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Inquiry on

DIGITAL SKILLS

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Questions 210 - 220

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10.15 am

Witnesses: Professor Dame Wendy Hall and Baroness Shields

USE OF THE TRANSCRIPT

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Members present

Baroness Morgan of Huyton (Chairman)
 Lord Aberdare
 Earl of Courtown
 Baroness Garden of Frognal
 Lord Giddens
 Lord Holmes of Richmond
 Lord Janvrin
 Lord Kirkwood of Kirkhope
 Lord Lucas
 Lord Macdonald of Tradeston

Examination of Witnesses

Professor Dame Wendy Hall, Director, Web Science Institute, University of Southampton, and **Baroness Shields**

Q210 The Chairman: Thank you so much for agreeing to come and share your thoughts with us this morning. We were particularly keen, as you could see, to have an evidence session with a focus on how on earth we raise the involvement of women in the sector from the age dot through to pension age. We are also acutely aware that, as well as being very eminent women, you are both very eminent across the piece, so we will not stick exclusively to the issue of gender, but we are very concerned. We have lots of evidence about the difficulties of women's involvement in the sector, from girls at school onwards. One of the things we are anxious to do is quantify what the change in the economy would be if we could shift the dial on that and, secondly, some practical ideas for how things could be changed. That is just by way of context about this morning's session. Thank you very much indeed.

Just a bit of housekeeping first. You have a list of interests that have been declared by the Committee. They were declared orally at the early sessions in July. This is a formal evidence-taking session of the Committee and a full note will be taken. It will be put on the public record in printed form and on the parliamentary website. You will be sent a copy of the transcript and you will be able to revise any minor errors. This session is on the record, it is being webcast live and will be subsequently accessible via the parliamentary website. You are very welcome to submit supplementary evidence after the session. Indeed, we may specifically ask you to do so on some issues. I am asked to remind you to speak up, and indeed all of us to speak up, although the acoustics are not bad in here actually.

I will start by asking you to introduce yourselves, and if you wish to make any opening remarks please do so but do not feel you have to. On some of the questions, clearly one of you may want to talk more than the other. That is completely fine. It is not a competition. If you want to chip in with each other, that is fine by us. We just want to get the information that we want to get this morning. Professor Hall, shall we start with you?

Professor Dame Wendy Hall: I am a professor of computer science at the University of Southampton, and for the last 15 years I have been working on the area of Web Science, studying the web. I knew Tim Berners-Lee before the web—we were working on hypermedia systems—and I have been involved with multimedia and hypermedia systems since the 1980s.

I will just say one thing. I have not prepared an opening statement—I think we are better having a discussion—but I wrote my first paper on the lack of women in computer science in 1987. That is a long time ago. I was a young junior lecturer and I realised that I was going into the October registration period and we had three years of computer science students and no women at all to teach, and really it has not got any better. At Southampton we are one of the top computer science departments in the country, and if we have 10% women on our courses that is good, and a lot of those will be from overseas. In some ways it has got worse rather than better in the area of tech, from my long perspective on this. I have worked tirelessly to try to change it, but if I knew any wonderful answers I would tell you.

The Chairman: Well, that is a cheering start.

Baroness Shields: Thank you, Lord Chairman. Like Dame Wendy Hall, I started my career 30 years ago in technology. In fact my first job, believe it or not, was as a product manager, designing chips that made analogue machines digital, so it has been a long road for me as well. My career has been primarily in product development and technology, but then eventually in executive positions with the companies that you all recognise, the Googles and Facebooks of the world. I have seen the transition of our world, our culture, our economy, who we are, how we live our lives and interact with each other, from the very early days all the way until now. Hopefully that perspective from the consumer side and from a society and culture perspective has fed into the work that I have been doing as the adviser to the Prime Minister on the digital economy.

Like Wendy, I remember there were three girls out of 500 in my computer science class in 1980 and it was daunting. I do feel that those figures have not improved anywhere near to the level that we expected. I expected pluralism to happen and that we would all be sharing it. The one thing I will say is that in developing products, the teams that I have been on that were gender-balanced were the most successful teams of all. It is absolutely essential, all the way through the product development cycle to society as a whole, that we somehow break down these barriers. I am sure Wendy feels the same. There are optimistic signs, and I believe there are ways in which we can do this. I thank you for inviting us here and look forward to answering your questions.

Q211 The Chairman: Thank you very much indeed. If I can start with a pretty broad-brush question: can you help define for us the importance of the digital sector in the wider sense to UK competitiveness? To what extent can we define what the economic impact would be on the UK if more women entered the IT sector in the broader sense and were equally skilled as men? How would this shift UK GDP and global competitiveness?

Baroness Shields: Thank you, Lord Chairman. As we have come out of this difficult double-dip recession, if you cut the data in a way that no one is really talking about, you look at them in the sense not of how many jobs have been created but of where those jobs have been created. Government has primarily contracted, and big business, if you look at the FTSE 250 or the Fortune 100 in the US, has also contracted. The real catalyst to growth has been

the entrepreneur-led businesses. In fact, those scale-up businesses have been the biggest contributors to the economy during this period and have pulled us out into growth. Many of those businesses are tech and digital businesses, so it is absolutely essential that we nurture and create the environment for those companies to flourish. If you just look at London, 27% of all job growth during the three-year period from 2010 to December 2013 has come from tech and digital businesses. If you took that out of the equation, we would not have recovered, so it is that essential to what is going on.

I see the green shoots everywhere. Two weeks ago I went up to Sheffield with the Deputy Prime Minister and we launched something called TechNorth. One of the most important things that we have to do is look at these green shoots of growth all across the country, and we in government have identified 13 clusters. There are many, many more. A Government cannot create a technology cluster, but what we can do is recognise the unique strengths of each of these cities, their great universities and how industry, universities and the cities all come together and how we can help them flourish. What are the conditions we can create? Everything from the R&D tax credit to the Patent Box, which is an absolutely brilliant concept, are things that allow more money to come in and give people the comfort that they should take the conviction of their ideas all the way forward and invest their time and energy in building businesses from the ground up.

Q212 The Chairman: It is really interesting that you raise that, because we had evidence from one of your colleagues about it. One of the things that we were trying to probe was what the constructive role is for government. Last week we were talking about the example of logistics in Sheffield. Here is a great opportunity to have a modern version of what they have done before and look at the logistics space: how can that be digitalised? What do you think the role of government is in making that happen? Rather than just saying, "Here you are. This is great. This is an opportunity for you", how does government then make the partners come together properly and make sure the right research funding goes in and all the rest of it?

Baroness Shields: I think the most important thing is to listen to the people on the ground. If I look at the defining factor of success in the last four years that I have been involved with Tech City, I would say it is listening to the people and asking them what they need specifically and then prioritising those. Oftentimes we react to anecdotal evidence. Wendy is a scientist. You absolutely have to have an evidence base, but informing that evidence base and validating the assumptions through direct contact with people in these clusters has really made the difference.

We host these things called Tech City breakfasts. We bring people in from all over the country and we hear about the primary thing that is holding them back. Is it finding talent or access to talent? Is it, "My people, my team, cannot get here fast enough in the morning because there is too much construction on the M1."? I do not know what it is, but it is identifying those things and then prioritising them that is the responsibility of government.

In many respects it has been more ad hoc than it should be, and part of the digital advisory committee that I am working on right now is taking all those initiatives and putting an evidence base behind them and then trying to prioritise and make the correct decisions, based on what is needed right now, and then a long-term vision in what we can do in the future.

The Chairman: That is really helpful, thank you. Professor Hall.

Professor Dame Wendy Hall: To add to that, I would like to make a point about the skills gap that we see. Our students are snapped up before they have finished their degrees. Many of our students start their own businesses, and that does not get reported properly in the statistics.

The Chairman: Is that why we are told there is quite high unemployment? We were puzzled by that.

Professor Dame Wendy Hall: I was going to come to that. Our evidence is that our students are absolutely snapped up and the companies come back to us for more. They particularly say, “We are looking for women”, and we do not have any. We have a handful of them. Last year in the statistics that were released by HESA, computer sciences comes bottom of the employability list, and that is really negative press. When you dig under, you find that a lot of different types of courses are classed under computer science. You have to dig to see which are the ones like those in the top CS departments; some of the new universities teach wonderful computer science. I still call them “new”, the non-Russell Group. You will get IT lumped in with all sorts of different things under computer science, and they are not necessarily the ones that we need. We need to make people employable, and that is bad press.

I was going to make the point that I travel a lot and go into universities and lecture to computer science students all around the world. When I go to the Far East, Singapore, Malaysia or India, the classrooms are more than half full of women. When I talk to the students, the CS classes are bursting, because in their culture they see this as a career that will earn them a lot of money and get them a job. I walked into a classroom of computer science at the University of Qatar that was 90% women. Then I realised that that was largely because the men were being educated overseas and the women could not go overseas, so you have to dig beneath the statistics. When I talk to the girls in India, some of them say, “My parents want me to do computer science because I will meet the right husband”. There are all these sorts of things underneath it, but it is still wonderful to go into a culture where they see these types of skills as absolutely top. They are probably more popular than law or medicine. That is our problem. We have this big culture thing that this is a geeky thing to do and, “It is not going to get me a job”. We have to shift that culture.

The Chairman: You think that with the concern about employment, they do not understand that it—

Professor Dame Wendy Hall: It is just making our issue worse. It is making it harder for us to recruit good students on to computer science courses.

Q213 Baroness Garden of Frognal: I think you have partly answered the question I was going to ask, which was: where should the Government focus efforts in order to grow the UK’s economy and support the digital sector? You have already suggested the tech cities and the hubs and entrepreneurs and so on. Are there other ways or places where you feel the Government should concentrate efforts and perhaps also comment on the Government’s role in improving female contribution in this area, because we have identified the lack? I realise, Professor Hall, that you have suggested that any bright ideas you would have had would have come out already, but I am just asking.

Professor Dame Wendy Hall: I have some. If I had a really amazing answer I would give it to you, but I do not. I do have some positive things I want to say, but do you want to take that question first Baroness Shields?

Baroness Shields: Yes, sure. There are many areas of technology that we, the UK, can lead the world in. We have a strong concentration in big data. In fact, Wendy is leaving this Committee hearing and heading over to the Open Data Institute for a speech there. We are leading the world to open data sets and what that will enable for the economy: artificial intelligence, machine learning. There are a lot of areas in other things, such as FinTech. Our financial technology sector is bigger than New York at this point. More investment is going in than is going in in New York, and we lead the rest of Europe by a long shot. There are more data scientists in the UK than there are in France and Germany combined. That is pretty exciting. We have so many strengths.

The question is how you pull those strengths out and nurture them somehow. You find that these clusters naturally gravitate towards their skillsets. The University of Southampton has incredible skills, and people come out of there and start businesses that relate to what they have studied and then a cluster forms around that. You know that you have access to talent in that university, and that happens organically without the overseeing of any institution or organisation.

Professor Dame Wendy Hall: The most important thing for me is that the Government should be consistent in their approach. We have both been at this game for a long time and in the UK I have seen campaigns come and go—mostly go—and they leave no legacy. There is no memory of what has happened. There are new things happening now: there is your Committee on Digital Skills, the DCMS Taskforce on Digital Skills, a new BIS initiative—what is it called, My Life?

Baroness Shields: Your Life. Yes.

Professor Dame Wendy Hall: Your Life. There is a huge issue. I was just reading in the *Times* at the airport this morning about the new virtual identity that is coming in. We, sitting in this room, might understand it. We probably understand it—I do not know how many of you understand what having a virtual identity means—but most people out there are not going to understand it. They need to have the skills, and it is more about digital literacy than digital skills. We need a mix. We do need people like extreme programmers. If you watch “The IT Crowd”, we teach a lot of guys like that. Computer science attracts guys who cannot talk to people but they can talk to machines. There are girls who work in that world and do extreme programming, and we need more of them.

The Chairman: Extreme programming; we have not heard that. It is great. Sorry, go on.

Professor Dame Wendy Hall: Stanford, for example, say that is what they teach in computer science at Stanford, and they feed Google. That is what they want, extreme programmers, and we need those skills as well.

Everybody in the country needs some level of digital literacy, and I totally applaud what is happening at the moment with the changing of the curriculum. We are talking about reintroducing programming back into primary school and teaching those skills through. In the long run, that will hugely help. Not everybody needs to be a programmer but everybody needs to have digital literacy skills, and I think the Government have to be consistent in putting it in place. It is about teacher training, educating the parents as well, educating

employers, but it has to be consistent instead of this start-stop mechanism that we have at the moment of fund something, fund a campaign for three to four years, then the money goes away and everybody has to start again. I was talking to the people at BIS starting Your Life. Is that the right name?

Baroness Shields: Yes. That is what it is.

Professor Dame Wendy Hall: I cannot get that name in my head. There are very hungry young researchers who are looking into what to do. They have no memory at all of what has happened in the past, what has worked, what has not worked.

Baroness Shields: They almost reinvent the same programmes.

Professor Dame Wendy Hall: They reinvent. They call me up and say, "Why are there no women in science and technology?" Oh dear, I want to say. Do some research. Look at all the things that have gone in the past and look at what has worked and what has not. But we do not leave any footprints in the sand, and I think the most important message for government is consistency and legacy to make sure these things build on what has gone before.

Baroness Shields: I would add that the road is paved with good intentions in this area. Again, people are almost reinventing the same programmes. What is interesting right now is that the conversation is happening all over the world.

A book came out recently by Peter Thiel, one of the most prolific investors in Silicon Valley, called *Zero to One*. Inside his book he talks about how everybody is creative when they are young. All kids are innovative; they are all special in their own way. Over time the institutions of school beat it out of them and they become less and less innovative. In fact, he said it is no coincidence that the most successful people in Silicon Valley are on the Asperger's spectrum, because they were the people who did not care what people thought about their ideas so they pursued them anyway. It is a really fascinating view into what is happening, because if you ask seven or eight year-olds, "How many of you are artists?", they will all raise their hands. I forget who said this; I did not say this. Someone said this, and I thought it was a fascinating comment. If you asked 13 year-olds, "How many of you are artists?", they all go, "Not me". By then they have lost their will to try because they are so worried about taking exams and delivering that A result.

I have a 15 year-old son. We went away on a break and he said something profound to me, and I think it is important to everybody here. He said, "When I was young, all I ever talked about was time travel. I wanted to come back to this point in time". He was fascinated with Einstein and he had all these ideas. He said, "Now, Mum, I am just trying to get from one day to the next". I think that is so profound. That is the strongest thing. As a mother, your heart hurts.

To be in this area, in this field, and to feel that, we have to do something. We have to flip this around. We have to make it about ideas, creativity and innovation and less about the structure. The reason Google do so well is because one day of the week, or a certain part, 20% of your time, of your day, is spent thinking. If we just gave our kids 20% of time to be creative, what would happen? You cannot even imagine what we would create.

The Chairman: I would love to have you two here when we have the government Ministers, actually.

Professor Dame Wendy Hall: Can I riff off of that, please?

The Chairman: Yes. I have two members of the Committee wanting to come in as well, but carry on.

Professor Dame Wendy Hall: My passion at the moment is what we call web science, which is about studying the way the web has evolved. We founded this new science with Sir Tim Berners-Lee and Sir Nigel Shadbolt.

Web Science is built on the idea that the web is a technology, but it grows because we put content on it. We, the people, everybody, and women probably more than men but certainly as much as men, use the internet. We are great communicators and we love the social networks, and we are great users in a way that we did not used to be. In the 1980s, when the first personal computers came out they were sold as toys for the boys because there was very little to do on them except assembly language programming and playing war games, and that is when it all started to go wrong.

Women love this technology, they love using it, but they are not involved in developing it. In the web science area, we study it from a sociotechnical point of view, so it is not just about technology. We look at it from the social science, psychology and economic perspectives, so at least 50% of our class on that are women because they enjoy that aspect of it. It is not about extreme programming. It is possible to do that and get real interest.

The other thing I will say is that all the research shows that in primary school the girls will work with the boys on technology until adolescence. It all goes wrong around about 12 to 13 in mixed education, where they suddenly do not want to be seen to be doing things that are not feminine.

Q214 Lord Lucas: One great resource of women who might get involved in technology are those who are returning after looking after children. What can be done to encourage them to look at something that they never learnt when they were in school and to get to the point where they know that this is something they might be good at?

Baroness Shields: You are absolutely right. Sometimes they stay out of the workforce for three to five years. Three to five years is a lifetime in this world. If you have a gap that large, you will come back without the skills that you need, and that is a very big issue. Then it is discouraging, so it is a self-fulfilling prophecy. You pull back; you do not put yourself forward any more. You feel like you cannot contribute or be on that path.

I think what is missing is thinking about this as you are going to have to in the future: dip into learning all along your life. There are going to be times when we all need to retrain on something, so we need to create a facility for people to dip in and out of learning.

One of the things that we are doing right now at Tech City is creating a digital business academy, and this is perfect for women returning to the workforce. If you know you are going back in six months, you can work on this MOOC and you can start learning the things that you will need and the skills that you will need to go back in. We are working with the Judge Business School at Cambridge and UCL to pull this coursework together and make it open to any university, Codecademy and other coding organisations.

It teaches you a couple of things. First, it is not focused on coding, because there are a lot of really good MOOCs on coding. It is focused on digital skills, how to operate in this world, and business skills. The other thing is that we always compare ourselves to the US, but in many ways we do not need to look over our shoulder to the US for inspiration because we have all

that inspiration here and all the great ideas here. What the US does differently is that it has four years of university and in that fourth year you become a well-rounded person. You take business courses. Even if you are a computer science graduate, you learn other things, and you learn additional skills that augment and make you that much more prepared for the workforce. That is one of the things that is missing at the outset, but later on it is about flipping people's mentality around and saying that everyone needs to retrain—retraining is something that we are all going to have to do—and about opening up those possibilities. The digital business academy is just one way of doing that.

Lord Janvrin: I hope this question is not at a tangent, but it picks up on what you were saying earlier about creativity. It comes back to a question we had in an earlier session about whether you can teach creativity and innovation. How do we do that? How do you stimulate people to get excited by that into their teens and throughout life?

Professor Dame Wendy Hall: It is hard to teach innovation. I think you have to be almost immersed in it, I would say. I love the idea of the academy. I think incubators are good. We are exploring this at Southampton, and other universities are as well. Our students do a lot of project work and we encourage them to think about how they would start a business and teach them those skills. We get people in from industry, and the people who have done the start-ups come and talk to them. In an incubator they can work in groups and think about starting businesses with help from people, just to learn the language. Many computer science degree courses will do some sort of project work that involves developing something that could be a product and thinking about how you would take that to market. I am talking university level here, but I think you have to do it. It is very hard to stand up and teach innovation.

Lord Janvrin: What is it?

Professor Dame Wendy Hall: Exactly. I was going to say something, if I may, following on from the question about woman returners. Sue Black, who is a force of nature—I do not know if she has given evidence—has started something called Techmums. Research shows that girls are influenced mostly by their parents and if their mothers are frightened of the technology and do not use it very much, that will put the girls off trying to follow a career in it. The idea is that we help the mums to get back. That does not mean they are going to have a career in this area but just to get them into the digital literacy-type programmes.

The Chairman: It is like English as a second language, in a way, is it not? It is focusing on the mum.

Professor Dame Wendy Hall: Absolutely. The whole point is that at the end of it they might well, of course, be able to go into the workforce in this sort of area if, as Joanna said, they have the confidence. It is a lifetime to be out for the time that you have your family and then try to come back. The technology has moved on so much.

Q215 Lord Giddens: Good morning. You might be able to answer this question. I am a social scientist and economist and this seems to me to be the biggest period of technological change ever, partly because it is global. It involves the creation of new skills, certainly, but also the constant destruction of old ones, and this can happen almost overnight, even in very skilled trades. It has happened many times already. My question is: how do we prepare ourselves? How do we future-proof the economy in order to ride this wave of change? It is likely to get greater rather than less, as far as I can see.

A supplementary question, in case you do not want to answer that. You mentioned that we should not look over our shoulders at America, but to me it is always important to look for best practice elsewhere. Is there another country like Norway, somewhere that has done so much for women, where women do better in relation to the digital economy? Where should we look for best practice? I do not think we should be too isolationist about it.

The Chairman: You have asked two questions, but that is fine.

Lord Giddens: The second was in case you did not want to answer the first.

Professor Dame Wendy Hall: I am going to go for the second question because I half-answered it before. I look to south-east Asia, not America. Of course you have Silicon Valley, but there are quite a lot of problems in Silicon Valley to do with gender.

Baroness Shields: Definitely.

Professor Dame Wendy Hall: There are a lot of problems with woman developers going to conferences and not having very happy experiences, and a lot of potential bullying and intimidation of women, in Silicon Valley. I might be wrong, but a lot of the entrepreneurs are geeky-type men, as you said earlier. There is a problem in that little bubble. Silicon Valley is a bubble, by the way, and most of my colleagues in America report the same. I was president of an American-based computer society and we had exactly the same issues with the lack of women in computing. I am looking for my research, and I look to the experience of the culture of south-east Asia for encouraging women into this area.

Baroness Shields: I will take on the future-proofing. I love the idea that we can future-proof the economy, but the minute you future-proof it in your mind, everything changes again. As you said about the changes happening at scale, this is exponential. It is really hard even to get your head around what is happening, and sometimes it is too late. I grew up in an area of the US where Kodak was the primary employer, and then I was at Facebook three years ago when we bought Instagram and Kodak declared bankruptcy the same month. Kodak was the major employer where I grew up, and you knew that if you worked hard you could get a job there and work there the rest of your life. I think this is happening across every industry that we know. In fact, we are talking about education. Education is being disrupted as much as other industries, and it is hard to stay ahead of that.

Lord Giddens: MOOCs are an example of that, possibly for the future. They could undermine campus-based universities. No one really knows at the moment.

Professor Dame Wendy Hall: I think that will be a real issue for universities. You are a social scientist. Sorry, Baroness Shields, do you mind me picking this up?

Baroness Shields: Not at all.

Professor Dame Wendy Hall: There is the whole issue of whether students need to be on a campus. For 18 year-olds coming out of school and going into university, the socialising at university is very much part of their growing up, but a lot of people are studying at a distance and using the technology that MOOCs are built on. Of course, MOOCs are free, so they do not give you a qualification. They are a means to an end, not an end in themselves. What comes beyond MOOCs, when we start charging for online courses that look really sexy and we can basically sell them to anybody in the world, will change the nature of universities, I think. All our universities will have to become global as a result. That is possibly another issue.

Baroness Shields: I think you will see the merging of the entertainment industry with education, because the production values have to be as interesting as when you sit down and watch a film or a documentary.

Professor Dame Wendy Hall: Absolutely, yes.

Baroness Shields: I think we are going to see a lot of change.

Professor Dame Wendy Hall: We will all have to sing.

Baroness Shields: Oh god, we are in trouble then, Wendy. Maybe you are good at singing; I am definitely not.

The only thing I would say is that ideas flourish when people have human contact, which is why I love the idea of the clusters and people coming together. The best way to make a MOOC successful is to keep people excited about it, because a lot of people drop off. The last I heard, only 8% of people finish it.

Professor Dame Wendy Hall: That is okay.

Baroness Shields: No, that is okay too. Yes, you are right. At the same time, it would be good if you could add a little human contact, as if we were all going through these courses together. Stanford University has something called a startup school right now, and if you have not seen it, have a look at it. Every week they release a course with an expert in the field who teaches that course: everything from how to raise financing to how to market your products on the web—all the various things that you can learn. The great thing about it is that the community that is talking about it. You have to encourage that idea-sharing otherwise the learning experience is not as strong.

Professor Dame Wendy Hall: I have a great story about that. Southampton is part of FutureLearn, the UK MOOC platform. Our first one was about web science, so it starred Nigel Shadbolt and me. Nigel and I started the week and ended the week, and then we had breakfast with Susan Halford and Les Carr every day, so it was a bit like entertainment. Thirteen thousand people registered and 2,000 finished it. They were from all over the world.

Baroness Shields: That is a lot.

Professor Dame Wendy Hall: That is a lot of people. Suddenly they know what we are doing. They know about Southampton, they know what we are teaching and they know something about web science. Then I was in India and I gave a talk about web science, and this chap came up to me and said, “My wife did your MOOC”. This is in Bangalore in India. I said, “That is amazing”, and he said, “Yes, and she used the social networks. She got involved with people, chatting”. You use the social networks to do the tutoring on the MOOCs, and they self-tutor. PhD students also do the tutoring. He said that she met people on the social networks and they started meeting in McDonald’s in Bangalore to talk about the MOOC. It is a whole different world.

The Chairman: I am going to move us back specifically to girls’ education at this point, because we do want to get underneath this a bit.

Q216 Lord Holmes of Richmond: Good morning. Just slightly continuing your idea of education and entertainment, when I was at Cambridge, having been lucky enough to be

lectured by Lord Giddens, I can say that his performance was equal to any Hollywood blockbuster.

Currently around 4,000 students do A-level computer science. Only 100 of those are girls. How do we get more girls doing STEM in primary and secondary education, particularly in your area of higher and further education?

Professor Dame Wendy Hall: I will pick up that one first, because I saw that statistic in the questions. There are several factors to this. One is that many universities do not require a computer science A-level to study computer science. That is partly because we have not had the teaching in the schools, and that will change now that the curriculum is changing. Also because the curriculum is changing, more people will be interested in studying it. It will become a better A-level because they will have learnt a lot of the basic skills earlier and they will be less intimidated, maybe, by doing a whole A-level. Largely, A-level computer science attracts the guys who do this for a hobby anyway at the moment. That is basically who it attracts.

The other thing is what I said before: that we need the Government's help to unpick the statistics that say computer science is the least employable degree to do, because that just sends such a wrong message. Why would I want to do a computer science degree if it is the least employable in that long table of employability?

The Chairman: Perhaps the Government could be showing the enormous gaps, the number of vacancies, that there are.

Professor Dame Wendy Hall: The gaps, yes, and highlight the types of courses where employability is way into the 90 per cents.

Baroness Shields: As Wendy said, though, you have to look beyond those statistics. It is slightly irresponsible for the media to perpetuate these myths. It is a myth, really. If you look beyond it and you understand, this is super frustrating because we are a myopic society led by media and we react to media. I say this all the time. We have to get out there and be more proactive about the facts and myth-busting, because it is damaging our potential and affecting competitiveness.

The other thing I wanted to say is that last summer I felt that I did not know enough about the world of computing, so I took a bunch of courses. I decided that I was going to learn to code again. It was the greatest thing I have done, and I have not really touched it much since then; you get a little bit busy. What I understood that is different today than when I studied computer science is that the premium, the thing that matters most, is your creativity and your ideas, because a lot of the code is off the shelf. There are modules that do this, that and the other thing, and you can bring them out, mix them all up and put them all together, and the secret sauce is your idea.

If we can get that concept out to women, I think you would see a lot more women go, "Okay, I get that, because I have the ideas and I am really good at thinking these things through". People still think you are going to sit in a dark room and write lines of code that have a small impact on a much bigger thing, but you can create a product on a Saturday, in code, yourself, and I think that that mental flip will change everything.

Professor Dame Wendy Hall: The work with Raspberry Pi so far, although the evidence is not clear, is attracting girls as well as boys to play with them.

Baroness Shields: And showing them how to build stuff. Once you see that, you get kind of excited—"I can build a product from start to finish"—and that is really encouraging.

Lord Holmes of Richmond: What about the importance of role models as well, to ensure that successful women in this space are out there and people can say, "I could do that. There are role models."? The importance of role models in anything cannot be overstated.

Professor Dame Wendy Hall: That is a hard one. Because there are so few of us, we get asked to do everything.

Lord Holmes of Richmond: You are sleeping too much.

Baroness Shields: I think people might get tired of us.

Professor Dame Wendy Hall: I just got off a plane from New York. I have come here, I am going to the Royal Society after this to chair a diversity event with Julia Higgins, then I am going to the ODI, and I will get home about midnight tonight. I am constantly asked to go out into schools, but I can only do so much, and the trouble is it really does not scale.

The Chairman: It is a media issue that you are describing: that somehow we have to find a way of explaining this world in a different way.

Professor Dame Wendy Hall: Yes, we are role models, but your average 16 year-old is not going to want to look at someone like me and say, "I am going to be like her". I am far too old for a 16 year-old to think, "I want to be like her". When we do our careers fairs, we get the employers to come and they always bring back the girls who have just gone out into the workforce, because they are the best.

Baroness Shields: I am older than the mums of most people I employ now, which is really strange. Oh well. We are still going at it.

The Chairman: Yes, you had better keep going.

Lord Macdonald of Tradeston: I do not want to argue that going to university should just be about improving your employability, but when you talk about a lot of these courses being lumped into a statistic that shows that they come at the bottom of the league table, does that not imply that academia is encouraging a lot of courses that are not providing value for money and that it is about time you were a bit more radical in the universities about clearing out the old stuff to make way for the new?

Professor Dame Wendy Hall: Yes. I do not want to point to any particular university; it is up to them to sort it out. I do think that we have to unpick these statistics, because if our students are 90-something per cent employable, there are some universities doing courses where the students are only 20% employable if the average is low. You may say that; I could not possibly comment.

The Chairman: This question about the funding of such courses is for us to bank for when we have Ministers as witnesses as well.

Professor Dame Wendy Hall: Of course, nowadays the students fund it themselves. They pay to go on it but they do not end up getting a job. We require maths. We like physics but we require a good maths A-level.

The Chairman: And not all do.

Professor Dame Wendy Hall: We teach computer science as an engineering subject. We definitely like maths and we like physics as well, if they have it, but we do not make that compulsory for computer science. It is for electronics.

Q217 Lord Aberdare: This very much picks up on what we have already been talking about, so I will try to give it a slightly different dimension. We have heard that some of the major problems include lack of awareness of the opportunities in this sector and what is described here as “patchy” careers guidance. I think that is extremely overpolite. Professor Hall, you said that in south-east Asia a lot of the girls see computer science as a career that can earn them money and get a job. Why cannot we develop that perception here? I was very struck when we went to the Hartree Centre recently. I had been slightly put off by the description of “big data”, but I suddenly discovered that they are actually answers for everything. If you could see this in terms of something that we can use to tackle the things we are interested in, maybe that would make a difference.

I suppose a specific dimension is: what is the role of parents? What is the role of teachers? We have talked a little about the role of media, but how can they be helped to contribute to this?

Baroness Shields: Also, what is the role of the student? We live in a world where you have to own your own destiny. Things are changing so rapidly that the careers advice cannot keep up, to be fair. It is about the hunger for learning and knowledge and encouraging that, because you have to learn those skills early on. I remember a statistic that I read, and I will get back to the Committee on it. It was a US Department of Labor statistic that said that the 18 year-old of last year would have 11 jobs by the time they were 37. If you have 11 jobs by the time you are 37, you have to own your own career path. The days are gone when you relied on a career counsellor, like you did in the early days, who said, “You might be this”, and then you became that for the rest of your life.

Professor Dame Wendy Hall: We have done research on what attracts women to computer science courses, and looked at the same cohort and why they were not interested in computer science, and it is so much about what the parents think. It really is, as well as peer pressure. It is the teachers, of course, but it is so much about what the parents think.

The Chairman: How do we break down the feeling that it is for a geeky minority? Exactly as Lord Aberdare said, we have received evidence here about big data. None of us are particular experts. When we saw it in practice—it was mapping health problems and all the rest of it—it became completely real to us, but that was because we saw it. How do we get that out to a much wider group of people so that they think, “That sounds really interesting. That is worth pursuing.”?

Professor Dame Wendy Hall: It is all about the curriculum. There is no quick fix, because it is a culture change. The culture changed dramatically—I can show you the graphs—in the 1980s. Women were about 30% of the computer science graduates in those days, before the personal computer. When the personal computer came along, suddenly it was toys for the boys. It dropped off dramatically, and we have never got over that. It is not a quick fix, because it is a culture change, but we need to make absolutely sure that the curriculum is right all the way through as we introduce the new curriculum, that it is really female-friendly, that it is something that is taught not just from a technical point of view but from a social point of view. It is about ethics and what it means to be a digital citizen. By the time

today's five year-olds grow up and start going out in the workforce, the world will have changed again. We could have chips in our brains or something. It will not be like it is today. It will be much more immersive, whatever it is.

Lord Aberdare: I want to follow up on the careers service bit, because the careers service as it is today cannot keep up. Is it possible to define a model, therefore, of what a careers service of the future might look like? What is the useful advice and support that young people could be given?

Professor Dame Wendy Hall: I would absolutely go the social network route. There is a company in Portsmouth that does this—I forget the name—helping students to decide which university to go to and which course to study, and it is all on social networks. Universities put information up about their courses, but it is all the chit-chat on the social networks. Students who are studying at Southampton will say, “I like this course”, or, “This was not what I expected”, and that builds up on the network. I would go that route.

Q218 Lord Lucas: What scope is there for getting universities to play a greater role in schools in this area? There is a great lack of knowledge in schools as to what careers can be, but by and large people at universities have a better feeling of that.

Professor Dame Wendy Hall: We get into trouble if we start trying to tell teachers what to do, and we should not, but I think the way to make it scale is to look at teacher training. That is where you make the difference, I think: looking at the curriculum in the teacher training courses, which are often in universities themselves.

Baroness Shields: Just to add to what Wendy said, social networks allow you to scale the advice and allow people, either as themselves or anonymously, to interact and have conversations about their future potential.

Something else that is really important is that when we were growing up we did this Myers-Briggs test—remember—which pushed you in one direction or the other and helped you understand the way you think, the way you react and various other things. Neuroscience and cause and effect in that area has changed a lot. I discovered a platform. There was a young self-taught neuroscientist in Vancouver who created a platform called Sokanu. It is a personal discovery experience online that is completely unique to you and it is all questions-based. It gets smarter as time goes on and suggests ideas for careers for you. It is absolutely brilliant. Again, it is about scaling that. The more people who get on that, the more the system learns, and that learning system helps to give better advice. These things get smarter and smarter over time, and it is absolutely brilliant. It is S-O-K-A-N-U. He was one of those kids who was not doing well in school, as I understand, and his mum bought him a book on neuroscience. He was 14. Now he is literally being consulted by the best neuroscientists in the world. It is fascinating.

Lord Janvrin: Just taking this one step further into what can industry do to effect culture change: are we missing a trick there? Are they just not interested in engaging in trying to change perceptions? Is there anything that they can be incentivised to do? Where does industry fit into all this?

Baroness Shields: I think every company is digital and has a responsibility in this area.

Lord Janvrin: Yes, absolutely.

Baroness Shields: I think one of the key roles in an organisation today is a chief community officer. Sometimes the community is a virtual community; sometimes it is a local area. That person and the team of people there have to be thinking about skills and thinking about how you cultivate the right skills, and that partnership between industry and schools is absolutely vital. You cannot complain that you do not have the right skills if you are not extending your hand to the schools in your area. I think this is grassroots. It is local, and it is absolutely vital. Every company should have a chief community officer and a team under them.

The Chairman: Most do not.

Q219 Lord Kirkwood of Kirkhope: Could we change the focus of the gender question, which you have been addressing in a very interesting and informative way? I have the same concern about low-income households, so it is more a question of whether inequality is inevitable unless we can connect some of these low-income households to the internet and what the consequences are in the long term for increased inequality if we do not solve that problem. Do you have any advice to the Committee about this? First, it is the same kind of problem as gender, but is it a problem. How should we be starting to address it right now?

Baroness Shields: What attracted me to the internet is the idea of social mobility and the fact that it would level the playing field and give everyone access to the same information, and in many ways it has. I grew up in a working class environment and I went to a state school, not one of the top schools, and you find your way. What I was so excited about is that with all this information accessible to people, everyone has the same level of opportunity, but it is still about helping them use that information and finding their way. In a low-income household, the parents do not necessarily have the skills or the knowledge of how to make the most of that. The walls have come down, the doors are open, the kingdom is available, but how do you get there and how do you make the most of what you discover there? We have not solved that problem yet, and I do not have the research for you, but this is a big issue. Low-income young people are not performing as well because they do not have the—I do not know whether it is role models or what it is, but it is a big issue and it is a concern.

Lord Kirkwood of Kirkhope: I do not want to put words into your mouth, but all your excitement and your progress seems to be working around Government rather than through Government. Tell me if I am wrong, but Joanna made the important point that you are now sitting on a digital advisory committee. Would it be better if there was a digital cabinet committee?

Baroness Shields: I think we can achieve the same thing. Putting it in a Cabinet role gives it a certain level of gravitas and importance, so maybe that is important, but I think we are working towards that anyway. There is recognition that we need a digital committee and that we need to focus on this, but again the road is paved with good intentions. Everyone is trying to solve these problems, but there has to be some kind of cohesive strategy wrapped around it. Everyone is doing great things but in a very small, micro way, and we have to think about how we identify and scale these best practices. I think that is what a Cabinet level or a Committee like this could do.

Lord Kirkwood of Kirkhope: You are too soft.

Baroness Shields: No one has ever said that to me, but I will take that on board.

Lord Kirkwood of Kirkhope: I say it with the best of intentions. Listening to what you say, it is such a powerful case it seems to me that if you really put your mind to it you could get Government to respond. A lot of work has been done, partially because of your efforts. This is not trying to attack people, because everybody is busy, particularly you, but should we not be giving Government a harder time?

Professor Dame Wendy Hall: My problem is that there are too many things going on. We have Joanna's efforts, we have Martha Lane Fox's efforts, we have the new Digital Skills Taskforce that is run out of DCMS.

Baroness Shields: That is the same one. There is only one.

Lord Kirkwood of Kirkhope: I think you are making my point, slightly.

Professor Dame Wendy Hall: Yes, and then there is Your Life and so on. I find it hard to understand what is going on. You may be closer to it than I am, but if somebody rings me up and says, "I have been tasked to do this", it comes out of the blue at me and it is another thing that is starting. We need more joined-up thinking, for sure, but that is so easy to say, is it not? It is so easy to say.

Baroness Shields: Yes. That is why this committee came about, and a committee to answer that is kind of an oxymoron. We do have to put it on a level of strategic importance, and a Cabinet-level position would give it that. This is what I have lived and breathed the last two and a half years. This is my passion. I think it goes back to the question about social mobility. My feeling is that the internet has the potential to empower so many people, and that is where Government has a responsibility to help.

In terms of business, it is about setting the conditions and then getting out of the way so that businesses can thrive. We do not have a Google or a Facebook. We do not have a big-scale internet platform that was built in the UK, and everybody thinks there is something systemically wrong here. The only thing that went wrong was that during the dotcom crash we retreated and said, "That is not a career to go into", and the US dusted themselves off and started going again. We lost six, seven, eight years, and we are behind right now because we lost those years. It is not because we do not have the skills, there is something wrong with our universities, we are not creative or we are not the ground-breakers that we of course are. It is just a mentality. When things went wrong, everybody retreated here and then they said, "Do not go into that. That dotcom crash was a disaster", and people really retrenched. The US said, "Fine, well, let us try something else". That is the difference in mentality.

Professor Dame Wendy Hall: The venture capitalists stopped investing in these types of companies. Yes. I suffered from that.

Baroness Shields: We are seven or eight years behind, but I predict that we will have great platforms. The only problem with platforms is that you get a first mover advantage and it is hard to unseat the first mover.

Lord Giddens: If I may just say so, looking at these things, one of the things that happened in the US was the transfer of digital technology to other industries, which we did not, and that has transformed the industrial base of the US. One of the things this Committee has to try to say is that there is no such thing as a digital economy because all aspects of the economy are digital.

Baroness Shields: Precisely.

Lord Giddens: You cannot start a small business or do anything, like be a personal trainer, without having a website or whatever. It is the whole economy we are talking of here, I think.

Baroness Shields: I completely agree.

The Chairman: Which brings us to our last question.

Q220 Lord Macdonald of Tradeston: I wanted to tighten the focus on what we have just been discussing and ask whether there is one key suggestion that you think that this Committee could be recommending to the Government that would improve the UK competitiveness, especially in the area of digital skills. How would you make it happen and how much would it cost?

Baroness Shields: I saw that question. Come on, Wendy.

The Chairman: We have asked this of everybody, because we want people to focus very clearly on the fact that there is loads and loads, but what is the most important thing?

Professor Dame Wendy Hall: I am going to turn the question around slightly. When I was on the Prime Minister's Council for Science and Technology, we were playing with these ideas and somebody said to me, "How much would it cost?". If the Government gave me an infinite amount of money, you would not actually be able to change it overnight. I suppose you could bribe people, but I do not think that would work. I have always wanted to try to give more scholarships to girls to study computer science, but we cannot because of the equality laws, which is fair enough. Some countries do that—I think Canada and possibly Ireland. It is Ireland. It is a country that has had a lot of success in giving scholarships to women to study computer science.

Lord Macdonald of Tradeston: Governments can change the law.

Baroness Shields: This would not cost a lot of money, but I have watched east London transform around a number of incubators, accelerators and Google Campus. Google Campus is run by Google and funded by Google, but it is not a Google P&L; it is separate. The last I heard, 22,000 businesses started from Google Campus. It is a hive. It is the most positive place in London.

The Chairman: We have visited. We have had a Committee visit there.

Baroness Shields: Exactly. It is buzzing with people.

The Chairman: The lights went out, unfortunately.

Baroness Shields: Really? Oh, no. Oh, dear. There is excitement. We used it earlier this year for the Flood Hack. We brought together 200 engineers to have a hackathon on the floods that were plaguing the country, and there are things that come out of people coming together in those environments. This has been said before too—there are no good ideas any more; they are just recycled—but it is about using old buildings and putting a Google Campus-type place in these buildings. All across the country there are unused assets. I just feel that you need a movement. The movement cannot say, "Here it is". There have to be people who want to do it, are passionate about it and pitch for it. Then we will take it forward. You cannot say, "We are going to create these centres", because that does not

work. You need the grassroots organisation of a local authority or a local community to say, "We are going to create an ideas factory right here".

The Chairman: What was the gender balance like on the hackathon?

Baroness Shields: It was pretty bad. There were very few women there, unfortunately, but we put out a call to arms. We did it on Friday night and by Sunday morning we had 220 engineers. You remember? It was incredible. It was a time of crisis, and what I love about that is that people come together in a community around a crisis.

The Chairman: It involves solving something. It is interesting. It is not abstract.

Baroness Shields: Exactly. We just have to own these problems on a local level and come together to solve them.

The Chairman: We will have to leave it there. We could have gone on for ages, but thank you very much indeed for coming this morning. It was really helpful. Thank you.