Securing our Future: Retaining Students in Computer Science Higher Education (UK)

Executive Summary

Computer Science is thriving in Higher Education in the UK, and is one of the fastest growing subjects in recent years, seeing a significant increase in applications, particularly among female students. Yet despite a diverse student population, concerns remain about student retention and employability, particularly around the high dropout rate, and lower continuation rates for disadvantaged students.

In this report "Securing our Future: Retaining Students in Computer Science Higher Education (UK)", BCS, The Chartered Institute for IT and the Council of Professors and Heads of Computing (CPHC) explore the challenges faced by higher education colleagues in managing an increasing and increasingly diverse student intake.

A series of interviews conducted with senior CS colleagues from institutions representing a range of mission groups and locations, explored topics such as growth trends, school-level qualifications, diversity, and innovative approaches; and a subset of Higher Education Statistics Agency (HESA) data returns were analysed to help construct a cross-sector, data-driven perspective on the health of CS in UK universities.

There is strong interest among providers in improving the sector's performance and capitalizing on high levels of interest in CS. To achieve this, several key steps are proposed:

1. **Enhanced Data Sharing:** Improve access to and sharing of comprehensive, trend-based data on admissions, continuation, and graduation.
2. **Collaborative Knowledge Sharing:** Coordinate and facilitate the sharing of practical advice on CS teaching, learning, and assessment, including mathematics support.
3. **Advancing Female Participation:** Develop and test specific strategies to increase female participation in CS higher education.

Key Recommendations

1. Growth of Computer Science (CS)

The growth in CS has been mostly positive, yet there's increasing awareness of a plateau or tipping point that may compromise student experience and retention of qualified staff. Additional expansion must be planned and managed to ensure that the continuation and progression of increasingly diverse cohorts are well-supported.

2. Diversity and Inclusion in CS

CS continues to attract a diverse intake with support needs aligned with universities' goals to widen access and participation. Retention of non-traditional students, especially those admitted with contextual offers, requires attention. Female participation remains low, and novel outreach may help address this. CS providers should review their inclusion strategies and student support to ensure retention and to prioritize growing female participation.

3. Non-Continuation of CS

Currently, non-continuation in CS is not a significant concern, but the expansion of CS programmes and rising student expectations suggest emerging risks. CS providers should monitor non-continuation rates at an institutional level, particularly for under-represented groups, to ensure that widening access leads to successful outcomes.

4. CS at School as Preparation for University

While a computing-based qualification before university could prepare students, it does not guarantee the skills necessary for programming success. Confidence and ability in mathematics (or a related numerate science) are universally viewed as essential for CS. Higher education providers should highlight support available to students new to CS, creating a foundation in the first year for those without prior computing experience. This could also inform outreach with schools and colleges.

5. Improving Diversity and Supporting Continuation

Feedback suggests that data-driven approaches to managing and improving student engagement are crucial as courses grow and diversify. Strategies range from hands-on support (e.g., mathematics skills) to longer-term curriculum and assessment development. Interviewees emphasized sharing knowledge on managing increased diversity. Institutions should develop structured ways for academics to share best practices, supporting positive CS development.

6. Insights from Data

Data from several universities aligns with perspectives offered nationally and indicates that prior CS qualifications may enhance retention. Institutions performing well in specific areas (e.g., female retention) highlight the need for a robust dataset to represent the sector accurately. CS providers should leverage data to support growth, improve analysis, enhance diversity, increase female participation, and contribute to strong graduate outcomes.

Introduction

Computer science (CS) in higher education across the UK is in good health. The latest application data from UCAS for 2023/24 suggest that it continues to grow at a pace not matched by many other subjects (particularly in the science, technology, engineering and mathematics – STEM – domain). Between 2021/22 and 2022/23, CS acceptances rose by 11%, the second fastest-growing subject behind Architecture. There has been a particular development in female acceptances of CS places, up 28% for 18-year-olds between 2021/22 and 2022/23. This is encouraging and very much in line with the indications of the need for provision to grow identified in the 2016 Shadbolt Review (Shadbolt).[1]

This growth, however, remains characterised by a sustained and significant imbalance between male and female applicants, reflective of the uptake of CS in schools across the UK (roughly 4M:1F). Equally, whilst the numbers applying to study CS from areas with typically low participation in higher education (as measured by the Q1 POLAR4 indicator) remains slightly above the overall HE figures, there are nuances in the more detailed index of multiple deprivation (IMD) analysis[2] that suggests it is worth looking further and monitoring the intake to CS by a range of student characteristics. CS continues to have a good profile in terms of diversity compared with the overall student population, with 17% of accepted students in 2022/23 having a declared level of disability (16% overall) and 44% from ethnic backgrounds other than white (33% overall).

The growth and reach of CS is a welcome recognition of the importance and attractiveness of the subject in higher education. As the subject grows and young people move through their studies, the profession is interested in ensuring that the teaching and learning experience remains high-quality and engaging and contributes notably to increasing workforce diversity. This is possibly particularly pressing as data suggests that CS is the subject with the highest drop-out rate across 14 UK higher education subject groupings at 8%[3] and long-standing evidence points to the lower continuation rates for young people with poorer socioeconomic backgrounds compared with their peers.[4] Non-continuation at the provider level is something that the Office for Students (OfS) in England is increasingly focusing on as a measure of performance.[5]

However, despite the growth of the subject, and its constituent and related disciplines, and the steps taken since Shadbolt to address employability[6], there is a regular, persistent, and relatively unchallenged undercurrent of concern about CS student continuation, graduation, and employability.[7] It is therefore important that the contribution of UK higher education to the supply of skills for computing and digital professionals is well understood to promote

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[1] Shadbolt, N. (2016). Shadbolt Review of Computer Sciences Degree Accreditation and Graduate Employability. https://www.gov.uk/government/publications/computer-science-degree-accreditation-and-graduate-employability-shadbolt-review

[2] Almost 50% of new entrants in 2022/23 in England came from the lowest two IMD quartiles, notably higher than across the entire student intake.

[3] Higher Education Statistics Agency (HESA): https://www.hesa.ac.uk/data-and-analysis/performance-indicators/non-continuation#non-continuation

[4] See, for example, https://researchbriefings.files.parliament.uk/documents/CBP-9195/CBP-9195.pdf and https://ifs.org.uk/sites/default/files/output_url_files/WP201431.pdf

[5] Office for Students (OfS): https://www.officeforstudents.org.uk/media/92d85140-2719-4af0-85c9-b28ee1038c5e/regulatory_notice_1_access_and_participation_plans.pdf (see paragraph 82)

[6] See, for example: CHPC. (2016). Computing graduate employability. Sharing practice. https://cphcuk.files.wordpress.com/2016/01/computinggraduateemployabilitysharingpractice.pdf and CHPC. ((2018). Promoting careers in Computing Education: sharing practice. https://cphcuk.files.wordpress.com/2018/08/cphc_promoting-careers_report.pdf

[7] Frankland, J. (2023). Does Computer Science still have the highest drop-out rates & lowest gender rates at UK universities? https://www.linkedin.com/pulse/does-computer-science-still-have-highest-dropout-rates-jane-frankland/ and Great Britain. Department for Education. (2019). Education Secretary warns universities over drop-out rates. https://www.gov.uk/government/news/education-secretary-warns-universities-over-dropout-rates

continued investment in the disciplines and constructively engage with any issues that expansion may cause.

To address this, BCS, The Chartered Institute for IT and the Council of Professors and Heads of Computing (CPHC) have taken the first step to better understand the challenges higher education colleagues face managing this increasing, and more diverse student intake and what it can do to ensure that young people continue to see CS as a rewarding study option.

Methodology

This 'Securing our Future: Retaining Students in Computer Science Higher Education (UK)'report results from a series of structured interviews with senior CS colleagues from various institutions across the UK, representing different mission groups (for example, Million+ and Russell Group), scales, and locations. Of the seventeen institutions approached between July and September 2023, ten agreed to offer feedback about CS at their institution. These institutions included providers in England, Northern Ireland, and Scotland.

The interviews lasted 45-60 minutes and covered topics including the growth of CS at their institution over the previous three years, school-level qualifications in CS and their suitability for progression to higher education, diversity, and how new approaches might be formulated and shared. The interviews were carried out based on the condition of anonymity and no attribution.

In addition, nine of the higher education institutions agreed to share a subset of their Higher Education Statistics Agency (HESA) data returns to help construct a cross-sector, data-driven perspective on the health of CS in UK universities.

Reflections from the interviews

The following sections look across the main interview themes and draw out the key notable points of agreement between the providers. They also highlight specific and intriguing viewpoints and identify, where possible, ways forward or new ideas about managing larger and more diverse cohorts of students.

The growth of CS

The experience of those interviewed for this project mirrors the data set out in the introduction. The growth of CS in their institutions has been notable and consistent in almost all cases, and by as much as 100% across three years and several 'general' CS courses taking in more than 600 Y1 students.

This growth has not been particularly strategic in any of the cases discussed. In some instances, it has been a response to incremental growth, born of a perception that the capacity to expand teaching and learning in CS is more straightforward and manageable than in other resource-intensive subjects (for example, biology, engineering, chemistry).

The addition of an extra viable cohort year-on-year can be seen as bearable if the perception is that CS does not require either specialist kit, dedicated teaching spaces, or additional teaching staff. This appears to be so, up to a point. Some elements of CS (for example, Cyber Security was mentioned) may require tailored teaching spaces, and even the facilities for large-scale CS teaching in Y1 may not be immediately flexible and able to be used by other subjects speedily and easily. The expansion of numbers puts increasing demands on teaching staff, particularly regarding maintaining high-quality formative feedback to students. While most institutions seemed content with their ability to recruit and retain appropriately qualified staff, one noted that they felt they were continuously in recruitment mode.

The capacity to offer useful and high-quality feedback on assessments was seen as critical to maintaining students' well-being (academically and otherwise). It could, if lacking, be something that contributes to student dissatisfaction and non-continuation. In that sense, the balance between growth and maintaining good quality student experience was in delicate tension and CS colleagues were conscious of the need to plan for growth actively and to do so in a strategically meaningful way. This was also the case for the strong parallel growth of postgraduate taught options in CS and the increased desire to build aspects of CS into other programmes across the sciences and humanities.

Interacting effectively and well with large cohorts is a growing challenge. This has been given a further dimension as the intake to CS has diversified. The subject increasingly draws in students from poorer socioeconomic backgrounds or those who are the first in their families to attend university. This shifted markedly in 2020/21 and 2021/22 due to the changes to the marking of secondary school examinations (A levels, Highers, Advanced Highers and their equivalents). Universities have notably altered how they manage such diversity, and this has been a benefit for CS students as well as others. However, as it is a subject that is doing more than others to widen access and participation, it may require additional support.

The expansion of CS was seen as a welcome development but with the caveats set out above, that is, growth does not come without a cost. The increased visibility of the subject as a strategically important subject in higher education was also viewed positively. This, interviewees suggested, did require some thought about the 'easy to expand' argument, as (for example) not having a dedicated and visible CS space for teaching and learning could also make students sense that the subject lacked a 'base' and an identity.

Many different elements fuelled the growth of CS. As noted above, there was evidence of a view that as a resource-lite subject, additional student numbers could be absorbed incrementally and without any great additional demands on teaching, learning, and dedicated resources. One respondent noted that it was possible, with (in England in particular) the diminishing real-term value of the unit of resource that comes with each student.[8], CS courses offered a 'margin' that could be used to cross-subsidise other more expensive courses. Equally, the increased interest in CS could be linked to employer demands and repeated identification of general and specific skill shortages in the UK.[9]

Diversity and inclusion in CS

As noted in the introduction, CS has some notable strengths regarding the diversity of the students it attracts and is regarded as a contributor to social mobility. [10]It has always been one of the subjects however, that has not managed to recruit a good balance of male and female candidates (something that is an issue for several subjects – not just in the sciences – and that begins in school).[11]

Most interviewees noted that whilst most other aspects of student diversity have shifted in a positive direction, the proposition of females taking up CS places at UK universities remained relatively fixed at 20%.

In most cases, those interviewed pointed to the very positive impact their university's widening access and participation strategies had regarding student intake and support. In many cases, this has paralleled the increased use of contextualised offers and, in one case, a deliberate attempt to build articulation links to local further education provision.

Looking at efforts to improve female uptake and continuation, several providers commented on the potential of programmes such as *Dress Code* and *Girls Who Code* to make a difference (although there appears to be little direct evidence of this currently).

Non-continuation and CS

Interviewees noted that managing increasingly diverse cohorts in CS was a live issue. This, however, was less from the perspective that there was any particular issue with CS and student progression between years and more in the context of the general efforts to widen access and participation in higher education.

The issue of non-continuation had not appeared as a discrete issue for any of those interviewed, and it was something that was a regular feature of department and faculty scrutiny and data analysis (although, in one case, it was noted that there was no way currently of looking at how this varied with a student's socioeconomic status).

Observations on the potential causes of non-continuation included:

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[8] Hillman, N. (2023). Weekend reading: Look Wot You Dun – Higher education in the run-up to election '24https://www.hepi.ac.uk/2023/07/29/weekend-reading-look-wot-you-dun-higher-education-in-the-run-up-to-election-24/

[9] See, for example: Coutinho, S. *et al.* (2023). Cyber security skills in the UK labour market 2023. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1173325/Cyber_security_skills_in_the_UK_labour_market_2023.pdf

[10] Sutton Trust. (2021). Universities and Social Mobility: Data Explorer. https://www.suttontrust.com/universities-and-social-mobility-data-explorer-rankings/

[11] Thomson, D. (2022). Is A-level maths a requirement for A-level physics and computer science? https://ffteducationdatalab.org.uk/2022/04/is-a-level-maths-a-requirement-for-a-level-physics-and-computer-science/

- Student expectations and preparedness – either through a lack of understanding of what CS and its allied subject comprised or not having well-developed mathematics skills. Recent work has suggested that some post-16 qualification in CS helped to reduce the repetition of years and non-continuation.[12]
- Young people being unfamiliar with higher education and its demands, particularly those who are the first in their family to make this step.
- The entry requirements for CS are very broad and accommodating and attract many who are interested in tech/digital careers. The encounter with the reality of CS in Y1 may be unsettling.
- CS environments not offering enough support, guidance and mentoring to female CS entrants.
- A sense that CS recruits a higher proportion of neurodiverse students than others, and that brings with it an increased need to work with students to ensure they can make effective progress and an increased risk that they do not if this support does not have a positive impact.

One interviewee noted that it was important to define carefully what is meant by non-continuation. Students may often choose to transfer to courses that still have a notable CS or digital component, even staying within a CS 'track', but this may be seen as non-continuation whilst they have made a well-managed move to a more suitable pathway. A second interviewee noted that it was possible to obscure non-continuation in Y1 by asking students to take a programming test before the November Higher Education Statistics Agency (HESA) census date to support course moves for likely non-continuing students before they are formally recorded.

It was also noted on several occasions that some of the risks associated with growth (and highlighted earlier) could begin to raise the issue of non-continuation and graduation on CS. Any downturn in the quality of teaching, learning, and formative assessment feedback for students could have a notable and negative impact on students' desire to continue their studies.

The lack of exposure (or indeed the over-exposure) of students to CS before coming to university appeared to have given many providers a stimulus to consider how best to manage this to equip students well for a transition to Y2 and beyond. Several institutions had developed and implemented curriculum reforms aimed at giving all students a broad introduction to CS that allowed an 'entry level' standard to be achieved, as well as stretching additional material for more experienced/qualified students. In one case, the curriculum reform was also designed to offer a view of the many different aspects of computing, showcasing aspects that may not have been visible or understood either at application to higher education or through information, advice and guidance at school.

The place of CS at school as a way to support the subject at university

When discussing risks related to student non-continuation, the role of pre-university exposure to CS as a factor was highlighted. Interviewees in all cases noted that CS (whether at A level, Higher, Advanced Higher or equivalents) was not and was not likely to be a requirement for anyone wishing to take up the subject at university.

There were many reasons for not having any prior CS experience as a requirement, with the most regularly cited reasons being that the qualifications were not universally available or so

[12] Dilnot, C. *et al.* (2022). Educational choices at 16-19 and adverse outcomes at university. https://www.nuffieldfoundation.org/project/educational-choices-at-16-19-and-adverse-outcomes-at-university

widely taken up to ensure good throughput of post-16 students with a CS-focused qualification.

Allied to this, interviewees noted concerns about the availability of good quality CS teaching in school[13], and that (in England) there was evidence that CS was graded more severely than other subjects at GCSE, so the opportunity to take it as an A level was very restricted.[14] This latter possible barrier to post-16 participation has been acknowledged in a recent Ofqual report, and action has been taken to address the GCSE grading issue.[15]

Providers also noted that having a post-16 CS qualification requirement would dramatically reduce recruitment (and, most likely, hinder attempts to maintain and improve diversity). If, and this remains a very long-term prospect, the availability of CS pre-university became more widespread, then entry requirements might change, and course designs may well reflect this.

CS courses in the UK, it appears, have been specifically designed to embrace an intake that has a very variable set of entry qualifications. Whilst CS qualifications may be seen as an asset (although a small number of interviewees also noted that prior CS experience could lead some students to be complacent about engagement with Y1 material when they started their courses).

The more important aspect of students' qualifications across all the providers interviewed was their ability in mathematics. Limited or poor mathematics qualifications were seen as a notable barrier to succeeding in CS and successfully transferring to Y2 and beyond (or to other closely related courses). The second most telling aspect of student progression in CS at university was their ability to understand and develop programming skills. Again, this was something where some familiarity pre-university could be seen as both an asset and a hindrance, depending on the programming language(s) they were familiar with: thinking like a programmer was a critical developmental route and was, perhaps, the aspect that led to most re-sits and repeat engagement for students.

Ways to improve and make the most of diversity and support continuation

The range of responses to questions concerning interventions and actions that support diversity and inclusion and to manage continuation and progress towards graduation was extensive. In many cases, they referred closely to the university's broad approach to widening access and participation such that a number could feel confident this was hard-wired into recruitment, retention, well-being and academic success strategies for all courses and staff.

Amongst the ideas that have been implemented, the most common and far-reaching were curriculum reform and differentiation to offer flexibility to accommodate different initial levels of understanding and experience. This was often based on identifying attainment patterns and direct feedback from students concerning difficulties and challenges.

Other opportunities to innovate that were mentioned included:

- Maths for CS support in Year one, based on the Sigma model
- Taking advice and guidance from cross-university equality, diversity, and inclusion groups

[13] Worth, J. (2023). Teacher labour market in England. Annual report 2023:
A summary for school leaders.
https://www.nfer.ac.uk/media/quthsqxe/tlm_england_annual_report_2023_a_summary_for_school_leaders.pdf
[14] Thomson, D. (2023). Revisiting subject difficulty at Key Stage 4.
https://ffteducationdatalab.org.uk/2023/06/revisiting-subject-difficulty-at-key-stage-4/
[15] Ofqual. (2024). A review of standards in GCSE computer science.
https://www.gov.uk/government/publications/a-review-of-standards-in-gcse-computer-science/a-review-of-standards-in-gcse-computer-science

- Working with *BCS* to expand and develop career role models for students and potential students (including outreach to schools)
- Supporting academics to work with internal data to identify trends and patterns in student performance and formulating ways of tackling these
- Working towards diversity goals such as the AdvanceHE Race Equality Charter and the Athena Swan Charter
- Making sure that student communications were clear and visible to ensure that criteria, goals and pathways were understood and engaging

The interviews suggested a good degree of agreement about the impact of interventions and how they had affected the development and implementation of CS teaching and learning. The effect of the following appeared to interviewees to be apparent in the stability or improvement of continuation and management of pathways to graduation:

- Regularly using data to understand student needs
- Enhanced interactions with students (including much better signposting and alerting about the structure and requirements of courses)
- Reforming the curricula and assessment to reflect a differentiated student group and more authentically evaluate attainment
- Looking across the university to other colleagues to learn about inclusion and diversity
- Offering support (particularly around mathematics and programming) whether pre-university or via drop-ins during term time

This impact had led some institutions to proactively use data to approach teaching, learning, and assessment evolution.

Interviewees were enthusiastic about developing better ways to share practice and information about managing challenges. Several pointed to the hubs established under the Institute of Coding and how they contributed to spreading ideas about teaching and learning practice and the use of AdvanceHE support to test and develop new approaches to inclusion.[16] A further and apparently rarely shared channel of intelligence concerning course re-design could be external examiners' reports if a sensitive and synthesised way of sharing key findings from these could be developed.

What the data tells us

At the time of writing, data was shared by four of the institutions involved in the interviews and feedback for this project. An additional three are pending. The template used to collect the data from the providers can be seen here: https://1drv.ms/x/s!Arh40vrmtj1BtDyxSWZXdbKq4cBj?e=9JBfiY

This part of the project intended to look across a range of institutions to understand better how the data being used to inform the delivery of CS matched national patterns and perceptions. It was also an opportunity to examine the extent to which data that might be of strategic interest was accessible and able to be shared.

Looking across the high-level demographic data, including socioeconomic status (measured using indices of multiple deprivation (IMD), sex, ethnicity, and disability, broadly reflects national findings that show CS to be drawing in a diverse student intake across most characteristics. One institution succeeds in recruiting and retaining an intake that comprises 30% females.

[16] See, for example: Blair, L. *et al.* (2022). Women's Sense of Belonging in Computer Science Education. https://www.advance-he.ac.uk/knowledge-hub/womens-sense-belonging-computer-science-education

The proportions appear to be relatively stable over the length of degree courses, suggesting that there is no particular that does not prosper in CS and where there are differences across the years, this appears to mirror national patterns (for example, in some cases, the proportions of students from the lowest IMD quartiles reduced over the years of studies whilst in others these increased).

In terms of the institutions students attended before taking a CS degree, the proportions align with national expectations. These are also relatively stable over the years of study, with the overwhelming majority of students coming from state/maintained schools (over 90%).

A small number of institutions were able to offer some insights into the extent to which their students possessed a pre-higher education CS qualification from school. Interestingly, despite there being no formal requirement to have such a qualification before beginning a university degree, around 50% of students appeared to have obtained a Regulated Qualifications Framework (RQF)/Credit and Qualifications Framework (CQF) Level 3 or S Scottish Credit and Qualifications Framework (SCQF) Level 6/7 award before beginning their degree. The small amount of data available suggests that the proportions with this kind of award increased throughout a degree, suggesting (as per Dilnot *et al.*[17]) that a qualification in CS helps students to persist and qualify.

It was not possible to calculate continuation rates consistently and robustly with the data collected from institutions. This was mainly a result of ambiguity over definitions and points to the need to work on agreed approaches and shared understanding of what data is used and how it is reported to avoid challenges and to offer a fair view of the sector, particularly about other subjects and HE more widely.

[17] Dilnot, C. et al. (2022). Educational choices at 16-19 and adverse outcomes at university. https://www.nuffieldfoundation.org/project/educational-choices-at-16-19-and-adverse-outcomes-at-university

Concluding remarks

The 2016 Shadbolt review[18] drew attention to concerns about CS graduate employability and diversity. Given the importance of digital and computing skills to economic growth in the UK, it is little surprise that the spotlight repeatedly turns to the pipeline of such skills and the role higher education has in creating a highly skilled and enterprising CS workforce.[19]

This brief, initial review is reassuring in the extent to which it shows providers dealing with change, and rather notable change in terms of volume and expectations of teaching and learning. These challenges range from managing physical space and staffing to the quality of the student experience and the nature of the curriculum (and its assessment).

The importance of accessing and using available data about student progression is surely necessary to underpin ideas about programme change and adaptation. Regularly monitoring and reflecting on this and other student and staff feedback is important in safeguarding against non-continuation or poor outcomes from undergraduates. This is important at institutional and sectoral levels, which the Shadbolt review *(ibid)* highlighted as its first recommendation (see below). It is also a central element in the quality assurance of higher education outcomes and their enhancement.[20]

Recommendation 1 (from the Shadbolt Review) – Improving the data

Data on the supply and demand for Computer Sciences graduates should be timely/up-to-date, accessible and comprehensive.

The Council of Professors and Heads of Computing (CPHC), Association of Graduate Recruiters (AGR), Association of Graduate Careers Advisory Services (AGCAS), and Tech Partnership should devise a programme of work to improve the quality, richness, granularity, availability and accessibility of data. This should start by working with HESA to inform their Data Futures review and with Government on the future publication of linked educational and employment record datasets. This will help higher education providers, employers, students, graduates, and policymakers better understand the graduate employment landscape and how this meets both the requirements of industry and an increasingly technology-driven economy now and in the future.

Being proactive about issues such as continuation and graduation, as well as diversity will enable the sector and the profession to have a more authoritative sense of the state of health of CS in universities and be better prepared to advocate for change.

Providers placed a greater emphasis on entry-level mathematics skills as a prerequisite for studying CS at university, with post-16 qualifications in the school and further education system being seen as helpful but not vital and that this would probably not change in the short- or medium-term. This also drove much of the activity to support more diverse student intakes, with outreach and Y1 measures taken to bolster mathematics attainment and ability.

[18] Shadbolt, N. (2016). Shadbolt Review of Computer Sciences Degree Accreditation and Graduate Employability. https://www.gov.uk/government/publications/computer-science-degree-accreditation-and-graduate-employability-shadbolt-review

[19] See, for example: Logan, M. (2020). Scottish technology ecosystem review. https://www.gov.scot/publications/scottish-technology-ecosystem-review/documents/

[20] QAA. (2023). An English higher education quality system fit for the future - policy briefing. https://www.qaa.ac.uk/docs/qaa/news/an-english-higher-education-quality-system-fit-for-the-future.pdf?sfvrsn=309cae81_5

The extent to which CS providers can or do share intelligence about, for example, reforms to teaching and learning in CS and activities to improve managing diversity is not clear. However, where this does happen it is welcomed and more of this openness and managed reflection on practice would be seen as a benefit to the sector.

Supporting students from diverse backgrounds is a central theme of higher education widening access and participation programmes. This is undoubtedly affecting how CS departments and faculties evolve their recruitment, teaching, learning, and assessment. The major and long-standing concern CS has (alongside several other subjects) is the extent to which it appeals as a study option to appropriately qualified women. The ratio of male:female CS entrants and graduates remains largely unchanged, and there may be space for more concerned efforts (including at school and through curriculum and assessment reform, changes to information, advice and guidance, and implementation of inclusive pedagogy) to promote CS and digital study at university actively.

This report has not sought to be definitive in establishing the 'temperature' of the CS higher education sector. It has found, from a good range of providers, that there are clear signs of interest in being able to demonstrate better how the sector is performing and to be clear about where it could be developing more and different ways of making the most of the current high levels of interest in CS. In this respect, there is little revolutionary, terribly new, or demanding to suggest about how some of these aims might be achieved, and these few changes are set out below:

- Improved access to, sharing, and use of comprehensive, trend-based, data concerning admissions, continuation, and graduation across the sector.
- Taking steps to coordinate and manage (perhaps on a thematic basis) the sharing of practical advice about adapting and developing CS teaching (including mathematics support), learning, and assessment.
- Developing and testing specific approaches to improving female participation in CS study in higher education across the sector and with the profession.