A Response to the Interim "Digital Britain Report" from the Council of Professors and Heads of Computing UK

Introduction

The Digital Britain report sets out a vision for the development of digital communications services, infrastructure, content and associated policy initiatives, including education, throughout the UK. The report acts as a response to a number of international initiatives, in particular the election commitments introduced by President Obama in the USA, the French Numerique 2012 plan, and initiatives in developing countries including China and India. The report in essence seeks to establish a baseline facility in the UK by 2012, which will form the basis for the UK Digital Economy for an undefined future period although indications in the report would suggest at least a ten-year window. The report follows on from the "Creative Britain" report produced in 2008, and makes a number of references to initiatives from that report.

The Council of Professors and Heads of Computing UK provides a forum and lobby facility for those involved in the management of education and research in Computing in the Higher education sector in the UK. In concert with the British Computer Society, the primary professional body for our discipline, and the Sector Skills Councils, e-skills UK and Skillset, CPHC has been involved in researching the educational and research needs of the UK IT/Computing, Communication and Creative Industries, to ensure that those industries are globally competitive and support the long term development of the UK Knowledge Economy. In the light of that work, CPHC has considered the interim Digital Britain report, and the impact of the recommendations it proposes on our work relative to those industry sectors. This response will focus predominantly on Section 5 of the report, which addresses the education and skills issues which are a primary concern of CPHC, further comments on other aspects of the report will consider the capability of the infrastructure to support research activity and the outputs of that research, and other education issues that emerge relative to those areas of the report.

Background

CPHC has been lobbying for some years over the decline in school pupils studying ICT and Computing to A level and equivalent, and the 50% decline in students taking Computing and IT degree courses at University since 2001. We have produced a number of reports on this, and in 2008 provided a Ministerial briefing to Bill Rammell MP, the then Minister for Higher Education at DIUS, a copy of which is attached in Appendix A. This decline has resulted in a shortage of highly-skilled graduates available to work in the high-end Computing and Creative Industries, and although many of these jobs are then filled by graduates with other skills, supported by on-the-

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job training, this impacts on the ability of UK industry to be globally competitive, especially in the development of high-technology added-value products and services.

The Digital Britain report identifies that there are 22 million people using ICT skills in their everyday work, but 2 million who specifically work in the IT and Communications industry. Work being led by OfCom is currently focusing on the needs of the whole population in terms of digital media literacy, digital life skills and digital inclusion. Recent studies by e-skills UK have also highlighted the 22 million plus people using ICT skills for their everyday work, referring to these as Digital Work Skills; a further 4-5 million people require Digital Economy Skills, being identified as a strategic understanding of the implications and potential for the use of IT to promote and develop the economy, and the majority of these individuals are identified as managers and leaders across a wide variety of industrial sectors; and 1 million highly-skilled IT and Communications experts, who require Digital Professional Skills to design, implement and derive value from IT and Communications systems and services. Skillset also identifies a further 550,000 creative industry professionals utilising similar high-level skills in the creation, development and distribution of creative content for the wide variety of distributed media.

CPHC has argued for some time that there is a need to identify and maintain this stratification to ensure that the high-skill added-value services and technologies developed by those operating as professionals within the IT industry are not conflated with the base-level, and growing, range of skills necessary to utilise ICT technologies in everyday work. This is of particular concern when we consider the development of ICT qualifications at Secondary School level, which have resulted in a large number of school children becoming disenchanted with ICT as a result of what is perceived as a "boring" curriculum. CPHC has recently contributed a response on the GCSE ICT curriculum as part of a consultation process, and a copy of that response is attached in Appendix B. CPHC would support an argument that ICT should be seen as a 4th "R", a fundamental skill along with "reading, writing and arithmetic", and that resources should be put in place to ensure that the teaching of this fundamental skill is exciting, interesting and enjoyable. However, we would argue strongly that Computing/IT should be seen as an advanced level subject, providing the basis for and not subsumed by ICT, and this should be taught separately, with equally compelling resources, to provide a supply of motivated and interested students for higher education Computing/IT, and, as a result, a supply of high quality graduates for UK industry.

Response to Report

General Comments

The CPHC membership responded to the report relatively negatively, finding it anodyne and unambitious. It can be argued that subject specialists who have access to high-quality and large capacity networks would take that view, but many of our members are directly involved in the provision of services to remote and rural locations, and to excluded and disadvantaged individuals. There was strong

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representation that the infrastructure proposals were understandable in terms of existing copper-wire services, but the decision not to seriously investigate alternative infrastructure models, many of which are currently offering significantly higher capacity services, was at best inappropriate. Although the target set for 2012 is more ambitious than Numerique 2012, it represents what should be seen as a minimum capacity for all users, more ambitious targets should be set for maximum or optimal capacities, and targets for the introduction and promulgation of new Communications Technologies offering even greater capacities.

Discussions on content are equally negative, and this is an area in which the UK does have an international lead. The content section focuses almost entirely on the capabilities and outputs of the public service broadcasters, and while the BBC i-Player may be an interesting and useful tool for use on-line, it represents a very small and non-revenue earning service, especially in comparison with on-line games and digital media services, and user-generated content services. Given the existing and recognised potential for growth in the Creative Industries sector, it seems extraordinary that these areas are not identified and the long-standing campaign for tax-breaks to support the development of the SME sector, on which most of this industrial sector is based, is not represented.

It is also particularly notable that there is a very limited evidence base presented, particularly in relation to section 5, apart from one major report on Child Protection. The report would benefit from a clear and well-established evidence base.

Specific Comments on Section 5

Section 5 is both extremely short and lacking in detail in terms of the consideration of the education and skills needs for a genuinely Digital Britain. Since this is an interim report, we take the view that this offers an opportunity to identify issues, opportunities and actions that have emerged from our previous reports, and offer proposals for future activities. Section 5.1 is of the most importance to CPHC, and we comment below on that specifically, but we found Sections 5.2 and 5.3 to be almost completely lacking in any content other than Child Protection. We take the view that Media Literacy is a significant issue for a large section of the population, especially in terms of Digital Life Skills, and would have expected to see both recommendations for activities and identification of existing initiatives, particularly by OfCom, in this area. Digital Security may need its own report, it is certainly not in any way served by the lack of consideration in this report, and there are a host of issues – system security, data protection, digital forensics, identity fraud and regulatory control, in which our membership are deeply involved. National Policy, guidance, infrastructure and support are needed, and the report needs to be extended to address this area or propose the development of a separate report, which we would recommend.

Section 5.1 Education and Skills

Whilst CPHC is delighted to see an appropriate stratification of the education and skills levels required for those working in the IT, Communications and Creative Industries, we are concerned that there should be consistency in the naming of these

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strata, and the meaning of those names. We would therefore argue strongly that the term Digital Economy Skills should be used as proposed by e-skills UK to identify a strategic understanding of the implications and potential for the use of IT to promote and develop the economy, with the majority of the 4-5 million individuals identified against this name being identified as managers and leaders across a wide variety of industrial sectors. We would also argue for the use of the term Digital Professional Skills to identify the 2 million professionals identified in the report, which we assume to be the 1.5 million in the IT and Communications industry identified by e-skills UK, and the 550,000 in the Creative Industries sector identified by Skillset. (It should also be noted that e-skills UK identifies only 1 million of that 1.5 million as requiring Digital Professional Skills, so perhaps the actual number should be revisited.) CPHC would strongly agree that those individuals working at the Digital Professional Skills level require higher-level skills and knowledge, and both depth and breadth of education. Unfortunately, the reduction in those undertaking degree-level studies in relevant IT, Computing, Communications and Creative Industries programmes identified in Appendix A, mean that it will be very difficult for UK industry to find the talent it requires to be globally competitive in the short term, and action will need to be taken to provide for the medium to long term.

CPHC would take some issue with the comment that Britain is not leading in this sector, as there are a number of areas in IT, Communications and Creative Industries where the UK does in fact have a world-leading position. Not least amongst these are UK Higher Education and Research in Computing, as evidenced by the outcomes of the recent Research Assessment Exercise and by the increasing popularity of UK Higher Education with foreign scholars. The grave danger is that if we cannot encourage UK students to study and work in these areas, then we will swiftly be overtaken by our international competitors and the UK will lose global competitiveness.

In terms of the difficulty in encouraging UK students to undertake degree-level studies in these areas, we would fully agree with the viewpoint expressed in the report that it is strongly correlated with the willingness to take on “hard” subjects, and we would also accept that there is a need to continue to work on the relationship of technical v. interpersonal and business skills, and in attempting to address gender issues. However, there is a need to identify actions that might impact on these issues, and in the reports in Appendices A and B CPHC have identified a number of potential actions, which are reproduced in the Actions List at the end of this response.

We are very pleased to see a recognition of the need to see ICT as an underpinning or horizontal technology, and, as indicated earlier we would argue for it being seen as a 4th “R”. However, there is still a vertical subject area that needs to be addressed, and we have indicated a preference for this to be distinguished from ICT by title, using IT/Computing, Communications Technologies, and Creative Technologies or similar to distinguish those subjects that should be studied to develop specialist higher-level skills which could lead on to degree-level studies. It might reasonably be argued that horizontal school-level ICT qualifications will form the basis of Digital Life and

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Work Skills, and can lead in to degree-level studies that could develop Digital Economy Skills. Likewise, vertical school-level IT/Computing, Communication and Creative Technologies qualifications could lead on to degree-level studies that could develop Digital Professional and/or Digital Economy Skills.

We would wish to echo the report in praising the Rose report on primary education, as it rightly recognises the need to ensure an inspiring and innovative curriculum to motivate and inspire school pupils in the use of these technologies. We would also wish to be encouraging over the range of initiatives identified from Creative Britain and the Sector Skills Councils, as long as we recognise that none of these is seen as a "magic bullet" that will satisfy all the competing demands of students, academics, employers and government. The reality is that we need a wide range of initiatives to meet these disparate needs, and we critically need effective interaction between the different groups involved to ensure that the benefits of these and similar initiatives are fully realised and disseminated. As indicated in the reports in Appendices A and B, we would strongly support initiatives to help attract and train teachers with appropriate skills, and to investigate and support mechanisms to provide updated and ongoing professional training.

In considering the mechanisms to support the development of skills at all levels within these industries, we would certainly support initiatives to develop closer industry-academic collaboration, and there have been a number of successful initiatives in this area (see Appendix A). As part of this collaboration, ongoing discussions are taking place on the skills needs for industry and the perceived shortfalls in skills and knowledge of new graduates, with a view to curriculum development to address these issues. However, a number of funding decisions made by the government and HEFCE have had a negative effect on the ability of the HE sector to respond effectively or to fund new initiatives. Decisions on STEM and SIVS funding have excluded Computing/IT from funding to develop new initiatives, encourage student recruitment and advertise available programmes. The withdrawal of ELQ funding has had a significant effect on the market for individuals seeking to re-skill to move into these industry sectors, which again limits the range of available talent and the skills-base within the sectors. Unfortunately, the argument that was used to defend the ELQ decision is also negative for these subjects, as offering additional undergraduate places when recruitment is in decline does not encourage any growth in the sector. In fact, the situation is worse than this, as there is no other opportunity for individual Universities to grow their funded numbers, so even if we were able to reverse the decline immediately we wouldn't have the student places to offer. The argument to permit Universities Additional Students Numbers (ASNs) in IT/Computing, Communication and Creative Technologies is made more acute by the fact that the number of graduates currently emerging from HE does not meet the industry need. In Appendix A, we identify that the impact of the current situation will result in a shortfall of over 50,000 graduates in the Digital Professional Skills workforce by 2016, based on the current decline in student applications halting now. Given the requirements for lifelong learning, flexible learning, more work-based learning, CPD, re-skilling and up-skilling, the existing funding arrangements for

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Higher Education provide a significant barrier to future development. Consideration of credit-based funding, where students can take a flexible approach to their studies to fit their needs, employers can see education as an ongoing process with their employees also being lifelong students, and the education providers can be funded on the basis of the educational credits achieved through a variety of granularities of study, should be on the table to support a future Digital Britain.

CPHC is delighted to be involved in a variety of the initiatives described in the report that support the identification and development of Digital Professional Skills, and in forming partnerships with industry, government, professional bodies, and the Sector Skills Councils, to enable this. Whilst it is too early to assess the effectiveness of the activities of TSB and KTNs, members of CPHC are fully involved and committed in these initiatives, and we hope that they will have a positive impact in improving innovation in the IT/Computing, Communications and Creative Technologies in the UK.

Proposed Actions List

This list has been generated from the commentary in the response above, and some of the key arguments presented in the papers in the Appendices. Our intention in highlighting these actions is to identify what can, and we believe should, be done to establish the necessary conditions for growth and development within the key IT/Computing, Communications and Creative Industries, in terms of the contribution made by the HE sector. The list of actions is not exhaustive, and some other recommendations made in this response are not reproduced here, as the focus is on what needs to be done in the immediate short term, to reverse a declining capability. The argument for the UK Knowledge Economy has been made elsewhere, in that it represents the most significant potential for the UK to maintain standard of living, world status, and leadership in technology areas within the global economy. Unfortunately, this argument is rarely set against the picture of declining interest amongst school pupils, College and University students in following courses that lead to the necessary Digital Professional Skills the UK needs to support the Knowledge Economy. Without significant intervention to address these issues and reverse these trends, the impact of Digital Britain will be akin to providing a feather bed for a man whose house has blown down.

The actions identified below may not appropriately reside within the Digital Britain report, but may be represented as recommendations of that report to other branches of Government, academia and industry. However, it is completely appropriate that they should be considered within the report, as the aspirations of Digital Britain are unlikely to be achieved without addressing these issues.

- Establish national, regional and local industry-academia research, knowledge transfer and education networks for IT/Computing, Communications and Creative Industries, to support dialogue on skills and educational needs, and to ensure industry and business needs are clearly articulated

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- Review and revise the ICT curriculum in Schools and Colleges as a horizontal underpinning subject area, develop IT/Computing, Communications and Creative Technologies curricula as vertical subject areas, and provide financial support and incentives to attract highly qualified, inspirational Computing and Creative Industries graduates to train as teachers

- Improve the attractiveness and quality of information on IT/Computing, Communications and Creative Industries careers, to grow the number, quality and diversity of new recruits – develop national resources as per STEM model

- Fund Higher Education on a learning credits based model – to permit greater flexibility in learning careers, lifelong learning, work-based learning and CPD, and thereby to offer greater potential for industry-academic joint initiatives

- Reinstate or provide alternative funding for ELQs to support re-skilling and up-skilling for the IT/Computing, Communications and Creative Industries

- Allow Additional Student Numbers (ASNs) for IT/Computing, Communications and Creative Technologies so these HE subject areas can re-grow as we increase potential student applications

- Recognise and fund IT/Computing, Communications and Creative Technologies fully as STEM subjects

- Provide scholarship and other funding support for postgraduate students in IT/Computing, Communications and Creative Technologies, both for those with non-Computing backgrounds and those looking to follow advanced study, to provide a more immediate increase in the graduate pool

- Offer tax incentives for University-based and University-linked IT/Computing, Communications and Creative Technologies education investment to increase HE-industry engagement, and encourage individual lifelong learning

- Continue to support and increase efforts on recruitment and publicity campaigns both for the HE sector and the industry, such as the HEFCE-supported Revitalise IT programme being led by e-skills UK – encouraging cross-branding of industry and academic campaigns

- Develop plans to support Masters programmes for those with non-Computing degrees, to encourage movement into the industry and development of deep knowledge. Campaigns are also urgently needed that encourage advanced postgraduate study for those with IT/Computing, Communications and Creative Technologies degrees, in line with recent policy announcements

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Appendix A – Briefing paper for Minister of Higher Education and DIUS, June 2008

The Decline in Computing Graduates: A Threat to the Knowledge Economy and Global Competitiveness

[This paper has been produced by the Council of Professors and Heads of Computing [CPHC] (representing the UK HE Computing sector), with support from e-skills UK (the Sector Skills Council for IT & Telecoms), the British Computer Society [BCS] (the professional body for IT Professionals) and Intellect (the industry body representing the UK technology industry).]

Overview

The evidence shows a significant and increasing gap between supply and demand for IT professionals in the critical IT sector of the UK economy. This shortfall, if left unchecked, will hit smaller employers and the public sector particularly hard. Input direct from industry bodies suggests that companies will increasingly move their computing work offshore, global corporations will choose not to place their operations in the UK, and the pipeline of skills into advanced level computing roles will be severely disrupted, compromising innovation and productivity in all knowledge economy sectors. The UK IT sector has historically focused on short-term solutions, i.e. taking more non-Computing graduates and migrant graduates, and off-shoring jobs, rather than with long-term solutions supporting Higher Education (HE) and increasing the available pool of UK Computing graduates. Recent developments such as the Revitalise IT programme and increasing employer engagement through e-skills UK are looking at long-term solutions and need to be supported and proliferated.

UK government policies reflect a view that market forces will adjust naturally to meet industrial need, but this is likely to lead to a stabilisation on those roles that cannot be off-shored, i.e. client and business facing, with a significant decline in UK-based capability in advanced technical roles, both in industry and research. This would damage the UK economy in a way that might be irreparable, but if not would certainly take decades in recovery. Rather than adopting a 'wait and see' attitude, action and leadership is urgently needed from all those involved in this situation, the UK HE Computing sector, the UK IT industry sector, the sector skills council, the professional bodies and the UK Government, to work together in partnership to support the HE computing sector, review funding arrangements, and join efforts to drive student recruitment.

The capability of UK HE Computing to respond to UK economic needs has been damaged by a number of funding decisions in recent years. Over £100 million has been removed from UK HE Computing grant income annually, through the decision to change Computing from Band B to Band C funding and the reduction in ELQ funding. Additional funding made available to STEM subjects has not been made available to Computing because, although it is frequently represented as a STEM subject, it is not treated as such for funding purposes. Although Computing is regarded as a strategically important subject, it has not been regarded as a vulnerable subject, so the additional funding available for SIVS subjects has not been available. Allied to the fall in student numbers, this has significantly changed the financial landscape for Computing departments, and a recent CPHC straw-poll shows a picture of diminishing resources, mergers and restructuring, staff redundancies and, inevitably, departmental closures. However, Computing is absolutely central to the UK economy (as is

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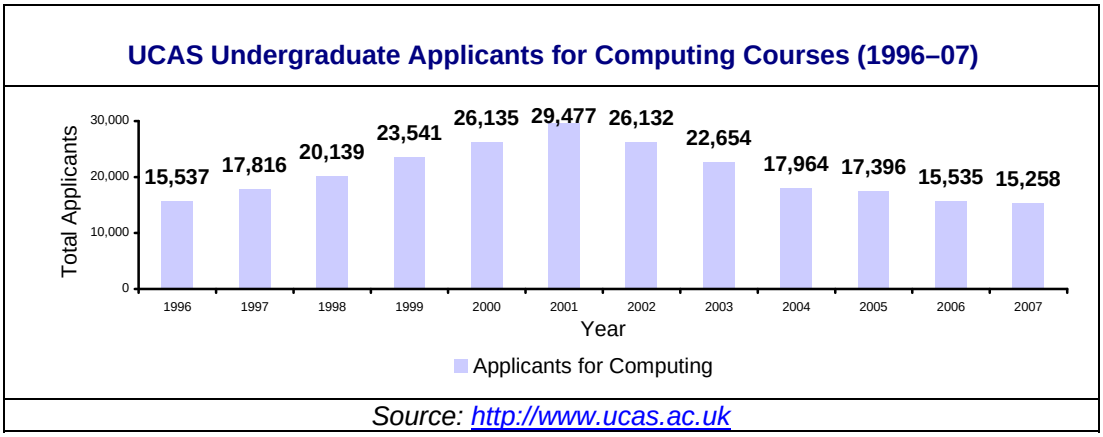
recognised for other STEM subjects), it underpins almost all disciplines in addition to the dedicated IT sector, so it is essential to the economy that it is re-invigorated and the partnership identified above is the right way to achieve that. New investment is needed to support this, particularly in terms of employer engagement, because of the incredible pace of technological development and because of the far-reaching impact of globalisation on the UK IT sector and on UK research capability, specifically in terms of needs for high-level skills and deep knowledge. As is already acknowledged with Foundation degrees, increased employer engagement carries increased costs on both sides, and mechanisms to provide the investment to meet those costs and also to help develop new and sustainable business models for future development are urgently required. We need to ensure future global competitiveness by working together in partnership and securing the necessary level of investment now.

The Evidence

1. Student Decline

The number of students in UK HE Computing rose in line with growth of demand for graduates in the UK IT Sector between 1996 and 2001, supported by additional investment from the Funding Councils, with student numbers doubling in that period. Since 2001 student applications have declined, despite continuing demand from the sector, to the extent that the numbers are now less than they were in 1996. Given the time lag between application and graduation, the decline has been reflected in graduate numbers over the past two years and, without significant intervention, we know that these numbers will continue to decline, at around 8% per year, for at least the next three years, giving an overall decline in the order of 50% by 2010 and taking graduate numbers back below the level of 1996.



Source: http://www.ucas.ac.uk

The decline in student applications also reflects a similar decline in secondary pupils undertaking A-level and Scottish Higher studies in Computing. Studies have identified considerable concerns over the secondary Computing curriculum, lack of distinction between ICT and Computing, and the qualification level and subject currency of secondary school Computing teachers. There are a number of initiatives under way to attempt to address these issues, such as the Teaching and Learning Programme, but many more are needed and there is also a need to provide financial incentives to encourage high quality, inspirational Computing graduates to become secondary Computing teachers.

2. Large and Growing Industry Demand

The UK IT job market has been steadily growing since 1994, with IT professional employment rising from 500,000 to over 1 million, and e-Skills UK research shows that, with replacement

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demand and continued growth in the sector, there is a requirement for 141,000 new entrants each year through to 2016, of which 26,800 are expected to come direct from education. Around 55% of new graduates entering the IT job market are from Computing disciplines. Whilst the relationship between supply and demand is complex, and we cannot therefore determine whether the take-up of Computing graduates is supply or demand driven, the need for around 14,000 Computing graduates entering IT professional roles each year is strongly indicated, representing 12,000 replacement staff to service existing activities and 2,000 new staff as part of the growth in the sector. UK IT professionals, as well as supporting the development of the knowledge economy, are central to development in other key areas such as financial services and creative industries, with some industry areas, such as television, music and computer games, becoming increasingly dependent on computing expertise.

3. The Supply Gap

We know that approximately 42% of Computing graduates enter the UK IT industry, which is a very high vocational rate. In 2006-2007 25,710 undergraduate and postgraduate degrees were awarded, so 42% represents approximately 10,800 new entrants to the industry, a shortfall of over 3,000 graduates. Taking into account the decline in applications of 8% per year, this will reach a total shortfall of nearly 18,000 graduates by 2010. Assuming steady state in the number of computing graduates from 2010 (since we cannot predict whether the current decline will continue past that date), this will result in a total shortfall (relative to the 14,000 annual requirement) of over 50,000 graduates by 2016. The result of this shortfall is that, far from growing at 15% as predicted by e-skills UK, the number of IT professionals with a computing degree (relative to the 12,000 churn) will decline by 15% in the same period (over 30,000 staff) from 20% of the IT industry population in 2007 (~1 million) to 14% in 2016 (~1.23 million). Employers are already complaining of increasing difficulties in recruiting sufficient volumes of Computing graduates, with volumes now falling well below employer need.

4. Shrinking Pool

Large corporations within the IT sector have already identified concerns about this shortfall, and in response have been more creative in their recruitment methods to optimise their graduate recruitment. This will further increase pressure on smaller employers and the public sector as they attempt to recruit from a shrinking pool. Consequently, more graduates from outside the UK, particularly Eastern Europe and Asia, are being employed in the UK as migrant workers, a higher percentage of jobs are being outsourced outside the UK, and the potential for growth in the UK IT sector, particularly in high-skilled jobs, is compromised.

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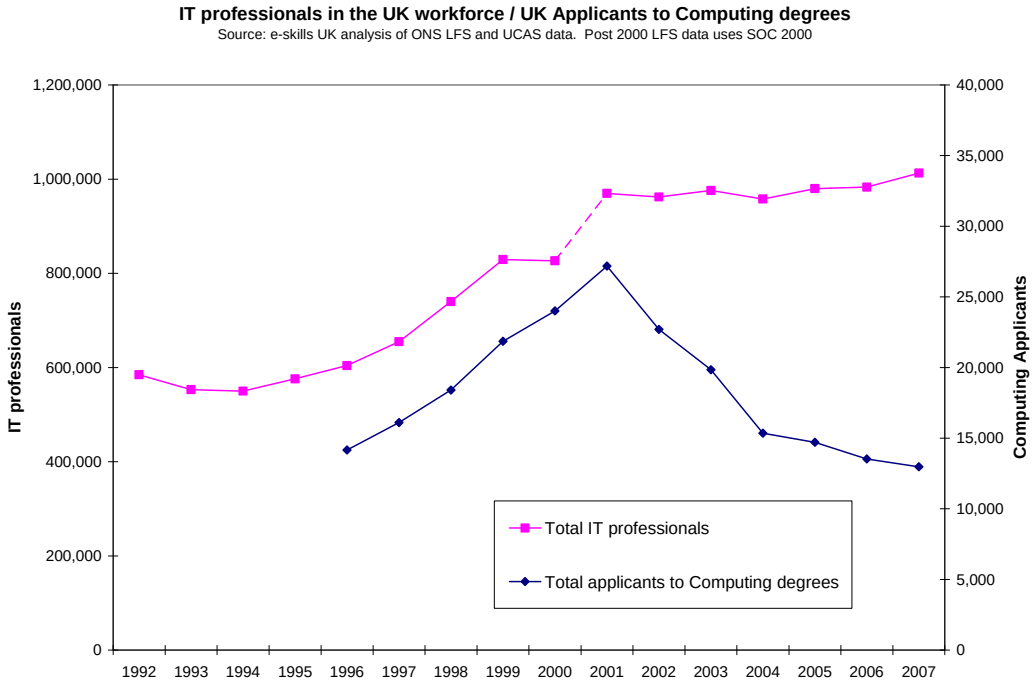

IT professionals in the UK workforce / UK applicants to Computing discipline degrees 1992 – 2007 (e-skills UK)I

5. International Competition

The effect of globalisation has led to greater use of offshore resources, but not to a decline in resources onshore. Instead, it has shifted the demand onto higher level skills. The pace of change has also increased, so IT workers are required to adapt and change their skills more quickly. In an analysis of the skills gaps existing amongst those occupying IT professional roles, e-skills UK identified a significant and growing technical skills gap as the most serious, alongside the need for development of business and interpersonal skills. For IT workers, developing higher-level skills, as well as flexibility and adaptability, will be impeded by a lack of the **deep knowledge** that could be gained from Computing degrees. This lack of **deep knowledge** not only impacts on the ability to undertake advanced level IT activities, but also on the ability of the sector to strategically exploit advanced technologies to support business research and development. For the large segment of existing IT industry professionals with non-IT degrees, and the 50% of the 141,000 new entrants to the sector each year coming from a non-IT background, routes to up-skill at an equivalent level in Computing have also been made more difficult, through the reduction in ELQ funding.

Failing to ensure an adequate UK-based supply of talented and skilled graduates to take up IT professional roles within the UK IT Sector represents a grave threat. Rather than competition for business, it will be competition for talent at the international level that presents the greatest risk to this sector of the economy, and those that rely upon it.

6. Long Term Effect on HE Capacity

UK HE Computing departments are under significant pressure through the decline in student numbers, and reductions in funding. Although regarded as a STEM subject, Computing receives neither funding nor support in relation to that STEM status, the impact of this lack of

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support is a contributory factor to a decline of 8% in computing graduates between 2002/3 and 2006/7 as opposed to a growth of 11% in the same period for STEM subjects. Computing is also regarded as a strategically important subject, but not as a vulnerable subject by the Funding Councils, hence does not receive SIVS status or funding. Coupled with the decision by the Funding Council to change the funding level for Computing programmes from Band B to Band C, this has resulted in a funding decline of over £100 million annually for UK HE Computing. There have already been staff redundancies, departmental mergers and restructuring, and departmental closures are currently inevitable, which reduces the capability of UK HE Computing to respond to initiatives to increase numbers of graduates, and progressively will damage research capability and hence international competitiveness. At the moment, the UK is a leader in research and teaching of Computing internationally, but, without significant intervention, that position will be eroded.

7. Industry Collaboration

The Lambert Review in 2003 identified that UK industry spends £23 billion on training, of which less than 1% is spent with HE. In 2007 Lambert, addressing UUK as Chair of the CBI, said that this had not changed significantly and there is a need to develop mechanisms to encourage greater collaboration in this area. The desire for greater engagement (including financial) by employers in HE is also expressed in the Leitch Review. One route to encourage development of such support is through partnerships in research and innovation, curriculum development, and direct industrial engagement in programme delivery, and there are a number of such initiatives under way which need to be supported. Current examples of collaboration between UK HE Computing and the UK IT sector offer a good basis for deepening collaboration in the spirit of the Leitch recommendations.

Recommendations

- Funding:
  - Move Computing into SIVS status and recognise it fully as a STEM subject.
  - Reinstate Band B HEFCE funding to maintain departments to avoid loss of facilities and staff.
  - Provide scholarship and other funding support for postgraduate students in Computing, both for those with non-Computing backgrounds and those looking to follow advanced study, to provide a more immediate increase in the Computing graduate pool.
  - Offer tax incentives for University-based and University-linked Computing education investment to increase HE-industry engagement, and encourage individual lifelong learning.

- Continue to support and increase efforts on recruitment and publicity campaigns both for the HE sector and the industry, such as the HEFCE-supported Revitalise IT programme being led by e-skills UK – encouraging cross-branding of industry and academic campaigns
- Develop plans to support Masters programmes for those with non-Computing degrees, to encourage movement into the industry and development of deep knowledge. Campaigns are also urgently needed that encourage advanced postgraduate study for those with Computing degrees, in line with recent policy announcements.
- Review and revise the IT curriculum in Schools and Colleges and provide financial support and incentives to attract highly qualified, inspirational Computing graduates to train as teachers.

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References

All of the information included in this document is referenced against, and supported by, the following reports:

1. A Study on the IT labour market in the UK 18th April 2008. Research Insights report commissioned by the Council of Professors and Heads of Computing. http://www.cphc.ac.uk/docs/reports/cphc-itlabourmarket.pdf
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4. DIUS Higher Education at Work, High Skills: High Value. 14th April 2008. DIUS Consultation document. http://www.dius.gov.uk/consultations/documents/Higher_Education_at_Work.pdf

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Appendix B – Response paper on GCSE ICT Curriculum, February 2009

A Consideration of the Issues relating to the Revision of the GCSE ICT and Computing Curricula

There has been considerable debate over the last few years between the Secondary School sector and the HE Sector over the appropriateness of the Computing curriculum in preparing potential students for University study. In particular, this has focused on the A-level curriculum, and recent changes, particularly those introduced by AQA [1], have met with broad approval from both sectors. However, this debate has masked a more serious and potentially damaging issue over the ICT and Computing curricula at Key Stages 3 and 4, leading to GCSE examination. Feedback from school pupils and University students into a number of studies, such as those carried out by CPHC [2], Microsoft [3] and CRAC [4], indicate that enthusiasm for Computing as a subject is being stifled at this point in their studies, with the result that they find the subject "boring" and eliminate it from consideration for further study. This can be evidenced from the decline in pupils taking A-level Computing and applying to study Computing/Computer Science at University, as reported by CPHC [5] and e-Skills UK [6]. Whilst there are obviously other factors influencing this decline, such as the issue of pupils selecting A-level subjects to optimise University application points, as reported in a recent Oxford-Brookes study, there is sufficient survey data and anecdotal evidence [see Appendix] to suggest a need to seriously consider revision of these curricula to address these issues.

The primary problem, whether considering the ICT or Computing curriculum, is to avoid the pupils enthusiasm being stifled by boring or repetitive tasks, which many of them already know how to do and which, while useful in terms of ticking off skills, may not contribute to their learning or understanding of the subject. Much of the evidence presented in the Appendix, whether from the CPHC study [2] or from anecdotal sources, highlights this problem. Perhaps most worryingly, the evidence is that pupils are emerging from Primary School with enthusiasm and interest in ICT and Computing, both genders, and within three years the majority have lost that enthusiasm, find the subject boring, and only a relatively small percentage, predominantly male, will continue to study it at A level and on to degree level. Teachers need the learning resources, content and skills to provide pupils at Key Stages 3 and 4 with subjects that are exciting, motivating and really show the power and creative potential of the tools that are available to them, and it is clear that this is not currently happening.

In discussions with the CPHC community, and in some recent consultations with Secondary School teachers of Computing at the Computer Science Research Conference in Cambridge (December 2008), another major issue identified is the

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conflation of the ICT curriculum with Computing, with the effect that pupils see no difference between the two. The analogy is often made, in considering this issue, with the use, maintenance, design and development of motor cars:

- Teaching GCSE ICT is about the preparation of school pupils to be users of computer systems and tools, in the same manner that one learns to drive a car, and relates closely to the European Computer Driving Licence (ECDL);

- As part of that curriculum, pupils will be introduced to the structure and workings of computer systems and software and hardware tools, sufficient to enable some basic maintenance and configuration (GCSE Computing), equivalent to the level of home maintenance carried out by the majority of car users, and affording the basis to move forward to further study;

- At the next level, pupils will either learn how to design, build and maintain computer software and hardware systems (A-level Computing), or develop higher-level skills in the use and application of computer technologies and tools to support different application areas (A-level ICT/IT for Business??). We can see this analogising to pupils going on to A-level studies leading to degree-level studies in Mechanical Engineering, Automotive Design, etc., as opposed to going on to studies in Transport Systems, Procurement, Supply-Chain Management, Marketing, etc.

From the foregoing, it should be clear that the view held by the CPHC community is that, while there is some crossover and mutual support between the subjects, ICT and Computing should be seen and treated as separate subjects. Perhaps most importantly, this distinction should be made early in the curriculum, to ensure that pupils are aware of the distinction and don't believe that the use of application packages, such as Word, Excel and Powerpoint, represents the major focus of Computing. However, this should not distract from the need to ensure that both subject areas are presented to pupils using teaching and resources that encourage, enthuse and motivate them to carry on their studies in these subjects.

In order to achieve this goal, CPHC would wish to engage in dialogue now with the curricular authorities and with the Secondary sector, to help in the creation of curricula and curricular resources that will support studies in both areas at Key Stages 3 and 4.

A further significant issue is in the training and updating of Secondary teachers in these subject areas, since it is both difficult to recruit appropriately qualified teachers, and extremely difficult for those teachers to retain currency within the discipline. As part of the dialogue identified above, consideration of mechanisms to encourage well qualified graduates to move into teaching, refresher and update programmes, and support tools and resources should also feature on the agenda.

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CPHC would wish to register our support for teachers of Computing in the Secondary sector, many of whom are doing an excellent job in difficult circumstances, and to identify that it is our belief that the issues are firmly centred on the Secondary curriculum and that these need to be addressed as a matter of considerable urgency. If the UK does not see a significant increase in those studying Computing, the ability of UK industry to compete globally will be severely impaired and the UK knowledge economy will be dependent on imported or off-shored services.

References

[1] The Assessment and Qualifications Alliance (AQA), www.aqa.org.uk
[2] "Investigation into the decline in BSc Computing/IT application to British Universities", CPHC July 2006, http://www.cphc.ac.uk/publications.php
[3] Microsoft "Developing the Future" report, June 2007, http://download.microsoft.com/documents/UK/developingthefuture/Developing_The_Future_07.pdf
[4] CRAC: The Career Development Organisation, "Do undergraduates want a career in IT?" report, 2008, http://www.crac.org.uk/crac_new/pdfs/undergraduates_it.pdf
[5] "A Study on the IT Labour Market in the UK – June 2008", CPHC June 2008, http://www.cphc.ac.uk/publications.php
[6] Technology Counts, IT & Telecoms Insights January 2008. Report by e-Skills UK http://www.eskills.com/Research-and-policy/Insights-2008/2179

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Appendix – actual and anecdotal evidence in support of response

Actual research evidence:

Investigation into the decline in BSc Computing/IT Applications to British Universities – CPHC (Council of Professors and Heads of Computing) commissioned report July 2006, authored by Anna Round.
http://www.cphc.ac.uk/docs/cphc-admissions-trends-report.pdf
Survey of 858 student questionnaires and several focus groups revealed the following:

"Many of the students who were taking neither CS nor ICT at AS/A-level stated that their negative experience of GCSE ICT was a primary reason for this. Common themes in criticisms of GCSE ICT included:

- The content is repetitive: "I did GCSE ICT and I never want to annotate another screen shot" was the view of one student. Others criticised the presence of multiple tasks including spreadsheets or other software items.
- The content is uncreative or .mundane: Several students complained that the ICT curriculum included too many tasks in which they were required to use software to perform dull or limited operations. Where students were aware of media or internet applications or of the exciting potential of Computing, the absence of a chance of focus on these issues at GCSE was criticised.
- ICT involves "a lot of very easy work". This view can be summed up by a quotation from one student in a focus group interview, who stated that "It [GCSE ICT] is a lot of time but none of it's very difficult". In a similar vein, numerous students stated that GCSE ICT was "boring".
- The sense that ICT is "not a proper subject". Several students, in particular those taking a "traditional" combination of A-levels or an all-science programme, wrote that they felt ICT was "a waste of a GCSE". Some focus group comments suggested that ICT was viewed as "there to support other subjects"; it is possible that embedded ICT across the curriculum contributes to this view. Others stated that it is "pointless" or "Mickey-Mouse".
- Some very interesting comments on this theme were made in the focus group interviews where post-GCSE students had not undertaken their GCSE ICT at the institution where the interview was taking place, i.e. where the enthusiastic CS/ICT teachers who had volunteered their institution to take part in the study had not been in charge of teaching this subject. Several of these students stated that GCSE ICT had been a subject "in which you could mess around". Stories of students using time at the computer to "message with friends or to do homework for other subjects were told by several students.
- ICT involves doing things "that you can do already". There were two strands to these comments. One was found among AS/A-level CS students, and also among some students who were not studying either CS or ICT at A-level. Most of the students who made comments of this sort appeared to be highly proficient in "hobby" computing. They had found that where computing tasks were involved in GCSE ICT, these were mostly operations which they had already learnt to perform themselves, and/or that the Computing elements of GCSE ICT had little to do with "real computing".
- "Real computing" was equated with programming, writing software, and creative activities, as opposed to the use of software applications. One student stated that "I couldn't really see what it had to do with computers. I mean, I spend all my spare time doing things with computers, and this was just spreadsheets and Office and stuff. You don't really learn anything about computers". S/he had been dissuaded from taking AS/A-level Computer Studies by his/her experience of GCSE ICT, but planned on taking Computing in HE where "you do the proper subject".

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- Students who were not taking Computer Science/ICT who stated that GCSE ICT involved "doing things you can do already" tended to be proficient in the use of particular software packages, and to feel that a school subject should not teach and reward "everyday" skills. Again, embedded ICT may contribute to this attitude.

"An unexpected but consistent finding was that there was great confusion over the difference between ICT and computing". There was also some sense among students who were not taking ICT at AS/A-level that it was a subject without a distinct 'home' of its own, and that its main function was to support studies in other areas.

"Very few of the comments on the GCSE curriculum and experiences of studying this subject were favourable. Even among students who were taking ICT at AS/A-level, students were likely to state how much more enjoyable their post-GCSE studies were in this area."

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Anecdotal evidence:

From two Students at a University in Scotland:

Student 1: “Hi, I was a victim of GCSE IT, specifically a dual award Applied ICT course.

If that's suitable for the matter I have a wealth of horror stories. Despite the fact I came out with top ten in the country for it I can honestly say it was a shambles.

The course seemed designed around "How ICT is used in the world" but in practice this meant writing inane reports on how computing could be used rather than how to use it. Only one third of the course was practical computing, and that was limited to the creation of a spreadsheet. While I am unable to vouch for the quality of teaching at other schools it was clear at mine that ICT was completely disregarded. For our two GCSE course we received only 3 hours per week (rather than the expected 4) under the tutelage of a geography teacher rather than a qualified computing teacher. As such, myself and one of my friends Neil practically taught the class, with the teacher telling us to solve other students problems. Had the course been anything other than an exercise in jumping through hoops this would have been an unacceptable burden. The exam was a ridiculous endeavour that asked us to produce simple documents and then punished us for minute faults in design choice. While I managed to come through unscathed, Neil - a boy who had been programming at an advanced level since primary school - only achieved a C grade.

Retrospectively the only thing I learnt from the course was how to create conditional formulae in excel, something that I learnt from a physics teacher after our ICT teacher instructed us this was impossible. Hopefully this has provided some use, other than giving me a chance to vent.”

Student 2: “I did a GNVQ in ICT (if that's what "computing" is)... my honest opinion is that it's a total waste of time - ICT should be taught as part of the general curriculum doing things like presentations in history, writing documents in English, etc.

The ICT teaching in secondary schools in uninspiring and discourages people from studying computer science/AI more than anything. I hated it, and so did everyone else in my class.

They should teach a computer science class as part of the technology teaching (I had food tech (cooking), textile tech (sewing), electronics, and design (woodwork)). They should teach people basic programming skills in those classes.”

From a Lecturer at a University in the North East of England

My eldest daughter is currently in Year 11 and is taking the double ICT award with a predicted A* outcome. She loves all things computery, she tinkers at home, she teaches herself new software packages, she did her work experience here in computer graphics and SFX and she would like to work in the computer animation industry.

We went to her school the other week for an A Level choices evening. She has decided upon Maths, Further Maths, Art, and Music Technology. Why not ICT? Because A Level ICT is much like GCSE ICT and it bores her rigid. It is not really a course studying computers, it is a course studying how ICT is used in businesses. I cannot quantify it without digging properly but it seems that every couple of weeks they're doing more spreadsheet projects, or PowerPoint presentations, or toy databases in Access. There is no study of the underlying computer science. Most schools are not equipped to study GCSE Computing or even A Level Computing (you seem to have to go to [another] College to do that) and so the next 'best'

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thing is ICT. But ICT is not computing; worse, it leads children to think that's what computing is about.

And after their fifth business plan presentation in PowerPoint with costings done in Excel they lose interest. It would be altogether more honest if the course were named "Business Communications in Microsoft Office". This is not to disparage business studies, rather a call for clearer labelling.

I think ICT is more akin to the European Computer Driving Licence than it is about studying computing as an exciting and stimulating subject. An analogy would be someone who loves cars and is interested in studying Automotive Engineering. "Ah yes! We have just the GCSE for you. Its name? GCSE Driving Test Preparation". As the driving test is to auto engineering, so GCSE ICT is to computer science.

From a Teacher at a school in the North of England

At my current school study of GCSE ICT is compulsory for all students however it has proved so uninspiring for both delivery staff and students that this is constantly under review. This year our head has decided the courses are too utilitarian and that now there will be a recognised base level alternative (i.e. the functional skills tests) we will use these as our compulsory element and students will not have to pursue ICT post key stage 3. At present we have not decided if straight GCSE ICT will even be available as an option. We are going to continue with Applied ICT as it is very successful with our lower ability students.

There are a number of issues that have resulted in this and I'm sure the same, or similar ones, can be identified in most schools. The curriculum focuses on skills on office applications which:

1. are difficult for students to see as relevant to their lives;
2. prove difficult to demonstrate the power and importance of due to the limited data sets we can show that the students will understand (for example the sorts of databases they work on have maybe 20 records made up of a dozen or so fields we cannot model more realistic data sets as they have to understand and create the structure as well as identify and create sorts, queries, forms, reports etc. and there is just not enough time alongside the other demands of the curriculum);
3. do not tap into students experiences and interest in ICT; they spend time using ICT to communicate, drive to school in cars with Sat Nav, download music and film, live in alternative universes through Second Life or computer games and the current curriculum at best just acknowledges the existence of such things but does not look at how the hardware works or how basic, often common, algorithms underlie their operations.

Additionally:

1. any algorithms they do meet, such as if statements in spreadsheets, are shown as solutions to that unique case, not as powerful decision tools underlying a multitude of simple and complex applications;
2. work on ICT systems and how they operate focus on buying a setup for various uses and there is very little discussion of how computers internal systems work; the way we have designed a system to communicate with a tool that is basically just a series of on and off switches this is a real loss of an area to engage stronger students;
3. the time it takes to write, review, publish and then deliver the curriculum means the technology it covers it is out of date when delivered to the first cohort let alone the last, usually about 5 years later (8 or 9 years later than it was starting to be designed); currently we have had to have a heated debate with examiner to allow our students to

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suggest systems be baked up on usb sticks or ISP servers as neither is recognised in the specification as standard back up media they would rather we had them using floppy discs and DAT tapes which are in the spec!!!!

On top of all the issues with the curriculum there is the added problem that most ICT is delivered by non specialists ex business applications, business studies, maths or science teachers in my experience. To some extent I believe this might be driving the curriculum planners as they know these teachers will be reasonably comfortable to talk about how to use basic office apps as they do it every day but may not know about the more technical (and engaging) aspects of computers (after all most children want to know how things work). My head of department is uncomfortable with proposing putting computer studies on the options list as he is not confident he, let alone the rest of his staff, have the knowledge base to deliver it.

The focus on office apps is also possibly because they are fairly static in what they do with only the front end changing in upgrades. To try and predict what the next big use for ICT will be is impossible for anyone let alone a curriculum designer. The frustration from a teacher who does know a little about how computers work is that, that has basically not changed and if we studied the heart of computers and how developers and user hang applications on this the curriculum might never become out of date rather than it being so before it even hits the classroom as it is at present.

Professor Dave Elliman, School of Computer Science, University of Nottingham

I can share my son's experience. James had grown up with computers since he was a toddler and wired a network between his and his sisters' bedrooms at ten years old on his own initiative. I was just asked to provide some cash for hardware but not for any technical advice. When he was 13, I noticed he was forming an English team to fight the Germans in some collaborative on-line Game and insisted on higher speed broadband so that he had a split second advantage in making a kill. I am pleased to say his English Army, from all over the UK, wiped the floor with the Germans in this re-enactment of the Battle of the Bulge. He would write small programs to help with his homework and could use word processors, spreadsheets and search engines as easily as riding his BMX bike. He graduated with a 2:1 in Computer Science from Cardiff University last year.

At Secondary School (the local state comprehensive) he was taught I.T. by a pleasant lady who appeared to have a head full of misconceptions on just about every aspect of computing and her teaching relied on giving the pupils standard worksheet exercises. James would complete these in five minutes and then feel so bored for the rest of the lesson than he grew to dread the lessons. If he put his hand up to disagree with some nonsense or other he was "slapped down" with sarcasm. The marks for the GCSE qualification were assigned by rather simple exam questions and a project. James did not achieve a high mark on either. In the case of the exam, he wrote answers that were at a higher level of sophistication than was expected at GCSE.
This meant that he used appropriate words and expressions, but one's that differed from the standard "expected" answers. He told me the questions and what he had written and I know for a fact that he deserved about 90%.
Instead he achieved a low mark because the scripts are apparently marked by people with no knowledge of the subject who just award marks for spotting "keywords". He was seething with the injustice of this.

I was impressed by his project which had to use an Excel spreadsheet. It worked out the optimum mobile phone deal depending on how many minutes a month the customer intended to spend on various cost calls and the number of text messages sent. It worked well and used an optimisation process that required the use of the advanced "Solver" facility in Excel.

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Because this went beyond the syllabus, and as the teacher could not figure out how it worked, he got a mediocre mark for what was an excellent project.

This experience put him off doing a Computer Science degree and he applied for other subjects. At the last minute, and as memories of GCSE IT began to fade, he changed his mind and pulled out of UCAS and arranged his place at Cardiff outside the system.

GCSE IT makes computing seem trivial, boring and lacking in any challenge and fails to give any flavour of the subject at university level. The staff teaching it often seem to have little in-depth knowledge of or enthusiasm for the subject and I think this is a matter of grave concern.

Professor Fintan Culwin, Professor of Software Engineering, University of South Bank

My grandson showed me his PowerPoint presentation that he was preparing for year 10 in ICT, it was essentially the same as he had done in year 7 at the start of secondary school and indeed essentially the same as he had done in year 6 in primary school. The presentation was using a wide variety of fonts, colors, fades, animations, etc. etc and had absolutely no consistency. When I suggested to him that he should simplify and standardise he told me that he would lose marks as he was gaining marks for each different 'feature' he used.

Less anecdotal: It is essential to have a syllabus that engages and energises - BUT it is more essential to have the staff who are truly able to deliver it. Only a very small proportion of ICT teachers are specialist in the sense that they have a specific ICT qualification even at PGCE level. If the government want to improve the standard of ICT secondary school education then they have to budget for improving the standard of secondary school ICT teachers. . .

Dr. Sue Black, Head of Department of Information and Software Systems, University of Westminster
My daughter was really looking forward to GCSE ICT as I've been into computing for most of her life. She was appalled at what they had to learn and do. Their first coursework was to write a user guide for MS Word for a 6 year old....she was expecting to learn how to program a computer! She dropped out.

Dr Simon Trainis, Associate Head of School (academic), School of Computer Science University of Hertfordshire

My colleague is the year tutor for year one of our undergraduate programme and has a role in schools liaison. She shared a personal anecdote with me regarding her middle son. As an aside we are talking about a whole family of computer scientists – her eldest is at Brunel studying computer science. Her middle son has recently taken the GCSE, and having completed it, has said it was so uninspiring that it put him off the subject domain forever. It was uninspiring as it seemed to involve just the use of applications.

Additionally, my colleague regularly talks about the lack of underpinning body of knowledge and hence intellectual challenges in the curriculum at GCSE and above. She also cites many teachers (those who hold computer science qualification) wondering who on earth authors the curricula.

Personally, I have often wondered if a useful activity would to use the subject benchmark to define suitable content for Schools, but I guess a lot of what is uninspiring is in the actual delivery of the materials. If as some of my colleagues indicate some teachers are told to teach ICT as “they have used a computer”, rather than being a subject specialist, then whatever the curriculum might say, it may well still end up uninspiring.

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Professor Michael J Goodwin, Dean, Faculty of Computing, Engineering and Technology, Staffordshire University

Anecdotally, I can confirm that I have heard that school pupils think that they know how to use PowerPoint and Word, so why would they want to study a degree in that?

Professor William Clocksin, Oxford Brookes University
Every year, I deliver two Open Days and from 5 to 8 "visit days". At the Open Days, around 30-50 school pupils come to check out our undergraduate programmes in computing and media technology. At the Visit Days, from 5-10 students who have been given offers of places visit to help with their final decision. I talk to the students, and one of the topics of conversation is often the contrast between school ICT and computer science. They all think ICT is boring and irrelevant to computing. These are the students who continue to be interested in computing despite school ICT, or who know something more about computing because of a hobby interest. However, they point to most of their peers, who are put off by ICT, and do not further consider anything to do with computers.

Each year, we host a visit from a local college that sends some of its students to university. The party is the ICT class, and usually several teachers attend. The teachers are committed to what they do, but they believe that computing is "more ICT". The teachers are just as surprised as the students to learn what we actually do, and how interesting it can be.

I have colleagues with children of school age, and I hear (second hand) that ICT is considered rather like the cookery class.

From a Professor at a University in the South of England
My daughter said, aged 15, "Dad, I can't believe that you teach this stuff ..."

Professor Ursula Martin, Vice-Principal for Science and Engineering at Queen Mary University of London
The only "evidence" I have is the hilarious account by my niece of how gross school IT was - she is now at medical school joining the ranks of computer-ignorant/phobic medics. If we had better IT education in schools we might have a better grip of it in the NHS etc.

If as alleged in the Telegraph various easy IT qualifications are being used as a way to push schools up league tables I guess that is a strong force for the status quo.

Dr Andrew Tuson, Head of Department, Department of Computing, City University, London

My experience with GCSE ICT is not good - I have been involved with student recruitment for over 8 years. Bright students, the ones we need to take the IT profession and industry forward, are clearly demotivated by an uninspiring syllabus that seems to serve the purpose of being a GCSE that allows weak students to contribute to a school's league table position.

Behind much of this is a confusion between 'IT user skills' and what goes on in universities and the IT industry: which is of such strategic national importance. How this arose is unknown, but this misconception needs to be crushed at all levels of the educational establishment. I see no reason why basic user skills could not be achieved by the end of the primary school cycle (the kids are capable), and any coverage thereafter focused on computing as a discipline and a profession and to excite and challenge them as to some of the most challenging future issues in our society.

The greater damage is however done to bright eager graduates and those from the IT industry that wish to teach an exciting and inspiring view of computing in our schools. I have

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met far too many of these teachers only to see them leave the teaching profession after 3 years frustrated at an unchallenging syllabus. I leave the reader to surmise what this may imply as regards those teachers who stay long term.

Dr Liz Bacon, Head of School of Computing and Mathematical Sciences, University of Greenwich
My niece told me that last year all her class were programming a drinks machine to produce the right combination of tea, milk and sugar etc. and that was fun. They were now being taught how to use PowerPoint and in addition to the actual presentation, they had to write excessive volumes of analysis on it e.g. why they had used a particular font. The analysis reports were more work than the original presentation and took many hours to complete. The whole class was bored and they all now hated ICT.

Professor David Brailsford, School of Computer Science and IT, University of Nottingham
The distressing truth (it seems to me) is that GCSE IT is largely aimed at teaching kids (who won't necessarily even go on to A-level) just a few buzz-phrases that might help them get a job in the "IT industry. Surely our recommendation ought to be to avoid GCSE IT like the plague for anyone who is even vaguely interested in (eventually) doing a Computer Science (CS) degree? My own feeling is that we should recommend students not to touch anything labelled IT until at least A-level. And even then we should push hard that a worthwhile preparation, at A Level, for a Univ. CS degree, should be labelled "CS" and *NOT* "IT". Moreover, the CS A-Level should include a *substantial* amount of programming.

The overlying advantage (and curse) of our profession is that computers and the (utterly pervasive) IT society are a very visible part of everyday life and the computers themselves are inexpensive and versatile enough to be very widely affordable.

Physics, Chemistry and Biology, by contrast, have been around so long now that they have become a part of the scenery and people just don't notice. Add to that the fact that the "really cool" bits of science tend to be VERY VERY expensive to pursue as a hobby (e.g. nuclear missiles; orbit-capable spacecraft; MRI scanners; analysis of flu virus structures. We are clobbered by the fact that in newsagents we get shelves full of: "Which Computer?" "What PC?" "PC adviser" "IT manager"
etc.which gives the general public the impression that the computer society is accessible to them (good) but also that everything to do with computers and computing is trivially easy (bad) and that all possible advances therefore are sure to be covered in "the next Microsoft or Apple release".

The physicists, chemists and biologists don't (judging from my newsagents!) have to cope with a news-stand full of "Practical Nuclear Missiles" "Which Strike Aircraft?" "Eurofighter Adviser"" "Teflon Manufacture News" "Analyse your DNA at home!" and "Build your own MRI scanner". The very cost of all of these technologies keeps them in their own exclusive niche and if any of the above titles exist they're likely to be by subscription to a few dozen people only. For a few brief years in the 60s and 70s, Computing was in this situation too :-)

But there is absolutely nothing wrong with having IT and CS GCSE and A-level qualifications that exist side by side. However, it has to be made clear that, in motoring terms the first of these corresponds to "the latest cool car and how to pass your driving test" while the second is "designing the next generation of automotive engineering".

From a Professor at a University in the South West of England

Last year 2007/8, in a cohort of 64 Home (by fee status) students, several dropped out or transferred. The Annual report reads as follows. 'While each is an individual, a common

theme (present in 7 of the 13) is “it’s not for me”. All of them agreed, significantly if not totally, with my analogy: “You passed your driving test, went to University to study automotive engineering, and found it was all about internal combustion engines rather than how to drive faster/better”. All had past experience of "computing" at school. Our course is 40% programming in the first year, and, though they admitted to knowing this, they didn't "realise it would be like that". I got the impression their vision of “programming” was Excel macros, and maybe JavaScript.

Dr. Peter Smith, Senior Lecturer, Department of Computing, City University, London

The GCSE ICT (and indeed the GCE A level ICT is even worse in this respect) is primarily aimed to introduce children to the use of ICT in the working environment. Here I will refer to the syllabus provided by the AQA, without suggesting that AQA’s syllabus is any better or worse than those of other examining bodies.

GCSE ICT is subdivided into two main areas:

1. **Tools, Techniques and Systems.** This section includes a study of Information Systems, word processing, charts, spreadsheets, flowcharts…
2. **Information Systems in Society.** This section includes Data Misuse, The Data Protection Act and Health and Safety.

While the syllabus as described might be eminently suitable for someone endeavouring to understand the role of ICT in the workplace and indeed it might be argued that this is useful for anyone who might encounter computer systems in the workplace, it is not however a suitable preparation for a Computer Science Degree course.

It only gets worse at A level, when Health and Safety, the Data Protection Act etc. are studied in greater depth, e.g. students are introduced to ergonomically designed chairs, wrist rests, eye tests etc. Speaking now with experience as an examiner at GCE A Level in ICT, I can only say that the material is stultifyingly boring. Typical A-level questions might be:

- Name five duties of a health and Safety officer.
- Give three characteristics of good data.
- Name three ways in which a software house might provide after sales support for a piece of software.

The answers given by candidates at A-level show a frightening degree of ignorance about what computing is really about. For example, in a question on the stages of development of an information system, under the section entitled “Implementation” – large numbers of candidates were completely at a loss to say what this stage actually involved. Many gave answers such as: “Putting data into the database”, “Building the system” – as though it were some physical entity.

On the one hand, ICT at both GCSE and A level is designed to enable children to understand the role of ICT and its context in the workplace. Many people from an older generation were able to remember the working environment prior to the introduction of a whole raft of legislation, including the Computer Misuse Act, The DPA and various H & S regulations. This material is important, it prepares children for the workplace – but it is also unbelievably dull.

Why is ICT so prevalent and Computer Science so rare? Why can’t children be introduced to inspirational computing, e.g. NetLogo?

Anecdotal evidence was solicited. My daughter is in year 10 and has turned her nose up at ICT – she regards it as a “subject for chavs”. Indeed speaking as a UCAS admissions tutor, I am forced to admit many students that have taken A-levels in ICT. Some years ago, I carried out a study of students that performed badly on our degree programme – two groups

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emerged – Access students (ill prepared for degree level study) and Double award ICT students.

We publish on our website a list of preferred subjects. Maths, physics and engineering are preferred, along with Computer Science. If I could, I would not admit candidates with totally unsuitable - levels – ICT is classed as barely suitable. I will study performances of students this year carefully, against their prior qualifications.

Dr. Bill Karakostas, Senior Lecturer, Centre for HCI Design, City University, London

In a sense, the current crisis in UG recruitment in CS is a result of the personal computer's tremendous success and ubiquity. PCs are pervasive today and the software industry for personal software productivity is very mature.

The aim of removing the end user as far as possible from the intricacies and complexities of the underlying hardware and systems software has largely been achieved. There is no real challenge, nor a long learning curve required to master today's desktop productivity applications that have been honed over the past 20 years. As there are myriads of applications to cover every possible aspect of the personal productivity domain, there is no motivation to create or invent something new either.

In the early days of PCs, trivial, by today's standards, tasks such as creating sounds or animation required at minimum programming skills in a high level language or even intricate assembly, machine code and/or hardware

Today the only challenge (if any) that remains is selecting one of the many ready made applications that is the nearest match to your requirements. So, it appears that the PC industry has gradually deskilled the end user and arguably the developer. The result is that, since the only true exposure of school children to computers is through PCs, mainstream operating systems and personal productivity software, the impression given is that there are no real challenges in computing that remain to be solved.

Educational tasks and GCSE IT projects equate to developing simple applications (simple databases, multimedia presentations etc) using mainstream tools and software where the emphasis is on setting up or configuring an already over simplified (through templates, 'wizards' and so on) development environment. The programming tools and languages industry and community are also equally responsible for being drawn in religious wars about programming styles, a plethora of esoteric languages and the extremes of both very simple languages and environments that deskill the developer, and very complex and arcane ones.

The equivalent of the personal Basics of the 1980s is missing today, not because today's equivalent languages are not powerful enough but because they lack a target. While with the programming languages of the 80s you could control your personal computer, today's languages lack a target to master and control, as controlling your PC is no longer a challenge. There is also a mismatch between how youngsters use the personal computer in their everyday activities (i.e. as a communication tool) and how they use it in their project (i.e. as a personal Productivity', 'organiser', or 'multimedia 'presentation').

In summary, perhaps solutions to rekindling students interest in IT should be looking at:

- Less emphasis on run of the mill IT projects that overuse industry's personal productivity tools.
- Creative projects that are not afraid of mixing software, hardware, communications and other technologies that reflect what computers are really about today.
- Programming languages that are the equivalent of the 'Lego' or 'BBC Basic' of old, but geared towards modern computer applications.

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From a Lecturer at a London University

I have had more experience with A-level ICT - but anecdotal evidence from my daughter's school suggests that ICT is regarded as one of the dullest subjects in existence.

Mr. Nick Ryman-Tubb, Honorary Visiting Fellow, Department of Computing, City University, London

In 2007, I visited Chiswick Community School as an observer. I observed the ICT class where each pupil sat at a PC (an old Viglen) and had a fixed task to carry out that was set-out in a standard text-book and set of software. This appeared to consist of tasks such as formatting and writing a business letter using word-processing or formatting a web-page for a make-believe charity. The teacher hardly interacted with the students, except to re-boot and fix the outdated computers/printer that had stopped working. None of the pupils were engaged with the task; the less-able just followed the text-book instructions by rote or in one case, did nothing for the entire class time, the more able completed the task within a few minutes and then proceeded to just talk to each other. When I spoke to the pupils, they told me that ICT was boring and that Staff had the opinion that ICT was not an interesting subject to teach and that it was better to including computers in the other subjects, rather than on its own. In my opinion, ICT and the Digital-Economy should be at the centre of teaching; it can encompass everything from the arts/creative, to software/hardware. It can be engaging, fun, challenging and current. It must include the latest developments; iPods, iPhones, blogging, etc., to really drive the imagination! It must link to all the other subjects in the syllabus.

As a comparison, I visited Charterhouse School Surrey (a 400-year old independent). I met Mr X, Housemaster, who told me that it was likely that the ICT would be dropped from the syllabus (since then it now has been). This was due to the poor relevance of the GCSE and that parents did not see the ICT GCSE as being useful. Mr X also did not enjoying teaching the subject. Again, the belief was that computers can be covered in the other subjects and that most pupils were in advance of the teachers anyway!

Thirdly, I arranged to meet Mr Y, Head-Teacher at a School in Surrey, he confided that they had difficulty finding and retaining good teachers for ICT; they were currently having problems, with ICT being covered by other teachers.

I was disappointed and sad to see that computing, that is now a ubiquitous part of our day-to-day lives and employs a growing number of people (over 6% of all employment in direct ICT jobs in the UK) see http://www.niesr.ac.uk/research/epke/TN2.pdf).

Mr. Sadaf Alvi, Student Employment and Employer Liaison Officer School of Computer Science and Engineering, University of Birmingham

There is a huge difference between what is taught in a Computing degree and an IT degree. When IT is taught at GCSE, students assume Computing degrees are based on the same idea i.e. they will learn how to use various software packages, similar to Microsoft Access and Excel. The concept of programming, not using but designing and developing software/databases/interfaces etc is not explained to them. Either both subjects (IT and Computing) should be taught separately or the curriculum should teach both and clearly show the distinction so students understand what a Computing degree will involve. Interesting topics like Artificial Intelligence, Robotics, software for Medicine and various research activities can help inspire young minds to study Computing.

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Professor Aaron Sloman, School of Computer Science, University of Birmingham
A couple of years ago when I heard that the GCSE computing syllabus was being revised, I volunteered to look at the draft and make comments on it. I thought it was very well-meaning but very dull, though possibly useful as a rather narrowly focused introduction to computing technology.

So I tried composing something to last two years, with the same general structure (two AS-level units and two A-level units, with each pair made up of a programming unit and a more general unit) which might inspire bright and academically varied students by introducing them to new computationally inspired ways of thinking about problems in philosophy, linguistics, psychology and biology, as well as engineering applications of artificial intelligent systems.

I invited some of our students and ex-students and a couple of teachers and some others, to comment and got very positive comments, except that the people who understood how syllabus changes work (which I don't) said it would be impossible to get the organisations involved to take it seriously. There are other practical problems, some of which I addressed by proposing bootstrapping with help from university departments.

Dr Gregory John Michaelson, Heriot-Watt University
Dr Michaelson gave a presentation to the Scottish Government last year on behalf of the Scottish Heads of Computing. He made the following points in his presentation which demonstrate that the problems elsewhere are similar.

- Universities think:
  - students don’t understand what Computing involves
  - school curricula do not sufficiently distinguish IT, Computing & Information Systems
- School/1st year UG students say:
  - SQA curricula do not take account of what is learnt at home and in primary school
  - they meet same material in different places
  - SQA Computing boring/not sufficiently challenging
- Computing teachers say:
  - school managers don’t understand Computing
  - status of Computing weakened because SQA Computing not requirement for University Computer Science
  - demarcation disputes with Business Studies
  - subject develops more quickly than curricula
  - Universities out of touch with School needs

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