Science and Technology Committee

Oral evidence: Digital skills gap, HC 740

Tuesday 26 January 2016

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Written evidence from witnesses:

- BCS, The Chartered Institute for IT in association with the Computing At School group
- Nesta
- FDM Group

Watch the meeting

Members present: Dr Tania Mathias; Carol Monaghan; Graham Stringer; Derek Thomas

In the absence of the Chair, Graham Stringer was called to the Chair.

Questions 69-134

Witnesses: **Peter Gaynord,** KS2 Teacher and Master Teacher in Computer Science, Histon and Impington Junior School, **Andrew Seager**, Head Teacher, Stratford School Academy, **Desmond Deehan**, Head Teacher, Townley Grammar School, and **Sara McManus**, Director of Vocational Curriculum, Carshalton College, gave evidence.

Q69 Chair: Welcome to the Science and Technology Committee's inquiry into the digital divide. Clearly, I am not Nicola Blackwood, who apologises. She is not well and she has asked me as a member of the Committee to chair this session. Perhaps I can begin by asking you to introduce yourselves and your positions.

Peter Gaynord: My name is Peter Gaynord. I am a full-time classroom teacher for key stage 2, currently working with nine-year-olds in a large north Cambridge junior school, which is part of a growing academy. I also have status as a CAS master teacher, so part of my role is to train other teachers in computer science in the primary area.

Andrew Seager: My name is Andrew Seager. I am head teacher at Stratford School Academy in Forest Gate, east London. We are a lead school in the network of teaching excellence in computer science, which is the Computing At School initiative. We have been teaching computer science for three to four years at key stage 4.

Desmond Deehan: I am Desmond Deehan, head teacher of Townley Grammar School. We are a computing hub school that started teaching the pilot computing GCSE. We have a master teacher as part of the network of excellence, and we are also a digital schoolhouse school.

Sara McManus: My name is Sara McManus. I am from Carshalton College. I am the director of vocational curriculum there, which means I have direct management responsibility for the whole of the college in all curricula, not just IT.

Q70 Chair: Can you tell the Committee what has been the response of your school or college to the computing curriculum so far?

Peter Gaynord: My own school started very early on when the consultation draft curriculum went out. At the time we embraced it as a welcome change to the curriculum. It seemed so relevant to what I had seen in my previous life; I was a retrainee in primary education about 10 years ago and had worked for 20-odd years in industry as an IT consultant in software modelling. We welcomed it and became a lead school. We have developed a curriculum. We have had after-school clubs with 60-odd children participating every week for the past two years or so. We are very fortunate. We are a stone's throw from the Cambridge science park, so our curriculum is very much welcomed by parents, who seem to have an enormous skill base on the doorstep. All the teachers in my school are very engaged in it. We have not gone down the specialised teaching route. We have tried our very best to model the national picture of this curriculum being taught by generalist primary teachers, and we feel that we have been very successful in that so far. It is an ongoing project, and we feel we are developing well.

Andrew Seager: In a sense, for us it was business as usual, because the direction we had set off in three or four years ago meant that as the changes came through, with the introduction of computing GCSE and shifting away from GCSE IT, they reflected what we were already doing. It confirmed the direction we were already going in, so we just pressed ahead.

Desmond Deehan: Similarly, we very much embraced computing and we took the pilot computing GCSE in 2011. We now have 80 students studying computer science GCSE, 30 students studying it at A-level and currently 24 are at university doing computer science. As a digital school hub, we support 15 primary schools, teaching encoding and training teachers. As a computing hub, we also train teachers in the local area in computing skills. Each year we take up to 40 of our computer science students to Silicon Valley as part of their course. We have very much embraced it. We developed it particularly as a girls school; we embraced the promotion of girls in computing and STEM subjects overall. We co-wrote the computing curriculum.

Sara McManus: I missed the first part of the question. Was it about the changes in the GCSE IT curriculum?

Q71 Chair: Essentially, what has been your response to the computing curriculum?

Sara McManus: My college does not offer GCSE IT. IT is taught at levels 1, 2 and 3. The college does not offer A-levels or GCSEs, apart from maths and English. Our curriculum did not change, although across the college we have embraced in earnest IT and the upskilling of staff and students with digital skills. We are now keen to embed digital skills in all classes, in all vocational areas.

Q72 Chair: Has the increased focus on computing meant that there have been pressures elsewhere in the budget? Are you spending more on computing in the different schools and colleges, and has that created any problems with reduced resources elsewhere in the system?

Peter Gaynord: My own school has spent quite a budget on computing, but we always bought a lot of equipment anyway. The anecdotal evidence, through my contact as a teacher trainer in a lot of other schools, is that so far in the primary sector there has not been significant investment in equipment. That has been in process, if you like, but so far, from my experience, I do not think schools have spent money on computing at the cost of any other area.

Andrew Seager: In terms of kit, I do not think that computing is expensive. Second-hand PCs, which are what we use, are perfectly adequate for teaching coding. The big expenditure and investment, looking back over the two to three years during which we have introduced computing, is on training teachers. If you have a workforce of teachers teaching IT, and who are therefore very au fait with Office applications, web design programs and so on, and you try to turn them into a group of teachers who teach coding, a big professional development programme is needed. Looking back, we invested very heavily in that. Our computing department has been overstaffed for the last two or three years, quite deliberately, so that teachers have lighter timetables and can team teach as they are learning to teach computing coding, rather than applications, and can go on courses. In terms of hardware, I do not think it is an expensive change to make. If schools are serious about doing it successfully, they have to be prepared to put a lot of money into the training of those teachers, and clearly that is quite a significant expense.

Q73 Chair: What I am trying to get at is whether it has caused resentment or difficulties, because it changes the structure of the budget in the rest of your institution.

Andrew Seager: No, it has not. Maybe it will now they know we have spent all that money on them.

Desmond Deehan: I would probably echo some of that. There are two key challenges: one is staffing and the other is equipment. With a shortage of sufficiently qualified and experienced computing teachers, inevitably recruitment becomes costly for schools, and whatever you spend in one area you do not have to spend in another. It is also difficult to compete with industry, where computing graduates can achieve a far higher salary than they can in teaching. Initiatives like Teach First have drawn some computing teachers away to certain areas and have not allowed other schools, which need to recruit them, to get them either. It does not have a terribly successful retention rate; about 50% of Teach First teachers go back to industry afterwards, so sustaining it is quite difficult. Although at the moment there are bursaries for computing teachers to go into training, schools cannot match those bursaries in the salaries they offer those teachers. Over 80% of a secondary

school budget is on staffing, and if they spend the majority of that on a smaller number of teachers, because they have to recruit them, inevitably they have less to pay others in terms of responsibilities and they have to make cuts in that area. It is becoming a more and more significant problem, solved only somewhat by the fact that there simply are not computing teachers to recruit in the first place. If there were, you would probably have to offer more and more money and spend money on their recruitment.

Hardware-wise, there is a similar problem, because at the moment the system is not built for success. If a school is successful and has a high uptake of students studying technology and computing, it is hard to sustain and develop that further than basic computing. I quite agree that teaching computing does not require a lot of expensive hardware, but once you have students who are capable in coding and want to develop apps for Android, you need powerful computers to enable them to do that. You need robotics equipment to enable them to apply what they have learned in a different context. That is where there are not sufficient funds currently. Inevitably, that will come out of the same budget that every school has. We are still in the early days, but particularly with restricted funding, including restricted post-16 funding, it is becoming an issue that will have an impact in other areas. To give an example, as much as I disagree with the removal of the ICT GCSE as a head teacher who has been supporting digital skills, I have had to cut it to make sufficient costs to pay for other staffing needs. That is what most head teachers have to do when they are facing deficits. Ultimately, it will be a bigger and bigger problem year on year.

Sara McManus: Our strategy has been very much to provide a broad-based platform for all vocational areas to work in. There has been huge investment in the network within the college. Each area, specifically IT and computing, will decide on the software it wants to purchase to enable students to learn. They have specific requirements in terms of packet tracers, diagnostic testing and specialist software. I echo what the other members of the panel said. The actual cost of additional bits of kit and equipment is not that much, but for our college the expense has been providing the platform for any piece of kit to work in.

Q74 Chair: Is ICT in computing part of the Ofsted inspection?

Peter Gaynord: I knew that question was coming, so I did a bit of research this morning.

Chair: So you have a model answer.

Peter Gaynord: I was going to go for last month's Ofsted reports, which have been published. I got up to about 57 of them and it is mentioned three times, and in one of those reports it is mentioned as an after-school activity, but that is in the primary sector. I am only talking about the primary sector.

Q75 Chair: It is very much a peripheral part of the inspection.

Peter Gaynord: At the moment, its status is that of a foundation subject; it has the same status as history, geography and art. At the moment it is not one of the three core subjects in the primary sector—English, maths and science—which is why the costs of introducing it are so different from those for my secondary colleagues. The model nationally for primary schools is that about 80% of schools cover their teacher non-contact time with

sports coaching, which means that most schools do not have the flexibility to buy in specialist teaching for computing at the moment. That is what we are trying to tackle with CAS. There is plenty of free training around; Barefoot and CAS have lots of materials for the primary sector. Of 57 reports, three mention computing.

Q76 Chair: And secondary schools?

Desmond Deehan: I am currently completing training as an Ofsted inspector. From that side of the fence, there is no specific focus on computing in the Ofsted inspection. From the other side, I certainly see an inconsistency. It depends very much on inspection teams and the place of computing and IT in the particular school.

One of the weaknesses is that ultimately you will have a lack of specialists in inspection teams, whereas you have a broad range of experience in other subjects. Just as there are insufficient computing teachers, equally there are going to be insufficient inspectors with computing experience in order adequately to inspect the computing curriculum. It is not a particular focus at the moment, although we were credited in our inspection because of the impacts on students overall. As to whether or not it gets focus, what we find is a patchy picture in terms of different inspection teams in different schools, and part of that is relevant to other areas of the inspection framework rather than specifically computing. For students and teachers generally, how much of the curriculum is computing will have an influence on the teaching and learning judgment.

Sara McManus: A few years ago, computing and embedding of IT was a criterion in an Ofsted inspection. At that time there was a huge focus to make sure that lessons and learning included it. Although that is now not the case, colleges have not dropped that requirement when they set out their teaching and learning programmes. For us, the embedding of IT is still very important. Most vocational curricula try to emulate industry. I went into a GCSE English class the other day where students were using their mobile phones to do research, so in terms of improving and increasing their research and digital skills, for me, IT was embedded in that lesson. I talked earlier about the use of software within each area. We still see it as a fundamental part of the learning environment that students are immersed in an environment where IT and digital skills are included.

Q77 Chair: As a final question—one word or sentence will suffice to answer it—do you think it should be a core part of the Ofsted inspection?

Peter Gaynord: Absolutely, without hesitation. Put together a committee of experts, like the people who wrote the computing curriculum, revamp the science curriculum and involve computing work for primary as part of the core for science, and just strip it back a bit so there is enough time for it to fit into the day.

Andrew Seager: It should probably have the same attention in an Ofsted report as maths, English and science.

Desmond Deehan: I have to disagree. I do not think that the way to give it status is through an inspection regime. For reasons I have already outlined, it would probably be a very ineffective inspection, because you do not have the experience and skills in the

inspection teams to judge it in the first place. I do not think you necessarily get the best outcomes from schools by doing an inspection and making a judgment. What you will be doing is guiding people's judgments about a curriculum based on a forthcoming inspection rather than what is good education. A better way to do it is adequately to fund it, support it and sustain it and have a long enough strategic plan for its development. Then inspectors should be able to judge the quality of education overall, whether it is computing, maths, science or whatever.

Sara McManus: I do not think it should be a criterion in an Ofsted inspection, although it should be a feature of the learning environment so that, when students come to college to follow a vocational curriculum, its IT content and their learning of digital skills emulate what is happening out there in industry. When they leave us, if they are going to work experience or work placement, they have to be prepared and able to cope with whatever is going on out there, whether it be a high or minimal level of IT.

Q78 Carol Monaghan: I am a teacher by profession; I was a physics teacher before I decided on a wee change. I am, however, more used to the Scottish system, which has IT skills embedded throughout. As a physics teacher, I know where my students benefited from that. I also know about some of the shortcomings that arose as a result of it. From your own experience, can you tell me a little about what benefits you think ICT has had for the numeracy and literacy skills of your students, and whether there are any drawbacks in those same skills as a result of the increased use of ICT?

Peter Gaynord: That is a broad question and there are lots of different levels for looking at it. In terms of the new computing curriculum for students in the primary sector, you can do an awful lot of embedded computing with the subject of maths, and it makes primary maths start to feel a bit less like an exercise in just teaching children arithmetic and calculation. A lot of my colleagues in the education sector are shocked that, in industry, when the power goes off on site, the first people to walk out of the building for a cup of coffee are the mathematicians. They are stunned that mathematicians mostly use software models. There is a strong connection. A great colleague called Phil Bagge runs a website for the primary sector called code-it. An awful lot of his embedded computing activities are very maths-based. I am not talking about the shallow level—the computer programs that give you repetitive practice in arithmetical skills and similarly in English skills. There are an awful lot of those around on tablets and laptops in use in primary schools. I see enormous potential for making it a purposeful exercise. One could almost turn the question about the three Rs around. Is it as important as the three Rs? I think it is the other way round. Are the three Rs important in digital skills in the modern world going forward?

Andrew Seager: I have seen good applications used in maths—I am a maths teacher by trade—particularly tackling the interrelationship between geometry and algebra and allowing geometry to be taught in more dynamic ways than is easy to do with pencil and paper. For a few years we have been part of the Cornerstone Maths project, which looks at specific applications that operate in that area of maths. My instinct is that students get a better grasp of the relationship between geometry, graphs, algebra and so on through using some applications. Clearly, there are places where IT applications are useful.

I have not picked up that IT skills and so on are particularly valuable in terms of GCSE English and English literature. That has not come through the grapevine to me. There are

pockets. Maths is an example where IT applications are useful. Research tends to show that internationally attempts to use IT to improve learning have often not been terribly effective. If you look at the big influences and what makes differences to pupil outcomes, through the work of John Hattie and people like that, IT in the classroom does not seem to make the top 20, as I recall.

Desmond Deehan: Echoing that slightly, I am conscious of the warning to beware of geeks bearing gifts. Sometimes there are too many tools promoted to help in other areas; there is an industry in trying to promote and develop those. You do not need ICT to develop literacy. There are tools that will help and there are also tools that you do not necessarily need for literacy. It is important to have a broader understanding of literacy. Literacy within ICT is different from literacy in English, and having the appropriate literary skills for the medium you are using is something that needs to be taught. How students communicate through technology is different from how they would communicate when writing a letter or an essay. It needs to be embraced in that way as well; it is just as important. Using electronic communication is not appropriate to write an essay. It is appropriate to be short, to use correct terminology and abbreviations where necessary, and none of those things would be appropriate within English. Literacy has to embrace the digital age and include literacy skills that are appropriate for that use too.

In terms of potential negative effects, one risk is students' over-dependence on ICT and the shorthand versions of communication that start to seep into more academic communications, such as essay writing and so on. That is a risk, although it is challenged by very good and competent English teachers who deal with it. Teaching students when to use appropriate language in an appropriate context in the right medium is part of their overall education.

Sara McManus: Within a college, there are students studying maths and English who did not necessarily gain their grades when they were at school, so there is a big lack of motivation factor in colleges for students studying maths and English. Software and IT tools are used by English and maths teachers to break lessons, motivate students and show them that maybe there is a different way to learn from the way they learned in the past, and to try to rejuvenate maths and English as topics in their learning programme.

Q79 Carol Monaghan: I would like to delve a bit more. Maybe I could give a couple of things from my experience as a physics teacher. We did a lot of data capture. We used ICT for data capture and could draw real-time graphs on a screen. Pupils could access that easily; it was very visual for them, and it worked very well. In the past it would probably have taken an hour or so to construct. The drawback for them in terms of their numeracy skills was that they had no concept of how to lay out a scale on a graph, or what a scale meant, so there were positives and negatives. In terms of their literacy, we suffered a lot from the copying and pasting of online research. What do you think are the benefits your students have gained from ICT, and what do we need to be aware of?

Peter Gaynord: A great example is what Ms McManus said a minute ago. Just before I came here I was in a place round the corner having lunch. I picked up my phone and read emails from my children, from the learning platform my school engages with. I was reading stories written by the boys in my class. In the primary age group, it is hard to get boys motivated to write and ICT is massively motivating. They are practising those skills

and going way beyond what you can reasonably ask them to do. The big benefit at the primary end is that you have children thoroughly engaged in learning. Strangely, it mimics the real world of industry in which I used to work. I got snowed off a couple of years ago and when I went back to the house I got emails from my children saying, "I've attached a presentation for you to look at, Mr Gaynord." They were acting like many adults in the real world at the time in terms of the sensible, efficient use of IT that we all do in our grown-up jobs. They are so interwoven that you cannot have one without the other going forward. I see huge benefits from both.

Andrew Seager: There are examples where traditional things we have always done in classrooms can be made more efficient by using IT. There is a place for things like My Math, which is online homework. It gives traditional examples that you work through and get instant feedback on as a student, but it is doing in a more efficient way what we have always done.

I do not know about data loggers. It sounds like a parallel example from the world of maths education. If you want to look at $y=x^2$, $y=2x^2$, $y=3x^2$, $y=x^2+2$ and $y=x^2+3$ and how changing the coefficients and the constants changes the graph and you have only pencil and paper, it can be quite laborious. You have to draw graph after graph after graph to do it. If you have a piece of software that allows you to change them and puts the graph up on the screen, and the focus of your lesson is to look at how the changes in the numbers relate to the changes in the shape of the graph, the application can help you focus on that. If you want to teach children how to do a graph with a pencil and paper, obviously that is not so. That is an example of where a well-thought-through application can allow a teacher to focus on the concepts and help develop them. If I had similar knowledge of history or geography, no doubt people would give me examples from that. There is definitely a place for well-thought-through applications.

Q80 Carol Monaghan: You feel that cognitive skills can still be developed within that in a much faster timeframe.

Andrew Seager: You are right. The points you want to get across can be done more quickly. The cognitive skills and conceptual stuff can be got across more quickly and efficiently and with better stickability than probably pencil and paper.

Desmond Deehan: In my experience, there is frequently a tendency by adults to underestimate the capacity of young people to engage with new technologies and equipment. We have found that by enabling students to use technology—frequently their own technology—by bringing their own devices, their smartphones, to the classroom, they will apply that to solving the problems they are presented with. They do not necessarily need to be told how to use that technology in order to solve the problem; they will come up with solutions that are far better than the ones we would probably come up with. For instance, students use WhatsApp to do collaborative group work. They do not even have to be physically in the same room to do that, but it is a collaborative group, in the same way as they would have done it in a study session together, or around a piece of paper. It is far more flexible. It happens when they have left the school as well; they do not have to be fixed in a room, but you have to enable them and allow them to use it.

You have to teach them about some of the pitfalls and drawbacks: for instance, managing information, looking at Google searches and understanding bias in sourcing materials. They are far more vulnerable to that in technology than they are in other areas. Books are published and edited; you can rely on them as source material far better than you can anything published on the web, but if you teach them about bias, make them savvy about it and enable them to use it, they are very adept at applying it and coming up with new uses, even to the extent that computing students will write code to solve a problem they are presented with. Some of my students have met medical undergraduates who have written code in order to diagnose the symptoms of Alzheimer's. Although those students were doing medicine, they learned coding and applied it to a problem. The main thing is to give them accessibility to IT with safeguards. There are drawbacks with things like online safety and so on; they have to be covered too, but it develops their thinking skills, not just technical or mathematical skills.

Sara McManus: I have probably already touched on this. Within the college we try to expose a student to as many online IT systems and as much software as we can. They have online learning plans and online learning environments. They test their work before they submit it; they load it up and receive feedback on it. All of it is online communication to make sure they have acquired those skills so that if they were out in the world of work, they would be able to use digital skills there. I am not saying that every area is as advanced as others. There are some areas in the college that are far more advanced, but it is quite fundamental that where we can, we replicate what is going on in industry. In industry you do not sit down with a piece of paper and draw it out; you get a piece of software and it is worked out for you. Students have to understand the underlying logic, but they are testing a piece of kit; they may have a machine or piece of software that tests it for them, and we want them to learn how to do that. If they are looking up technical data, we do not want them to work it out from scratch, but to be able to use databases and data available to them online.

Q81 Dr Mathias: I have an allied question. Thank you for what you have shared so far; it is very illuminating. I take on board what you say about the money required to train teachers and for the hardware. I would like to know how current teaching of computing compares with the experience of One Laptop per Child. I ask that because of the extraordinary results they have had in one village in Ethiopia with no teachers. Tablets were dropped off and within days apparently the children were using nearly 50 apps per day per child. Within five months, with no teachers and no extra hardware, the children had hacked Android, which MIT did not think would be possible, with their Exo tablets. Given those extraordinary results from almost nothing, apart from the tablet, how does the teaching for our children compare?

Peter Gaynord: That is an interesting story. In our world in England we are some way down that route in the primaries. We use an awful lot of what you would call virtual learning or non-synchronous materials. An awful lot of use is made of materials such as YouTube videos and things like that, but certainly from my experience we do not use an awful lot of synchronised learning like webcasts where no teacher is involved. My own school is into virtual learning platforms. We are now going down the route where children begin to teach one another and create their own small videos that show in-depth mastery of something in maths. They then share it with the year group as a prop and support for

completing some homework tasks, but we are some way off having a building that is empty of all teachers.

Q82 Dr Mathias: I am not saying it is ideal, but it is interesting to see what happens when you do not have teachers.

Peter Gaynord: I would put in a caution. Just because it is a virtual classroom does not always make it good teaching. I have seen materials that are widely used and popular across the world that we would not use in this country because we do not consider them to be valid—it is not great teaching. We are going down that road; in my school, I have done pre-teaching exercises where I send online videos to children on a brand new topic they have never encountered before and they hit the road running when they come into the classroom. That is interesting. When I first did that it was shockingly new. I thought, "How are they going to get on without me?" A technology called screencasting is yielding huge dividends in my sphere at the moment; you can capture activity on screens, or on desks if it is visualised, with a voiceover. You can teach parents how to do primary maths, where traditionally there has been a knowledge gap. We have also discovered that you can use that technology not just in terms of how to push the buttons, perhaps in a software application, but to put over real mastery and depth of understanding of exactly what is happening in a particular piece of learning. We are some of the way down the road, but we are not at the level in the picture you have given.

Q83 Dr Mathias: A little village in Ethiopia.

Andrew Seager: I am not aware of that particular story. At my place, over the past three to four years in particular, we have tried to look at what educational research across Europe, America, New Zealand and Australia shows are the most effective, important things that teachers can do to improve student outcomes. We have adopted an approach to teaching based on one proposed by John Hattie, a professor of education in Australia, which he calls direct instruction. That is perhaps not a phrase that plays terribly well in the English system, but that is what he calls it. It has about seven or eight elements. They blend together the things teachers do that most influence good pupil outcomes. As I mentioned previously, the research he has done, and from which he developed that approach, looked at the use of computer systems and so on to teach students. They do not appear to yield particularly good results. The style of teaching he proposes would be recognisable to many of us; it is fairly traditional. We would use the example of graph plotters that I talked about to look at how changing variables changes the shapes of graphs and so on, but that would almost come into an element of a lesson where traditionally one would use a textbook. We have stuck with a fairly traditional approach. We do not use a lot of IT in our lessons, and certainly have not tried to substitute the teacher for that. For us, teacher-led lessons are still the right thing to do. Why? Because the research shows that they tend to get the best outcomes for students.

Desmond Deehan: There was a similar initiative in India where a computer was embedded in a wall and young people were allowed to access it.

Dr Mathias: In the slums.

Desmond Deehan: It taught us that young people are very good at accessing technology. The challenge is between accessing that technology and applying it. If you give young children some technology, they will pick it up and learn to use it quickly. It is a long way from that to be able to use it in a constructive manner, to apply it and exercise judgment in how you use it. The internet provides an awful lot of useful information; it also provides an awful lot of rubbish, and students need to learn to distinguish the two. For that they need teachers as well. There is a case for virtual classrooms; things like the Khan Academy are very useful as supplements to student learning, allowing them to extend it beyond the classroom in their own time at different hours, holidays and so on.

Q84 Dr Mathias: And in refugee camps.

Desmond Deehan: Absolutely. Where you do not have access to a teacher, or there is limited access to a teacher, it is a useful stopgap. In terms of developing young people further, and being able to apply and use technology constructively and deciding how best to use it and judge it, ultimately you need some kind of instruction. My feeling is that the best teaching—I think this comes through from Ofsted as well—is dialogic teaching: work, feedback, response and continuing development. What we want to get to as a longer-term strategy is that, rather than just getting young people to access technology, which they can do very easily, they apply it, understand it and develop it further. That is where you still need a combination of the virtual and the real to achieve it.

Q85 Dr Mathias: Is there something to be gained from letting the child play with the laptop—the child who can then hack—compared with the child at your school who might not be finding out those computing skills?

Desmond Deehan: Naturally, if you leave young people with technology they will initially experiment and learn with it. That is sometimes better than instructing them. Your perceived use of that technology might be different from the one they apply to it, so it is a two-way issue. It certainly works with younger students if you allow them the opportunity to play with it and become familiar with it.

Q86 Dr Mathias: That would be similar to leaving the laptop with the children with no teacher.

Desmond Deehan: Potentially. The danger for schools in particular, if it is internet access, is online safety. You have to be able to put in safeguards, and they are constantly changing and moving. You have to be able to apply that. If you want to develop that further and use it, or even if children create their own technology, which is probably part of the goal, it involves instruction. I do not think I would necessarily support the direct instruction model in that respect. It is more about dialogue with students. You need a mixed diet: you need a combination of all those to be effective.

Sara McManus: I am not quite sure which question I am answering.

Q87 Dr Mathias: It is how your teaching of computing in school compares with the experience of the charity One Laptop per Child where, without much hardware and without a teacher, children were able to learn, on their own, amazing skills, even down to hacking Android.

Sara McManus: I am not sure it is relevant, but in the college we changed from a much more teacher-led focus in lessons to a much more project-based approach within a lesson, which encourages problem-solving and teamwork. It is trying to develop other skills to be able to take a problem and achieve an outcome, particularly within IT and games programming, which we do at my college. We might get an employer in and use the employer to set a project, and then students work on it as a team as they would in real life.

Q88 Dr Mathias: Allied to that, what is being done for children from lower income families if they do not have access to the equivalent of the Exo laptop?

Chair: Before you answer that, you are providing us with very valuable and interesting evidence but we are beginning to run out of time, so if you could be relatively short and sharp with your answers it would be helpful. If you could not repeat what others have already said, that would also be helpful.

Peter Gaynord: The north Cambridge primary where we work is considered to be in an affluent area, as opposed to an inner-city school in Stoke, where I grew up. There are pockets and individuals everywhere, and you have to address it everywhere. The sort of things we do are simple. We make facilities available to those children. Within the school we run homework clubs. They have choices as to which one they attend, whether before or after. For my class, the other night I had parents having coffee in the staffroom chatting while their children completed their digital homework on a laptop. In the future, if funding was available it would be nice for those children perhaps to have broadband and a device at home, but it is not that simple. I have worked with children who did have broadband at home and the device was an Xbox, which is not so great for doing homework. It is a complex issue at times.

Andrew Seager: In my school, about 50% have free school meals, so we are in a relatively deprived area. Children not having access to IT at home is not a major issue. Most seem to have it, but there are some examples; either it is the PC itself or often just the cost of getting a broadband connection. The solution to that is that we are open from eight until five, so students can get in early and stay late and do stuff they need to on PCs.

Desmond Deehan: I agree about opening hours; we do the same thing. Additionally, we provide laptops through pupil premium funding for students who require them. There is the same challenge about access at home. We do not have control over whether they have internet access at home, and parents' attitude to IT and their ability to use it is also a challenge.

Q89 Derek Thomas: Can I take you back to the decision to scrap ICT GCSE? What do you think was the Department for Education's rationale behind it? Can you explain the difference between ICT and computing? Would it have been better just to reform ICT, or was it right to scrap it and start again? You do not all necessarily need to answer.

Peter Gaynord: It is probably best answered by my secondary colleagues who teach it.

Andrew Seager: I do not know what the rationale was. I guess you would have to ask them. They are different courses, and there are arguments for GCSE computing and for GCSE IT, or at least the content of that.

Desmond Deehan: I know what the DFE told me the rationale was—that there was too much overlap between computer science and ICT. It is the same overlap as between geology and geography, ancient history and history, film studies and media studies and even English literature and English language. It does not sound a very convincing rationale. I think the answer, as you just mentioned, is reform. The better solution would have been to reform ICT. There is expertise and willingness within education to do so. Everybody has accepted that ICT has not always been quite what it could be. You have examples from the development of the computing curriculum to show how effective it can be when you bring educators into those decisions. The problem with the DFE's decision is that it did not do that. It was sudden and lacked consultation, and it did not involve the people who would actually be affected by it. My suggestion is that the better option would be to reform ICT to make it more to the standard of the computing GCSE.

Q90 Derek Thomas: My local school spent several thousand on books that they were then unable to use. Computer science is a subject that is understandable globally. Is changing it to "Computing" going to matter? Will it disadvantage our children in any way?

Andrew Seager: I was trying to think about this, and the position that GCSE computing now has, in the arrangements by which schools are held accountable. I was trying to imagine what would have happened if I had been head of a school that had not gone down the route of computing and had stuck with GCSE IT and that kind of stuff. I would now be panicking a little, because I would have a department of people and I would be thinking, "How on earth are they going to teach computing? This is a massive change." I think I could work out a way of effectively quietly dropping computing from the picture while protecting the measures by which my school would be judged in the future, in particular the progress 8 measure. It could be done. It might be an unintended and unfortunate consequence of dropping GCSE ICT if schools think, "Blimey! We can't get our IT department teaching computing well and successfully," and maybe just drop the whole thing and focus on science, history, geography and the other things in the relevant bucket, as they are called. Potentially, there could be some problems up the line and things may not work out quite as hoped.

Q91 Derek Thomas: Do you think it will affect the post-16s in terms of how they enter further education?

Sara McManus: Sorry, I find the echo of the room quite difficult.

Derek Thomas: How do you think the changes at secondary level will affect post-16 children? Do you think it will have a knock-on effect?

Sara McManus: In my college, we see very few students who have come through the school system having undertaken GCSE IT or computing. My experience of those who

have is that their IT skills are not what I thought they would be. In fact, I feel that the GCSE has almost ill-served them; they do not appear to have the level of IT skills I would expect of them. I was talking to a colleague earlier and saying that everybody is now going to be doing computer science, and he said, "I don't think our local schools go anywhere near that kind of GCSE; it is very much ICT the whole time."

Q92 Dr Mathias: How important do you think it is for teachers to get CPD accreditation in computing?

Sara McManus: Are you referring to teachers who do not teach computing or those who do?

Q93 Dr Mathias: Those who do.

Sara McManus: I would say it is extremely important. I could not imagine a situation where they did not. It is absolutely fundamental, full stop.

Q94 Dr Mathias: Is there any different opinion?

Desmond Deehan: I do not think that accreditation is the important factor for most teachers. They enjoy being able to apply what they have learned in a challenging context. If you are a computer science graduate teaching computing, you want to be able to teach it to A-level. Most teachers want to be able to teach to a high enough level to use the knowledge and understanding they have, to be challenged and to apply and develop it. That is far more important than any external accreditations that may go with it. It is a matter of giving them scope to develop and grow in a way they would have grown if they had gone into industry and had possibly been able to develop and move.

Q95 Dr Mathias: Do you know what the Government are doing to help increase the number of computer science teachers, aside from industry?

Desmond Deehan: I mentioned the bursary earlier. The jury is out on whether that will have a great deal of effect in terms of recruitment.

Andrew Seager: Bursaries will have their place, but even if they attracted the right people, looking at how long it would take for those people slowly to replace the IT teachers in the system, we will be here for ever. The reality is that we have to retrain IT teachers to teach computing, which means giving them new subject knowledge. Whether or not that needs accreditation, it needs a major commitment to get them out for that training. They have to have the subject knowledge. You want to be taught physics by somebody who understands and knows physics; you do not want to be taught by somebody who does not. If you have people being taught computer science, they need to understand it sufficiently to do it. Love the ones you are with: your IT teachers. Give them the training and get them to become computer studies teachers.

Desmond Deehan: One of the weaknesses is that all too frequently there is short-termism. You suddenly recruit or train a batch of computing teachers now and you do not think

about five years or 10 years from now. If we are promoting computing and IT and we want students to be studying this and developing that, hopefully so that they are able to progress and go to university, you then need to be able to recruit them to the teaching profession as well. At the moment we have a shortage of computing engineers, so anybody who graduates in computing has lots of places crying out for them other than teaching. You need enough students coming through at GCSE and A-level in order to become undergraduates and graduates and then go into teaching, so that you do not suddenly find five years from now that you have run out of computing teachers. You have a spurt for one term of office of a Government and after that suddenly there are no more because they have not been given a progression route. The incentives need to be at that point for them to follow computing and go into teaching in the first place, so that you have teachers five and 10 years from now as well, when potentially the number of students wanting to study computing will have doubled or quadrupled.

Peter Gaynord: In the primary sector I do not see CPD as an issue in take-up for schools because there is so much free stuff out there. I run network meetings for colleagues to come along and be supported on a regular basis. Our local education authority's IT-type services are still out there, as traded services now; they are running courses. There is an awful lot of online CPD that is beautifully put together—it is all very modern—by Barefoot and in initiatives that CAS has undertaken. At the primary end there is an awful lot of CPD support for generalist teachers to acquire what they need to push this forward in their schools.

Chair: Thank you for providing us with some very valuable information and evidence that will eventually go into a report that the Committee will produce and present to the House of Commons. We may want to write to you to ask further questions, but thank you for giving us your time and evidence this afternoon.

Examination of Witnesses

Witnesses: **Simon Humphreys,** National Co-ordinator, Computing At School, **Amy Solder,** Education Project Lead, Nesta, and **Sheila Flavell**, Chief Operating Officer, FDM Group, gave evidence.

Q96 Chair: Thank you for coming this afternoon, and welcome to the Science and Technology Select Committee of the House of Commons. Could you introduce yourselves and your positions, please?

Simon Humphreys: I am Simon Humphreys, national co-ordinator for the Computing At School group. I was a teacher for 25 years before embarking with Computing At School, first in music and then in computer science. So that the panel is aware, I am very hearing impaired, so I would be grateful for loud voices.

Amy Solder: My name is Amy Solder. I am the project lead for education at Nesta, which is a charity focused on innovation. Nesta's area of expertise on this particular panel is looking at informal education and support for the computing curriculum, as well as how technology is being used across many subjects in schools.

Sheila Flavell: My name is Sheila Flavell. I would like to thank you very much for inviting FDM to participate in today's Committee. I am chief operating officer of FDM Group. FDM is the UK's leading IT employer. Last year, 2015, we employed 893 graduates in IT in FDM. Since 2008 we have employed 5,000 IT graduates in our organisation. We firmly support diversity, and today I am looking forward to offering our opinion on how schools, universities and industry can work together to improve the digital skills gap.

Q97 Chair: I think all three of you listened to the previous session. We want to get as many opinions as we possibly can. Was there anything in the evidence we heard in the previous session that you thought was fundamentally wrong, that you disagreed with or on which you had a different perspective?

Sheila Flavell: I would like to pick up one previous question from you, which was whether the Government were right to abolish the ICT curriculum. I have a letter from a school teacher and head of faculty, which arrived only yesterday. She advises me that in 2015 111,000 students sat the GCSE IT, of whom 43% were female. Conversely, 35,000 students sat the computing GCSE A-level, of whom only 14% were female. For me, that is very worrying, because if we are looking at unconscious bias and the gender gap and females are being drawn more towards the ICT programme, I hope we can look at reform and rebranding and not eradication in this area.

Q98 Chair: Are there any other comments? It does not matter if there aren't.

Simon Humphreys: One comment that came up a lot in the previous panel was the focus on technology. I guess it is part of the Select Committee's remit, but certainly within the computing curriculum it is important that we separate the computing curriculum from the technology. A significant amount of brilliant resources and activities are going on in our

schools in an unplugged curriculum. The role of teaching some core computer science principles could be performed in this room; we do not need machines, tablets or whatever. That point did not come across quite as clearly from the earlier panellists.

Q99 Chair: Sheila Flavell, why is the employability of computer science graduates so low? Why do so many of those graduates find it difficult to get employment?

Sheila Flavell: You are absolutely right; it is the degree discipline where there is the highest unemployment. There is a serious mismatch between what is taught in schools and universities and what businesses require. We work actively with 134 universities; we have partnerships with them. We speak with another 70 universities. Last year we received 31,000 applications from graduates within the UK who had studied STEM and were looking for a career in IT. They wanted to apply to FDM because they had been unsuccessful. They do not have the skills and experience to get into a role in IT and the education system is not preparing them well, or at all.

Q100 Chair: Do you think there is something fundamentally wrong in the design of computer science courses?

Sheila Flavell: I do, yes. I feel they are too theoretical and there is not enough vocational learning. One of the big reasons we at FDM turn people away is that they do not have the right base level of soft skills. One of the core components of our eight to 16-week training programme is to train graduates in soft skills to help them to be work ready.

Q101 Chair: Do you know how many undergraduates are now pursuing computer science and IT to graduate level?

Sheila Flavell: I do not have that figure.

Q102 Chair: If you could send it to us, it would be helpful. Just over a year ago in December 2014, the Government published their science and innovation strategy, in which they said there would be an independent review of computer science degree accreditation so that universities do better and get graduates into the labour market. If I may put this to the whole panel, do you have any perspective or views on that review?

Amy Solder: I do not have any on that one in particular.

Simon Humphreys: I do not. I welcome it, given the figures that have been mentioned. I represent and am employed by BCS The Chartered Institute for IT, which accredits many of the universities. It is undertaking its own independent review on the matter and will be contributing to the Shadbolt review.

Sheila Flavell: I was writing. I am afraid I missed the first part of the question.

Q103 Chair: Essentially, I was asking whether you had any views on the Government's review of their science and innovation strategy and how they could improve computer

science degree accreditation—so that they could answer the question we asked before about why undergraduate courses were not designed very well. Do you have any views on that review?

Sheila Flavell: I have not read the review.

Q104 Dr Mathias: I am sure there are lots of ideas, but perhaps I could start with how you think girls can be encouraged into this and STEM subjects. Is there something another part of industry or Government have not thought of to get girls to do it, and to carry on in the industry?

Simon Humphreys: There are many factors, aren't there? Fundamentally, the change to the computer curriculum will reap results in this particular area. The focus and emphasis on computational thinking skills from primary school all the way through to secondary school will enable younger children, girls and boys, to understand much better the technology they will end up having to use; and we should try to provide the resources, as we do within Computing At School, to support teachers. We need to be solving real-world problems; there needs to be relevance. A very good example was provided earlier by the previous panel about the way in which technology can enable us to access real data and solve real problems within the classroom in a much more inventive and invigorating environment than we might have done hitherto. The phrase we have is: year eight is too late. If we have not enabled, motivated and inspired girls as well as boys that STEM-related subjects and computer science are relevant to them and provide an opportunity to participate in the workplace in something so transformative and life-changing, we have lost them. That is why the changes made to the primary curriculum for computing in computational thinking, creative problem solving and setting challenges pre-puberty are very important.

Q105 Dr Mathias: That is interesting. Basically, it is a matter of making it exciting, because that is not gender bias.

Simon Humphreys: I pause over the word "exciting", because sometimes there are inevitably aspects of education that are tough to learn and that might come across as being dull, but in the hands of good teachers any subject can be made exciting. One of the key facets for any good computing education system to be world class is to put the right tools and the right understanding and confidence into the hands of the teachers and it will be transformative.

Q106 Dr Mathias: Where I am there is an all-girls nursery school. Five-year-olds became incredibly excited when I brought in an inventor who happened to be a man. I did not see a gender problem at all. They were all buzzing. What do you think?

Amy Solder: I support Simon in the sense of working and developing at primary level. I would argue against doing activities focused just on getting girls. It is more about creating a broad range of activities that will stimulate interest for many of them, rather than targeting girls. Wearing Nesta's hat in particular, informal learning has the greatest success when the appeal is much broader. In something like Code Club, which is an after-

school coding club in primary schools, it is fairly equal between boys and girls. Apps for Good runs a programme in secondary schools, predominantly about creating an app to solve a social problem. Again, it is fairly equal between boys and girls. It is the breadth of activities rather than targeting just girls.

On its not being a gender issue, one of our concerns, looking particularly at informal education, is that it is not necessarily a gender divide; it is a geographical divide. Enormous numbers of activities are centred in London and particularly Manchester in the north-west. However, other areas that are more rural and less urban-centred have many fewer opportunities. That is definitely an area to look at. It has not necessarily been covered before because a lot of focus has been on gender.

Q107 Dr Mathias: You are going back to breadth in what you are doing rather than going down one route.

Amy Solder: Yes.

Sheila Flavell: I concur with my colleagues on the panel. To add to their comments, in a recent survey commissioned by Accenture, 4,000 girls, women, parents and teachers were surveyed. Of the 12-year-old girls surveyed, 60% said that IT was too difficult and it was for blokes, not for girls; only 14% of the parents understood the benefits of IT; and 51% of parents felt they were ill-equipped to guide their children into a career in technology.

There is also a distinct lack of role models. If I asked anybody here to identify a role model in technology, you would probably think immediately of Bill Gates, Steve Jobs and Mark Zuckerberg. I am sure the names of Baroness Lane-Fox, Sheryl Sandberg, CEO of Facebook, or Marissa Mayer, president and CEO of Yahoo, would not come up. Children do not recognise those formidable ladies as role models. We need to do more in government, industry and education to promote more female role models. I have a saying, which is that people cannot be what they cannot see. If parents and teachers, who are the prime influencers of young girls, cannot guide them in information technology and the fantastic careers available, children will not follow that career. They will drop computing—ICT, computer science or whatever you want to call it—and they will never go into a career in STEM. That is why only 17% of the IT workforce in the UK is represented by females.

Q108 Dr Mathias: You would fully support Greenlight for girls, which has been to Parliament; they go round the world exciting girls—exactly the names you were talking about—and inspiring them in all the STEM subjects.

Sheila Flavell: Absolutely. They are 46% of the workforce, and we need them out there working in IT, which is a hugely growing area—the digital revolution.

Q109 Dr Mathias: What do you think about connecting the STEM subjects with the arts? Like other science people here, I think that ultimately science is creative, but what is your opinion?

Sheila Flavell: Yes, yes and yes. Computer science is a turn-off for girls. Why is such a small percentage of girls doing computer science at GCSE? Why is an even lower percentage of girls studying computer science at university? Because it is deemed to be engineering; it is boring and techie, and in the main it is not for girls. The Government will say that the ICT course was never designed for girls, nor was computer science designed for men, but the perception is out there. If you ask a young person to draw a typical IT worker, they will probably draw a geeky fellow with glasses and spiky red hair.

To get back to your question, we need girls to be turned on by IT. Girls are turned on by data, big data, business analysis, web design and digital marketing, and a lot of those roles require artistic skills. Art and science need to come together more formally and in a more structured way.

Amy Solder: Nesta would argue that the combination of technical and creative skills is important for future jobs, but we would also argue that there is lack of evidence about the take-up of STEM in UK secondary schools. There will be greater automation of jobs. Creative jobs are less likely to be automated in the future, so it is important to have technical and creative skills together. We encourage the use of computing in, say, an art class or whatever, and combinations and interdisciplinary activities. However, there is lack of evidence about how students take STEM subjects. By that, I mean are they taking maths and science as well as art or design? There is less evidence about those combinations of GCSEs. At the moment Nesta is conducting research to look at the variation in take-up of STEM in secondary schools in both England and Scotland and, crucially, to examine whether take-up of STEM varies by student characteristics, such as gender and ethnicity. There is work to be done; the evidence is not necessarily there.

Q110 Dr Mathias: We have not got it yet. That is very helpful.

Simon Humphreys: I sit here having spent half my life as an arts graduate, a musician and composer, on which I still work, and a teacher of computer science. I have no hesitation in saying that I fundamentally believe that the craft of programming is the most creative activity that a student can undertake—more than composing a symphony.

Q111 Dr Mathias: Or perhaps on a par with it.

Simon Humphreys: There are certainly different skill elements, but I would quite happily argue internally with myself about which is the more creative. Is it composing a symphony or solving a problem?

Q112 Dr Mathias: We should do an MRI on you and map it.

Simon Humphreys: I would also refer the panel to the Next Gen report that came out, I think, in 2011. It looked at the visual effects industry and the games industry—that whole area. One of its two core recommendations—it made several—was that computer science should be in the school curriculum, but also that art and computer science should be in the English baccalaureate. When you think of the games industry, they are not looking for computer scientists. Well, maybe they are, but they are also looking for story-tellers,

animators, artists and physicists. They are looking for a wide skillset embodied in very versatile people. We have inherited a situation over the years where certainly in secondary schools our subjects are siloed. Over the next however many generations, we need to begin breaking down those silos and stop talking about people as musicians, geographers or historians. We need skills and knowledge from all those areas that we bring into our modern-day workplace.

Q113 Derek Thomas: My question is primarily about how we get the education system to meet the demands of industry and the digital skills gap, and you have kind of addressed that. Can you think of ways that the education system can do more to equip young people for the digital economy, other than what you have already said?

Amy Solder: I have nothing directly to add.

Simon Humphreys: That is a very broad question. There is a tension. As a former teacher, the notion that I was necessarily preparing the children in my classroom for the workplace was several steps removed from the day-to-day needs. Clearly, that is an inevitable result of a high-quality education system, but certainly as a music teacher I did not necessarily believe that I was training my children to become active participants in the music industry. I always felt a very similar thing as a computer science teacher. I never had the view that I was preparing my students as a stepping stone towards participating in the computer science or IT industry. That was the role of the whole school. All of us collectively as an organism that is an educational establishment, such as a school, are preparing those children and students to become better informed, equipped and skilled to take on the challenges of industry.

Sheila Flavell: We have to get the kids at a very young age. If we do not get them by 12, we are not going to get them, because they are turned off by computer science at that time. I do not work in a school and I do not know too much about what goes on in schools, but I was extremely worried by what I heard in the previous session about the lack of funding and in particular the lack of skills—more than the lack of funding—that school teachers have. School teachers have a core job and IT sits at the side of that, so it is as well as, and they are spending their spare time on school sport. I did not get the feeling or comfort that IT was taken seriously, and that was extremely worrying.

Schools need to pay attention to what is being said about dropping the ICT course. We do not have to have just a computer science GCSE. Why is there not a digital communications GCSE, something a bit more funky and sexy, that will turn people on and motivate them to want to learn ICT? Employers also have a huge responsibility. I do not think Government should support employers; they should spearhead it at the front end and create a structure, because if we do not get kids into IT, ultimately employers and the economy will suffer. Barclays, who came before the Committee on 12 January, have launched their digital eagles programme, which is absolutely fantastic. They have 20 volunteers out there in branches working with customers and staff, but I liken it a bit to using a feather duster to mop up an earthquake. I applaud what they are doing, but it will need a lot more than just Barclays. There is a call for action from employers to work with educational establishments to make sure there is a funnel whereby we get kids to learn the right thing to encourage them to go to the next level of education and ultimately have a career in technology.

Amy Solder: Industry has a big role to play in helping to support young people or education. We argue that there is a great role for volunteers particularly from the tech industry as well as from outside it. The techUK white paper report "We are just not doing enough" estimates that currently fewer than 1% of tech industry employees volunteer. That is incredibly low. It would help those companies as well if they supported a developing workforce. There are examples where industry is doing things, such as Barclays digital eagles. BT supported Barefoot Computing, and Google has a partnership with Code Club Pro. Some organisations are playing a more strategic role and supporting this agenda, but industry can probably play a greater role in terms of volunteers and support for the sector.

Q114 Chair: Ms Solder, can you tell us what impact you think Nesta's initiative Next Gen has had in schools? Has it encouraged people into careers in the gaming industry or into more creative jobs?

Amy Solder: I was not part of the Next Gen review. I can talk about the education policy side, but I will have to give supplementary evidence to the Committee about the other points because one of my colleagues leads on that work. In terms of reforms, we are delighted that computing is part of the curriculum, and that it is being taken on board and goes across all schools in England. It is already in Scotland, as one member said, as of 2010. We hope that it will also be integrated in Wales as they look at their curriculum review. On the other points about talent development, I will have to come back to the Committee.

Q115 Chair: As a more general question, do you think that children learn from getting involved in gaming? Is it helpful, destructive or neither of those things? As a parent I have to say I found it destructive.

Amy Solder: I would talk personally about young people making games and about the role of a creative individual. We talked earlier about science and technology, arts and STEM, and moving them together. There is an enormous amount you can do to motivate and encourage children by developing their own games. There are different competitions set up across the country. Manchester University runs something called Animation 16, Abertay University runs something for graduates on game design, and BAFTA has a young games design award. Lots of different things are happening with universities. I would focus more on the aspect that the creation of games is useful to young people rather than the playing of games, which is a different subset on which, in my current role, I would not be able to answer correctly.

Sheila Flavell: Learning should be fun. I watch children from the age of two playing games and learning how to use a tablet or an iPad through gaming. I have watched kids study for GCSE and do revision and use games sensibly. Nowadays there are parental controls you can apply, but I can see where it crosses the line and becomes a distraction.

If I may go back to a previous question, you asked me how many people were pursuing a career in computer science. I have the answer.

Q116 Chair: You have inspiration.

Sheila Flavell: In 2014-15 in the UK there were 63,470 undergraduates enrolled, of whom 9,585 were female and 53,870 were male; 15 did not specify gender. At postgraduate level 11,800 are currently enrolled in a computer science degree.

Q117 Chair: Thank you. That is valuable, and it will save you writing to us. We have talked about designing games, as opposed to playing them, being helpful in fostering creativity. How else can students be encouraged to experiment and develop creative talents in computer technology and IT?

Amy Solder: I can speak from the informal sector side rather than within the curriculum. Nesta has spent a lot of time either funding or working with organisations that are trying to support young people's computing skills, but with a creative outlook. Often, that has been with animations, games and developing an app to solve a problem, but the thing that holds them all together is having a purpose behind it. Many of those activities result from trying to create something or solve a problem; it is not just for technology's sake. I would argue for the importance of developing skills while making something in the real world.

Simon Humphreys: I would agree. It is making the problems matter to individual students in the classroom. Then they will be more motivated to find out what the answers are.

Q118 Dr Mathias: I love your idea about getting more volunteers from the tech industry. There have been amazing results with literacy volunteers, so I can see how that could take off. Do you know what work schools are doing with industry bodies to provide mentors for pupils and/or teachers?

Simon Humphreys: We have been directly involved in a number of projects. One was entitled the Barefoot Computing project. Soon after the programme of study for computing was published there was concern among many primary school teachers: "I'm not sure I understand the words on this page; I'd like somebody to come and explain them to me." Through the Barefoot project, funded by the DFE, we ran over 900 workshops in primary schools all over the country. The people who actually went in and ran those workshops were local IT professionals from GE Healthcare, BT, the retail sector and the banking sector. We said to anybody we could find, "Please go and run a workshop." We trained them so they understood what the constraints were within the classroom. That was very powerful, and some of that relationship is ongoing.

Similarly, Amy mentioned the Code Club programme. A significant number of those after-school programming clubs are often run by local parents of the school, but they tend to be people from the local IT sector, or for whom IT is their job. The children see them as mentors and role models. I agree it would be lovely if there were more women doing that. I probably should not say that, because I do not know what the numbers are, but it would be good if there were lots taking on those particular activities.

Q119 Dr Mathias: Do you think that is growing?

Simon Humphreys: I do not work for Code Club so I do not know, but I believe they are now part of the Raspberry Pi Foundation and within that there would be a great deal more growth.

Q120 Dr Mathias: Do the others agree, or do you have anything to add?

Amy Solder: The STEMNET ambassadors national programme is looking at professionals in STEM who will go into schools and often give careers advice. Those are one-off volunteering opportunities. They have also developed something called TechFuture ambassadors who look particularly at the tech industry. A nice joined-up approach is the fact that STEMNET will do your DBS checks for going into schools. Code Club runs its volunteers through STEMNET's DBS checking. Therefore, you are collecting more volunteers who could be used for something like STEMNET and going into schools. That is a nice example of some cross-overs between different initiatives.

Q121 Dr Mathias: Does every school have access?

Amy Solder: Every school has access to a STEMNET ambassador and every school can join up for Code Club. You have to find a volunteer, or they try to match volunteers to your particular area. It could be that you are a school but you cannot find a local volunteer; it could be that you have some enthusiastic parents or amateurs and maybe they take it on rather than a tech professional, and they will learn a little bit before the young people. Tech professionals are part of the answer, but parents are also part of it. Hobbyists and people interested in this area are also part of the solution in working with young people to develop their skills.

Q122 Dr Mathias: Could we find out the percentage of schools where this is already happening?

Amy Solder: Yes. I have some figures for Code Club, but we could provide others that are more up to date.

Q123 Dr Mathias: Great. Would you agree?

Sheila Flavell: Yes. Code clubs are on the increase. We are very involved with code clubs, STEMNET, hackathon and lots and lots of other groups. At FDM we have advantage sessions where we invite along not just students but their parents. We do that for the reason I stated earlier, which is that parents will influence their children and see for themselves that a career in technology is something to be embraced.

Q124 Dr Mathias: Is that available to all schools?

Sheila Flavell: Yes.

Q125 Dr Mathias: You can tell us the number who have taken it up.

Sheila Flavell: I do not have that.

Q126 Dr Mathias: But we could ask.

Sheila Flavell: Yes. It is something we do as a matter of course.

Q127 Derek Thomas: What can further education colleges do better to support students to adopt and develop digital skills? You are picking them up when they have gone through primary and secondary school. Is it too late when they go into colleges, or is there still an opportunity to get them to fill the digital skills gap?

Sheila Flavell: There is always an opportunity. It is a bit more challenging to hook them in if they had a poor experience earlier. I am sure you have had a poor experience at some point in your skill career. It puts you off that subject going forward. I will give an example of what we do to hook those candidates in. I have three daughters, and they all work in tech. They are business analysts for international banks through our organisation, but they never studied tech at school or university. They studied sociology, economics and business. They came in through a very soft route; they came via the business route into business, and we then slowly and softly introduced them to tech, and out they went having learned coding and a number of other technical skills—SQL, VB and suchlike. They are now working very competently in major banking institutions, along with thousands of other girls who have done the same. There is not one way to capture those candidates. There are many ways to skin a cat.

Amy Solder: We have not worked directly with further education.

Simon Humphreys: I have nothing to add to that comment.

Q128 Derek Thomas: Does the apprenticeship levy introduced in the spending review, or autumn budget, give enough flexibility to allow tech companies to invest in nurturing talent? You may not have given it any thought. Basically, there is now a levy on big businesses.

Sheila Flavell: It is a cost to the employer.

Q129 Derek Thomas: That is right. Does that help or hinder them in developing talent? Does it take resources away, or could it?

Sheila Flavell: I do not know a huge amount about the apprenticeship levy, but what I do know is that a lot of organisations are not geared up for developing their workforce. They outsource training. Unlike back in the day, when big companies had big training departments, that does not seem to be the case now. Having to pay to develop your apprentices may be a little less appealing, but it is necessary to supplement the digital workforce. Only this afternoon I looked at the growing numbers in the digital space of data analysts or digital marketeers. It has gone from zero to thousands in just a few years. I do not think companies have too much choice at the moment.

Q130 Derek Thomas: Do you have anything to add?

Simon Humphreys: I have nothing to add.

Q131 Derek Thomas: Is there a strong demand for STEM degree apprenticeships? What can we do to encourage youngsters and training colleges to provide STEM apprenticeships for businesses?

Simon Humphreys: I do not feel qualified to answer that.

Amy Solder: I am afraid I do not either.

Sheila Flavell: I think we have answered it, haven't we? What are we doing to encourage more people into STEM? Again, I use a personal example. This morning I asked the question: how many programmers do we have working for us at the moment? We have circa 500 programmers. Our model is that after two years we allow our staff to work for the institutions in which we place them, so 70% of those candidates after two years with us will migrate to become permanent members of staff of those organisations. We are continually having to replenish our work base, hence it is only 500. None the less, it is challenging to get young people into the development space, especially females. It is much easier to get graduates to work as testers. I also asked the question: where do we get the greatest demand from our 200 clients, who are huge institutions, including central Government? What is it they are looking for at the moment? It is test analysts, business analysts, PMO and data analysts. Finding those candidates is not a challenge because the level of expertise required is not as great as for a coder. Finding people with good coding skills is proving to be the challenge, not just for us but industrywide.

Q132 Derek Thomas: That might explain why the Government have moved away from ICT to the coding element.

Sheila Flavell: Most likely.

Derek Thomas: We might have stumbled across the answer without realising it.

Sheila Flavell: It does not solve the gender question.

Derek Thomas: I understand that.

Simon Humphreys: Sheila unpacked that. At the moment it is a hope that, because computer science is now taught in our primary schools, some of these fundamental foundational concepts and understanding of our digital world will be more firmly embedded in the hearts and minds of young people, for whom it just becomes natural. It is one of the aspects to celebrate in the change of the curriculum, and interestingly at the moment the rest of the world is gazing at us to see how successful we might be.

Derek Thomas: That is very good.

Q133 Chair: If you had the Prime Minister here and wanted to tell him about one policy you would like him to pursue to close the digital divide, what would it be?

Sheila Flavell: I would like him to concentrate on educating teachers. If we do not capture at that level—at foundation level—we are not getting a pipeline.

Q134 Chair: Amy Solder.

Amy Solder: Perhaps you could ask Simon first and I will come back to you.

Chair: Have a think.

Simon Humphreys: The challenge that the new curriculum has presented cannot be underestimated. We are introducing a brand new subject in the school curriculum, fundamentally computer science labelled as computing. That is a long haul. The key people in that process will be the teachers. It is absolutely vital that we ensure they feel sufficiently equipped and confident to teach the new subject. Many will lack the required subject knowledge and pedagogical knowledge they need to teach the subject, so highest on the agenda should be: what can we do to support that workforce as best we can?

The previous panel made a point about accreditation and seemed to be generally in agreement on that. We could put in place a benchmarking standard that said that over the next five to 10 years we would like to see all our teachers of computing having evidenced their knowledge and approach. That can be done with a relatively low-cost, light touch approach to teachers, but they need access and time within their timetable from their head teachers and governing bodies to give them the space to learn.

Amy Solder: I would argue for not forgetting the work that happens outside the school, by which I mean informal work and parents. We can learn lessons from the BBC's micro project 30 years ago. That was a campaign in the home as well as in school. As we go forward, a lot can be learned from a programme as broad and ambitious as that one was.

Chair: Thank you for spending time with us this afternoon and giving us very valuable evidence. We may wish to write to you if any more questions occur to us, but thank you very much.