BCS, The Chartered Institute for IT Call for Evidence Submission: House of Lords Committee on Education for 11-16-year-olds.

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Introduction

This is the BCS submission to the House of Lords Committee on Education for 11-16-year-olds, a parliamentary select committee chaired by Lord Johnson of Marylebone. The Committee is conducting an inquiry examining education for the 11-16 age range, with reference to the skills necessary for the digital and green economy. This document covers our additional responses to questions asked during our oral evidence to the committee on April 27, 2023.

Executive Summary

1. The 11-16 curriculum for computing needs to address the complementary needs of three groups:
   - Future specialist computing professionals, who will create new digital products and services.
   - Future professionals in other fields, understanding how to use digital technology in their sectors.
   - Digitally literate citizens with the knowledge and skills to use digital tools and expect and drive the creation and innovation of high quality, ethical and effective digital products, and services.

At Key Stage 4, the needs of all three groups are not addressed coherently. No single GCSE spans the full range of computing, leaving it as the only subject whose GCSE offer does not cover its own national curriculum. Three-quarters of mainstream state-funded pupils leave school without a qualification in IT skills or computing, having ended their studies at age 14, and the curriculum for 11–14-year-olds is distorted by

the need to prepare a small number for a specialist route. [1]

2. Students interested in specialising can take GCSE Computer Science. However, there are no qualifications meeting the needs of potential professionals in other fields and no generally available qualification in digital literacy. Alongside improvements to the current GCSE in Computer Science, we need:
   - A qualification (or choice of qualifications) that recognises higher-level technical knowledge and skills at the GCSE level – valued equally to the CS GCSE. Parents support this, according to BCS research[2] .
   - A digitally enabled portfolio-based assessment of all young people's digital literacy.
3. GCSE Computer Science is abstract and demanding, emphasising recall rather than application. Teachers and students believe that getting a good grade is harder than in other subjects, making the GCSE unattractive for school leaders. The GCSE should be reformed with a greater focus on the applications. Only 13% of the cohort take the GCSE; approximately 3% of all girls. This is far short of a robust pipeline of future specialists. [3]
4. Computer Science sits with the compulsory natural sciences in the EBacc, so Computer Science tends to be offered in the more general subject option. Creating a broader science and technology 'bucket' within the EBacc would go some way to addressing this issue, as would the approach taken in Wales.
5. The most authentic way to assess the practical application of their knowledge and skills is through extended project work. We encourage awarding bodies and others to explore how technology can be used to manage practical work over longer periods to ensure its provenance.
6. Schools struggle to recruit computing specialists, creating a tension between providing computing for all and the specialist route. Shortages in England create significant variation in students' access to the GCSE. In 2020-21, 72.6% of Comprehensive schools offered it, compared with 92.6% of grammar schools. Under 75% of the recruitment target for initial teacher training has been met in the past five years. [4] Schools cannot compete with salaries in other sectors, so a traditional view of recruitment will not work. We propose exploring 'braided' careers, training non-specialists, at scale centralised virtual specialist provision, and promoting the intrinsic rewards of teaching computing.
7. Advances in digital technology and increasing adoption across the economy and society only reinforce the need for computing for all. Computing will continue to develop, as will the knowledge and skills it demands. We need to consider a more agile approach to developing qualifications and curriculum because of the speed of digitisation.

1. Our Mission

1.1. BCS is the professional body for computing dedicated to making the entire digital society and economy work for everyone. We focus on skills and capabilities, aiming to build a virtuous circle between three groups to drive ethical digital innovation and adoption to meet the needs of individuals, society, and the economy.

1.2. These groups are:

- **Specialist computing professionals:** there is a need for a large, diverse talent pipeline to enter the workforce as researchers and creators of future products and services. The school system provides the only mechanism at scale to ensure the necessary supply of digital talent.

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[1] https://www.bcs.org/about-us/bcs-academy-of-computing/the-roehampton-annual-computing-education-report/

[2] A YouGov survey commissioned by BCS in February 2022 found that nearly all parents (96%) said learning computing and IT skills at school was important, and the majority (80%) also agreed young people should not leave secondary education without a qualification in IT skills or computing. Almost three quarters (74%) of those parents said they supported the introduction of a broader IT Skills GCSE. These figures are published for the first time in this submission.

[3] BCS Landscape review: https://www.bcs.org/policy-and-influence/education/bcs-landscape-review-computing-qualifications-in-the-uk/

[4] New DfE ITT figures show cause for concern - NFER

- **Professionals in other fields:** capable of making the most of current and future digital products and services; for instance, understanding the opportunities, risks, and management of Artificial Intelligence in their sector.
- **Digitally literate [5] citizens:** who can engage, participate, and function in a society where IT skills are increasingly required to carry out high-stakes tasks such as applying for benefits, jobs, and bank accounts through to registering to vote. They should also understand the ethical implications of how technology, and their data, are used. All young people should leave school with the digital skills to participate as informed, effective users of digital technology.

1.3. While these groups have differing needs, all need an understanding at an appropriate level of how digital systems work.

2. The school curriculum

2.1. We have a lot to be proud of. The National Curriculum for computing, introduced in 2014, sets out an entitlement for every learner to access a high-quality computing education. It can equip pupils to use computational thinking and creativity to understand and change the world. However, the programme of study is a short document compared to other subjects. There is an overemphasis on the newer computer science content at the expense of IT and Digital Literacy. At Key Stage 4, the needs of all three groups identified above are not addressed coherently.

2.2. Consequently, most students do not pursue a deeper understanding of computing or tech beyond the age of fourteen, with most girls opting out altogether. That is despite our school system and curriculum being open and inclusive, and digital skills being increasingly vital in all jobs and for participation in society itself.

2.3. Computing is also shaping every other subject in the curriculum. Brilliant and passionate teachers use technology to deepen their students' understanding and engagement. Pupils also learn how geographers, biologists, historians, and sports coaches leverage digital technologies and computer science in their professions. The current National Curriculum and assessment framework does not reflect this.

Responses to specific questions:

Question 1: Do the 11-16 curriculum and the qualifications available in this phase sufficiently value your subject and effectively balance knowledge acquisition and practical application?

2.4. While employers and parents recognise the importance of computing[6], the 11-16 curriculum and its qualifications are not fully meeting the needs of any of the three groups. No single GCSE spans the full range of computing to provide a foundation in computer science, IT, and digital literacy, leaving computing as the only subject whose GCSE offer does not cover its own national curriculum.

2.5. Students interested in the specialist route can opt to take GCSE Computer Science or one of a handful of Technical Awards with titles like "Digital Technologies". However, only 80,000 students take the GCSE, about one-third the entries of GCSE Geography for example. That is about 13% of the cohort and approximately 3% of all girls, significantly fewer than needed to provide a robust pipeline of future specialists.[7]

2.6. A YouGov survey commissioned by BCS in February 2022 found that nearly all parents (96%) said learning computing and IT skills at school was important, the majority (80%) also agreed young

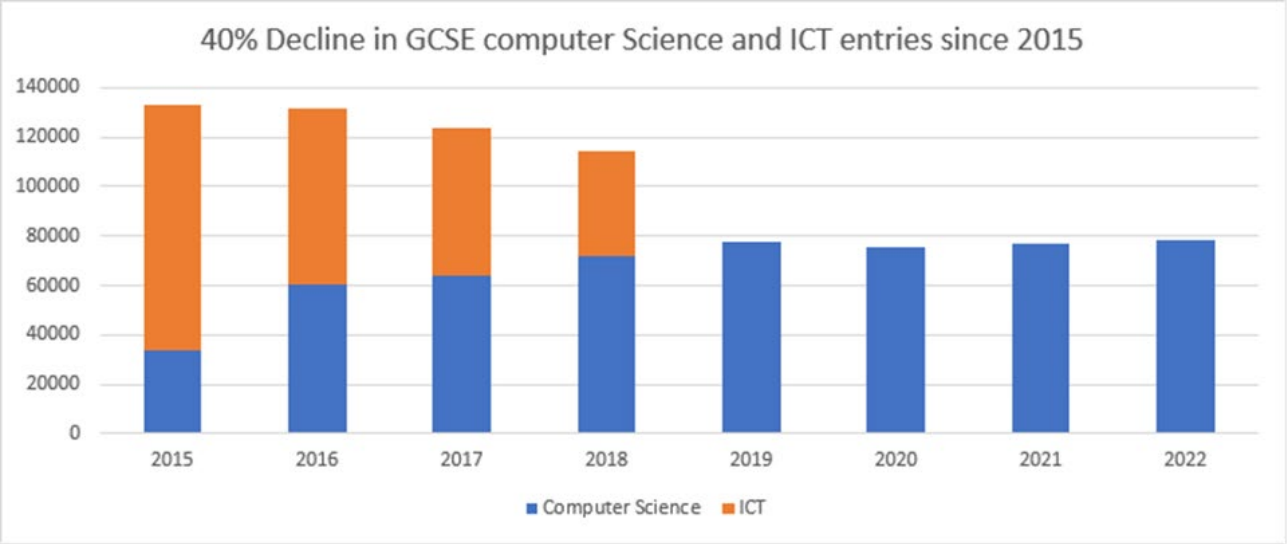
[5] BCS defines Digital Literacy as the knowledge, skills and behaviours needed to:
- make confident, creative, and effective use of digital technologies and systems, and
- make well-informed critical judgements about the implications and impact of how digital technology is used.

[6] https://www.worldskillsuk.org/news/new-research-highlights-uk-digital-skills-gap/

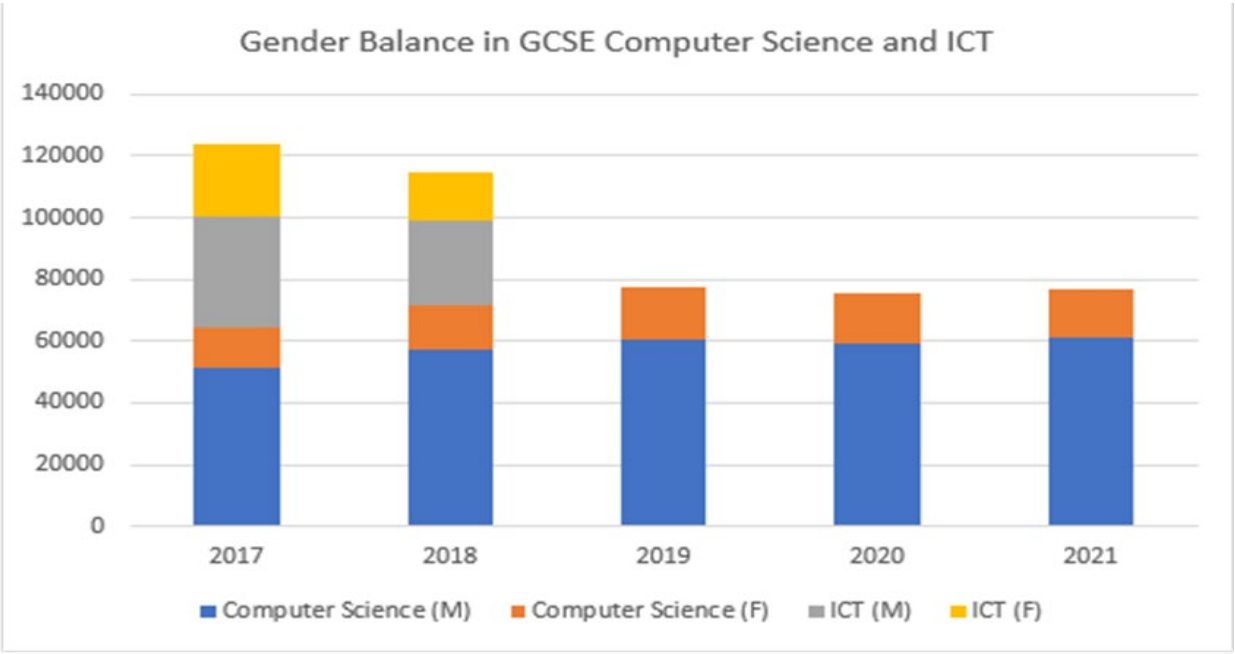
[7] https://www.bcs.org/policy-and-influence/education/bcs-landscape-review-computing-qualifications-in-the-uk/

people should not leave secondary education without a qualification in IT skills or computing. However:

- there are no qualifications, such as an applied GCSE in computing, which address the needs of potential professionals in other fields, and we are inconsistent about how digital impacts other disciplines.
- there is no generally available qualification in digital literacy. Given the importance of digital literacy to further study and employment, this contrasts with the other core skills of numeracy and literacy- with qualifications taken by all Key Stage 4 students. As a result, schools do not prioritise digital literacy and employers lack crucial information about potential employees' capabilities. Approximately three-quarters of mainstream state-funded pupils leave school, aged sixteen, without a qualification in IT skills or computing. They ended their studies at age 14, and the curriculum for 11–14-year-olds is distorted by the need to prepare a small number for a specialist route. (See table below from Data in the BCS Landscape Review.)



2.7. 9 in 10 girls leave school without IT skills or a computing qualification and girls are underrepresented in general and vocational qualification entries. Given the need to make computing, and STEM subjects in general more diverse[8] across the economy, this is a significant issue. (See table below from BCS Landscape Review)



2.8.

[8] https://publications.parliament.uk/pa/cm5803/cmselect/cmsctech/95/summary.html

2.9. The BCS School Curriculum and Assessment Committee's view is that the current GCSE offering is abstract and demanding[9], emphasising the recall of subject knowledge rather than the application of that knowledge to solve meaningful problems. This does not reflect young people's lived experience of computing, is shaped by digital technology, and fails to make the links between computing and the opportunities and challenges that engage them.

2.10. Qualifications drive the curriculum and current qualifications over-emphasise recall of knowledge at the expense of assessing what you can do with your knowledge. Teachers of well-established STEM subjects can compensate for this by making the connections between their discipline and its application. The Computer Science GCSE is often taught by non-specialists who may lack the knowledge of the applications of computer science to bring it to life.

2.11. In practice, the 'availability' of a qualification in a school, rather than its in principle availability on the list of approved qualifications, depends on other constraints in the school. The shortage of teachers is addressed below. Other factors that have an impact arise because of timetabling constraints due to the EBacc. While Computer Science is listed as an EBacc subject, it is grouped with the natural sciences. As these are compulsory National Curriculum requirements, Computer Science tends to be offered in the more general subject choice 'buckets' alongside subjects such as Art, PE, DT and so on, where, because of its perceived difficulty, it struggles to attract students.

2.12. There is a strong perception amongst teachers, school leaders and students that getting a good grade in GCSE Computer Science is harder than in other subjects. Our analysis of the comparative performance of candidates in different subjects supports this view, and this is an issue we have raised with the regulator.[10]

2.13. These additional factors make offering GCSE Computer Science unattractive for school leaders focused on government-set targets. Creating a broader science and technology 'bucket' within the EBacc would go some way to addressing this issue, as would the approach taken in Wales (see later.)

3. Question 2: Are the current GCSEs an appropriate way of assessing knowledge and skills in your subject, and if not, what other assessment methods would you recommend?

3.1. The GCSE prepares students going on to A Level (where the mode of assessment is similar), but most young people do not (87%).[11] The fundamental purpose of computing is to build/modify/use things that change how we live, work and play. The Computer Science GCSE does not reflect this – it is akin to science without labs, music without performance, and there is evidence that some teachers only teach the practical elements required to get through the examination.

3.2. The most authentic way for candidates to demonstrate the practical application of their knowledge and skills in computer science is through extended project work. However, we recognise that the plagiarism concerns that led to the end of this form of assessment remain. Awarding bodies are exploring online assessments that would provide candidates with opportunities to demonstrate this application of knowledge and skills through practical activity in a controlled environment. We support this development and further encourage awarding bodies and others to explore how technology can be used to manage candidates' practical work over longer periods to ensure its provenance.

3.3. Alongside improvements to the current GCSE in Computer Science, we also need:

- A qualification (or choice of qualifications) that recognises higher-level technical knowledge and skills at the GCSE level – valued equally to the CS GCSE.
- A digitally enabled portfolio-based assessment of young people's digital literacy for every learner.

[9] https://www.bcs.org/about-us/people-and-governance/our-boards-and-committees/school-curriculum-and-assessment-committee/

[10] Submission to Ofqual https://www.bcs.org/media/8418/scac-letter-ofqual-chief-regulator-plus-annex.pdf and Ofqual's response https://www.bcs.org/media/8392/ofqual-response-0222.pdf.

[11] BCS Landscape Review

4. Question 3: To what extent is your subject affected by challenges in teacher recruitment and retention, and what could be done to address these issues?

4.1. Schools are finding recruitment of computing specialists challenging. England's Computer Science teaching workforce has grown but not sufficiently to meet demand. However, as the number identifying as ICT teachers has decreased, the overall number has remained static for the last eight years.

4.2. At best, there is typically one designated Computer Science teacher per secondary school in England. However, the available data indicate that not all schools (~77%) offer the qualification, so there may be a higher proportion of these specialists in schools that do offer the qualification. The likelihood of a student having access to Computer Science GCSE varies significantly. In 2020-21, 72.6% of Comprehensive schools offered it, compared with 92.6% of grammar schools. [12]

4.3. Recruiting computing teachers to initial teacher training remains a challenge, with under 75% of the target figure being met in the past five years. Last academic year was significantly worse, with a mere 348 trainees recruited (30% of the target). This appears set to continue. The DfE-funded Computer Science Teacher Scholarships has supported more than eight hundred new trainees since 2013. (We lack data enabling us to understand the impact of interventions like this – so it is unknown how many scholars successfully go into mainstream state-funded schools and how long they stay).

4.4. The demand for individuals with computing skills from employers in every sector will continue to grow. This means the challenge to recruit those very same individuals as teachers will continue indefinitely. While financial rewards can have an effect, schools will never be able to compete with the salaries computing professionals can earn in other sectors, so a traditional view of recruitment is going to be ineffective.

4.5. We propose several approaches to tackling the shortage of teachers:

- More specialists spending part of their career in education, referred to as braided careers. There are some interesting initiatives where computing professionals donate their time and expertise to schools to support and supplement the provision of computing education. One example is a Fintech company supporting schools in East London. Within two academic years, the attainment impact increased from 46% of students achieving grades A–C to 100%. [13]
- Support existing non-specialists to train as computing teachers. The Government's commitment to teacher CPD in this area is ongoing, including the National Centre in Computing Education, which provides courses and curriculum resources. To date, over 5,000 primary and secondary teachers have achieved certification for their CPD. This starts teachers on the journey but does not get them to the destination as subject specialists. The reality is that there are still very few skilled practitioners. CAS, the community of practice for computing teachers, supports over 12,000 practitioners today. It provides ongoing peer-to-peer support that goes well beyond any discrete episodes of CPD.
- Explore more innovative solutions like at-scale centralised virtual specialist provision, e.g., as offered by Oak Academy, CAS and Barefoot and others during the pandemic.
- Promote the intrinsic rewards of teaching computing. We need a more sustained commitment to teaching as an attractive profession for computing specialists, with teachers teaching knowledge and skills they value - to young people who also appreciate them. Teacher motivation is directly affected by student motivation - the 11-16 curriculum needs to be explicitly related to students' needs and aspirations. Teachers are in the 'future business' 16-year-olds leaving school now will be in employment and active citizens in the last years of the 21st Century; some will live into the 22nd Century. Teachers need to feel that what they do makes a positive contribution and is recognised as such. We should build positive relationships between employers and educators and celebrate teachers as key agents for building that digital future by giving status to digital educators.
- Reduce the stress associated with high-stakes accountability by moving to more continuous assessment, powered by digital, throughout the secondary curriculum so that teachers and

[12] BCS Landscape Review

[13] https://www.bcs.org/articles-opinion-and-research/bank-staff-help-inner-city-kids-master-computer-science/

schools are not judged by what happens in a few weeks in May and June at the end of a five-year secondary school experience.

4.6. Quality qualifications drive a quality curriculum. This resonates with young people as they enjoy their learning, which motivates teachers. Get all this right, and employers will want to lean in and be part of the story rather than peeling away to individual interventions and initiatives, creating an overall solution that is less than the sum of its parts.

5. Question 4: How will technology shape your sector in the future and does this affect how your subject should be taught and assessed today?

5.1. Digital technologies are shaping every sector of the economy and almost every occupation. New capabilities and increasing availability are shifting our jobs, how we do them, and where we do them. The rate of that change is accelerating – consider how recent developments in AI are already augmenting human endeavour. We can't know what's new in tech, but we understand that what can be digitised, will be. And we can prepare young people through the curriculum to develop critical thinking skills and essential knowledge to enable them to thrive now and in the future digital world.

5.2. Things that might have been considered more specialist digital skills are becoming more prevalent outside specialist digital roles as organisations use technology and become more capable of using it. E.g., data analysis, workflow automation, and low-code-no-code platforms are increasingly commonplace in jobs far from the IT department. An ever more significant proportion of the workforce will be producers of digital solutions, not just users.

5.3. The intent of the computing curriculum is to prepare all young people for their futures. Advances in digital technology and increasing adoption across the economy and society only reinforce the need for Computing for All. We are sceptical of claims that, for example, new technologies such as generative artificial intelligence (as in products such as ChatGPT) will remove the need for people to learn about how computers are programmed. While it is undoubtedly the case that much coding outsourced elsewhere in the globe can be delivered by AI, three important principles remain:

5.4. Firstly, AI is trained on a restricted dataset which it uses to create the algorithms to produce responses to inputs. This can lead to unwanted consequences such as biases.

5.5. Without critical judgement, algorithms can have devastating effects. We saw the impact of flawed algorithms on automated trading decisions, which accelerated the financial crash and the awarding of grades during the pandemic. These algorithms were created by humans - unchecked automated algorithm generation offers more opportunity for disaster. Also, AI identifies patterns, but innovation is more than simply creating products predicted from existing ways of doing things.

5.6. Secondly, much of the ill-informed commentary on AI is based on a lack of fundamental understanding of how the technology works. Without that understanding, it appears to be magic or human-like qualities are inferred incorrectly from the behaviour of an (all-be-it very complex) Turing machine. AI's potential for good will need to be supported by a programme of increased emphasis on computing education and adult digital skills and awareness programmes to help the general public understand and develop trust in the responsible use of AI, driven by the government and industry. This topic requires much further discussion than space here allows; BCS are producing additional thoughts on the opportunities and threats offered by AI [14] and how we should work to address them, and what this means for schools.

[14] https://www.bcs.org/articles-opinion-and-research/schools-will-need-help-to-cope-with-ai-generated-homework-computing-teachers-warn/

Approaches across the UK

6. Common themes

6.1. In March 22, BCS published its Landscape Review of the current state of computing and digital qualifications in the UK[15]. What is becoming more apparent is that each administration is dealing with a genuine challenge - a tension between teaching computer science and digital skills for all, with key common themes:

- The recruitment and retention of skilled teachers.
- Breadth or depth - should we prioritise universal digital and computing education or curate specialist knowledge.
- How many students should follow the specialist route to meet future need.
- Specialism vs adaptability.
- The imbalance in the uptake of and progression within the subject by male and female students.
- How these impact on the curriculum.

6.2. This tension between computing for all and the specialist route is felt universally. In the UK, there are different approaches.

7. The approach in Wales

7.1. The reformed curriculum in Wales recognises that all learners need to develop digital competence as a statutory cross-curricular skill alongside literacy and numeracy.

7.2. There is also a compulsory digital route in their Science & Technology area of learning and experience for all students at the GCSE level with two complementary pathways: computer science and digital technology. The sciences have been reduced to the equivalent of two qualifications from three at Level 2, as part of a broad and balanced curriculum approach for all learners aged 3-16.

Concluding Remarks

7.3. The future belongs to those economies, organisations and individuals who become digital product creators, not simply **passive users.** Our aspirations to become a high-skill, high-wage economy will only be met if we address this challenge head-on. This is particularly an issue for digital, where we have become reliant on migration and outsourcing to meet skill shortages, yet employers still struggle to recruit. Countries as diverse as Albania and South Korea are modernising curricula to achieve this.

7.4. Digital products can easily reflect or magnify implicit or explicit biases and discriminate against individuals, groups, or demographics. The systems that tech companies build and what we produce in mono-cultural teams lead to bias. We need the people designing, developing, programming, and using the tech to be diverse, representative of society, competent, accountable, ethical, and inclusive.

7.5. A digital economy depends on specialist digital innovators and informed digital citizens. These two aspirations are mutually supporting – each depends on the other. **All citizens** need digital skills to participate in the digital economy. Capable and critical citizens increase the demand for high-quality, effective, and ethical digital products and services.

7.6. The skills that young people possess will only open up opportunities for them if they are recognised through **qualifications**. Qualifications provide the information needed to ensure the demand for skills docks effectively with the skills young people can supply. The lack of recognised qualifications leads to a skills market failure which compounds the issues created by skills shortages.

[15] BCS Landscape Review

7.7. Finally, computing will continue to develop, as will the knowledge and skills it demands. We need to consider a **more agile approach to developing qualifications and curriculum** because of the speed of digitisation.

Who we are:

BCS is the UK's Chartered Institute for Information Technology. The purpose of BCS as defined by its Royal Charter is to promote and advance the education and practice of computing for the benefit of the public.

We bring together industry, academics, practitioners, and government to share knowledge, promote new thinking, inform the design of new curricula, shape public policy and inform the public.

As the professional membership and accreditation body for Information Technology we serve almost 70,000 members including practitioners, businesses, academics, and students, in the UK and internationally.

We also accredit the computing degree courses in over ninety universities around the UK. As a leading information technology qualification body, we offer a range of widely recognised professional and end-user qualifications.