



House of Commons
Science and Technology
Committee

Digital skills crisis

Second Report of Session 2016–17



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*Report, together with formal minutes
relating to the report*

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Science and Technology Committee

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Summary

The evidence is clear that the UK faces a digital skills crisis. Although comparative nations are facing similar challenges, only urgent action from industry, schools and universities and from the Government can prevent this skills crisis from damaging our productivity and economic competitiveness. The Government deserves credit for a range of effective interventions launched over the last Parliament but only the computing curriculum and widespread take-up of digital apprenticeships offer game-changing potential, and their impact may not be evident for a generation. Given the scale of the digital skills crisis we face as a nation, it is time for further action. The Government's imminent Digital Strategy needs to go further than drawing together cross-government digital activity, it needs to offer genuine leadership and vision for the future of digital skills and our digital economy.

Digital skills are becoming increasingly essential for getting access to a range of products and services. However, there is a digital divide where up to 12.6 million of the adult UK population lack basic digital skills. An estimated 5.8 million people have never used the internet at all. This digital skills gap is costing the UK economy an estimated £63 billion a year in lost additional GDP.

The skills gap presents itself at all stages in the education and training pipeline, from schools to the workplace. An audit of IT equipment in schools found that 22% of it is ineffective. Only 35% of ICT teachers hold a relevant qualification. The Government has been able to recruit only 70% of the required number of computer science teachers into the profession. The UK will need 745,000 additional workers with digital skills to meet rising demand from employers between 2013 and 2017, and almost 90% of new jobs require digital skills to some degree, with 72% of employers stating that they are unwilling to interview candidates who do not have basic IT skills. Two-thirds of 'datavore' businesses report that they have struggled to fill at least one vacancy when trying to recruit analysts over a 12 month period, and 93% of tech companies find that the digital skills gap affects their commercial operations. As a result of emerging technologies, there is also a growing demand for high level digital skills in areas such as cyber security, cloud and mobile computing and data analytics. Despite the vacancies, however, some 13% of computer science students are still unemployed six months after graduating.

In this Report, we have examined how the digital skills crisis is being experienced in the workplace, schools and in higher education.

It is essential for the UK to have the IT professionals it needs to build a robust digital economy. The average advertised salary in digital roles is just under £50,000—36% higher than the national average. The workforce, from highly skilled scientists to workers in manufacturing, are affected by the rapid changes in the use of technology in the workplace. There is a lack of awareness of career opportunities within the digital sector, sometimes reflecting skill and gender stereotypes around the types of roles that exist. Many organisations are not maximising the potential of new digital technologies or utilising the skills and talents of their employees in the most productive way. Almost 50% of employers have a digital skills gap, which includes specialist technical roles.

The recommendations from the Shadbolt and Wakeham reviews of computer science and STEM degrees may go some way in reducing the shortage of tech specialists, but other immediate solutions should also be considered. The Government should work with the Tech Partnership to develop industry-led, vocationally focussed digital careers advice in universities, and encourage universities to provide 'code conversion courses' to help graduates from non-computer science backgrounds to enter the tech sector. The Government should also clarify the full extent of 'Equivalent and Lower Level Qualifications' exemptions for STEM subjects. Digital skills should be one of the core components, alongside maths and english, in all apprenticeships, not just 'digital apprenticeships', making it the focus of its 3 million apprenticeships target. This will help to ensure the long-term future of the UK's economy, as would simplifying the apprenticeship scheme's processes to encourage SMEs to invest in them. The qualifying requirements for the new IT roles under the Tier 2 visa should be reviewed, making it easier and more flexible for employers to recruit the best talent globally.

There has been a gradual shift to digital technology in schools. To help meet the future demands of a digital economy, the Government launched the computing curriculum in September 2014, which introduced 'computer science' at GCSE level, and discontinued 'ICT'. The new computing curriculum is world leading and, properly taught, has the capacity to transform the digital skills potential of the next generation. The ICT curriculum did not provide the skills that industry and higher education value. Despite support for the transition, many ICT teachers still do not have the qualifications or the knowledge to teach the computing curriculum. Given the pace of technological advances, it will always be a challenge for schools to keep up with the latest innovations. As digital skills are increasingly becoming essential for many industrial sectors, schools will have to invest in offering high quality computer science options and upskilling teachers to deliver them. The Government should request Ofsted to include the computing curriculum in their inspections and require schools to deliver credible, sustainable plans for embedding computing. Schools should look for innovative ways to boost capacity through coding clubs and other informal learning opportunities offered by industry leaders.

To ensure digital education in schools continues to keep pace with business needs, the Government should work with the Tech Partnership to establish a regular forum for employers to raise and discuss their priorities for ensuring the computing curriculum and its teaching stay up to date, and to help ensure that other school subject qualifications provide a foundation for a broader range of digital careers. The ICT streams of the Teach First and Master Teachers initiatives should be scaled up to help deliver the number of teachers needed for the long term health of UK digital education.

Ministers accept that it is vital that Government coordinates a coherent strategy to address the digital skills crisis at all stages in the education and training pipeline. Accordingly, we cannot understand why the Government has delayed for so long the publication of its Digital Strategy. In the absence of further details, there is a doubt that it will give sufficient weight to the vital areas for change that we have highlighted in our inquiry. The gap between the digital skills that children and young people take into their working lives and the missing skills actually needed for the digital economy demonstrate a long-running weakness in the UK's approach to developing digital skills. Initiatives currently in train will help to fill that gap, but the forthcoming Strategy

should be more than just a catalogue of initiatives. It needs also to be more than just a programme of work for Government departments. We need to change the UK's cultural perception of digital technology. By setting out a vision for the future, to be delivered by collaborative work between industry, educators and Government, the Strategy should be more than the "aspirational" document that ministers propose—it should be a Strategy that actually delivers.

The Digital Strategy should be published without further delay. It should take into account the recommendations from both the Shadbolt and Wakeham reviews. It should include dynamic mapping of public sector and industry initiatives and public spending on digital skills against the economic demand for those skills, and benchmarks and defined outcomes that are necessary to measure levels of success and decide on next steps. There should be goals for developing better basic digital skills, for increasing the number and diversity of students studying computer science, and for increasing digital apprenticeships and for fostering digital champions. There should be a plan for greater awareness and scaling up of business-led initiatives, strategies for addressing the shortage of skills of particular strategic importance to the UK economy and how these capabilities should be introduced in workforce training, strategies for recruiting and retaining computer science teachers in schools, and a framework through which the private sector could more readily play a collaborative role with communities and local authorities in initiatives to raise digital skills in local SMEs.

1 Introduction

1. When Sir Tim Berners-Lee invented his distributed ‘information management system’ at CERN in 1989, no one anticipated the transformative impact of the digital revolution. In almost every aspect of our lives, we use digital products and services—in finance, health, education and entertainment. These products and services enrich our lives, opening up countless new opportunities: life-saving research innovations, access to knowledge and all sorts of ventures from grassroots campaigns to tech start-ups that begin in spare rooms only to emerge as ‘unicorn’ businesses.

2. We can be proud that the UK is already a global tech hub and a world leader in e-commerce: the online retail market accounted for 8.3% of GDP in 2010.¹ If as a nation we want to secure our position as a digital world leader, we need to ensure that investment in infrastructure, skills and cyber-security keeps up not only with the exponential growth of the sector but also with its restless innovation and creativity. Digital skills have no single definition, but have been variously described to include a general ability to use existing computers and digital devices to access digital services, “digital authoring skills” such as coding and software engineering, and the ability to critically evaluate media and to make informed choices about content and information—“to navigate knowingly through the negative and positive elements of online activity and make informed choices about the content and services they use”.² These skills are no longer sector specific. The rise of the Internet of Things, Big Data and robotics means that 65% of children entering primary school today will be working in roles that do not yet exist.³ This means that our education and training system—whether teaching the next generation or continuously upskilling the existing workforce—will need to be more agile if it is going to meet the challenge of future-proofing the workplace.

3. The UK will need 745,000 additional workers with digital skills to meet rising demand from employers between 2013 and 2017,⁴ and almost 90% of new jobs require digital skills to some degree. Some 72% of employers state that they are unwilling to interview candidates who do not have basic IT skills.⁵ As a result of emerging technologies, there is also a growing demand for high level digital skills in areas such as cyber-security, cloud and mobile computing and data analytics.

4. The Tinder Foundation have outlined six main benefits of widespread digital skills—earnings potential, employment, communications, transaction, time-saving and NHS cost savings.⁶ They calculate that over the next 10 years, an investment of £1.65 billion in skills and devices would reap benefits to both individuals and the Government of up to £14 billion.⁷ The Centre for Economic and Business Research estimate that providing basic digital skills for 790,000 people over the next year would realise £12 million a year

1 TechUK [Securing our Digital Future: The TechUK Manifesto for growth and jobs 2015–2020](#), (16 September 2014) p 14

2 BCS [DIG0001](#); Fujitsu [DIG0006](#); Ofcom [DIG0050](#).

3 World Economic Forum, [How technology change the future of work](#) (February 2016)

4 O2 and Development Economics, [The Future Digital Skills Needs of the UK Economy](#) (2013)

5 Tinder Foundation, [A Leading Digital Nation by 2020: Calculating the cost of delivering online skills for all](#) (February 2014)

6 Tinder Foundation and GoON.UK, [The economic impact of basic digital skills and inclusion in the UK](#) (November 2015)

7 Tinder Foundation and GoON.UK, [The economic impact of basic digital skills and inclusion in the UK](#) (November 2015)

in NHS cost savings and a further £31 million from fewer job-seeker benefit payments and higher income tax and NI receipts. For the individuals concerned, the benefits would amount to £314 million in terms of earnings, employment, transaction, communication and time saving gains.⁸

5. Basic digital skills are also a powerful social enabler, opening up opportunities for improvements in education, better health care services, connecting people to their communities more effectively and helping adults find work. Furthermore by increasing employment and giving small businesses the confidence to do more business online, digital skills can help boost the UK economy.⁹

6. Since 2010, the Government has provided £36 million to fund programmes “to help people gain the basic digital skills they need to access the benefits of being digital”. These programmes, it said, have helped more than 1.5 million people to develop their digital skills, and it anticipates that a further one million adults will be supported over the five years from 2014.¹⁰ The Government published a Digital Inclusion Strategy in 2014, setting out a two-year time frame to reduce the number of people digitally excluded by 25%. It identified four barriers: a lack of access to the internet, missing skills to be able to use the internet, a lack of motivation, and a lack of trust.¹¹ The Strategy identified actions that government, private, public and voluntary sector stakeholders need to take to reduce digital exclusion:

- make digital inclusion part of wider government policy, programmes and digital services;
- Establish a quality cross-government digital capability programme;
- Give all civil servants the digital capabilities to use and improve government services;
- Agree a common definition of digital skills and capabilities;
- Boost Go ON UK’s [a digital skills charity] partnership programme across the country;
- Improve and extend partnership working;
- Bring digital capability support into one place;
- Deliver a digital inclusion programme to support [Small and Medium Enterprises] and [Voluntary, Community and Social Enterprises] using data to measure performance and improve what we do.¹²

8 Department for Culture Media and Sport [DIG0060](#) para52

9 Tinder Foundation and GoON.UK, [The economic impact of basic digital skills and inclusion in the UK](#) (November 2015)

10 Department for Culture Media and Sport [DIG0060](#)

11 Cabinet Office and Government Digital Service, [Government Digital Inclusion Strategy](#) (December 2014)

12 Cabinet Office and Government Digital Service, [Government Digital Inclusion Strategy](#) (December 2014)

7. The Government has identified a number of specific initiatives which bear on the digital skills agenda. In our Big Data Dilemma inquiry, it highlighted:

- a new national curriculum in computing in September 2014 and reformed GCSEs/A-levels in computer science;
- reforming apprenticeships in software development;
- investment in doctoral training in aspects of data;
- investment in the employer-led Tech Partnership;
- the ‘Cyber Streetwise’ online safety campaign; and
- the Shadbolt Review on the accreditation of computer science degrees.¹³

During our current Digital Skills Crisis inquiry, it added:

- a new broadband Universal Service Obligation by 2020, giving everyone the legal right to request broadband at minimum speed from a provider at a reasonable cost;
- establishment of a Digital Engagement Council (to be chaired by Ed Vaizey) by early 2016 [replacing the previous Information Economy Council¹⁴];
- investment of £3 million to extend the network of Master Teachers, helping to increase teacher capability to deliver the new computing curriculum, which was launched in September 2014;
- launch of the digital Degree Apprenticeships, the first cohort of apprentices started in September 2015, with over 40 employers and nine universities collaborating to create a curriculum that meets industry sector needs;
- confirmation in the Autumn Statement 2015 of funding for the Ada National College for Digital Skills. There will also be a new Institute for Coding to support high level skills; and
- funding of computer science courses through a competition managed by the Higher Education Funding Council for England for which pilots are due to start in September 2016.¹⁵

8. However, despite the Government’s initiatives and the demonstrated productivity benefits that digital skills offer, two-thirds of ‘datavore’ businesses report that they have struggled to fill at least one vacancy when trying to recruit analysts over a 12 month period,¹⁶ and 93% of tech companies find that a digital skills gap affects their commercial operations.¹⁷ Despite the vacancies, some 13% of computer science students are still unemployed six months after graduating.

13 Department for Business, Innovation & Skills and Department for Culture, Media & Sport, [BIG0069](#)

14 The Information Economy Council was set up by the [Information Economy Strategy](#) (June 2013)

15 Department for Culture, Media and Sport, [DIG0060](#)

16 Nesta [DIG0048](#)

17 techUK [BIG0086](#)

9. As we seek to address the shortage in high level digital skills, digital exclusion remains stubbornly high with an estimated 23% (12.6 million) of the UK population lacking basic digital skills.¹⁸ Of these, 49% are disabled, 63% are over 75 and 60% have no formal education qualifications. A higher percentage of men have digital skills (80%) than women (74%).¹⁹ The Tinder Foundation have highlighted that an estimated 46% (5.8 million) have never used the internet at all.²⁰ The digital skills gap is costing the UK economy an estimated £63 billion a year in the lost potential for additional GDP, and consumers who are not online are missing out on average savings of £560 a year.²¹

10. Age, gender and socio-economic status are factors that contribute to digital exclusion.²² An estimated 10% of the population may never be able to gain basic digital skills because of severe disabilities or poor literacy skills.²³ Older people and the severely disabled are at particular risk of becoming digitally excluded.²⁴ For disabled people, data from the Office for National Statistics (ONS) show that 50% of all digitally excluded people have a disability as defined by the Equality Act.²⁵ As well as being more likely to have poor digital skills in general, disabled people are also more likely to have no access to the internet. According to the ONS, just 51% of people with a disability are internet users, compared to 84% of the general population.²⁶

11. Some 4.5 million of the 12.6 million people in the UK who do not have basic digital skills are actually in work and therefore have employers who could help them develop their skills needs.²⁷ Lloyds Banking Group's most recent Business Digital Index survey showed that as many as 1.2 million small businesses in the UK lack basic digital skills. The economic and social case for investing to close the digital skills gap could not be clearer.

Our inquiry

12. The Government's initiatives do not amount to a strategy. In February 2015, the Lords Select Committee on Digital Skills published a report calling for action in six areas, as follows:

- The economy—millions of jobs are at risk of automation;
- Skills—the UK population needs to learn the right skills for the future;
- Schools—make digital literacy a core subject;
- Internet—view the internet as important as a utility;
- Inclusion—realise the benefits of universal digital access;
- Women—realise the economic potential of more women in digital careers.²⁸

18 Ipsos Mori for GoON.UK and Lloyds Banking Group, [Basic Digital skills UK report 2015](#), (October 2015)

19 Ibid

20 Q4

21 Strategy& (formerly Booz & Co), [This is for everyone – the case for universal digitisation](#) (November 2012)

22 Significance, [Mind the Gap: the digital divide and digital inclusion](#) (September 2015)

23 Cabinet Office and Government Digital Service, [Government Digital Inclusion Strategy](#) (December 2014)

24 Cabinet Office and Government Digital Service, [Government Digital Inclusion Strategy](#) (December 2014)

25 Office for National Statistics, [Statistical bulletin: Internet users 2015](#)

26 Ibid

27 Q4

28 House of Lords, [Make or break: the UK's Digital Future](#) (February 2015)

The Lords Committee recommended that the Government develop “an ambitious Digital Agenda”, to be led by the Cabinet Office, reporting on progress by summer 2016. Their report described improvements needed to deliver these changes, though with few specific recommendations for implementation. The Government’s response to the Lords Committee in July 2015 promised details on the Government’s digital agenda in the autumn of that year, and suggested that it would be produced alongside or soon after the 2015 Spending Review.²⁹

13. Subsequently, in our recent *Big Data Dilemma* report we highlighted a “digital skills crisis”.³⁰ We described the risk of a growing data analytics skills gap as big data reaches further into the economy, and warned that “this not only has economic implications but also puts the quality and security of data at risk”.³¹ We decided to undertake our current inquiry on digital skills, under which the big data analytics discipline falls, to identify specific urgent actions needed to deliver the vision put forward by the Lords Committee a year ago. We have focused on the digital skills gap and its impact in two main areas: in the workplace and the role of higher education and apprenticeships (Chapter 2), and in schools (Chapter 3).

14. Our wider aim, however, has been to highlight issues that the Government should take into account in its forthcoming Digital Strategy (Chapter 4). During our *Big Data Dilemma* inquiry, Ed Vaizey told us in December 2015 that the Government’s Digital Strategy would be published towards the end of January 2016.³² The Government launched a consultation at the end of December 2015, seeking views on a ‘refreshed digital strategy’ which would focus on four themes: “unlocking digital growth, transforming government, transforming day to day life and building foundations”.³³ With the Digital Strategy still not produced as we concluded our current inquiry, we expect the Government to take our report into account in the document it eventually publishes.

15. Digital exclusion has no place in 21st Century Britain. While the Government is to be commended for the actions taken so far to tackle aspects of the digital skills crisis, stubborn digital exclusion and systemic problems with digital education and training need to be addressed as a matter of urgency in the Government’s forthcoming Digital Strategy. In this report, we address the key areas which we believe the Digital Strategy must deliver to achieve the step change necessary to halt the digital skills crisis and bring an end to digital exclusion once and for all.

16. We have not addressed infrastructure issues such as access to the internet and the services it makes available because the Culture Media and Sport Committee is undertaking an inquiry into internet connectivity, and examining the measures needed to improve accessibility. Suffice to say, this infrastructure provides the cornerstone of our digital economy with connectivity playing a pivotal role in creating a digitally inclusive

29 Department for Culture, *Media and Sport, The Government’s response to the House of Lords Select Committee Report on Digital Skills* (July 2015)

30 House of Commons Science and Technology Committee, *The big data dilemma – Fourth report of session 2015–16* (February 2016)

31 Science and Technology Committee, *The big data dilemma, Fourth report of Session 2015–16*

32 Ibid, Q248

33 Department for Culture, Media and Sport, *UK Digital Strategy – the next frontier in our digital revolution* (29 December 2015)

society. Superfast broadband services are available to 83% (24 million) of UK premises and 46% (13 million) are covered by 4G mobile services, but there are still areas where fast broadband services remain unavailable.³⁴

17. We announced our inquiry in December 2015, and received 70 submissions and took oral evidence from 17 witnesses, including from academia, businesses, think tanks and education establishments, as well as Ed Vaizey MP (Minister of State for the Digital Economy) and Nick Gibb MP (Minister of State for Schools). We also visited Google Garage at Manchester Central Library (see Annex). We would like to thank everyone who contributed to the inquiry.

2 Digital skills and business

Skills for a digital economy

18. The House of Lords Select Committee on Digital Skills highlighted in 2015 that the digital sector alone was worth an estimated £105 billion in gross value added to the UK in 2011.³⁵ The relentless pace of emerging digital technologies has already transformed the way we communicate and work. Research in the Netherlands has shown that employees lose nearly 8% of productive time due to poor IT resources or inadequate digital skills.³⁶ The CBI note that those equipped with the knowledge and tools to engage with digital technologies, however, earn a higher wage, reflecting their greater productivity. Tech City UK calculate that the average advertised salary in digital roles is just under £50,000—36% higher than the national average.³⁷ There is a pressing need for high level specialist skills in data science, cyber-security and data security as a result of high growth rates associated with key emerging technologies in which UK has particular strengths:

- Internet of Things (expected to reach \$7.3tn by 2017)
- Wearable technologies (expected to reach \$70bn by 2024)
- Big Data and Data Analytics (expected to reach \$32.4bn by 2017)
- 5G and associated wireless technologies (expecting a 40-fold increase by 2018)
- Robotics (expecting to reach \$29bn by 2018)
- Autonomous vehicles (expecting to reach \$28bn by 2020)
- Advanced manufacturing, building automation (expected to reach \$49.5bn by 2018)³⁸

19. Tata Consultancy Services note that “the UK’s skills shortages are most severe in emerging technologies”,³⁹ and that without intervention this growth trend will only continue. The Tinder Foundation reported that already almost 90% of new jobs require digital skills, with 72% of employers stating that they are unwilling to interview candidates who do not have basic IT skills.⁴⁰ Businesses and workers, like our education system, will need to accommodate future trends. Automation is slowly changing the services we use and the jobs we do, from banking to health care to education. A 2014 study by Deloitte and Oxford University concluded that 35% of jobs could become automated over the next 20 years.⁴¹ Office and administrative support, transportation, sales and services, construction and manufacturing are most likely to be computerised or automated.⁴² Jobs paying less than £30,000 will be five times more likely to be automated than jobs paying over £100,000.⁴³ Charlotte Holloway from techUK explained that:

35 Lords Select Committee on Digital Skills, *Make or break: the UK’s Digital Future* (February 2015)

36 CBI, *Engineering our future – stepping up the urgency on STEM* (March 2014); Tech Partnership (DIG0040) para 3.1

37 TechCity UK and Nesta, *Tech Nation 2016 - transforming UK industries* (February 2016)

38 TechUK: *Securing our Digital Future - the techUK manifesto for growth and jobs 2015–2020*, p 15

39 Tata Consultancy Services (DIG0016), para 3

40 Tinder Foundation, *A Leading Digital Nation by 2020: Calculating the cost of delivering online skills for all* (February 2014)

41 Deloitte & University of Oxford, *Agiletown: the relentless march of technology and London’s response* (2014)

42 Deloitte & University of Oxford, *Agiletown: the relentless march of technology and London’s response* (2014)

43 Ibid

We can see the changing nature of the workforce [...] Smaller tasks are made easier or frictionless, and it changes how employees at an individual level can get on with their jobs and play a wider role in different sorts of organisations. We have to acknowledge that the structure of the workforce will be changing as a result.⁴⁴

20. There are already, however worryingly digital skills gaps in industry. The economic impact of this skills crisis is already clear. Research by O2 showed that the UK would need 745,000 additional workers with digital skills to meet rising demand from employers over the period 2013–2017.⁴⁵ Failure to fill these vacancies would cost the country between £1.6 billion and £2.4 billion a year.⁴⁶ TechUK told us that “93% of tech companies surveyed believe that the digital skills gap affects their commercial operations and talent acquisition.”⁴⁷ Approximately 50% of employers have digital skills gaps which include specialist, technical roles.⁴⁸ Go ON UK calculated that:

85% of hard-to-fill positions are difficult to recruit because of the lack of specialist, technical skills. These could have a wide range of impacts, restricting economic growth and productivity, unable to develop new areas of business, putting an increased pressure on existing employees to deliver more.⁴⁹

21. Nesta told us that many data-driven companies were struggling to find suitable talent. Businesses are constantly generating data based on our shopping, entertainment, business and finance activities. By analysing that data they can identify trends, increase efficiency, personalise services and create opportunities for innovation. However, such data analysis requires a firm foundation of digital skills.⁵⁰ In a recent report, *Skills of the Datavores*, Nesta found that data-driven companies are over 10% more productive than ‘dataphobes’—firms that do not exploit their data.⁵¹ Nesta found that two-thirds of ‘datavores’ struggled to fill at least one vacancy when trying to recruit analysts over a 12 month period.⁵²

22. In the face of domestic shortages of digital workers, it is start-ups and SMEs who lose out. While larger tech companies are able to recruit globally, sourcing 16% of talent outside the EU, University Alliance and CaSE believed that smaller firms are limited by current immigration policies.⁵³ The Government recently acknowledged that specialist technology roles are in short supply, accepting the Migration Advisory Committee’s recommendations for allowing businesses to recruit specialists outside the EU. The roles added to the ‘Tier 2’ visa ‘shortage occupation’ list include IT product managers, system engineers, data scientists and cyber-security specialists.⁵⁴ However, only ‘qualifying businesses’ will be able to benefit from these changes—primarily SMEs employing

44 Q39

45 O2 and Development Economics, [The Future Digital Skills Needs of the UK Economy](#) (2013)

46 Ibid

47 techUK ([BIG0086](#))

48 Q3

49 Go ON UK ([DIG0054](#))

50 Nesta ([DIG0048](#))

51 Ibid

52 Ibid

53 Tech City UK and Nesta, [Tech Nation 2016 - Transforming UK Industries](#) (2016); University Alliance and CaSE, [Standing out from the IT crowd: How do we make Britain a world leader in digital skills?](#) (March 2015)

54 Home Office, [Tier 2 shortage occupation list - Government approved version](#) (19 November 2015) p14

between 20 and 250 employees and those independent of larger companies.⁵⁵ These new measures, although welcome, would bypass the many tech sector SMEs or start-ups with fewer than 20 employees. Companies more than 25% owned by a larger company will not be ‘qualifying companies’, including those with significant investment from FTSE 100 companies.⁵⁶

23. In the face of recruitment difficulties, the Wellcome Trust highlighted the need to develop training opportunities and career structures that would ensure a future supply of data scientists to serve academia, industry and the public sector. They believed that:

The UK’s world leading position in science will only be maintained if we can establish an effective pipeline of individuals with specialist skills in data science and coding, and a broader scientific workforce equipped with a firm grounding in mathematics, data analysis and computing.⁵⁷

24. The CBI’s 2014 *Gateway to Growth* report found that 61% of surveyed businesses reported weaknesses in IT skills competencies; a 4% increase from 2009.⁵⁸ According to research recently commissioned by Barclays, businesses are not doing enough to improve their employees’ digital skills. Instead, an estimated 40% of businesses are choosing to hire younger, more digitally knowledgeable employees to address the digital skills gap rather than train up mid-level employees.⁵⁹ The Tinder Foundation urged employers of low-skilled staff “to make sure they take responsibility to upskill their workforce”.⁶⁰

25. SMEs, sometimes more than larger businesses, benefit from emerging digital technologies such as social media and online selling and payments. They face particular challenges, however, both in generating the financial capacity to invest in continuous change in digital technologies and in building the capacity to support workplace training in these technologies. Lloyds Banking Group’s most recent Business Digital Index survey showed that a quarter of small businesses lacked digital skills.⁶¹ For the voluntary sector, the figure was even higher at 50%.⁶² Nick Williams from Lloyds explained that “a third [of SMEs] did not have the right skills, a third believed that they had the right skills and did not need to do more, and a third were just not interested”.⁶³ CompTIA told us:

The majority of industry-focused initiatives from government are still far too top heavy in their input from larger firms, such as the Government’s ‘Trailblazer’ initiative on industry-led apprenticeship standards. This means they are often not suited for SMEs and not taken up fully, missing a massive opportunity to boost digital literacy in a large segment of the UK’s population—whose primary source of digital skilling and reskilling will be via work training.⁶⁴

55 Ibid

56 Ibid

57 Wellcome Trust ([DIG0004](#))

58 Department for Culture Media and Sport ([DIG0060](#)), para 4

59 Training Journal [CEO of Barclays warns the UK must act now to improve digital skills](#) (March 2016)

60 Q6

61 Q11

62 Q2

63 Q11

64 CompTIA ([DIG0024](#))

26. As digital skills increasingly become the foundation of a competitive economy, businesses need to invest in digital training to increase productivity and stimulate innovation, or we risk the UK being left behind. The rapid pace of digital transformation is changing the nature of the UK workplace. We must equip the next generation not just with the skills that we know industry needs today but also with the skills they will need for a future not yet imagined.

27. The Government's new computing curriculum, which we discuss in Chapter 3, is world leading and, properly taught, has the capacity to transform the digital skills potential of the next generation. It will however take time to impact the workplace. *To address immediate gaps, therefore, the Government should put in place coherent strategies to address the shortage of skills of particular strategic importance to the UK economy—including cyber-security, big data, the Internet of Things, mobile technology and e-commerce—and how these capabilities should be introduced in workforce training.*

28. The imperative for businesses to develop the digital skills of their employees is now a matter of survival. *In order to maximise the opportunities that the digital economy presents, the Government should set out in its forthcoming Digital Strategy a plan for working with businesses to share best practice of, and scale up, existing business-led initiatives to upskill both employees and customers. These plans should include a framework through which the private sector could collaborate with communities and local authorities to raise digital skills in local SMEs and the wider community.*

29. *In its forthcoming Digital Strategy, the Government needs to establish an effective pipeline of individuals with specialist skills in data science, coding and a broader scientific workforce that is equipped with a firm grounding in mathematics, data analysis and computing. The Strategy should commit the Government to annual dynamic mapping of public sector and industry initiatives and public spending on digital skills against the economic demand for those skills. This would help it assess the effectiveness of measures that are already in place in addressing the digital skills crisis, and create a long term mechanism for investment in and adjustment of the Digital Strategy to maximise its effectiveness.*

30. SMEs and start-ups are the wealth creators in the UK and should not be obstructed from hiring the talent they need to become more productive. *The Government should review the qualifying requirements for the new IT roles added to the Tier 2 visa 'shortage occupation list', making it easier and more flexible for SMEs and start-ups to recruit top talent from outside the EU.*

Digital Champions

31. Businesses not only need a digitally skilled workforce but also a digitally literate customer base. Some businesses have developed the concept of 'digital champions' to engage with communities by sharing the benefits of the internet with people who are 'not online'. We heard from Barclays and Lloyds Banking Group about their respective initiatives. As part of its Helping Britain Prosper Plan, Lloyds intends to train 20,000 digital

champions to help improve the digital skills and financial capability of its customers by 2017.⁶⁵ The bank already has 11,000 digital champions and has partnered with the Tinder Foundation to provide access to a network of over 5,000 UK online centres.⁶⁶

32. Barclays Bank have trained nearly 16,000 volunteers through its Digital Eagles initiative, operating in branches across the country.⁶⁷ The aim is to help its customers, businesses and the public to understand the benefits of the internet and mobile apps.⁶⁸ Working in partnership with Age UK and the NHS, it also offers ‘Tea and Teach’ sessions for the elderly and disabled, tackling issues such as fraud and scam awareness and booking and cancelling GP appointments.⁶⁹ Barclays have also formed a partnership with the Department for Work and Pensions, where the Digital Eagles concept was replicated in Jobcentres and more widely across the Civil Service as part of a Digital Friends initiative.⁷⁰ The goal is to increase the digital capability of DWP staff, to allow them to support their customers more effectively.⁷¹ Go ON UK’s Digital Skills Charter allows businesses to pledge their support to improve basic digital skills. A wide range of businesses have signed the charter, including the Post Office, NHS, Age UK, Shelter, EE and TalkTalk.⁷²

33. Digital Champions are a useful lever to engage with those who are hardest to reach—those with low digital skills which makes them more receptive to face-to-face support. The Government should step up its Digital Friends initiatives to go beyond its cross-government approach by extending it widely across the public sector.

34. Businesses’ ability to deploy a workforce with the required digital skills depends in part on a pipeline of graduates and apprentices with suitable skills, as we discuss below.

Meeting industry needs: higher education

35. Computer science skills are vital to the UK’s economy across the full range of business and industry. However, many young people are leaving education without the skills that employers are looking for and are unable to progress within the labour market.⁷³ According to the Destination Leavers from Higher Education survey for 2014–15, computer science graduates have one of the highest unemployment rates of any degree subject.⁷⁴ Figures from the National Centre for Universities and Business indicate that 13% of computer science students are still unemployed six months after graduating, compared with an average of 8% across all subjects.⁷⁵

36. Sheila Flavell from FDM Group (an IT graduate employer) believed that “there is a serious mismatch between what is taught in schools and universities and what businesses require”.⁷⁶ FDM Group went further, telling us that:

65 Lloyds Banking Group ([DIG0063](#))

66 Ibid

67 Barclays Bank PLC ([DIG0055](#))

68 Barclays Bank ([DIG0055](#))

69 Ibid

70 Cabinet Office, Government Digital Service, *Civil Service ‘Digital Friends’ to help get the UK online* (March 2015)

71 [Department for Culture, Media & Sport, Local digital inclusion initiatives: success factors](#) (August 2015)

72 [Go ON UK Digital Skills Charter](#)

73 UK Commission for Employment and Skills, *Sector insights: skills and performance challenges in the digital and creative sector – Evidence Report 92* (June 2015)

74 Higher Education Statistics Agency, *Destination of Leavers from Higher Education 2014–2015* (2015)

75 Higher Education Careers Services Unit, [What do graduates do?](#) (September 2014)

76 Q99

Current teaching in universities is devoid of commercial reality and does not have a strong enough commercial aspect. Graduates are emerging from degrees with a broad knowledge of IT Theory but no in-depth technical understanding of particular disciplines or the professional skills needed for a career in the sector.⁷⁷

At a recent digital skills seminar, however, a combination of other factors were put forward as possibly contributing to a relatively high unemployment rate for computer science graduates.⁷⁸ For example, some believed that there has been a tendency for employers to recruit computer science graduates from a small cadre of universities, although they did not present evidence about how this differed from other subjects, or how the high demand in the tech labour market had overcome any such bias.⁷⁹ Others pointed out that graduates tend to use the advice of their networks of family and friends to seek job opportunities, but the scope for this might be less for still developing sectors compared with longer established ones.⁸⁰ It was also noted that certain universities have exceptionally high employment rates for computer science graduates compared to other poorer performing institutions. There were examples of innovative solutions being developed by the higher education sector: Birkbeck launched an MSc in Data Science, a conversion course specifically designed for existing graduates to take up Data Science careers,⁸¹ and Hewlett Packard partnered with the Tech Partnership to develop Information Technology Management for Business and Software Development degrees.⁸² Samsung recommended “creating a code conversion course to help graduates from non-computer science backgrounds enter the tech sector with a recognised qualification”, making it easier for tech companies to provide digital skills training.⁸³

37. There is a significant gender disparity within the IT sector, where women are under-represented, making up only 17% of IT professionals.⁸⁴ This can in part be traced to higher education. Research by the Tech Partnership showed that 16% of new graduates from IT related degree courses were female compared to 44% of new graduates as a whole.⁸⁵ The situation regarding other aspects of diversity is more complex, as the Royal Society explained:

For mathematics, computer sciences, engineering and technology, men are more likely to be employed in graduate level science occupations than are women. While women are not under-represented in the overall scientific workforce, they are highly under-represented in senior roles. Black and minority ethnic groups are over-represented in the digital/IT sector, as are those with a disability, but under represented at senior levels. Socioeconomic background strongly affects whether an individual enters the scientific workforce.⁸⁶

77 FDM Group ([DIG0005](#))

78 University Alliance and CaSE roundtable, [Standing out from the IT crowd: How do we make Britain a world leader in digital skills](#) (March 2016)

79 Ibid

80 Ibid

81 Birkbeck, University of London [2016–17 entry for MSc in Data Science](#)

82 Hewlett Packard Enterprise ([DIG0031](#))

83 Samsung ([DIG0007](#))

84 FDM Group ([DIG0005](#))

85 Tech Partnership, [The Women in IT scorecard](#) (2015)

86 The Royal Society ([DIG0014](#))

The Shadbolt and Wakeham Reviews

38. Part of the problem of the under employment of computer science graduates appears to lie with computer science degrees themselves. These are currently accredited by the British Computer Society and the Institution of Engineering and Technology. While the British Computer Society accredits the vast majority of computing courses, it is difficult for employers to differentiate the strengths of particular IT or computing courses. Some stated that computer science as a degree subject was perceived as too generic by employers, not understanding the course content in which graduates were actually qualified. In addition, university 'JACS' codes are not applied consistently, making it very difficult for employers to establish the content of particular courses between different universities when considering CVs.

39. Accredited degrees and curricula are required to meet standards designed by academia and industry to ensure its relevance, but it has been widely accepted across academia, professional bodies and industry that improvements need to be made to the accreditation systems for computer science degrees to ensure that they are future-proofed for emerging technologies. Following its 2014 Science and Innovation Strategy, the Government commissioned two independent reviews.⁸⁷ The Shadbolt Review considered the employability of computer science graduates, while examining the provision of computer science degrees and how degree accreditation systems might be reformed to keep pace with the needs of the computer science profession.⁸⁸ The Wakeham Review examined the skills requirements of employers, the relevance of STEM knowledge and skills for industry, and how existing accreditation systems might provide better support to graduates.⁸⁹ The Higher Education Funding Council for England summarised the key findings from these reviews:

- Employers are looking for 'work-ready' graduates, who can apply their academic studies and abilities in a commercial or work context. Work experience is invaluable, but not all employers want the same things, or are willing (and sufficiently resourced) to mould and train staff;
- Industry is changing at a rapid rate. This presents a dilemma for universities and colleges if they try to keep up with industry demands;
- Graduates need to upskill and adapt to a changing jobs market. Their degree will only get them in so far in a career that may span 50 years;
- Industry and higher education need to engage collaboratively in curriculum design, in assessment and accreditation, and in providing work experience opportunities and careers advice;
- The value of degree accreditation system varies by STEM discipline. Some have established, respected systems, while others are still developing or are yet to be recognised and valued outside higher education.⁹⁰

87 HM Treasury, Department for Business, Innovation & Skills, [Our plan for growth: Science and Innovation](#) (December 2014)

88 Ibid

89 Department for Business, Innovation & Skills and Higher Education Funding Council for England, [Terms of Reference for The Wakeham Review of STEM Degree Provision and Graduate Employability](#) (February 2015)

90 Higher Education Funding Council for England, [Graduate employment and accreditation in STEM](#) (May 2016)

40. When Ministers gave evidence to us in March 2016, both reviews had not been published. Ed Vaizey told us then that the Digital Strategy (which we discuss in Chapter 4) had already been written.⁹¹ As a result of our prompting, he undertook to take account the findings of the Shadbolt Review in the Strategy.⁹²

ELQ Exemptions

41. The Government's 'Equivalent and Lower Level Qualifications' (ELQ) policy stipulates that students already holding a qualification at the same or lower level have to pay full fees if they want to study a further different subject, even for the purposes of reskilling. In the 2015 Spending Review, the Chancellor announced the extension of tuition fee loans to all students studying for a second degree in a STEM subject from 2017–18. However, so far a full list of these ELQ exemptions have not been published creating challenges for university applications and course creation.⁹³ The Open University has also made the case for extending ELQ exemptions to include 'half-STEM' degrees such as a BSc in Computing and Business and Conversion Degrees.⁹⁴ Others have queried the applicability of ELQ exemptions to digital and STEM apprenticeships, especially in the context of the Apprenticeship Levy as a tool for upskilling existing, often graduate, workers.

42. *The Government should take into account the recommendations from both the Shadbolt and Wakeham Reviews in the forthcoming Digital Strategy to help deliver the required supply of digital skills for the UK economy. With the opportunity now afforded by the delay in publishing the Digital Strategy, the reviews should be fully embedded in the Strategy.*

43. *The Strategy should also include a commitment for the Government to work with the Tech Partnership to develop industry-led, vocationally focussed careers advice in universities that prepares the future workforce for the growth in digital.*

44. *The Government should encourage universities to provide 'code conversion courses' to help graduates from non-computer science backgrounds to enter the tech sector with a recognised qualification.*

45. *We recommend that the Government clarify the full extent of ELQ exemptions for STEM subjects as a matter of urgency. These exemptions should include STEM conversion courses and Digital and STEM Apprenticeships (which we discuss below) to encourage the use of the Apprenticeship Levy to upskill the existing workforce.*

Meeting industry needs: Apprenticeships and work placements

46. Apprenticeships provides an important source for meeting employers' needs, including for digital skills. There are three types of apprenticeship qualification levels—intermediate, advanced and higher/degree apprenticeships. The Richard Review recommended that new apprenticeship standards be developed by employer groups known as 'Trailblazers'.⁹⁵ There are currently 140 Trailblazers developing apprenticeship standards, one of which will include core elements of maths and english and, where relevant, digital skills.

91 Q151

92 Q164

93 Birkbeck, University of London ([DIG0075](#))

94 The Open University ([DIG0056](#)), para 21

95 Department for Business, Innovation and Skills, [The Richard Review - Apprenticeships](#) (November 2012)

47. There are also digital degree apprenticeships. The Tech Partnership calculate that more than 17,000 people started digital degree apprenticeships in 2014–15; a 21% increase from the previous year. Some 30,000 people are now on digital degree apprenticeships, which accounts for 3.1% of all apprentices.⁹⁶ The Tech Partnership have noted that take up by women has been significantly better than the proportion studying for computer science degree courses.

48. In further developments of digital apprenticeships, the Tech Partnership have worked with industry partners to develop an apprenticeship standard for a ‘digital and technology solutions professional degree apprenticeship’ to meet the tech industry’s needs. These standards will be published shortly and will replace existing IT apprenticeship frameworks.⁹⁷ Their aim is to help apprentices develop qualifications up to degree level, available for upskilling the existing workforce—a particular pressure point for businesses as well as new staff.⁹⁸

49. TechUK and other witnesses believed that the current process for apprenticeships generally is too complex and may be too time consuming for some, and that the system can be improved to attract more businesses into apprenticeships. The Government told us in April 2016 that:

Reformed apprenticeships are putting industry in the driving seat to design standards that meet their needs. [...] Over 40 employers and 9 universities have collaborated on the new Digital Degree Apprenticeship to provide the right mix of technical and professional skills. There is a ‘data fundamentals’ element in every programme of study, and two universities offer a specialism in data science.⁹⁹

Ed Vaizey told us: “We want to ensure that apprenticeships going forward have an element of digital skills ... basic literacy, basic english, basic maths and basic digital skills.”¹⁰⁰ The Government, he told us, is focusing on digital skills in apprenticeships:

We have 17 digital standards we are working through [...] and we have already achieved three. I think 90,000 people are doing [STEM] apprenticeships, which is an increase of more than 50% over the last five years.¹⁰¹

50. The Government announced in May 2015 a commitment to have three million apprenticeships by 2020.¹⁰² To support that initiative, the Enterprise Act 2016 made provision for an Institute for Apprenticeships—an employer-led independent body to control the content and quality of apprenticeship standards—to be operational from April 2017. The Apprenticeship Levy was announced in the 2015 Autumn Statement to help deliver the 3 million apprenticeships target.¹⁰³ It is anticipated that the Levy will raise over £3 billion a year by 2019–20. The Levy will be funded two-thirds by government and

96 The Tech Partnership, [Digital apprenticeships growing at more than double the UK average](#) (May 2016)

97 Ibid

98 HM Government, [The Future of Apprenticeships in England](#) (December 2015)

99 Science & Technology Committee, [The big data dilemma: Government response to the Committee’s Fourth Report of Session 2015–16](#), HC 992, para 9

100 Q165

101 Q159 (90,000 refers to STEM related apprenticeships rather than just digital apprenticeships).

102 Cabinet Office, [Queen’s Speech 2015](#) (May 2015)

103 HM Treasury, [Spending Reviewing and Autumn Statement 2015](#) (November 2015)

one third (and an apprenticeship wage) by employers.¹⁰⁴ The Levy will be applied across all industries across the UK, replacing the previous apprenticeship funding scheme. Employers with a pay bill exceeding £3 million a year will be charged 0.5% of their pay bill, in excess of an allowance of £15,000.¹⁰⁵

51. While many have welcomed the Government's proposed Apprenticeship Levy scheme, some in industry have raised concerns about the process being "too complex".¹⁰⁶ Samsung was concerned that it could "impose an overly rigid training regime which will be detrimental to the ability to train young people in the skills that businesses need".¹⁰⁷ The Apprenticeship Levy should be seen as an investment, which can be used to retrain existing staff. Hewlett Packard Enterprise wanted the Apprenticeship Levy to enable business "to apply the money they have contributed to train and retrain staff in relevant skills throughout their careers, reflecting the nature of the modern labour market".¹⁰⁸ They told us that:

The focus on a headline number may drive policy decisions, when the nation would be better served if the policy drivers were quality of training and ensuring the qualifications develop skilled, work-ready staff. If this was truly the driver, then questions about whether companies can train partners' apprentices would be removed. [...] Like every other business, we would welcome timely confirmation that all of the levy will be available for the training of apprenticeships.¹⁰⁹

52. The Publishing Association recommended a number of principles for the scheme:

- Contributions to the levy from creative industries employers should be invested for the benefit of creative industry companies to ensure that levy revenues raised from creative companies stay within the sector;
- Levy funding should initially at least be diverted to develop the new standards required for apprenticeship delivery [...] and to create a quality assurance process, and to maintain a strong evidence base of labour market information to inform activity;
- Consideration should be given to the creation of Degree Apprenticeships for those companies and sectors looking to develop undergraduates in their workforces;
- Consideration should be given to having flexible transition arrangements in place, such as a rolling start to the programme to allow less well developed sectors time to catch up. This should be covered in a three year pilot period, running until 2020.¹¹⁰

104 Department for Culture, Media and Sport ([DIG0060](#))

105 Department for Business, Innovation & Skills, [Apprenticeship levy: how will it work?](#) (March 2016)

106 Unite Live, [A levy too far?](#) (January 2016)

107 Samsung ([DIG0007](#))

108 Hewlett Packard Enterprise ([DIG0031](#))

109 Ibid

110 The Publishers Association ([DIG0047](#))

53. Complementing apprenticeships, work placements can give students invaluable insights into the technology industry. Placements can provide students with the opportunity to gain skills that are specific to their course of study or choice of industry, as well as employability skills needed for the work place, and allow them to make informed choices about their future career.¹¹¹ Barclays, for example, told us that:

Students who undertake work experience opportunities are more likely to secure highly skilled graduate jobs. They receive the best of both worlds [...] as concepts taught in the classroom are brought to life in a commercial environment, consolidating learning and allowing challenge and insights to be shared.¹¹²

54. **The Government has promoted vocational skills as an equal-value alternative route for individuals and businesses in developing specialist digital skills. Apprenticeships are critical in ensuring the long-term future of the UK's digital economy. They are now available up to degree level and offer flexibility for young people to learn work skills while they study and for the established workforce to gain valuable new skills. We welcome the establishment of the industry-led Institute for Apprenticeships. *In the period until it is operational in April 2017, the Government needs to work closely with employers, higher education institutions and schools to understand the apprenticeship marketplace, to ensure that education aligns with industry's requirements needs, and that apprenticeships are delivered in a flexible way to adjust to future changes in the digital sector.***

55. *The Government should emphasise the need for more digital skills components in all apprenticeships, not just 'digital apprenticeships', to gear them to the needs for jobs across the economy. The Government should make digital skills the focus of its 3 million apprenticeship target. It should also work closely with industry, to encourage more women to pursue apprenticeships in the tech industry.*

56. **The standards for the Government's 'Trailblazer' industry-led apprenticeships reflect closely the input from larger businesses but, as a result, some SMEs may be unable to take advantage of the opportunities offered. *The Government should review its Trailblazer initiative, making it more streamlined and accessible for SMEs. The Government should examine the scope for simplifying the scheme's processes, to encourage business in the technology sector, especially SMEs, to invest in apprenticeships.***

57. *The Government must also make it easier for industry to partner with universities and colleges to support student teaching. Industry, universities and schools should also collaborate in promoting work placements in an open and transparent way. This will make it easier for all students to have the opportunity to experience a 'taster' of the industry that may well lead to permanent employment. One way of facilitating such partnerships and collaborations for businesses would be to allow the cost to be written off against Apprenticeship Levy contributions.*

58. *The Government should work with the Further Education sector to develop 'Digital Colleges' to replicate the National College for Digital Skills model across the country.*

¹¹¹ Professor Tim Wilson for the Department for Business, Innovation & Skills, [A review of Business-University Collaboration](#) (February 2012)

¹¹² Barclays Bank ([DIG0055](#))

3 Digital skills in schools

Embedding digital technology in the school curriculum

59. Addressing the digital skills crisis starts with our education system. The Royal Society identified the central importance of education as the engine of a more digitally skilled workforce:

If the workforce is to be future-proofed, education systems in the UK must be designed to equip everyone with strong literacy and numeracy skills, information literacy and a mind-set that is flexible, creative and adaptive. This will be crucial to preparing today's young learners for a future economy in which the skills needed are not only unpredictable now, but will continue to change throughout their careers; a future in which workers must have the ability and confidence to continue to learn and adapt long after leaving formal education.¹¹³

Crucially, witnesses impressed upon us that students who were only exposed to digital education in designated ICT classes suffered a distinct disadvantage when compared to those whose schools chose to mainstream technology and digital skills across the curriculum.

60. Over the last two decades, there has been a gradual shift to embed digital technology, with pupils being more active participants in the classroom, for example through the use of interactive whiteboards and tablets.¹¹⁴ Research has shown that digital technology can be effective in teaching mathematics and science as well as increasing attainment levels in numeracy and literacy.¹¹⁵ Technology can make a positive contribution to the lives of all learners, but attempts to use IT to improve learning outcomes may not always be effective, especially if students become over-dependent on the technology.¹¹⁶ Students using technology in the classroom is not enough in itself—they only translate this experience into key digital skills through good teaching and following good role models.

61. Despite Government initiatives in this area (paragraph 63), however, Ofsted has concluded that the impact of digital technology on education standards has been varied, reflecting different levels of investment, access to high quality broadband and teacher support.¹¹⁷ Not only do just 35% of ICT teachers have a relevant qualification but the British Educational Suppliers Association (BESA) calculated that 22% of IT equipment in schools is ineffective.¹¹⁸ There are currently 730,000 tablets in schools (expected to increase to 903,000 in 2016). Many schools are using them as part of everyday learning to deliver some aspects of the school curriculum, but there are still other schools that are relying on the use of a separate ICT suite.¹¹⁹

113 Royal Society of Edinburgh ([DIG0010](#))

114 National College for School Leadership, *Issues of ICT, School reform and Learning-Centred School Design* (2003)

115 The Royal Society, *Shut down or restart? The way forward for computing in UK schools* (January 2012)

116 OECD, *Computers and Learning: Making the connection* (September 2015)

117 Ofsted, *ICT in schools 2008 – 11: an evaluation of information and communications technology in schools in England 2008 – 11* (April 2013)

118 British Educational Suppliers Association, *Tablets and Connectivity, Full Report English Schools* (June 2015)

119 British Educational Suppliers Association, *Tablets and Connectivity, Full Report English Schools* (June 2015)

62. *The Government has set targets for recruiting teachers in Maths and Physics. They should also make a similar pledge for Computer Science. This would demonstrate a commitment to equip our future generation with the tools and resources to navigate the digital world, and provide a means of monitoring progress.*

The computing curriculum

63. Since the Education Reform Act 1988, ICT has been compulsory for all pupils aged 5–16 years in maintained schools.¹²⁰ In 2013, Ofsted reported on the quality of ICT teaching in schools in England, concluding that it was stronger in primary schools than secondary schools, where “poor teacher capability and lack of resources accounted for significant weaknesses in delivering the ICT curriculum”.¹²¹ It was left to schools’ discretion how ICT was taught and Ofsted noted that overall more emphasis was given to office applications (e.g. Microsoft applications) than design elements (such as programming). This was dependent on individual teachers’ confidence and ability to deliver the subject content. A Royal Society report in 2012 stated that many pupils found ICT “repetitive and boring”, resulting in a steady decline in the number of students studying the subject since 2007.¹²²

64. In February 2013, the Department for Education launched a public consultation on the Government’s proposal to replace the national curriculum ‘ICT’ syllabus with ‘computing’ at all four Key Stages.¹²³ The changes were proposed because of what the Government described as “the negative connotations and poor value associated with ICT, as well as making the subject a more rigorous academic discipline”.¹²⁴ The consultation proposed not to offer both ICT and computing courses because there was an overlap in their subject contents. Responses to the consultation showed that 39% were in favour of replacing ICT, while 26% were against and 26% were unsure.¹²⁵ The Department for Education decided not to approve two GCSEs and A-levels that would offer similar qualifications and decided not to redevelop ICT at GCSE and A-level.¹²⁶ The Government told us that “the reformed computing curriculum is equipping young people with the computational thinking that will prepare them for continued study or employment in digital roles”.¹²⁷

65. The new computing curriculum was launched in September 2014, focusing on the basics of how computers work, digital literacy and information technology.¹²⁸ The curriculum was designed by industry experts and academia. Computing is now a statutory national curriculum subject at all four Key Stages (alongside English, mathematics, science and physical education). ‘Computer science’ GCSE is also now included in the English Baccalaureate as a ‘science’. ICT is still available to 14–16 year olds, but only at vocational level.

120 House of Commons Library Briefing Paper, [The school curriculum and SATs in England: reforms since 2010](#) (April 2016)

121 Ofsted, [ICT in schools 2008 – 11: an evaluation of information and communications technology in schools in England 2008 – 11](#) (April 2013)

122 The Royal Society, [Shut Down or Restart? The way forward for computing in UK schools](#) (January 2012)

123 Department for Education, [Reform of the National Curriculum in England](#) (February 2013)

124 The Royal Society, [Shut Down or Restart? The way forward for computing in UK schools](#) (January 2012)

125 Department for Education, [Changing ICT to Computing in the National Curriculum](#) (July 2013)

126 Department for Education, [Further additional GCSE and A level subject content consultation](#) (November 2015)

127 Science & Technology Committee, [The big data dilemma: Government response to the Committee’s Fourth Report of Session 2015–16](#), HC 992, para 7

128 The Royal Society, [Shut Down or Restart? The way forward for computing in UK schools](#) (January 2012)

66. Google, Microsoft, BBC and many other witnesses welcomed the new computing curriculum, seeing this as a “world leading” step in equipping children and young people with fundamental skills for the UK’s digital economy. However, it is a significant step up in what teachers are being asked to teach and, therefore, implementing the curriculum continues to be a challenge for some schools due to lack of qualified teachers (as we discuss below) and IT resources. The Government and industry recognised these issues early, however, and a lot of work has been done to develop the new curriculum. This includes a range of resources and support for schools and teachers and coding clubs (paragraph 77). Schools and industry could also look to whole school programmes with which they are already familiar, like the Big Writing literacy initiative, as a possible model for mainstreaming digital skills.¹²⁹

67. Every student must have access to education that enables them to participate in the growing digital economy. The Government deserves credit for its leadership in introducing the computing curriculum but there is still some way to go for it to become truly embedded in all schools, let alone delivered to a consistently high standard. Given that digital skills are of the highest priority to the future of the UK economy and the future chances of young people, we find it surprising that computing is not explicitly considered in Ofsted’s schools inspection framework. We recommend that the Government request Ofsted to include the computing curriculum in their inspections and require schools to deliver credible, sustainable plans for embedding computing.

68. The Government should encourage the uptake of existing available resources by schools, many of which are free. Learning from the success of existing teacher support initiatives like The Big Write, and working closely with academia and industry, the Government should consider whether developing a similar model for computing will also help address gaps in IT resources.

69. Furthermore, to ensure digital education in schools continues to keep pace with business needs in an evolving tech environment, we recommend that the Government work with the Tech Partnership to establish a regular forum for employers to raise and discuss their priorities for ensuring the computing curriculum and its teaching stay up to date, and to help ensure that other school subject qualifications provide a foundation for a broader range of digital careers. This forum—which could be attached to the minister-chaired Digital Engagement Council (paragraphs 7 and 90)—would also be a springboard for ambitious expansion of industry support to schools, going beyond code clubs (discussed below) to include careers advice, Apprenticeship schemes and work placement programmes (paragraphs 46–53).

Upskilling teachers for a digital age

70. With only a third of ICT teachers holding a relevant qualification, the British Computer Society recently reported that many teachers were struggling to deliver the new curriculum, stating that only 25% of computing teachers felt confident delivering the

¹²⁹ Big Writing is an approach to teaching to improve writing standards. The aim is to advise schools on how to raise attainment levels in speaking, listening and writing using vocabulary, connectives, openers and punctuation. The model is currently used by numerous primary schools in the UK, targeting students in Key Stages 1 and from ages 5–11; See University Alliance and CaSE roundtable, [Standing Out from the IT Crowd: How do we make Britain a world leader in digital skills](#) (March 2016)

curriculum.¹³⁰ The Department for Education has provided more than £4.5 million over the past three years for ICT teachers to be upskilled to deliver the new curriculum through organisations such as Computing at School, Naace and the UK Forum for Computing Education.¹³¹ There is no mandatory requirement, however, for teachers to take up this training. Submissions we received show that there is some residual, continuing resistance to the change from the ICT curriculum to the computing curriculum.

71. Computing at School has developed a network of ‘Master Teachers’ to support the implementation of the computing curriculum. A study by Sheffield Hallam University showed that the Master Teacher programme was well regarded by teachers. There were still schools, however, which have not yet engaged with the computing curriculum.¹³² The British Computer Society thought that it was an “unrealistic expectation that the 15,000 hours of training would be enough” to ensure a smooth transition for teachers.¹³³

72. Beyond the computing curriculum, digital technology can enable teachers to be more creative in the classroom where it can be used to teach many subjects, including literacy, maths, art and design. However, research from the University of Cambridge showed that some teachers may lack the confidence and skills needed effectively to integrate the use of ICT across the school curriculum in a way that would motivate students or create an interest in digital technology.¹³⁴

73. As well as difficulties in upskilling ICT teachers, the Government has only been able to recruit 70% of the required number of computer science teachers into the profession.¹³⁵ There are currently an estimated 14,000 teachers delivering ICT at GCSE and A-level, who will need support and training to teach computer science.¹³⁶ In 2012, cash incentives were given to schools to release teachers from the classroom for training, but this central funding is no longer available. Andrew Seager, head teacher of Stratford School Academy, argued that the Government’s focus should be on retraining and incentivising recent computer science graduates to become teachers.¹³⁷ The shortage of qualified and experienced teachers has become an issue for some schools competing with an industry that inevitably pays much more. Although initiatives such as Teach First and bursaries have attracted computer science graduates into teaching, retention rates have not been high, with 50% returning to industry.¹³⁸ Simon Humphreys from Computing at School expressed his concerns:

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 [...] 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

130 See University Alliance and CaSE roundtable, [Standing Out from the IT Crowd: How do we make Britain a world leader in digital skills](#) (March 2016)

131 Westminster Higher Education Forum, [Next steps for computer sciences in Higher Education](#) (February 2016)

132 Sheffield Hallam University, [Independent study of Computing At School Master Teacher Programme](#)

133 Westminster Higher Education Forum, [Next steps for computer sciences in Higher Education](#) (February 2016)

134 University of Cambridge, [Teacher perspectives on integrating ICT into subject teaching: commitment, constraints, caution and change](#)

135 National Audit Office, [Department for Education: Training new teachers](#) (February 2016)

136 Schools Week, [Government to scrap GCSE and A’ level ICT qualifications](#) (November 2015)

137 Q95

138 Q70

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 as we can?¹³⁹

74. **Given the pace of technological advances, it will always be a challenge for schools to keep up with the latest innovations. As digital skills are increasingly becoming essential for industrial sectors, schools will need to invest in offering high quality computer science courses and upskilling teachers so that digital skills can become more mainstream rather than as a standalone subject. The Government seems to treat computer science as a separate subject rather than a mechanism to enhance learning across other subject disciplines. ICT teachers are now expected to teach the new computing curriculum, but too many do not have the qualifications or the confidence to teach computer science. The Government and industry deserve credit for efforts so far to embed the computing curriculum, including in the provision of free resources and training. However, it is clear that greater investment is necessary to address the teaching skills gap. *We therefore recommend that the Government increase its investment in teacher training as a long term commitment and request that, as part of its monitoring of the delivery of the computing curriculum, Ofsted take into account the uptake of free resources and training.***

75. **The Digital skills crisis includes not only shortages of key digital skills in the economy but also a shortage of qualified, confident ICT teachers. *We commend Teach First and the Master Teachers initiative but, given the rate of loss to a highly attractive private sector, we believe that the ICT streams of these programmes should be scaled up to have any hope of delivering the sheer number of teachers needed for the long term health of UK digital education.***

76. **So far financial incentives have not attracted sufficient computer science teachers to the profession. *In its forthcoming Digital Strategy, the Government should review the case for financial incentives for recruiting and retaining computer science teachers in schools, mindful of the higher pay remuneration available in the private sector. As an interim solution to recruitment shortfalls, the Government should consider categorising computer science teachers as one of the ‘shortage occupations’, thereby making it easier for schools or local authorities to recruit from outside the EU.***

Informal learning

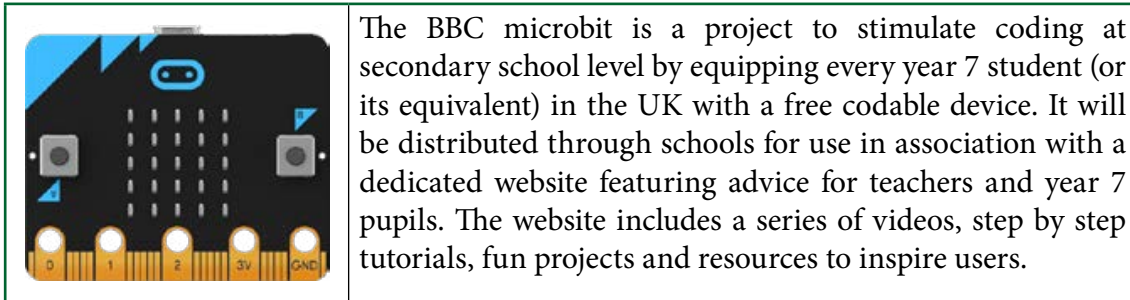
77. Outside the curriculum, informal learning is also being used by schools to increase digital skills. Coding clubs, such as Code Club, are typically free volunteer-led after-school networks, usually for children aged 9–11. Since 2012, there have been 4,900 Code Clubs registered in the UK, teaching over 57,000 children.¹⁴⁰ Their activities include making computer games, animations and websites. The BBC recently launched ‘micro:bit’—a collaboration between 29 partners to inspire digital creativity (Figure 1). This provides an excellent opportunity for Year 7 students to experiment with a pocket-sized codeable computer and develop skills in science, technology and engineering as well as digital creativity.¹⁴¹

139 Q134

140 [Code Club](#) (accessed April 2016)

141 [BBC micro:bit](#) (accessed April 2016)

Figure 1: micro:bit



Source: BBC

78. While coding clubs have been a success, their accessibility across schools around the country has been patchy, being dependent on commitment from teachers, parents and industry. Amy Solder from Nesta believed that while clubs were successful in getting both boys and girls interested in computing, there was a geographical divide. She told us that “areas that are more rural and less urban-centred have many fewer opportunities”.¹⁴²

79. There is also a big role for volunteers from industry in helping to support children, acting as role models. Amy Solder highlighted a techUK estimate that less than 1% of tech industry employees volunteer, and told us that “industry can probably play a greater role”.¹⁴³ TechUK have listed ‘making it easier for industry to volunteer’ as one of eleven key steps to meet the digital skills challenge.¹⁴⁴

80. While video games and gaming have often been perceived as a distraction from learning, they have recently been shown to have cognitive benefits such as improved perception, attention, memory and decision-making.¹⁴⁵ Educational video games can complement formal learning, increasing levels of literacy as well as teaching mathematics, biology and computer programming.¹⁴⁶ Research by BESA found that many schools see games consoles and smartphones playing an important role in primary school education.¹⁴⁷ Gaming has also helped to stimulate children’s interest in digital technology, with many children wanting to design and develop games themselves in after-school clubs.¹⁴⁸

81. Given the pace of technology change and the challenge it presents for teachers trying to keep up with it, it is right for schools to take up the opportunity to offer coding clubs.

82. We have been impressed by the range of innovative and exciting coding and computing clubs and resources offered by industry for schools. Given the pace of innovation, industry will in many cases be best placed to provide the technical underpinning of these initiatives. We believe therefore that it is only common sense that take-up of these clubs and resources should be the norm for schools rather than the exception. It is vital that the Government encourages industry to scale up its involvement in these initiatives, and schools to grasp the opportunities that become available.

142 Q106

143 Q113

144 TechUK, [We aren’t doing enough to meet the digital skills challenge](#), (10 July 2015), p 6

145 Massachusetts Institute of Technology, [Moving learning games forward](#) (2009)

146 Paul Howard-Jones – University of Bristol, [Toward a Science of Learning Games](#) (2011)

147 Teaching Times, [Games consoles benefit children’s education](#) (2014)

148 The Guardian, [Britain’s computer science courses failing to give workers digital skills](#) (January 2012)

83. *We recommend that the Government works with the Tech Partnership to raise the ambition for, and coverage of, industry-led digital training, and to make it easier for businesses of all sizes to get involved.*

Role models and diversity in STEM

84. Research by Nominet Trust has shown that parents' perception of IT can significantly influence a child's level of digital skills.¹⁴⁹ Parents who are familiar with IT and regularly use it are able to play a crucial role in their children's internet and IT use in a way that it does not distract from learning.¹⁵⁰ A proportion of parents are not aware of the range of career opportunities that exist in the IT industry, and encourage their children towards traditional careers.¹⁵¹ There is also a lack of home support for technology use among lower income families, where it is easier to purchase a tablet or smart phone than a functional computer, limiting a child's digital skills.¹⁵²

85. In a school setting, individual teachers' pedagogies can also have a significant impact on a pupil's level of attainment as well as stimulating interest in digital technology.¹⁵³ There has been an increased emphasis on teaching coding since the introduction of the computing curriculum. This can help develop problem-solving and logical thinking skills that can be used across a wide range of disciplines and careers.¹⁵⁴

86. There is continuing concern over the lack of diversity among computer science/IT graduates and in wider Science, Technology, Engineering and Maths (STEM) careers. Role models are an effective way of inspiring confidence to pursue a career path, but FDM Group highlighted that children and young people are more likely to identify with Bill Gates (Microsoft), Steve Jobs (Apple) and Mark Zuckerberg (Facebook) as technology role models than Baroness Lane-Fox, Sheryl Sandberg (CEO of Facebook) or Marissa Mayer (president and CEO of Yahoo).¹⁵⁵

87. Despite long standing campaigns from Government and industry, however, there remains a marked gender imbalance in those studying computing—only 16% of computer science students at school are female (compared with 42% who studied ICT) and this low level of representation persists through higher education and in the workplace.¹⁵⁶ A survey of more than 4,000 girls, young women, parents and teachers in 2015 showed that 60% of 12-year-old girls in the UK and Ireland thought that STEM subjects were too difficult to learn and nearly half thought that they were a better match for boys. Sheila Flavell from FDM Group told us that:

Computer Science is a turn off for girls [...] because it is deemed to be engineering; it is boring and techie, and in the main it is not for girls [...] 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.¹⁵⁷

149 Nominet Trust, [Mapping learner progression](#) (October 2014)

150 The Children's Partnership, [Empowering parents through technology](#) (October 2010)

151 Association of Colleges, [Careers guidance: guaranteed](#) (May 2014)

152 Brian Sharland ([DIG0038](#))

153 ICF Consulting Ltd for the Scottish Government, [Literature review on the impact of digital technology on learning and teaching](#) (November 2015)

154 STEMNET ([DIG0015](#))

155 Q107

156 Joint Council for Qualifications, [GCSE and Entry Level Certificate Results](#) (Summer 2015)

157 Q109

88. If students have such ill-founded misperceptions, they need to be tackled head on and as early as possible in their school years. Embedding science and digital skills in the wider curriculum must be part of the solution. Many witnesses emphasised the need to address the gender imbalance. Simon Humphreys from Computing at School told us that:

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 prepuberty are very important.¹⁵⁸

Although girls ranked parents and teachers as their biggest influencers when making a decision about study choices, 51% of parents felt that they were ill-informed on the benefits of STEM subjects and only 14% said they understood the different career opportunities that existed for their daughters.¹⁵⁹ There have been several initiatives to attract more girls to STEM such as STEMNET and Girls Can Code.¹⁶⁰

89. More young people—particularly girls—must be attracted to education and careers in computing. With only 16% of students studying computer science being female (paragraph 87), the UK is missing out on a large talent pool. *The Government needs to work with employers and educators to better understand and address why female students in schools, colleges and universities do not apply for digital courses and careers. However, the Government also needs to focus on other areas beyond gender—looking at other diverse backgrounds such as disability, ethnicity and disadvantaged socio-economic groups—so that children and young people can have a wide range of role models to inspire them to study and pursue careers in STEM.*

90. *Employers can also actively engage with schools, acting as role models and mentors. Interest in computer science (and STEM) needs to be captured at primary school level, then maintained until key career defining choices are made in selecting subjects at GCSE and A' level.*

158 Q104

159 Accenture, [Accenture Finds More Than Half of 12-Year-Old Girls in the UK and Ireland Believe STEM Subjects are Too Difficult to Learn](#) (September 2015)

160 [STEMNET](#) (accessed April 2016)

4 A strategy for digital skills

91. Following the previous Government's publication of its industrial strategy for the 'Information Economy' in 2013, it set up an Information Economy Council to take it forward, comprising Government, business and academia.¹⁶¹ The current Government has set up a Digital Engagement Council in its place "to drive further cross-sector activities and partnerships, and focus on segments of the population who will benefit most from increased digital capabilities".¹⁶² It has also been developing a 'Digital Strategy' during the course of our inquiry.

92. In its July 2015 response to the report of the Lords Select Committee on Digital Skills, the Government promised details on the Government's digital agenda in the autumn of 2015, and suggested that it would be produced alongside or soon after the 2015 Spending Review.¹⁶³ As we described in Chapter 1, Ed Vaizey told us in December 2015 that the Government's Digital Strategy would be published towards the end of January 2016,¹⁶⁴ and that the Government subsequently launched a consultation on 29 December, seeking views on four themes: "unlocking digital growth, transforming government, transforming day to day life and building foundations".¹⁶⁵

93. The minister told us in March 2016 that the Digital Strategy had "been written" and was awaiting a publication slot in the Downing Street 'grid'.¹⁶⁶ He told us that the Strategy would not have "any particular new funding attached" to it, and that the Strategy "is looking at the aspirations for the next 10 years".¹⁶⁷

94. On 'transforming government', one of the Government's intended themes for the Strategy, there is more to do. In our recent *Big data dilemma* report we highlighted that the Government's work in making its databases 'open' had "put the UK in a world-leading position", but also that "there is more to do to breakdown departmental data silos, to bring data together in order to further improve public services and data quality". We noted the "great strides" by the private sector in identifying opportunities for bringing different datasets together and that the Government's Digital Catapult had "a vitally important role in facilitating private sector data sharing in a 'safe', trusted environment".¹⁶⁸

95. There is also a lack of digital skills within the Civil Service. Dr Ellen Helsper of London School of Economics told us that "Government is one of the biggest employers in this country. It also has one of the biggest client bases in the country; Government services reach everybody [...] Leading by example should be a fundamental part of the Digital Strategy".¹⁶⁹ A National Audit Office survey in December 2015 found, however,

161 Department for Business, Innovation and Skills, *Information Economy Strategy* (June 2013)

162 Department for Culture, Media and Sport (DIG0060)

163 Department for Culture, *Media and Sport, The Government's response to the House of Lords Select Committee Report on Digital Skills* (July 2015)

164 Science and Technology Committee, *The big data dilemma, Fourth report of Session 2015–16*, Q248

165 Department for Culture, Media and Sport, *UK Digital Strategy – the next frontier in our digital revolution* (29 December 2015)

166 Q151

167 Q153

168 House of Commons Science & Technology Committee, *The big data dilemma – Fourth Report of Session 2015–16*, HC 468, paras 42, 56

169 Q37

there was “widespread acknowledgement of a digital skills gap [where] most organisations see digital and technology as mostly about IT”.¹⁷⁰ These differing views can underestimate the importance and value of digital skills.¹⁷¹

96. Many of our witnesses thought that the Government’s digital initiatives (paragraph 97) were too fragmented and called for a more cohesive approach. Currently, government ‘digital’ responsibilities sit in three departments: the Cabinet Office, DCMS and BIS. Ed Vaizey acknowledged the issue when he told us:

If you look across the silos of Government, there are two different joining-ups that need to take place. One is the link between BIS, DCMS and the Cabinet Office on the top-level digital stuff—digital in business, digital infrastructure and the tech investment environment—and the Government Digital Service, which is the Cabinet Office. Then there is the trickier task of the cross-Government departments. Education will have a big focus on digital learning; Health will have a big focus on how you make the health service more digital so that you can treat patients in the home; Transport will have a huge focus on digital both in terms of making the trains run better through to mobile on trains and driverless cars [...] and Energy in terms of smart meters. It is in almost any department. We need to think hard about how we join that up.

We have a Digital Taskforce that brings Ministers together to get the issues on the agenda and move it into the centre, if it needs a push, but we have to think about whether we need central; expertise that can help particular departments with specific digital projects that they may want to make happen. Should those be happening in separate silos?¹⁷²

97. But our inquiry has demonstrated the importance of a Digital Strategy that goes beyond improving skills in Government. Go ON UK believed that

there is a significant skills gap in the UK, from basic to advanced skills, that is unlikely to be closed based on Government’s current plans and ambitions. The skills gap represent a major risk to productivity and prosperity in the UK.¹⁷³

Helen Milner from the Tinder Foundation told us that

I do not think that the Government ever articulated what they think the goal is [...] There should be much more clarity about it not just being a good thing, but actually something that the Government significantly believe in.¹⁷⁴

98. Ecorys UK Ltd, who undertook research for BIS and DCMS on the current and future demand for digital skills in the UK economy, made four key recommendations in January 2016:

- Government should provide leadership, coordination and key resources in establishing the conditions for digital skills development;

170 National Audit Office, [The digital skills gap in government](#) (December 2015)

171 Ibid

172 Q155

173 Go ON UK ([DIG0054](#))

174 Q21

- Employers should take ownership of digital skills development;
- The education sector should develop and adapt their efforts to meet the changing needs of the digital economy, working with policy and funding frameworks established by the government departments—Business, Innovation and Skills, Education and Culture, Media and Sport;
- Local and regional government agencies should address the digital skills needs of their local areas.¹⁷⁵

Go ON UK put forward their preferences for the content of the forthcoming Digital Strategy:

We need a much more joined-up and co-ordinated approach to skills at all levels. There needs to be more investment in skills programmes at all levels, but there is not a one-size fits-all solution. We need to test and learn some different approaches and identify the four or five key approaches that we can scale up across the UK to help that broad range of individuals to gain the skills they need.¹⁷⁶

Nick Williams from Lloyds Banking Group warned that:

What we do not need is a competing, conflicting Digital Strategy that consumes resources and does not deliver the existing objectives of the Government. I would encourage us to think how our Digital Strategy can underpin and deliver today's existing objectives, and even accelerate some of them. I would use it as an enabler for the Government to deliver their existing plan rather than creating something in isolation that will be prioritised against other objectives at the same time.¹⁷⁷

Margaret Sambell from the Tech Partnership told us that “employers very much hope that the Digital Strategy will encompass the gamut of the skills base that the country need to be competitive in a digital world.”¹⁷⁸

99. We found that the digital skills crisis was present in all stages of the education and training pipeline. The publication of the Digital Strategy, and formulation of a coherent cross-Government policy, is thus long overdue. We cannot understand why the Government has put off publishing the Digital Strategy—15 months after the Lords Digital Skills Committee's call for a 'digital agenda'—even though it has apparently been written for some months.

100. *Given the significance of the digital agenda for UK plc and to ensure that the Strategy has sufficient weight in Government, and its cross-departmental elements are appropriately joined up, we recommend that the Digital Economy Minister attend Cabinet and a Minister in each relevant department be identified as responsible for delivery of the Government's digital agenda.*

¹⁷⁵ Department for Business, Innovation & Skills and Department for Culture, Media & Sport, [Digital Skills for the UK economy](#) (January 2016)

¹⁷⁶ Q137

¹⁷⁷ Q34

¹⁷⁸ Q5

101. The gap between the digital skills that children and young people take into their working lives and the skills actually needed by the digital economy demonstrate that the problem is more than simply demand outstripping supply. It indicates that the UK's approach to developing digital skills—although on the right track with a reformed school curriculum for computing, digital degree apprenticeships, and the Tech Partnership coordinating industry response—is still suffering the effects of long term historic weaknesses.

102. The forthcoming Digital Strategy therefore needs to be more than just a catalogue of initiatives. It needs also to be more than just a programme of work for Government departments. We need to change the UK's cultural perception of digital technology. By setting out a vision for the future, to be delivered by collaborative work between industry, educators and Government, the Strategy should be more than “aspirational”—a Strategy that actually delivers.

103. *The Digital Strategy should be published without further delay. It should include benchmarks and defined outcomes that are necessary to measure levels of success and decide on next steps. There should be goals for developing better basic digital skills, for increasing the number and diversity of students studying computer science, for increasing digital apprenticeships and for fostering digital champions, a plan for greater awareness of business-led initiatives, and a framework through which the private sector could more readily play a collaborative role with communities and local authorities in initiatives to raise digital skills in local SMEs.*

Conclusions and recommendations

1. Digital exclusion has no place in 21st Century Britain. While the Government is to be commended for the actions taken so far to tackle aspects of the digital skills crisis, stubborn digital exclusion and systemic problems with digital education and training need to be addressed as a matter of urgency in the Government's forthcoming Digital Strategy. In this report, we address the key areas which we believe the Digital Strategy must deliver to achieve the step change necessary to halt the digital skills crisis and bring an end to digital exclusion once and for all. (Paragraph 15)

Digital Skills and business

2. As digital skills increasingly become the foundation of a competitive economy, businesses need to invest in digital training to increase productivity and stimulate innovation, or we risk the UK being left behind. The rapid pace of digital transformation is changing the nature of the UK workplace. We must equip the next generation not just with the skills that we know industry needs today but also with the skills they will need for a future not yet imagined. (Paragraph 26)
3. The Government's new computing curriculum ... is world leading and, properly taught, has the capacity to transform the digital skills potential of the next generation. It will however take time to impact the workplace. *To address immediate gaps, therefore, the Government should put in place coherent strategies to address the shortage of skills of particular strategic importance to the UK economy—including cyber-security, big data, the Internet of Things, mobile technology and e-commerce—and how these capabilities should be introduced in workforce training.* (Paragraph 27)
4. The imperative for businesses to develop the digital skills of their employees is now a matter of survival. *In order to maximise the opportunities that the digital economy presents, the Government should set out in its forthcoming Digital Strategy a plan for working with businesses to share best practice of, and scale up, existing business-led initiatives to upskill both employees and customers. These plans should include a framework through which the private sector could collaborate with communities and local authorities to raise digital skills in local SMEs and the wider community.* (Paragraph 28)
5. *In its forthcoming Digital Strategy, the Government needs to establish an effective pipeline of individuals with specialist skills in data science, coding and a broader scientific workforce that is equipped with a firm grounding in mathematics, data analysis and computing. The Strategy should commit the Government to annual dynamic mapping of public sector and industry initiatives and public spending on digital skills against the economic demand for those skills. This would help it assess the effectiveness of measures that are already in place in addressing the digital skills crisis, and create a long term mechanism for investment in and adjustment of the Digital Strategy to maximise its effectiveness.* (Paragraph 29)
6. SMEs and start-ups are the wealth creators in the UK and should not be obstructed from hiring the talent they need to become more productive. *The Government*

should review the qualifying requirements for the new IT roles added to the Tier 2 visa 'shortage occupation list', making it easier and more flexible for SMEs and start-ups to recruit top talent from outside the EU. (Paragraph 30)

7. Digital Champions are a useful lever to engage with those who are hardest to reach—those with low digital skills which makes them more receptive to face-to-face support. *The Government should step up its Digital Friends initiatives to go beyond its cross-government approach by extending it widely across the public sector. (Paragraph 33)*
8. *The Government should take into account the recommendations from both the Shadbolt and Wakeham Reviews in the forthcoming Digital Strategy to help deliver the required supply of digital skills for the UK economy. With the opportunity now afforded by the delay in publishing the Digital Strategy, the reviews should be fully embedded in the Strategy. (Paragraph 42)*
9. *The Strategy should also include a commitment for the Government to work with the Tech Partnership to develop industry-led, vocationally focussed careers advice in universities that prepares the future workforce for the growth in digital. (Paragraph 43)*
10. *The Government should encourage universities to provide 'code conversion courses' to help graduates from non-computer science backgrounds to enter the tech sector with a recognised qualification. (Paragraph 44)*
11. *We recommend that the Government clarify the full extent of ELQ exemptions for STEM subjects as a matter of urgency. These exemptions should include STEM conversion courses and Digital and STEM Apprenticeships ... to encourage the use of the Apprenticeship Levy to upskill the existing workforce. (Paragraph 45)*
12. The Government has promoted vocational skills as an equal-value alternative route for individuals and businesses in developing specialist digital skills. Apprenticeships are critical in ensuring the long-term future of the UK's digital economy. They are now available up to degree level and offer flexibility for young people to learn work skills while they study and for the established workforce to gain valuable new skills. We welcome the establishment of the industry-led Institute for Apprenticeships. *In the period until it is operational in April 2017, the Government needs to work closely with employers, higher education institutions and schools to understand the apprenticeship marketplace, to ensure that education aligns with industry's requirements needs, and that apprenticeships are delivered in a flexible way to adjust to future changes in the digital sector. (Paragraph 54)*
13. *The Government should emphasise the need for more digital skills components in all apprenticeships, not just 'digital apprenticeships', to gear them to the needs for jobs across the economy. The Government should make digital skills the focus of its 3 million apprenticeship target. It should also work closely with industry, to encourage more women to pursue apprenticeships in the tech industry. (Paragraph 55)*
14. The standards for the Government's 'Trailblazer' industry-led apprenticeships reflect closely the input from larger businesses but, as a result, some SMEs may be unable to take advantage of the opportunities offered. *The Government should review its Trailblazer initiative, making it more streamlined and accessible*

for SMEs. The Government should examine the scope for simplifying the scheme's processes, to encourage business in the technology sector, especially SMEs, to invest in apprenticeships. (Paragraph 56)

15. *The Government must also make it easier for industry to partner with universities and colleges to support student teaching. Industry, universities and schools should also collaborate in promoting work placements in an open and transparent way. This will make it easier for all students to have the opportunity to experience a 'taster' of the industry that may well lead to permanent employment. One way of facilitating such partnerships and collaborations for businesses would be to allow the cost to be written off against Apprenticeship Levy contributions. (Paragraph 57)*
16. *The Government should work with the Further Education sector to develop 'Digital Colleges' to replicate the National College for Digital Skills model across the country. (Paragraph 58)*

Digital skills in schools

17. *The Government has set targets for recruiting teachers in Maths and Physics. They should also make a similar pledge for Computer Science. This would demonstrate a commitment to equip our future generation with the tools and resources to navigate the digital world, and provide a means of monitoring progress. (Paragraph 62)*
18. *Every student must have access to education that enables them to participate in the growing digital economy. The Government deserves credit for its leadership in introducing the computing curriculum but there is still some way to go for it to become truly embedded in all schools, let alone delivered to a consistently high standard. Given that digital skills are of the highest priority to the future of the UK economy and the future chances of young people, we find it surprising that computing is not explicitly considered in Ofsted's schools inspection framework. We recommend that the Government request Ofsted to include the computing curriculum in their inspections and require schools to deliver credible, sustainable plans for embedding computing. (Paragraph 67)*
19. *The Government should encourage the uptake of existing available resources by schools, many of which are free. Learning from the success of existing teacher support initiatives like The Big Write, and working closely with academia and industry, the Government should consider whether developing a similar model for computing will also help address gaps in IT resources. (Paragraph 68)*
20. *Furthermore, to ensure digital education in schools continues to keep pace with business needs in an evolving tech environment, we recommend that the Government work with the Tech Partnership to establish a regular forum for employers to raise and discuss their priorities for ensuring the computing curriculum and its teaching stay up to date, and to help ensure that other school subject qualifications provide a foundation for a broader range of digital careers. This forum—which could be attached to the minister-chaired Digital Engagement Council—would also be a springboard for ambitious expansion of industry support to schools, going beyond code clubs (discussed below) to include careers advice, Apprenticeship schemes and work placement programmes (paragraphs 46–53). (Paragraph 69)*

21. Given the pace of technological advances, it will always be a challenge for schools to keep up with the latest innovations. As digital skills are increasingly becoming essential for industrial sectors, schools will need to invest in offering high quality computer science courses and upskilling teachers so that digital skills can become more mainstream rather than as a standalone subject. The Government seems to treat computer science as a separate subject rather than a mechanism to enhance learning across other subject disciplines. ICT teachers are now expected to teach the new computing curriculum, but too many do not have the qualifications or the confidence to teach computer science. The Government and industry deserve credit for efforts so far to embed the computing curriculum, including in the provision of free resources and training. However, it is clear that greater investment is necessary to address the teaching skills gap. *We therefore recommend that the Government increase its investment in teacher training as a long term commitment and request that, as part of its monitoring of the delivery of the computing curriculum, Ofsted take into account the uptake of free resources and training.* (Paragraph 74)
22. The Digital skills crisis includes not only shortages of key digital skills in the economy but also a shortage of qualified, confident ICT teachers. *We commend Teach First and the Master Teachers initiative but, given the rate of loss to a highly attractive private sector, we believe that the ICT streams of these programmes should be scaled up to have any hope of delivering the sheer number of teachers needed for the long term health of UK digital education.* (Paragraph 75)
23. So far financial incentives have not attracted sufficient computer science teachers to the profession. *In its forthcoming Digital Strategy, the Government should review the case for financial incentives for recruiting and retaining computer science teachers in schools, mindful of the higher pay remuneration available in the private sector. As an interim solution to recruitment shortfalls, the Government should consider categorising computer science teachers as one of the 'shortage occupations', thereby making it easier for schools or local authorities to recruit from outside the EU.* (Paragraph 76)
24. We have been impressed by the range of innovative and exciting coding and computing clubs and resources offered by industry for schools. Given the pace of innovation, industry will in many cases be best placed to provide the technical underpinning of these initiatives. We believe therefore that it is only common sense that take-up of these clubs and resources should be the norm for schools rather than the exception. *It is vital that the Government encourages industry to scale up its involvement in these initiatives, and schools to grasp the opportunities that become available.* (Paragraph 82)
25. *We recommend that the Government works with the Tech Partnership to raise the ambition for, and coverage of, industry-led digital training, and to make it easier for businesses of all sizes to get involved.* (Paragraph 83)
26. More young people—particularly girls—must be attracted to education and careers in computing. With only 16% of students studying computer science being female, the UK is missing out on a large talent pool. *The Government needs to work with employers and educators to better understand and address why female students in schools, colleges and universities do not apply for digital courses and careers. However,*

the Government also needs to focus on other areas beyond gender—looking at other diverse backgrounds such as disability, ethnicity and disadvantaged socio-economic groups—so that children and young people can have a wide range of role models to inspire them to study and pursue careers in STEM. (Paragraph 89)

27. *Employers can also actively engage with schools, acting as role models and mentors. Interest in computer science (and STEM) needs to be captured at primary school level, then maintained until key career defining choices are made in selecting subjects at GCSE and A' level. (Paragraph 90)*

A strategy for digital skills

28. We found that the digital skills crisis was present in all stages of the education and training pipeline. The publication of the Digital Strategy, and formulation of a coherent cross-Government policy, is thus long overdue. We cannot understand why the Government has put off publishing the Digital Strategy—15 months after the Lords Digital Skills Committee's call for a 'digital agenda'—even though it has apparently been written for some months. (Paragraph 99)
29. *Given the significance of the digital agenda for UK plc and to ensure that the Strategy has sufficient weight in Government, and its cross-departmental elements are appropriately joined up, we recommend that the Digital Economy Minister attend Cabinet and a Minister in each relevant department be identified as responsible for delivery of the Government's digital agenda. (Paragraph 100)*
30. The gap between the digital skills that children and young people take into their working lives and the skills actually needed by the digital economy demonstrate that the problem is more than simply demand outstripping supply. It indicates that the UK's approach to developing digital skills—although on the right track with a reformed school curriculum for computing, digital degree apprenticeships, and the Tech Partnership coordinating industry response—is still suffering the effects of long term historic weaknesses. (Paragraph 101)
31. The forthcoming Digital Strategy therefore needs to be more than just a catalogue of initiatives. It needs also to be more than just a programme of work for Government departments. We need to change the UK's cultural perception of digital technology. By setting out a vision for the future, to be delivered by collaborative work between industry, educators and Government, the Strategy should be more than "aspirational"—a Strategy that actually delivers. (Paragraph 102)
32. *The Digital Strategy should be published without further delay. It should include benchmarks and defined outcomes that are necessary to measure levels of success and decide on next steps. There should be goals for developing better basic digital skills, for increasing the number and diversity of students studying computer science, for increasing digital apprenticeships and for fostering digital champions, a plan for greater awareness of business-led initiatives, and a framework through which the private sector could more readily play a collaborative role with communities and local authorities in initiatives to raise digital skills in local SMEs. (Paragraph 103)*

Annex: Google Garage

As part of our inquiry, Google extended an invitation for us to visit their Digital Garage at Manchester Central Library to see first-hand what work industry are doing to provide training and support to individuals and businesses with digital skills. We visited on Thursday 3 March.

Google operates the Digital Garage and Digital Garage Online Academy for small businesses in the UK. This is part of their initiative to train up to 200,000 businesses in digital skills by the end of 2016. Their programme provides free face-to-face training and tutorials in digital skills such as website creation, web analytics and social media to small businesses, entrepreneurs, students and the voluntary sector, helping to improve their digital ways of working.

The Digital Garage opened in Manchester on 1 December 2015 and provided free seminar training and one to one mentoring sessions in digital skills to small businesses and individuals in the Greater Manchester area. Regular seminars were held at Manchester Central Library and staff were available for one to one bespoke mentoring. The Digital Garage team had also visited neighbouring towns, including Bolton, Chorlton and Didsbury. Nearly 2,000 people had received training in Manchester. As the digital garage moved from town to town, the Manchester Digital Garage closed on 31 March 2016.

The Digital Garage in Manchester was part of a national commitment to train small businesses in the digital skills they need to succeed. The Digital Garage initiative has so far helped train over 21,000 people both in physical digital garages in Leeds, Birmingham and Manchester, but has also toured Belford, Caerphilly and Cheltenham, as well as running an online academy. Google works with local and national partners to deliver this programme. National partners include Department for Business, Innovation and Skills and charitable organisations such as Code Club, MediaTrust, Raspberry Pi and Technology Trust.

During our visit, we were able to witness first hand, digital skills training in the community. We also met with representatives from Hive Manchester and Code Club North West to discuss the digital skills agenda. We discussed the value of computational thinking and collaborative working where the new computing curriculum could be applied to other subject areas and projects. Hive Manchester and Code Club provided us with background on the work that they do, linking informal learning approaches through the use of clubs and competitions to stimulate children's interest in computing.

Through the Digital Garage project, Google has funded Code Club Pro to train 200 hundred teachers to teach the new primary curriculum in computing and Raspberry Pi to train a further 750 teachers across the country through 'Picademies' aimed at pupils studying computing at Key Stages 3 and 4.

We also attended a training session, "Reach new customers online", delivered by Google's Manchester Digital Garage. Over 40 people attended the session, which includes advice on Search Engine Optimisation, using social media effectively and analysing online activity. We heard from participants including a manager of a small marketing agency, a cleaning business owner who receives a third of business online and wanted to expand further, an

amateur artist who had recently been made redundant and was keen to turn her interest into a revenue stream, and a new entrepreneur who was just starting a clothing business and wanted initial advice.

People who attended the session had heard about it from a variety of sources: through media stories, personal referrals, from the Library directly and referred by their job centre advisor. Research conducted by the IPPR North in November 2015, found that after training and support at the Digital Garage:

- 88% of participants had made changes to the way they run businesses online;
- 27% had seen more sales or bookings;
- 32% had seen an increase in customer numbers;
- 49% had seen an increase in website visitor numbers; and
- 9% had hired additional staff to manage their digital work¹⁷⁹.

We would like to thank the staff at Digital Garage Manchester for accommodating our fact-finding visit as part of our inquiry.

Formal Minutes

Tuesday 7 June 2016

Members present:

Nicola Blackwood, in the Chair

Victoria Borwick	Dr Tania Mathias
Stella Creasy	Carol Monaghan
Jim Dowd	Graham Stringer
Chris Green	Matt Warman

Draft Report (*Digital skills crisis*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 103 read and agreed to.

Summary and Annex agreed to.

Resolved, That the Report be the Second Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

[Adjourned till Tuesday 14 June at 9.00 am

Witnesses

The following witnesses gave evidence. Transcripts can be viewed on the [inquiry publications page](#) of the Committee's website.

Tuesday 12 January 2016

Question number

Nick Williams, Consumer Digital Director, Lloyds Banking Group, **Helen Milner OBE**, Chief Executive, Tinder Foundation, and **Margaret Sambell**, Director of Strategy, The Tech Partnership

[Q1–34](#)

Steven Roberts, Strategic Transformation Director, Barclays plc, **Dr Ellen Helsper**, Director of Graduate Studies, Media and Communications Department, London School of Economics and Political Science, and **Charlotte Holloway**, Head of Policy and Associate Director, techUK

[Q35–68](#)

Tuesday 26 January 2016

Peter Gaynard, 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

[Q69–95](#)

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

[Q96–134](#)

Tuesday 8 March 2016

Rachel Neaman, Chief Executive, Go ON UK, and **James Thickett**, Director of Market Developments, Ofcom

[Q135–150](#)

Mr Edward Vaizey MP, Minister of State for Culture and the Digital Economy, Department for Culture, Media and Sport, and the Department for Business, Innovation and Skills, and **Nick Gibb MP**, Minister of State for Schools, Department for Education

[Q151–175](#)

Published written evidence

The following written evidence was received and can be viewed on the [inquiry publications page](#) of the Committee's website.

DIG numbers are generated by the evidence processing system and so may not be complete.

- 1 Apps for Good ([DIG0046](#))
- 2 Aviva Plc ([DIG0020](#))
- 3 Barclays ([DIG0055](#))
- 4 BBC ([DIG0009](#))
- 5 BCS - Chartered Institute for IT ([DIG0064](#))
- 6 BCS - The Chartered Institute for IT ([DIG0001](#))
- 7 Birkbeck, University of London ([DIG0075](#))
- 8 BT ([DIG0037](#))
- 9 Caroline Chisholm School ([DIG0026](#))
- 10 CCITE ([DIG0076](#))
- 11 Chartered Institute of Library and Information Professionals ([DIG0017](#))
- 12 Cifas ([DIG0045](#))
- 13 City & Guilds ([DIG0027](#))
- 14 City of London Corporation ([DIG0013](#))
- 15 Communications Consumer Panel and ACOD ([DIG0057](#))
- 16 CompTIA ([DIG0024](#))
- 17 defenddigitalme ([DIG0061](#))
- 18 Department for Culture, Media and Sport ([DIG0060](#))
- 19 Dr Ansgar Koene ([DIG0029](#))
- 20 EMC ([DIG0042](#))
- 21 FDM Group ([DIG0005](#))
- 22 Federation of Small Businesses (FSB) ([DIG0011](#))
- 23 Food Standards Agency ([DIG0044](#))
- 24 Fujitsu ([DIG0006](#))
- 25 Go ON UK ([DIG0054](#))
- 26 Google ([DIG0053](#))
- 27 Greater London Authority ([DIG0051](#))
- 28 Hewlett Packard Enterprise ([DIG0031](#))
- 29 HP Inc UK Limited ([DIG0059](#))
- 30 Lloyds Banking Group ([DIG0063](#))
- 31 Met Office ([DIG0022](#))
- 32 Microsoft ([DIG0018](#))
- 33 Miss Leanne Forbes ([DIG0079](#))

- 34 Mr Aleks Lukic ([DIG0068](#))
- 35 Mr Alex Melhuish ([DIG0070](#))
- 36 Mr Brian Sharland ([DIG0038](#))
- 37 Mr Byron Calderwood ([DIG0039](#))
- 38 Mr Daniel Phelan ([DIG0071](#))
- 39 Mr Harvy Tamber ([DIG0073](#))
- 40 Mr Kevin Drumm ([DIG0066](#))
- 41 Mrs Jane Broxton ([DIG0072](#))
- 42 Mrs Kay Sawbridge ([DIG0067](#))
- 43 Mrs Kay Sawbridge ([DIG0077](#))
- 44 Mrs Lucy Cripps ([DIG0065](#))
- 45 Mrs Maria Tilley ([DIG0069](#))
- 46 Mrs Roberts ([DIG0074](#))
- 47 NCC Group plc ([DIG0025](#))
- 48 Nesta ([DIG0048](#))
- 49 Ofcom ([DIG0050](#))
- 50 Paul Long ([DIG0035](#))
- 51 Philip Virgo ([DIG0036](#))
- 52 Remploy ([DIG0032](#))
- 53 Research Councils UK ([DIG0019](#))
- 54 Samsung ([DIG0007](#))
- 55 Shropshire Council ([DIG0012](#))
- 56 Sky ([DIG0028](#))
- 57 STEMNET (Science, Engineering, Technology, Mathematics Network) ([DIG0015](#))
- 58 Sunderland Software City ([DIG0033](#))
- 59 Tata Consultancy Services ([DIG0016](#))
- 60 techUK ([DIG0041](#))
- 61 Terry Greer ([DIG0003](#))
- 62 The Open University ([DIG0056](#))
- 63 The Publishers Association ([DIG0047](#))
- 64 The Royal Society ([DIG0014](#))
- 65 The Royal Society of Edinburgh ([DIG0010](#))
- 66 The Tech Partnership ([DIG0040](#))
- 67 Tinder Foundation ([DIG0008](#))
- 68 UK Forum for Computing Education ([DIG0052](#))
- 69 University of Leicester ([DIG0043](#))
- 70 Wellcome Trust ([DIG0004](#))

List of Reports from the Committee during the current Parliament

All publications from the Committee are available on the [publications page](#) of the Committee's website.

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2016–17

First Report	EU regulation of the life sciences	HC 158
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Session 2015–16

First Report	The science budget	HC 340 (HC 729)
Second Report	Science in emergencies: UK lessons from Ebola	HC 469
Third Report	Investigatory Powers Bill: technology issues	HC 573
Fourth Report	The big data dilemma	HC 468 (HC 992)
First Special Report	Royal Botanic Gardens, Kew: Government Response to the Committee's Seventh Report of Session 2014–15	HC 454
Second Special Report	Current and future uses of biometric data and technologies: Government Response to the Committee's Sixth Report of Session 2014–15	HC 455
Third Special Report	Advanced genetic techniques for crop improvement: regulation, risk and precaution: Government Response to the Committee's Fifth Report of Session 2014–15	HC 519
Fourth Special Report	The science budget: Government Response to the Committee's First Report of Session 2015–16	HC 729
Fifth Special Report	The big data dilemma: Government Response to the Committee's Fourth Report of Session 2015–16	HC 992