a work-related education element.

[177] **Mr Liles:** The work placement is a critical element for all programmes. I have to reflect back on the Pathways to Apprenticeship programme, the Welsh Government's initiative, which had work placements as an inherent part of it. They were absolutely critical and as we now move into the new learning programme areas, once again, the work placement is an essential element of that particular activity, more so within the STEM area.

[178] **Mick Antoniw:** One of the areas that I have been particularly impressed with, for example, through my contact with Coleg y Cymoedd, is that employers—and there are some much established employers, such as GE, which are quite sophisticated—know what they want. It seems to me that those sorts of relationships are not only very good and effective, but they are partly so because they are dealing with large employers that know exactly what they want, and they know what they need from you and so on. I am quite impressed as well with preparations for things on the horizon, such as the railway electrification, the training in progress for that, but is that common across the board? Are those just tip-of-the-iceberg examples? Are you satisfied that, across the board, with the quality of engagement with employers and the interlinking of subjects with training, we are actually providing what employers want? How consistent is that?

[179] **Mr Liles:** Within the STEM areas I would say that it is increasingly consistent. Naturally, looking at our geographical area, I dream of having an Airbus or a GE on my doorstep.

[180] **Mick Antoniw:** Absolutely.

[181] **Mr Liles:** On that basis we have to work a lot harder when we deal with perhaps up to 200 small and medium-sized enterprises that only take one apprentice every three or four years. What I am finding, however, is that, increasingly, it is a win-win relationship. We benefit from the fact that we supply apprenticeships, therefore there is a requirement by the companies to work with us as well in terms of viewing and identifying young people for progression into employment. On that basis, that is encouraging this dialogue and the relationship that exists. A vast majority of SMEs are now particularly alert to the benefits of apprenticeships, as are the major companies where there is a fantastic infrastructure for training and development. What we find as colleges is that we now work as the HR and training departments of the small SMEs, because they do not have the time, the workforce—the staff—to do that, and we are increasingly doing that for them. So, we are engaged in the

recruitment and selection of young people into those companies.

11:00

[182] **Mick Antoniw:** If we take the past five years, how do you evaluate the changes or the progress that may have been made within this? How would you see what needs to be done, or what developments need to take place over the next five years, because this is a continually moving feast, is it not?

[183] **Mr Liles:** It is, and I think that the five years that you selected are particularly profound when you look back at what happened in 2008 and 2009, when we worked with the engineering and technology companies in our locality. It was survival, and many are still receiving support from the ProAct initiative and what is coming out of Jobs Growth Wales now. My immediate answer would be to have more of the same of what we have done over the last five years, but we need to increase it rapidly in terms of pace and quantity, because the demand will accelerate because we have an aging workforce in those areas. As I walk through those companies nowadays, I can see former students. The workforce is aging, and the replenishment of the workforce is not happening. So, it is more of the same, but much more of the same, I would say.

[184] **Dr Walker:** Looking ahead five years, I would pick out three factors. One would be the introduction of learning programmes for the mainstream further education learners from this September, which are an envelope of learning much more tailored and designed to meet the needs of individual learners, and that is the new basis of the new planning and funding system being introduced by the Welsh Government for colleges and other post-16 providers from September. That should make work-related education and community engagement links much easier and much more integral to the programme, whereas previously we were funded by qualifications under the previous system. That would be one point.

[185] The second point would be the big developments that we are hoping will come on-stream in the next five or 10 years or so, such as Energy Island in north-west Wales, the circuit of Wales, perhaps, and potential developments in north-east wales with enterprise zones and the like. So, there are big initiatives there on which colleges are already working very closely with local employers and providers to make sure that the opportunities for STEM learners are maximised.

[186] The third thing that could help is the introduction of the new Welsh baccalaureate in September 2015. I know that a couple of other colleagues mentioned this in earlier sessions, but there should be opportunities through the use of team challenges—I do not know how much you have been informed about the new Welsh baccalaureate, but one aspect of the new Welsh baccalaureate will be team challenges that learners will have to do in order to fulfil their requirements to get the Welsh baccalaureate. There will be plenty of engineering foundation STEM bodies and the like that will structure those challenges around STEM-based challenges. I think that that will really help engender interest among learners in STEM. I am not sure that that is happening to a huge extent with the current Welsh baccalaureate, where the focus is on slightly different areas. That will depend on good implementation of the new Welsh baccalaureate, of course, and it will probably take three or four years to work through, but that is potentially an exciting development.

[187] **Mr Liles:** Would you mind if I talked on the basis of what Greg mentioned there in terms of going forward and the new funding methodology? What we have to reflect on in terms of the STEM subjects is that an intensive capital investment is required, and that needs replenishment. That is something that we have perhaps lacked in the FE sector, and in certain areas you will now see—. If I look back 15 years ago, I will see that, probably, engineering would have been offered in every college in Wales. Those colleges such as ours that have a

pocket of manufacturing excellence in the area would maintain that investment, but, critically, to move forward to introduce new technology, we are looking at introducing far greater capital investment in those areas to support that learning going forward.

[188] **Mick Antoniw:** I have one other question. There are areas of European funding—through INTERREG and Erasmus, for example—that are available for some very specific purposes. How have we benefited or what impact have those had in terms of some of your ambitions?

[189] **Dr Walker:** I think that there are two points on that. The first one is that, generally, ESF and ERDF funding has not been available to supporting mainstream funding, for obvious reasons. It has to be additional; additionality is the key principle of those programmes. So, we have not been able to use that money to support STEM, as such. However, I think that what we could point to is STEM development generally and stimulating projects that are related to STEM skills more broadly with companies and so on. I do not have a list in front of me in terms of European-funded projects, but I think, certainly, that higher education institutions have used that money for STEM-based research. On the extent to which ESF has helped colleges with STEM skills, specifically, I am not sure that we have many projects directly on that.

[190] **Mr Liles:** A number have come through—initiatives such as A4B, knowledge transfer partnerships. I think that the sector has been very good there in adapting new technologies linked for industrial projects, but, in the meantime, they also feed back in to support the curriculum. I think that that is where we have a great advantage of utilising not direct funding for the curriculum, but for projects and then using them for the curriculum.

[191] **Dr Walker:** A couple of exceptions to that might be foundation degree programmes and ESF foundation degree programmes, which Coleg Sir Gâr will have a major interest in, and also an ESF-funded, work-based learning project. Obviously, ESF supports the apprenticeships programme extensively and that has to be factored in to the equation. In terms of mainstream 16 to 24 funding, that is limited by the additionality principle.

[192] **Julie James:** Turning to the vocational qualifications that we have for STEM, can you both give us a view as to what the take-up is, what we can do to encourage a bit more of that, and generally, a view on non-higher education STEM pathways done through the FE colleges?

[193] **Dr Walker:** Today is a very appropriate day to discuss this, actually, because it is Vocational Qualifications Day, as you may have heard in the media and on Twitter. There is a lot of activity, which is very pleasing, and the Deputy Minister for Skills and Techynology is helping to launch that this morning. We can use the old terminology of a lack of parity of esteem still between general, academic educational qualification and vocational qualifications, and I think that that is reflected in the massive attention that is still garnered by A-level and GCSE results in August and not so much attention being paid to the excellent achievements of young people and older people in terms of vocational qualifications. There is still, I think, an ongoing, underlying cultural attitude that general education qualifications, academic qualifications, are the way to get into HE or to get into a sustainable career. It is improving slowly over the years and there are plenty of examples of learners. It is projects like Vocational Qualifications Day that try to project those positive images and positive role models for vocational learners on to the younger school and college cohort, but there is still a lot more to do. What Richard Spear would have talked to you about is relevant there in terms of careers advice and guidance. That will be crucial for young people; I think that year 9 has been referred to as a crucial point. Are they making the right GCSE choices? Are they also making the right choices as to whether, at 16, they will be taking a vocational education qualification or an academic qualification?

[194] In the colleges, certainly, we are not sure—to predict euphemistically—that that impartial guidance is coming through from the schools. We would prefer more independent routes for students of that age, getting the right advice as to whether they should be studying vocational educational qualifications or academic ones, or a mix of both. Colleges, of course, can provide that mix of different types of qualifications and do so very well, with some excellent outcomes. You may have seen in the *Western Mail* last week the fact that a number of colleges have an excellent track record, and, indeed, are best practice hubs for students going on to the most prestigious universities in the UK. We expect a report on Oxbridge entrants in the next few weeks. So, although colleges excel in both general education qualifications and vocational qualifications, we are still concerned that that impartial advice and guidance is not coming through at the right stage.

[195] **Julie James:** That is because the schools themselves are giving the advice, basically, at that stage. I think that that is what we have just heard from Careers Wales.

[196] **Dr Walker:** I think that we have to be frank and say, 'Yes' to that one.

[197] **Mr Liles:** I would like to be critical of the sector here, if I may. I would support Huw Evans's review of qualifications at this point. We have not, over the last decade, helped ourselves with the plethora of qualifications in vocational areas, with a range of acronyms that are unknown to the important influences of parents and teachers. I think that that is what we need to do—we need to clean up that range of qualifications. I will say that that is easy in terms of GCSEs and A-levels, because they are well-known by everybody, but when you talk about the acronyms that we have, we have not helped ourselves there. That is certainly one point.

[198] On influences within the schools, we have seen the demise of direct support in terms of Careers Wales supporting schools and their careers adviser. We need to work hard with them to inform them. There are initiatives. For example, we, as a college, now bring Careers Wales staff and careers advisers into the college on an annual basis for a day just to outline the changes happening to the curriculum.

[199] **Dr Walker:** The 14 to 19 agenda was meant partly to address this point, in the sense that students would be able, at 14 and 15, to get a taster of vocational courses, see whether that suited them and have a real choice then as to whether to pursue that. Colleges help schools to try to give those taster examples, but I would argue that, sometimes, schools, especially the smallest schools and the smaller sixth forms, are not often the best place to offer a good range of vocational education qualifications.

[200] **Julie James:** You have an open door from me on that argument.

[201] **Dr Walker:** On academic qualifications, I do not want to invest too much in anecdote, but on Richard Davies's point about further maths, one of the advantages of having a larger FE college doing the tertiary academic general education provision—for example, Gorseinon or Coleg Sir Gâr in Llanelli or Yale College in Wrexham—you have a critical mass of learners in each curriculum and discipline area, and more staffing and curriculum resources can be put into place to make sure that the students have the right choices in academic qualifications as well as in vocational qualifications.

[202] **Julie James:** Could I just pursue a hobby horse of mine on that point? I wholly agree with what you said there—that is true—but for some students the college experience of a big FE college is crippling. Actually, I think that some smaller schools have a better pastoral system, shall we say, for students who are not yet grown up enough to be able to cope with that environment. Do you think that that affects the sorts of choices that people make?

[203] **Mr Liles:** It certainly does; I can certainly see that in terms of the early weeks in the year. It is a big step to take from a very small, close-knit community into a large environment. On steps that we have taken, we break those down into families. Those families tend to be curriculum-area based. Once they are embedded within the sub-family, it does work. However, I am also aware that that close-knit feeling within the school environment is used to the school's advantage on many occasions to inappropriately keep young people on.

[204] **Julie James:** I do not disagree with that either. Do you think that more guidance on the right kind of learning environment, to pick up some of these vocational qualifications and so on, might also be appropriate? I give an example of someone who is very interested in becoming a technician, who cannot do that in a traditional sixth form, but who is quite an introverted, young-for-their-age sort of person. They would struggle in a big college.

[205] **Mr Liles:** On advice, an initiative that we are taking forward at the moment, annually, is to have five open evenings. Let us cut to the chase: they are marketing opportunities for the college. What we now do is split the college up and have industrialists and employers alongside teaching staff. So, when the young person comes in, they do not speak to a marketeer from a college; they will talk to an industrialist regarding the best routes into that occupation. That is the alternative independent advice that we are providing.

[206] **Dr Walker:** Finally, there are colleges that try to replicate something of the sixth-form experience in their facilities. For example, the Rhyl Sixth, which is part of the Coleg Llandrillo Menai group. You also have new plans by Coleg Cambria for an academic centre in north-east Wales, which will be—

[207] **Julie James:** Those are good initiatives, but I will say that they tend to focus on the academic children and not the vocational ones.

11:15

[208] **Dr Walker:** You are speaking about those who are opting—

[209] **Julie James:** What I am saying is that you could be a child on a vocational route, but you are not necessarily an extrovert, grown-up child. You can be quite an introverted, bookish child and still want to be a technician, a mechanic or an electrician, or whatever it is your route is going towards.

[210] **Mr Liles:** That is where we have the advantage, within a college environment, where they can actually study both. What I want for the learner of the future is the ability to build their own curricula, so that they can take one academic subject and a vocational subject; the right mix for the person. It is not about the institution; it is about what the learner needs for their career.

[211] **Eluned Parrott:** I wanted to talk about the transition from school into further education. We have heard some evidence this morning from your colleagues in higher education that they have to provide additional tutoring and support for some students, to get them up to the standard that they need in order to complete their studies, particularly perhaps in maths, where further maths is not offered. Is it the experience of FE colleges that young people coming from school are well prepared to go into STEM subjects, whether they are vocational or academic?

[212] **Dr Walker:** There is lots of evidence that there are some serious deficiencies in levels of literacy and numeracy—to that degree—for entrants into colleges at 16, or indeed 17. Despite some of those students having pretty decent GCSE grades, when colleges do

initial diagnostic assessments and tests when they are inducted into the college, some of the scores from those respected tests are very low and show that there are real deficiencies in their level of skills—basic skills, sometimes. Therefore, the remedial and remediating work that the universities have to do at level 4, level 5 and level 6, we have to do at a lower level in order to bring the students up to speed, in order to do what we would like to allow them to come out with, which is a level 3 intermediate skills qualification, then progressing up to a higher level qualification, either within the college or at a university. So, this is a major issue, as you will have, no doubt, heard, for colleges. We have schemes and programmes in place in each college for those students to catch up, to allow them to be able to progress to a higher level course, but we have a lot of learners doing entry level qualifications—level 1 qualifications—prior to doing level 2 or level 3 qualifications. Barry, it is something that you have great experience of.

[213] **Mr Liles:** Regrettably, it remains a major problem for us. Even those in possession of some GCSE qualifications, when they are tested, are not at the standard required for progression to the next level. So, we do see ourselves, at 16 years of age, being quite a remedial service, particularly in terms of numeracy and employability skills. It is a significant issue and it is impacting on our ability to deliver the core vocational requirements that employers seek from us. We are treading a very thin line here in terms of maintaining our credibility and status in terms of the vocational skills required by an employer, while also putting the remedial requirements back into the young people.

[214] **Eluned Parrott:** Are you seeing this trend becoming more serious? Is it stable, or is it something that is declining at the moment?

[215] **Mr Liles:** I would suggest, from personal experience over the last three years, that we are looking at an improving picture.

[216] **Dr Walker:** Prior to that, there was a deterioration, I think. Certainly, in the previous 10 years, there had been a deterioration. However, as Barry indicates, there may be a corner being turned, which is a very good sign.

[217] **Mr Liles:** We need to look at the qualifications offered within the schools as well, particularly for STEM-related subjects. I know that you have had that evidence this morning from the HE sector, but we are talking about science and mathematics in particular. We have to ask the question: what qualifications are offered in school for what purpose? Is it for the purpose of the young person or for the school, in terms of the outputs of the school? If we want the right pupil to move into the STEM area, it has to be the choice. It has to be qualification-led for the pupil, which is not often the best case for the school.

[218] **Eluned Parrott:** Do you see a difference in terms of this kind of deficit, if you like, between those young people going into vocational pathways as opposed to academic pathways in further education?

[219] **Dr Walker:** Do you mean on literacy and numeracy?

[220] **Eluned Parrott:** On literacy and numeracy.

[221] **Dr Walker:** Yes, I think that it would apply both to those going to general education routes and those going into vocational education routes.

[222] **Eluned Parrott:** When young people are coming to you particularly for vocational courses, presumably they have had some form of careers advice. Do you feel that when young people are coming to open days and they are talking to you about their options that they appear to have had an appropriate level of guidance, or are you also concerned about the

information that they have received in that regard?

[223] **Dr Walker:** We are very concerned about the level of information and guidance that they have received. Although there are systems in place, as Richard elaborated, so that some advice and guidance is given to students at key stage 4, the evidence when they present themselves at open days and when they choose courses is not always that they are making the right choices in terms of their future career paths. There is a lot of confusion, I think, as we have talked about, about the difference between general education and vocational education qualifications. That is one aspect of it. In earlier sessions, I think you talked about making the right choices in order perhaps to go through to higher education to read a STEM degree. That is an additional dimension to it. So, those two angles, I think, are worth highlighting.

[224] **Mr Liles:** We have taken initiatives and interventions of our own to remedy the situation. A critical factor for us has been the ability to look at vocational delivery at 14 to 16 years of age over the last 10 years. That has had a profound effect on careers advice. If you look at us, as one college, we have 1,000 young people at 14 to 16 years of age who are now studying at college from one half day a week to up to three days per week for the two-year period. That has had a major influence on career choices and decisions into STEM, but we have had to take even earlier interventions. We have just had, for instance, towards the end of this last term, 800 primary school pupils coming in to spend the day with us in a vocational environment. We have to do that. The next stage is to work with employers to take them onto construction sites. I honestly believe that you cannot start too early, and that advice is best seen practically and visually as opposed to in a room with an adviser.

[225] **Dr Walker:** Keeping people within the vocational STEM route is also important at that later stage, and Barry has been very modest in not highlighting already the work that he does as the skills champion for Wales and as a leading part of the skills network for Wales, which we highlight in the last few pages of our written evidence. That is a major cross-sector attempt; obviously, the colleges play a huge a role in that, and the Welsh Government provides important pump-priming for those competitions. That helps to give role models and aspirational goals for vocational learners; it also gives a UK and international profile for them. The impact of that on learners in colleges and on work-based learning providers is real and significant. Although it is probably only in the last four or five years that these kinds of competitions have come to the fore, we find that that is a really fantastic way to motivate learners and to keep them interested in the area. So, that is worth highlighting.

[226] **Eluned Parrott:** Finally, from me, I want to drill into this nervousness that you have about the careers guidance that young people are getting before they get to you. I want to try to understand whether you are concerned that the advice is too late, that the advice that they have had has been inaccurate or not helpful in some way, or that there is just simply not enough of it. What kind of issues are you seeing coming through? Are people making bad choices or just not aware of the decision-making process that they need to go through?

[227] **Mr Liles:** We heard and benefited from listening to the evidence earlier. We are aware of the reduction in resources that has occurred. There is far too much emphasis, in my personal opinion, on relying upon web-based information. That is having a tremendous impact, because young people are now one step away from that information, but what we find is—and it is great to have aspirations—that we have young people now who, because they have looked at a website, feel that that is within their grasp. They all want to be managers, designers and high-technologists, and when you then consider that there is a long a process to reach that, they are not prepared for that process. They want to get to the end goal immediately. It is this society that we live in, I presume—having that is one touch away.

[228] Going back to the situation, we cannot rely on web-based information. Invariably, due to lack of resources, we now find that it is those who are probably at risk of being not in

education, employment or training who have the priority and the norm—the majority—is not dealt with and relies upon web-based information. I also feel that year 9 is too late; year 11 is definitely too late, because decisions have been made that will affect their performance anyway. We need to start before year 9, to help in the transition from year 7 to 9. That is the critical period in my opinion, but we need much more resource to be added to that area.

[229] **William Graham:** Joyce Watson is next, then Dafydd.

[230] **Joyce Watson:** Could you give, in your opinion, the reasons why you think that there has been in notable increase in progression into STEM study in higher education and particularly in south-west Wales, and, following on from that, any lessons that could be learned from that progression?

[231] **Dr Walker:** Well, certainly, it was notable in the study that the regional learning partnership conducted in the south-west that, although the upturn in progression from colleges to universities was good across the board, there was a particularly strong link-in from STEM. We have to be careful not to overstate the evidence here, but certainly a number of people have noted that the extent to which that region has tertiary education—Gower College Swansea has an element of tertiary, Neath-Port Talbot is entirely tertiary, almost, and Llanelli has a very strong tertiary background as well—allows curriculum breadth and depth, and critical mass to ensure that students and learners are properly supported through what, for some of them, will be difficult journeys. STEM subjects are perceived as being more difficult—whether that perception is correct or not is another matter. However, that sort of critical mass of facilities, teaching resources and so on that is possible through the tertiary education background may account for the fact that there seemed to be, during the period 2007 to 2010, which was the timeline involved in that particular study, a markedly higher increase in STEM progression from FE to HE or of 16 to 18-year-olds into HE than in other parts of Wales.

[232] **Mr Liles:** A further analysis, looking at the detail behind that, would be the fact that a lot of those were progressing through part-time higher education. To me, the intervention required is critical employer engagement. We have to have the employers on board in terms of offering the opportunity for them to see the benefits of that progression through the apprenticeship route to higher apprenticeship routes, cadetships or whatever. The analysis provides an overall figure but you need to drill down to see where those occurred and, significantly, they were as a result of progression on a part-time basis for employed status personnel, not a traditional undergraduate to graduate process in that area.

[233] **Dr Walker:** That is a strong, viable route into careers, of course. It should not be seen that the only route into a STEM career is through a traditional bachelor's degree at a traditional university; it can be through higher national diplomas, higher national certificates or foundation degrees and then directly into STEM professions. So, I think that is working out here.

[234] **Joyce Watson:** If you were going to give one lesson that could be learned, what would you say it is? What would you say that we need to take on board?

[235] **Dr Walker:** You have identified the careers advice angle, which has come through clearly this morning, I think, from pretty much everybody. For the college sector, certainly, there is the issue of capital funding for learning resources for STEM. We have introduced, as I said, new learning programmes from September and those tariffs will be different between arts and humanities subjects and STEM subjects. I think what is particularly notable is the need for and the cost of investing in laboratories and engineering facilities. Colleges obviously need proper capital investment to keep those going but also to refresh those facilities. That is an issue and it is an issue that we are working through, and certainly in your

case, Barry, with the Welsh Government. Those would be two key issues. Levels of funding, generally, would be third point that I want to highlight, in that we want to keep learner volumes up and we want to keep the opportunities for learners to progress through all the routes to progression, and, obviously, that requires continued investment from the Welsh Government. As you know, there have been problems in the last year with levels of investment, so, obviously, we want to keep that point very much at the forefront of Assembly Members' minds.

11:30

[236] **Mr Liles:** In addition to Greg's points there about careers advice and capital investment, I would have to say that there is no one answer; we need to look at a string of things. I would start with the curriculum and the qualifications offered in schools, and then the careers advice to progression, but critically, again, linkages with employers for meaningful employment and sustainable employment thereafter. I think that that is critical, that interface.

[237] **Joyce Watson:** You started talking about skills competitions, which I was going to ask you about. I actually hosted a female who came through a competition held in Coleg Sir Gâr—she is from Pembrokeshire—and now has a workplace apprenticeship. That is the positive; the downside is that, actually, she was a substitute for the male who fell ill. There you go; I will say no more. She is going on further, to the next level of competition, as you will know—her name is Amy Phillips; you will know exactly who I am talking about. So, anyway, the point that I am getting to—I had to make that aside—is this: do you evaluate, because you did not mention whether you do, the participation of those people who engage in competitions and the value to them? Now, I have given you an evaluation of that one person, but do you do it generally?

[238] **Mr Liles:** Absolutely, and we have done an extensive piece of work, nationally, on this. I sit on what is termed the portfolio group for skills competitions in the UK, and there is an excellent evaluation by the Learning and Skills Improvement Service, which we can provide for you, on that basis. The greatest impact within the college environment is on the quality of teaching and learning, because it is not only for those engaged in competitions. The spin-off is far greater; it is for all the peer group of those engaged. It is maximising engagement in competitions, initially in classes, groups and colleges, and hence we go up towards the top in terms of the international competitions. However, it is all-level engagement, and it raises aspirations, and I would say that, now, we are still at an all-time low in terms of the aspirations of young people.

[239] We found that, in addition to enhancing teaching and learning, it does certainly raise the aspirations of young people. It has a tremendous benefit. Economically, it makes those young people very employable, and that is a major advantage, and we are raising significantly the skill levels offered above the norm.

[240] **Dr Walker:** I would encourage committee members to go to the skills show in Birmingham in—is the end of October, or November?

[241] **Mr Liles:** November. On a serious note, it would be worth your while to appreciate what goes on in terms of STEM at that particular UK final of skills competitions. If you want to, I can arrange it for you. [*Laughter.*]

[242] **Yr Arglwydd Elis-Thomas:** A gaf ddweud—[*Anhyglyw.*]—brwdfrydedd ynglŷn â'r holl faes yr ydym wedi ei drafod heddiw? Rwy'n hoff iawn o'r syniad o ddisgybl yn

Lord Elis-Thomas: May I just say—[*Inaudible.*]—enthusiasm in relation to the field that we have discussed today? I was very taken by the idea of a pupil being able to

gallu dewis ei gwricwlwm ei hunan, fel petai, a hynny ar draws yr hyn yr ydym yn arfer ei alw'n 'alwedigaethol' a, beth bynnag yw ei ystyr, 'academaidd' ar wahân i hynny. Fodd bynnag, rwyf eisiau gofyn mwy am ddau faes. Beth yw cyfle datblygu'r graddau sylfaen, y *foundation degrees*, newydd, neu weddol newydd, yn y cyd-destun hwn, a beth yw effaith wirioneddol—ac mae Greg wedi cychwyn ar ateb fy nghwestiwn i—y dull newydd o gyllido ar sail rhaglenni dysgu? Sut y bydd hwnnw yn effeithio ar y ddarpariaeth yn y maes hwn, yn arbennig o ran y pynciau yr ydym yn delio â hwy?

set his own curriculum, as it were, and that that could range across what we tend to call 'vocational', and, whatever its meaning is, 'academic' separate to that. However, I want to ask more about two specific areas. What is the opportunity to develop the new, or relatively new, foundation degrees, in this context, and what is the actual impact—Greg has started to answer this question of mine—of the new method of funding on the basis of learning programmes? How will that affect provision in this area, particularly in terms of the subjects that we are dealing with?

[243] **Mr Liles:** Mi fyddwn yn cytuno â chi ar hynny. Mae hwnnw yn gallu digwydd mewn rhanbarth lle mae ysgolion yn gweithio gyda cholegau. Nid yw'n rhywbeth yr ydym ni fel colegau yn unig yn gallu ei gynnig. Yn awr yn sir Gaerfyrddin, rydym yn edrych ar ysgol newydd yn Ninefwr, Ysgol Dyffryn Tywi, a bydd disgybl yno yn gallu mynd i'r ysgol am dri diwrnod ac i goleg am ddau ddiwrnod.

Mr Liles: I would agree with you on this. This can happen in a region where schools collaborate with colleges. It is not something that we as colleges alone can offer. In Carmarthenshire now, we are looking at a new school in Dinefwr, Ysgol Dyffryn Tywi, and a pupil in that school could attend school for three days and the college for two days.

[244] Hynny sy'n bwysig. Mae profiad gennym ar gyfer creu cwricwlwm newydd, a gallwn brofi hwn yn awr. Mae perthynas gennym â Phrifysgol Cymru, Y Drindod Dewi Sant. Lle rydym yn gweld lle mae dyfodol pobl ifanc i fod, rydym yn gallu creu cwricwlwm newydd. Rydym yn gallu rhoi graddau—y 'foundation degrees' newydd, yn arbennig—a'r rheini sydd eu heisiau ar ddiwydiant i gael dodi pobl ifanc mewn i waith. Hynny sy'n bwysig. Felly, ar hyn o bryd, rhwng addysg bellach ac addysg uwch, mae cyfle gwych gennym i greu cwricwlwm newydd.

That is what is important. We have experience of creating the new curriculum, and we could prove it now. We have a relationship with University of Wales, Trinity St David. Where we see where the future of young people should lie, we can create a new curriculum. We can award degrees—the new foundation degrees in particular—and those are what the industry requires so that young people can enter the world of work. That is what is important. So, between further and higher education, we have a fantastic opportunity at present to create a new curriculum.

[245] **Yr Arglwydd Elis-Thomas:** Diolch yn fawr. A'r effaith, felly—.

Lord Elis-Thomas: Thank you very much. And the effect, therefore—.

[246] What about the funding issue related to that?

[247] **Dr Walker:** Obviously, the learning programme system has not quite kicked off—it will not until September this year—and programmes will generally be two years in length, although not exclusively. So, it would be difficult to make a judgment, yet, on how the programmes are going, with the exception of two pilots that are taking place currently in Coleg Gwent and Coleg Cambria. The rulings from those two pilots are pretty good. We do not necessarily have any data from those in terms of STEM, specifically, but, I think that there is a general welcome for the switch in approach to planning and funding, towards a more coherent programme of learning idea, rather than the funding of individual qualifications. This should help us to build in the right amount of work-related education and

other elements that will help students to get the right skills to progress to a high level, either in terms of employment or education progression.

[248] HNDs and HNCs are still very much appreciated by employers; they are at the same level as foundation degrees, as you will be aware. In Wales, especially, even though there has been a big increase in foundation degree take-up, there has also been a healthy continued interest in HNDs and HNCs—higher national diplomas and higher national certificates. I think that we should not just totally focus on foundation degrees, as there is still a lot of employer buy-in and credibility with HNDs and HNCs.

[249] **Lord Elis-Thomas:** Would you have some specific data relating to the STEM subjects that we have been looking at that would relate to that breakdown between HNC, HND and foundation degrees, which might be of help? I do not know if we have that data, but I think that it would be very useful to have it.

[250] **Mr Liles:** Gallwn. **Mr Liles:** We could.

[251] That is accessible, yes.

[252] **Dr Walker:** By chance, the study to which I referred in terms of south-west Wales also has a national report that gives a pretty good breakdown up to 2009-10.

[253] **William Graham:** That is available, is it?

[254] **Dr Walker:** Yes. We will communicate that to the committee.

[255] **Yr Arglwydd Elis-Thomas:** Diolch yn fawr. **Lord Elis-Thomas:** Thank you very much.

[256] **William Graham:** Thank you very much. Keith is next.

[257] **Keith Davies:** Un o'r materion mwyaf rydym ni wedi bod yn trafod yn ystod yr ymchwiliad hwn yw'r prinder merched sy'n dilyn cyrsiau STEM. A oes data gennych chi am y gwahaniaeth rhwng bechgyn a merched sy'n dilyn y pynciau hyn? Hefyd, a oes unrhyw gynlluniau gennych lle yr ydych wedi gwella'r sefyllfa? **Keith Davies:** One of the main issues that we have been discussing in this inquiry is the lack of women who follow STEM subjects. Do you have data on the difference between boys and girls who follow these subjects? Also, do you have any schemes where you have improved the situation?

[258] **Mr Liles:** Mae dau beth. I ateb y cwestiwn cyntaf, oes, mae data gennym. O ran pob myfyriwr sy'n mynd trwy'r coleg, mae hwnnw gyda ni. Rydym yn gallu gweld lle maen nhw'n mynd ar ôl astudio yn y coleg. **Mr Liles:** There are two things. To answer the first question, yes, we have the data. In terms of every student who goes through the college, we have those. We can see their destination following their studies in the college.

[259] O ran yr hyn rydym wedi'i wneud, sy'n wych, mae clwb dydd Sadwrn gennym i ferched. Felly, mae clwb peirianneg gennym i fechgyn a merched a hefyd mae gennym glwb arall i ferched yn unig. Mae hwnnw'n bwysig iawn, hefyd. Rydym hefyd yn rhedeg, gyda'r ysgolion, y rhaglen MAT—*more able and talented*—ac yn y rhan fwyaf o'r rheini, In terms of what we are doing, which is excellent, we have a Saturday club for girls. So, we have an engineering club for both girls and boys and we also have another club for females only. That is very important too. We also run, along with the schools, the MAT programme—the more able and talented programme—and we can see that in

merched sy'n dod drwyddo. Eto, y ffocws yw mynd â'r rheini tuag at STEM, felly mae pethau rydym yn gallu'u gwneud, sy'n gweithio.

the majority of those it is girls who come through. Once again, the focus is to take those learners towards the STEM subjects, so there are things that we can do that actually work.

[260] **Keith Davies:** A ydych chi'n rhannu hynny â cholegau eraill yng Nghymru? Os yw'n gweithio mewn un rhan o Gymru, fe ddylai fod yn gweithio mewn rhannau eraill.

Keith Davies: Do you share that with other colleges in Wales? If it works in one part of Wales, then it should work in other areas.

[261] **Mr Liles:** Ydym. Mae hynny'n bwysig.

Mr Liles: Yes. That is important.

[262] **Dr Walker:** Yes. That is a typical type of activity. At a national level, the education engineering scheme, as it was originally called, or STEM Cymru, runs a series of national events. It has some funding from Welsh Government and it tries to co-ordinate girls and women to become more interested in STEM. So, there is that national picture, as well. However, perhaps we could try to work with the Welsh Government to get some data on shifts in study for STEM qualifications. It is not easily available, despite many hours spent searching the StatsWales website a couple of weeks ago, but it may be that we can pick up some trends with the Welsh Government statisticians to see whether there are any shifts. However, anecdotally, there is some evidence that there is an improvement being made, gradually, and hopefully some of the schemes that Barry and others have mentioned might contribute to that. However, I think that we are far from getting to the point we want to be at.

[263] **Keith Davies:** As we said earlier—you mentioned it and Eluned mentioned it earlier—we are looking at year 9, year 11. How old are these girls who take part? Is this happening from a very early age, so that they make the right choices?

[264] **Dr Walker:** You may have hit the nail on the head there in the sense of what earlier evidence givers to the Assembly have highlighted in terms of the research. I think that Mrs Sadler earlier on was saying that a lot of the academic research now is pointing to the fact that it is primary school interventions that are most effective in getting girls interested in STEM. Maybe that is something where, at an all-Wales level through the education engineering scheme, we should be considering how we can focus efforts on a wider range of girls and young women.

[265] **Mr Liles:** Clearly, the activity required here is to influence the influencers, particularly in our school environment. It is critical. We can almost track this in terms of the females who, naturally, fare very well in a STEM environment. If you talk to the parents, you can see the influence invariably goes back to a source. It will be the mum or the dad with a career or something in that area who will have influenced that young person going forward. That is the sad bit. I can reflect on the situation many, many years ago when I was the head of engineering and organising with the school community the progression at 14 years of age, and each and every year I would have the comment from the school, 'There we are; the girls will come on the bus for the hairdressing and the boys will do the engineering'. We have got to get back to that source, to influence that source.

[266] **Keith Davies:** Thank you.

[267] **William Graham:** Julie is next.

[268] **Julie James:** On that subject, in terms of the data you were talking about and the STEM data, Gower College did some very useful research for me when I was doing a short

debate on this very subject, and what was very interesting there was that it was not differentiating at the top level between the various sorts of STEM. So, for example, very traditional female subjects—pathways to nursing, for example, or domiciliary care—were showing as STEM subjects, quite rightly, but that skewed the figures into looking as though it was 50% women and 50% men. When you went below those figures, things separated out quite alarmingly into much more gender-stereotypical sources, including, for example, that only 18% of their physics students were female for that one year. So, I just wonder, when you look at those datasets, whether you can make sure that you are not doing something similar.

[269] On the influences point, I agree absolutely. I wonder whether you can do the same thing as the HE people were saying earlier on about sending some of your students back into the schools they came from, just to talk about it really and to influence the children. It is obvious in all the research that STEM-related parents are the only ones whose daughters really push those careers, and we have got to do something about it, basically. We have got to change that, have we not? It is about what the colleges can do in terms of the visibility of these pathways to the schoolchildren who are making those decisions in the first place.

[270] **Mr Liles:** I can give you an anecdotal example of what we do in our own college on that basis, but it is so important, I feel, that they have that communication with their younger peers. Men in suits do not turn up; we actually engage student ambassadors. I suppose that, in the old school days, they would have been the prefects. We actually pay them £250 per year. They are kitted out in red hoodies with the logo and, when the staff go back to local schools to give talks, the talk is given by the young person, the ambassador, on that basis. If you were to visit or any dignitary visited, the ambassadors would meet them. On the parents' and open evenings, they are there, uniformed up on that basis, and they do a fantastic job for us.

[271] **Julie James:** Well, that is the sort of role model that we are looking for really.

[272] **Mr Liles:** Absolutely.

[273] **Dr Walker:** The skills competitions help that again because you have got the clear role models in terms of being able to identify that for the next cohort of learners.

11:45

[274] **Julie James:** The only other point that I wanted to make—and I am sure that you have heard us talking about it in the committee as well—is that when you are preparing people to go on to the next level, into the world of work or indeed into further study, what preparation do you give to some of the females who are interested in STEM for dealing with that? I think that one of the big issues that we have is the attrition rate out of employment for women in STEM subjects, frankly because there is quite a hostile culture in quite a lot of the employment that they go into.

[275] **Mr Liles:** I have to agree with you. Again, it is the linkage with employers that is so critical. It is not that many years ago when I was actually dealing with the first-ever female apprentice into a significant employer and literally, at the twelfth hour, we had a telephone call to say that she could not actually be employed because there were no shower rooms. In the end, we managed it by actually creating a shower room in the managerial area. This still exists, unfortunately, on that basis. It is all about keeping everyone informed in that process. Again, working with the employers is critical to get their mindset ready for that purpose.

[276] **William Graham:** I have just one final question, which is on recruitment. In terms of qualified educational people for your colleges, is that still satisfactory, or can it be improved?

[277] **Dr Walker:** Do you mean in terms of the recruitment of students into STEM?

[278] **William Graham:** No, the recruitment of teachers into your colleges—your recruitment.

[279] **Dr Walker:** It will depend. On the STEM areas, the challenge is to get the right qualifications for colleagues, but also to get the relevant industrial experience in the areas in which they are teaching. To get the combination of the two is sometimes a challenge for colleges. We tend to—obviously more than schools—employ those with that industrial background, and that is a real advantage, I think, in the sense of getting students to identify with someone who has experience in the trade. I think that that helps, but I think that there is still—as with schools and universities—a challenge in getting recruitment to some of the key areas. Barry may have more detail on that.

[280] **Mr Liles:** We have taken conscious decisions in terms of recruiting staff. Joyce will be aware that we, and Pembrokeshire College, have employed a female welder for that purpose, to encourage females into it. One of my biggest problems with the recruitment of staff at the current time is actually delivering through the medium of Welsh. We have taken a strategic decision to actually no longer operate only bilingual provision, but to actually offer—STEM included—Welsh-medium provision. Forty-two per cent of our learners come in with a good level of Welsh currently. My staffing is below that, but the number of staff prepared to deliver through the medium of Welsh is also far less. So, it is a huge challenge to actually develop teachers teaching in the medium of Welsh in these subjects. That is my biggest problem.

[281] **William Graham:** Thank you very much. Time has beaten us again. Thank you very much for your evidence. You know that there will be a Record for you to examine. I am much obliged for your attendance today. Thank you.

[282] **Dr Walker:** Thank you.

[283] **Mr Liles:** Diolch yn fawr.

11:48

Ymchwiliad Dilynol i Sgiliau Gwyddoniaeth, Technoleg, Peirianneg a Mathemateg (STEM) (Sesiwn 7)
Follow-up Inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (Session 7)

[284] **William Graham:** We welcome Dr Crick, and we will move straight to questions. I will ask the first question. Could you explain further the fundamental issues, in your opinion, within the current ICT framework, and how these will this affect the supply of STEM professionals in the future?

[285] **Dr Crick:** Yes, definitely. I co-chaired the Welsh Government's review of the ICT curriculum last year. We reported back to the Minister in September 2013. This was the culmination of a two or three-year journey for an evaluation of the ICT curriculum in Wales. I suppose that, more broadly, there has been significant reform across the UK. So, there is a new curriculum for ICT and computing that is starting in England in September, and there is computing science, which sits within Scotland's curriculum for excellence. There has been significant upheaval across the UK for this subject area.

[286] One of the biggest problems for ICT more broadly within the UK, and especially within Wales, is that it is overlooked within the broader STEM agenda. So, there is an issue

with the wider public perception of the discipline because it is seen to be much more about skills and a vocational type of activity—so, digital literacy and IT-user skills. The computing science side has been overlooked within the broader STEM agenda. So, for example, in the January 2011 report from this committee, there probably was not as much focus on ICT as we would have liked in the sense of the broader STEM agenda. Clearly, within the past 10 to 15 years, there has been a significant focus on things like the uptake of mathematics, physics and chemistry, but, increasingly, computer science is seen as not only a facilitating discipline like mathematics, which underpins and pervades all the other STEM disciplines, but the quintessential STEM discipline, because it has mathematical foundations and a rigorous body of knowledge, it is based on science and engineering design principles, and what is the 'T' in STEM if it is not computer science? So, I think that there has been a significant concern about the number of people taking the qualifications and the perceptions of the discipline and how important it is educationally and economically.

[287] **William Graham:** Do you think that there is sufficient understanding of the difference between ICT and computing?

[288] **Dr Crick:** No, and I think that that has been the crux of the problem, especially in the choices made by young people. First, there has been an issue with the availability of qualifications. We have seen GCSEs in computer science only since 2010. So, when the old O-levels for computer studies vanished, that had a dramatic effect on the uptake for A-level computing, because it is a challenging A-level, as it should be. When ICT was first formed in 1997, there was a move to address more the IT user skills and the digital literacy part of the curriculum rather than the more rigorous academic discipline of computer science. I can give you one very clear statistic, which addresses uptake and gives you the ratio of females—. I will give you the headline statistics. In 2003, when there was a breakaway for A-level computing and it, basically, split into uptake for A-level ICT and A-level computing, 28,000 people took A-level computing in the UK and that split into 16,000 taking ICT and 8,000 taking computing. In 2012, 11,000 took ICT and 4,000 took computing. The ratio for females is, frankly, disastrous. In 2003, the ratio of females taking A-level computing to A-level mathematics was 1:3. So, for every female who took computing, three were taking maths. In 2012, it was 1:100, so there is a significant—. Among males, it has changed from 1:2 to 1:15, so we are seeing that this is disastrous and a significant capability issue.

[289] **William Graham:** I will just ask you about the Welsh Government's response to your steering group report.

[290] **Dr Crick:** I recognise, having been intimately involved in this process for the past two or three years, the wider curriculum for Wales context that it is sitting in. So, I know that there is an ongoing curriculum for Wales review, and it is important to make sure that we find an appropriate solution to the educational issues in Wales. I think that members of the ICT steering group and the co-chairs were disappointed with the timescales of the response and the actual response, because there appears to be nothing material in the response that we did not really know when we submitted the review. It addressed the digital literacy aspects of the curriculum. One of the headline proposals was to reform the subject—have curriculum and qualifications reform, creating a new subject called computing, and separating out the digital literacy aspects, which could be much more embedded across the curriculum, in the same way that literacy and numeracy are, so that would give space for the computing subject. However, it only addressed the digital literacy aspects, which are happening inside essential skills Wales qualifications and the Welsh baccalaureate too. There has been no clear response to the educational and economic importance of developing computing skills, and that is deeply concerning.

[291] **Julie James:** I entirely share your view, as you know. Have you had a chance to feed into the qualifications review? I asked the Minister on the floor of the Chamber in Plenary,

the other day, about it—

[292] **Dr Crick:** I saw that.

[293] **Julie James:** I was a little alarmed by his answer, I have to say. Have you had a chance to feed into that curriculum review?

[294] **Dr Crick:** The co-chairs of the ICT review met with Professor Donaldson in April, in the lead-up to the consultation, which is ongoing now. I suppose that the response is that now there is this independent consultation, it is, essentially, delegated from the Welsh Government. So, it all depends on what happens over the summer with the consultation and when Professor Donaldson delivers his report.

[295] **Julie James:** Will you get another chance to speak to him once the consultation has finished, do you reckon?

[296] **Dr Crick:** I hope so. I actually bumped into him yesterday in Cathays park 2. It is important that we ensure that the broader ICT or computing education agenda keeps the momentum that it had. Our ICT review was very positively received across the UK. There has been some criticism of what is happening in England with the new computing curriculum, especially funding and building capacity to deliver it, which is the big challenge, because it is such a disruptive change from primary through to secondary. In Wales it was very well received for the changes in Wales, because we had specificity for the problems in Wales, but also we had addressed some of the issues about a significant focus on CPD for teachers and actually building capacity in initial teacher training to make sure that we can deliver this curriculum from foundation through to the devolved qualifications.

[297] **Julie James:** My last point is that I have also been told that there are funding difficulties with the continuation of Technocamps, which I am also—

[298] **Dr Crick:** Agreed.

[299] **Julie James:** I just wondered whether you wanted to make some comment on that.

[300] **Dr Crick:** Very much so. I sit on the steering group of Technocamps, which is a fantastic £6-million-a-year ESF Welsh Government project based at Swansea University, Aberystwyth University, Bangor University and the University of South Wales. It has had, frankly, a profound effect on addressing or changing attitudes to computing for the ages of 11 to 19 in the convergence areas of Wales. I am just saddened that it is not a pan-Wales project, because it is truly needed to address the problems in Wales. There has been no clarification about the end of funding after the end of September. It has probably been one of the most successful ESF projects, I would say, and it is addressing both curriculum-type stuff—so, it is changing perceptions of the discipline, and also informing the potential for studying these subjects at school—and also addressing broader things like NEETs and socioeconomically deprived areas. It is changing aspirations, which is exactly what the project was aiming to do.

[301] **Julie James:** I am just awaiting an answer to a written question that I have put in to the Minister on that very point. I will come back again, Chair, once other Members have had a chance.

[302] **William Graham:** Okay. Keith is next.

[303] **Keith Davies:** Gwnaf ofyn yn Gymraeg. Sut mae modd herio a gwella argraffiadau pobl o lwybrau addysg

Keith Davies: I will ask my question in Welsh. Is there a way of challenging and improving people's perceptions of education

cyfrifiadureg? Pwy a fyddai'r gorau i wneud hynny?

pathways in computing? Who would be best to do that?

[304] **Dr Crick:** That is the crux of the problem, because this is the thing that I always lament when I tell people that I am a computer scientist: usually, the first response is, 'I've got something wrong with my computer. Can you fix it?' and, you know, that is fine. [*Interruption.*] I will have a look now. [*Laughter.*] Technology is the biggest lever on our lives, so there are different levels of competencies required. I sit on the UK forum for computing education. There was the Royal Society report in 2012, which was an evaluation of computing education in the UK, and the forum is led by the Royal Academy of Engineering. We have categorised the different types of skills that people would need. The first one is not great, because it is called 'digital Luddite', but that is in the sense of saying that there are no skills required. Then there is 'digital citizen', 'digital worker' and 'digital maker'. So, it is identifying the jobs that are currently available in the UK and sort of specifying forward into the future how they sit within those categories. You need to have baseline digital skills just to be a digital citizen—to be a functioning human being in our society. They are an absolute baseline minimum. The focus has been on those, but we need to have the projection for developing this deeper understanding of technology and the huge potential that goes with it. So, it is not just about creating more computer scientists. There is actually a deeper educational contribution to be had from studying these subjects at school. It genuinely is a perception problem. The broader STEM agenda has changed people's perception of why it is actually quite cool and genuinely intellectually interesting to study such things as mathematics, physics and engineering, but, unfortunately, computer science has not really had the same thing. Beyond your tech billionaires, where it is maybe aspirational to be a billionaire, the perception of studying computer science still needs to change. It is about informing young people about the value of studying these subjects, but also the availability of careers in Wales, because there is the classic problem that there some excellent computer science departments in Wales, so we are producing some very good graduates, but they are probably not staying in Wales because there are not enough jobs to support them.

[305] **William Graham:** Mick is next.

[306] **Mick Antoniw:** I just have a couple of short questions. The National Science Academy engagement and enrichment activities—how effective have they been?

12:00

[307] **Dr Crick:** I am somewhat biased, because I have had over the last few years around £100,000 from it to do stuff. So, I would say it is a fantastic initiative. [*Laughter.*] However, the reason why it has been a good model is that it has been a mechanism for me to do precisely what the previous question was addressing, which is to change the perception and also to do some very tangible things in schools that were not enabled by the curriculum, or were not being done in schools. In 2012, I had the delight of spending nearly £15,000 on LEGO, but doing it with three primary schools—Romilly Primary School, Barry Island Primary School and Cadoxton Primary School in the Vale of Glamorgan. We undertook some enrichment activities around LEGO Mindstorms, programming and engineering, and that has cascaded to thousands of students in that area, and it has changed their perception of that discipline. This is in primary school, so it will be interesting to see what happens when they progress on to secondary school. It has been a fantastic initiative, but I am still concerned about the longer term change, because that is predicated on there being curriculum change. It feels like there is a bit of a void at the moment, because teachers in Wales are looking enviously across the border to England and Scotland, because not only are they seeing a clear declaration about the curriculum, they are seeing significant support for CPD and upskilling to deliver that curriculum. I think that there is some frustration with that.

[308] **Mick Antoniw:** On top of all of that, of course, it depends on having the teachers having the skills themselves. If they do not have the skills themselves, it is very difficult for them to motivate and to develop. What do you think is the situation now? Do we have a significant deficit? Is this a major challenge for us?

[309] **Dr Crick:** I think that is a challenge. The Royal Society report from 2012 certainly highlighted the qualifications of teachers and attracting teachers through initial teacher training, because it was very hard to get computer science graduates to come in and teach ICT. That is the case, because many of them would have come through school and would not have wanted to teach that subject. I think that has changed now and we have seen, through the initial teacher training consortia in Wales, that there is significant interest and even the names of the courses have changed from ICT to ICT and computing or ICT and computer science. We are building capacity to deliver. It is not going to happen overnight, but I think that is certainly changing.

[310] With regard to addressing the broader CPD requirements for the existing workforce, the organisation that I lead in Wales, which is called Computing at School, is part of a broader UK organisation that has, I suppose, led curriculum reform in England and Scotland. It has a cascade model of best practice that is called the network of computer science teaching excellence, which identifies regional excellence among people who have proven practice in teaching computer science. It is a cascade model, and works with universities and regional hubs to identify demand for CPD and training. It has, essentially, built a community of practice of computing and ICT teachers. That model is nascent in Wales and is happening through things like Technocamps and CAS. The universities are on board to do this, because they have the computer science expertise as well as the education and teacher training expertise. However, essentially, it is a funding and capacity issue to roll that out across Wales because there is still a lack of clarity on what is going to happen with the curriculum, and whether there will be anything before September 2015 or 2016.

[311] **Julie James:** Just going back to what you were saying about the cascade through the LEGO Mindstorms, and all of that, I do not know whether you had a chance to see some of our earlier sessions today, but the conversation about engaging people in physics led on to a conversation about girls' and boys' toys, and so on. Would you like to talk a little about the difficulty in getting women and girls into this area as well?

[312] **Dr Crick:** Yes, I caught the tail-end of the very first session. I am very aware of the pinkification of toys and the gender-targeting of certain toys. LEGO is a particularly good—or, rather, bad—example of that. From a computer science perspective, there is—. I am a trustee of the BCS, which is the Chartered Institute for IT, formerly the British Computer Society, which champions the global IT profession. It has 70,000 members—predominantly in the UK, but across the world. However, the statistics for females within the IT profession are terrible; it is around 15 to 20%. That is a big issue. It is a pipeline problem, because, if you go back to the number of entrants for qualifications, then, as the statistics I gave earlier showed, it is very hard to—. Females are probably being put off this subject very early on. That may be because it is not being taught in primary schools, when perceptions are formed. When you start to get through to key stage 3 and the start of secondary education, they make qualifications choices and it is then too late, because it is seen as a geeky boys' subject. The only real change that will have a longer term effect, because it will change the system, has to be based around curriculum reform, because you need to have this subject built into stuff at primary school.

[313] On the flexibility as to how that is done within the curriculum, there is huge value around more thematic stuff. Computing across the curriculum is eminently possible, because of the way that it pervades science, mathematics and creativity. Programming is a creative

endeavour—you are manipulating and creating in a digital world. So, it has to start at primary school, because as soon as you start to come through to key stage 3 and you make choices at key stage 4, it is very hard to change perceptions. There is no gender bias for performance in these subjects, but females are generally not choosing them.

[314] **Julie James:** Is that affected by Technocamps and the cascade model that you were talking about?

[315] **Dr Crick:** I know that Technocamps have superb gender balance, and I think that they have stopped doing male-only and female-only classes. They say 'We want to make sure that the environment is a mixed environment'. You can do some initiatives to target females with female-only activities, but if men are part of the problem, they have to be part of the solution. You have to make sure that these classes are all together, to show that it is not a predominantly geeky boys' subject.

[316] **Julie James:** You have heard me on this subject before, but one of the issues is that the geeky boys who are doing it have a perception themselves of the environment they work in, which can be hostile to incoming females.

[317] **Dr Crick:** Agreed. It perpetuates the existing stereotypical computer science person, when actually it is a rigorous, challenging discipline—as any discipline is. However, we need to change the broader public perception, because people think of an *IT Crowd* type of person—a geek who is just hunched over their computer—or the other extreme is a Mark Zuckerberg tech billionaire. That is not a very representative perception of why people could be studying this subject, which has a profound educational and genuine economic value for Wales and the UK. This is a global problem.

[318] **Julie James:** Do you have the same pipeline problem as, say, physics, where women who are computer scientists still drop out of the profession?

[319] **Dr Crick:** Not necessarily. If I think back to my undergraduate class, there was a poor gender split. It is certainly changing, particularly at my university, where we have a very good gender balance, which is better than the UK average—it is about 30% female to males. It is how the pipeline, post-university works. They will go into graduate careers, but whether they are graduate IT careers is the challenge. Given our demographics, there is probably a lack of those types of careers in Wales. That is the push-pull problem, in the sense that we want to attract high-value industry to Wales. We probably do not have the skilled graduate workforce to support it, but the industry is not here, so the workforce is going to go somewhere else. It is a bit of a catch-22.

[320] **Julie James:** What would you do about that, if you had a magic wand?

[321] **Dr Crick:** The problem is that I do not think there is a magic wand; there is no way of seeing significant changes within a year or two—it genuinely has to be a long-term fix. There are interventions that can be made to change perceptions, which is genuinely crucial. I am responsible for undergraduate studies for our computing programme, so I give the open-day talks, and we are well represented from a gender split perspective. However, the perception of the discipline is still quite poor, so we need to change the perception of parents and the public of this subject, because they think that it is just about giving young people IT user skills, which are seen to be quite transient and superficial, or they do not see any high-value career. They will not see this as the equivalent of studying engineering or going into a profession. However, every sector in the UK depends on information technology, so talking about the IT sector is a bit of a misnomer now.

[322] Going back to the categorisations from the Royal Academy of Engineering, we have

statistics: we are going to need 13.6 million digital workers who have substantial digital skills for their career, and we are going to need at least 2.9 million digital makers, namely people who have a deep understanding of technology and are able to be creative and innovative with technology for economic benefit. These are startling statistics for the type of skills base that we need; it is not just about computer science and programmers, because it is underpinning manufacturing and life sciences.

[323] **Joyce Watson:** You have given us the problem; where is the solution? Does it rest with HE? Does it rest with us? Does it rest with industry? How are we going to change the idea that computing is different?

[324] **Dr Crick:** HE is probably a bit too low, because HEFCW has already categorised computer science and informatics as a strategically important subject, and has done so for many, many years, as has HEFCE. So, it is very hard if the pipeline is not wider coming into HE and FE. I think that it has to start with a curriculum change at school. Certainly, the perception change is significant. Industry has a role to play, and that is something that we recommended in the ICT review. We talk about not only connecting up the educational pipeline, but also about having much more engagement with industry beyond someone coming in to give a talk about 'This is what I do'. There needs to be much more long-term, strategic engagement with primaries, secondaries, colleges and universities to say, 'This is how we can show cutting edge industry practice and this is how we are doing stuff', showcasing the very diverse roles that exist using technology and industry.

[325] **Keith Davies:** We looked at innovation yesterday with the Minister. As part of that, we were talking about putting areas of the curriculum together—IT was one, engineering was another and medicine was another. We went to the Institute of Life Sciences in Swansea, where all three are together. The other messages that I have had over the past month or so, in papers that we have had, from a company in Llanelli called Tinopolis, and from people I know who work in the BBC, say that there is a real shortage of technical people for the creative industries. What do we do about that?

[326] **Dr Crick:** That showcases the importance of 'tech'. It is not as if it is just mainstream tech, as if you are writing software or creating hardware. The importance of the tech industry for the digital and creative industries is profound. In broadcasting in Wales, we have the BBC, S4C and ITV; it is a very big presence and that skillset has changed the way that is done and how it will be done in the future. So, essentially, it is not STEM; it is kind of STEMA, which is science, technology, engineering, mathematics and art. It is a fusion—you are not a luvvy or a boffin; the fusion of these skills is really important. Again, to keep reiterating the point, it is about a curriculum change. It is very hard to retro-fit and develop those skills when people have already done their A-levels or their degree. This is also very clear in underpinning science and research capability in the UK. The Royal Society 'Science as an Open Enterprise' report in 2012 said that computational techniques have moved on from assisting scientists in doing science to transforming both how science is done and what science is done.

[327] We saw the people who won the Nobel Prize for chemistry this year—they were computational chemists. It is in the intersection of disciplines where interesting research is done—so bioinformatics, computational chemistry and life sciences. There is leverage in computation to solve problems. This is a UK research capability issue of researchers not having the computational skills to do science. So, there are the baseline digital competencies for being a human being, through to underpinning the majority of industrial sectors in the UK, but also the very high-value computational skills that support things like science and research. The importance of computing is across the entire landscape.

[328] **William Graham:** The last question is from Eluned.

[329] **Eluned Parrott:** You said a little earlier that there are, perhaps, not enough graduate-level jobs in computing to keep our best graduates here. That is certainly something that we would all be concerned about. A lot of computing companies are small, self-starting companies, so what are universities doing to help undergraduates and postgraduate students learn the kind of commercial skills that would be required to help them become a spin-out success?

[330] **Dr Crick:** I agree. The Welsh Government funded centre for student entrepreneurship, particularly, in south-east Wales between Cardiff Metropolitan University, USW and Cardiff University is really important. I think that it is about creating the ecosystem or the environment for people to meet to discuss stuff. So, if people are very technical and doing really interesting stuff with creating intellectual property and ideas, you want to create an environment where they can chat to people who can put them in touch with more business-minded people, or provide opportunities for accessing finance and venture-capital-type funding.

12:15

[331] It is about showcasing the potential for this, and I think that universities have really cottoned on to the idea of why they need to create the environment for technical people to exploit the ideas that they have in their undergraduate and postgraduate degrees. However, it is also broader. You are right in terms of the start-up, spin-out-type stuff from universities. If there is not a bigger system and anchor companies to support the SME base in Wales, I think that that is also a problem. They will not all be successful, but they do need bigger companies like BT, General Dynamics UK, Alcatel-Lucent. They are big anchor companies in Wales, but you also need the SME base to fit in to those. There is a skills problem in terms of having enough people to feed the success of these small companies, but whether there is enough funding and access to opportunities for those companies to be successful is another thing. I think that initiatives like the centre for student entrepreneurship have been useful, because they open people's eyes to the potential of doing this kind of stuff, but I think that it will be much longer term, and creating the environment is really crucial.

[332] **William Graham:** Thank you very much for your answers.

[333] **Dr Crick:** Thank you for the opportunity.

[334] **William Graham:** A transcript will be prepared and sent to you. Thank you very much for coming.

Daeth y cyfarfod i ben am 12:16.
The meeting ended at 12:16.