Response to the Royal Society Computing in Schools Project
Faculty of Computing and Engineering, University of Ulster

The Faculty welcomes the opportunity to respond to The Royal Society's Call for Evidence. The Faculty is one of the largest providers of computer science education on the island of Ireland, with currently over 2,500 students. This response is structured into two sections: comments against the questions posed and then some general observations.

Response

1. Is computing a discipline, in the same way that mathematics, physics, chemistry are?

Yes, Computing is as much a discipline as any other scientific discipline, requiring the same intellectual and academic rigor.

2. Is programming a fundamental form of literacy for the modern age?

No – it is just one specialist aspect of Computer Science.

3. What purpose should the teaching of ICT and Computing in schools serve?

ICT provides the required digital literacy skills – probably should be compulsory. Computing should be viewed as a specialist subject preparing pupils for the discipline and further/higher education leading to employment as a professional.

4. Is the teaching of ICT (and accompanying qualifications, such as ICT GCSE) fit for purpose for all students? What should be done to address this?

ICT should be compulsory for all pupils and delivered before the GCSE stage – it does not need to be taken as a GCSE and the level of the current GCSE in ICT is questionable (certainly the pupils seem to find it too easy). Much like other more established disciplines, teachers should need a formal qualification in Computing before they could teach that subject.

5. Is computing and ICT best 'taught' in classrooms or 'learnt' by other means? How do learners learn computing and ICT skills?

Mixture of classroom and laboratory methods is most appropriate for Computing (like any other science discipline). School pupils with home access to computers and the Internet have an advantage as they can practice and reinforce their learning outside of school, many gaining significant ICT skills before they reach even KS3. However, this is not true of all, meaning that ICT will still need to be part of the secondary curriculum.

6. What motivates students to study computing? Is it what they learn in school or something else?

Many students are attracted to computing through computer games, use of the Internet and technology in general, e.g. mobile phones and other hand-held devices. However, this can lead to a misunderstanding of computer science and clearer guidance of computing as a challenging, problem-solving discipline is needed.

7. How is computing presented at school, and is there a variation between schools? Why?

In general, computing is poorly taught in schools. Many of the teachers of computing lack a background in the subject and therefore the depth of knowledge to make it engaging and challenging and to present it enthusiastically. The curriculum is out-of-date and focused on applications and the rote-learning of facts instead of the main aspects of computing. Facilities are often old in schools and indeed the pupils may have more modern machines at home! Many schools do not offer Computing, preferring to concentrate on ICT for league-table advantage. Northern Ireland still has selective education at secondary level and again Computing would rarely be found outside of the grammar (selective) schools – indeed evidence in the NI STEM Review should show a significant difference between grammar and non-grammar schools in terms of science performance.

8. Who is teaching computing, and what qualifications do they hold? Are teachers sufficiently supported with subject-specific CPD? Are there enough specialist teachers? Why do they leave/join the profession? What are the barriers to improving the situation?

Few Computing teachers hold undergraduate degrees in the subject. Some may have degrees in other disciplines and then have taken a 'conversion masters' in computing. Few would also enter teacher training in computing. Many of the teachers have been 'managed' into the subject from other declining disciplines to address school needs. Given the skills shortage in the IT Industry in general and the attractive salaries on offer in the Industry, this is not surprising. There is little CPD available for teachers of computing and yet it is essential in such a changing profession. Both universities in Northern Ireland offer masters modules in computing as professional updating/CPD, but uptake has been low due to lack of support for the teachers to participate – both financially in terms of fees and also in terms of release from duties.

9. Why do some universities prefer their undergraduate applicants to have studied mathematics rather than computing at A-level?

We accept either at Ulster, but this is mostly to do with the content of the A-level Computing curriculum. It is felt that the mathematics A-level is better at developing problem-solving and analytical skills in the student. As mentioned before, the computing curriculum is old and focused too much on applications and facts.

10. What are the perceptions of computing and ICT amongst learners, teachers and headteachers? How can information, advice and guidance be improved?

Some pupils (generally the academically better ones) find ICT in schools boring and lacking in challenge – again, colouring their view of computing as a career. Teachers tend to find it difficult and from a management perspective expensive to deliver due to the ongoing costs in maintaining up-to-date hardware and software. Since most universities do not distinguish in terms of UCAS tariff points between A-level Computing and ICT, many question the wisdom in getting their pupils to study Computing. Improving careers guidance and the understanding of the profession by careers teachers would help. Campaigns by the IT Industry, such as BringITOn in Northern Ireland, are also most helpful.

11. Are these issues unique to the UK?

No. Countries such as the USA, Australia and most of Western Europe are reporting the same issues. However, in China and India the IT Industry is viewed as a valuable career on a par with medicine and law and often attracting the highest salaries.

12. What can universities do to improve the situation?

Universities need to engage more with schools – although this is resource intensive. Schemes such as Researchers in Residence are helpful. Project work and competitions all contribute to the engagement.

13. Is there a case for curriculum reform? Is this the barrier?

There is always a need for curriculum updates and this would probably be a good first step.

14. Is there a need for an increased recognition of ICT and computing as part of the T in STEM, through representation in STEM forums and increased funding?

Definitely. This may open arguments over whether it should also be part of the E in STEM – but the key thing is for it to be recognized as part of STEM. In Northern Ireland, Computing is included by government as part of STEM.

15. What happens if we do nothing?

We can't do nothing as we all need to promote the discipline, not just to maintain enrolments but in recognition of the contribution that our graduates can make to the economic performance of the country. The IT Industry is growing and the supply and demand gap is growing. As the industry matures, the replacement numbers will also increase and add to the demand. In a Northern Ireland context, we are moving from traditional engineering towards a knowledge-based economy and that will be dependent on computer science graduates. Growing the economy through foreign investment (companies locating their software houses in NI), has always been due to the quality and quantity of our IT Graduates in the past and this must be maintained.

General Observations

1. There has been a significant decrease in the number of students taking Computing as an A-Level. At the same time there has been a large increase in the number taking ICT. Overall, there has been a substantial net increase in students studying a computing–related A-level, with greater numbers then applying for computing courses and entering the University with some computing background.
2. It would appear from talking to ICT/Computing teachers that the decision to offer an ICT A-level is driven by league tables and school budgets.
    a. Teachers are reluctant to publicly admit this but will often do so "off the record".
    b. ICT is seen as an A-Level in which the majority of students can perform well. Computing is seen as significantly more demanding and hence less likely to result in success for the students or the school. A good grade in ICT can be achieved with adequate problem-solving skills. Problem-solving is implicit in studying Computing. There is no programming as such in the ICT curriculum.

   c. Teaching Computing at A-level is also likely to be 'more expensive' in terms of the skill needed by the teachers involved and the facilities that need to be provided. ICT can be delivered by a wide range of teaching staff – Computing can not.

3. Curriculum Designers (A-Level) are aware of the mass market appeal of ICT and appear keen to make a clear distinction between ICT and Computing. We suspect that this distinction is increasing.
4. Students can often comment that "ICT is boring". These students can be switched off from the subject and potentially good students may be dissuaded from studying Computing at University.
5. Possibly as result of the ICT curriculum, some have a very blinkered view of Computing, seeing it as little more than "Microsoft Office with bells". These students may apply for a computing course unaware of its true nature (until it is too late?). Conversely the fact that ICT is delivering basic skills to a wide audience can have a positive impact – introducing students to the subject, which may in turn stimulate them to explore the subject more.
6. We need better teachers and advocates at all levels in schools (e.g. in careers). Some schools rely on staff who because of insufficient interest and/or understanding make a less than enthusiastic presentation to their students.
7. Students appear to get into Computing by a number of routes. Often it is a side effect of interest in some area (computer games, home network security, mobile computing etc.). It can also be by inspiration of a schoolteacher, sibling or other influential person.
8. Mathematical skills underpin many aspects of Computing and, historically, students with good scientific backgrounds perform well in computing courses.
9. It is probably unreasonable to expect schools to solve this problem. One strategy for improvement is to build better links with schools to make clear the nature of a university degree in computing. We might also facilitate a link with employers so that job opportunities are reasonably well understood. We also need to be consistent in our advice. For example, in the current situation what should we be recommending that pupils study at A-level? Differential admissions offers (i.e. lower offers for those offering A-level Computing) could also be considered.

Professor Richard J Millar
Dean

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