AoC & ALT Submission

November 2010

AoC/ALT Response to Royal Society Call for Evidence Computing in Schools

The Association for Learning Technology (ALT) and the Association of Colleges (AoC) are pleased to respond jointly to the call for evidence.

The Association of Colleges (AoC) represents and promotes the interests of Further Education Colleges and their students. Colleges provide a rich mix of academic and vocational education.

- Every year Colleges educate and train three million people.
- 39% of entrants to higher education come from Colleges.
- More than half of all Foundation Degree students are taught in Colleges.
- 172,000 students study higher education in a College.
- 737,000 of these students are aged 16 to 18 which compares to 487,000 in schools.

The Association for Learning Technology (ALT), a membership charity, is the leading UK body bringing together practitioners, researchers, policy makers and funders of learning technology within and beyond UK FE and HE. ALT has over 700 individual and over 200 organisational and sponsoring members, covering government, institutions and industry.

ALT and AoC signed a memorandum of understanding in July 2010 and this joint response[1] is one of the early products of the collaboration that the memorandum of understanding envisages.

1. Is computing a discipline, in the same way that mathematics, physics and chemistry are?
Yes, computing (defined as curricula which focus on the use of computers to solve problems) is a distinct discipline insofar as it might be taught in ways similar to existing more 'traditional' subjects; but it should be noted that all disciplines require differing ways of being taught, and many disciplines (of which computing is one) draw heavily on other disciplines.

Computing and Computer Science should not be confused with "Digital Literacies" – which are part of the key skills agenda. It is the view of ALT and AoC that the teaching of these key skills is often the cause of the issues that students have with the teaching of computing more generally. This distinction is fundamental to the answers to the questions given below.

2. Is programming a fundamental form of literacy in the modern age?
The answer to this question depends on definitions and especially that used for 'programming'. Certainly, the ability to analyse and manipulate information is increasingly fundamental to working in the knowledge society, and programming is certainly one way of addressing that need (along with understanding statistics, office products and exploratory data analysis tools). If, however, literacy in this context is defined with reference to fluency in a particular language and programming may be defined as a language then the nature of the question is changed.

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[1] The response was prepared jointly by members and staff of AoC and ALT including Professor Alexandre Borovik, Professor Hugh Davis, Matthew Dean, Dave Pickersgill, Seb Schmoller, Professor John Slater and Kristian Still.

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

The same set of purposes that every other discipline taught in schools serve. There is no single purpose in teaching Mathematics say, nor ICT and Computing. A right to education has been created and recognized by some jurisdictions: since 1952, Article 2 of the first Protocol to the European Convention on Human Rights[2] obliges all signatory countries to guarantee the right to education. It can be argued that digital literacy is part of that fundamental right as are other key skills. The argument for Computing being included or offered at a particular level is less clear as a right but it is something that can fit into the general purposes of education in schools, as are Physics or History.

These purposes may include teaching meta skills (learning to learn, problem solving etc), providing relevant vocational knowledge and training, fitting the person being educated to take a full part in society, and providing necessary knowledge, skills and competencies to support other education. Computing and ICT contain elements of all of these purposes.

Again it is important to distinguish between 'Digital Literacies' (which should be taught to all) and Computing which should be an introduction to the discipline. Notwithstanding the scope for children to acquire a basic conceptual understanding of some aspects of computing at a young age using environments like Logo[3] or Turtle Blocks[4], it may be that Computing-as-a-discipline should be reserved for the later stages of school education as it can be conceptually quite advanced.

4. Is teaching of ICT (and associated qualifications) fit for purpose for all students and what should be done if not?

A number of problems arise in teaching ICT and Computing. While some of these are shared with the other 'disciplines', some are not. We highlight some of the issues in the bulleted list below.

- The IT (GCSE) and Computing (A level) curricula as designed are somewhat prosaic and artificial as a result of historical legacy and the need for curriculum to satisfy a number of competing interests. As an example, when spelling, punctuation and grammar were considered to be of paramount importance by the authorities/government, the use of spelling and grammar checkers was considered to be a form of 'cheating' to be avoided.
- Until very recently the current knowledge and skills of those teaching C&IT in schools and FE were considered to be either variable or uniformly poor. This has only been partially addressed by some new teachers entering the profession after the dotcom bubble collapsed and by the use of the technology itself to add to the skills and knowledge of existing teachers.
- Teachers now have available to them considerable resources and peer support. These are not yet fully used. The same is true of learners. The move to learning partly through peers rather than mainly from a teacher has been slow but is beginning to pick up.
- The field is fast-moving. There is a need for a significantly higher refreshment rate for syllabus and assessment schemes than is required in most disciplines. It is hard for examining authorities to do this with current approval and consultation cycles which can last 5 years form first consideration to first student with qualification.

[2] http://en.wikipedia.org/wiki/European_Convention_on_Human_Rights last accessed 24/10/2010
[3] http://en.wikipedia.org/wiki/Logo_%28programming_language%29 last accessed 24/10/2010
[4] http://activities.sugarlabs.org/en-US/sugar/addon/4027 last accessed 24/10/2010

- The transition from key skills to solid discipline work is fudged. Mathematics and English for instance make it much clearer that there are changes in form and content between the "every knowledge economy worker must know" of GCSE and the "discipline in preparation for HE" of A level.
- Problems occur in the school year 8/9 area where choices are being made. There is a lack of really good advice or engaging materials here. Some sort of "learning ladder" as with English or as with Foreign Languages could possibly be constructed for IT and Computing.
- Partially as a result, the A-level in Computing was considered to be a 'second class', award (as with Law and others). This was articulated by many in UK university Computer Science departments; although the situation has changed somewhat as recruitment numbers decreased. While analysis and problem solving were articulated as key, and these are things which are needed in HE, the view was that opportunities to circumvent were included and that there was too high a component of routine material which stressed formulaic at the expense of conceptual knowledge.

To address this ongoing problem a number of changes are needed:

- The emphasis on analysis, conceptual understanding, and problem solving needs to be reinforced at A level with a syllabus update. The knowledge and skills required in the transition to A level has to be clearer and better understood by those in schools.
- More use of technology should be made to teach all disciplines but especially CS & IT. Greater peer support for teachers and learners should be available. This can happen very quickly and at low or zero cost with a change of mindset and rewards.
- A mechanism for much more rapid refreshment of dated material (in particular syllabuses and assessment schemes) must be found, and the latter should be made product and/or application neutral.
- Advisors in schools should be more up to date and positive about the learning at all levels and not rely on outdated views (for instance that as a result of the dotcom bubble there are now very few career opportunities in Computing).
- Those in HE should also be more positive and less conditioned by their own somewhat out of date experiences and their own pedagogical knowledge and approaches. This is important in the light of the profound social, economic and cultural impact of what is becoming ubiquitous technology.

5. How should Computing be "learnt"?

A form of blended learning is required, mixing "doing" with more traditional learning and experience. This is no different from say Mathematics but probably needs more group work and definitely needs more technology support.

6. What motivates students to study Computing:

There are many answers to this question, ranging from the fact that students may find it fun, that they enjoy it and that it may help their career. They are often inspired by a mentor/ role model. This role model is sometimes within the school and sometimes outside. All of this is as with other disciplines. It may also be argued that the immediacy of working with computers to solve specific problems is an intrinsically satisfying way to learn.

7. How is it presented and what is the variation?

There is tremendous variation between traditional learning and modern technology supported learning. In practice, a blended model is needed with some freedom over the blend but significantly shifted towards use of technology, exploratory work, and peer-based learning.

8. Who is teaching computing?
This should be the subject of specific evidence from other sources. Anecdotally there is a severe shortage amongst teachers of those whose degrees are in CS, Mathematics, Physics, or IT, or who indeed themselves have A level Computing. Authoritative data here would be of immense use to others looking at this area.

9. Why do some universities prefer Maths to Computing A level?
Please see the answer to question 4; this needs to be addressed in the Computing A level. There are three perspectives here:

- Computer Science as taught in some universities is a branch of Mathematics;
- past research has shown that performance in Maths A level is a better indicator for success at University than that in A level Computing;
- students with Maths A level have demonstrated the ability in modeling and abstraction that is also needed for Computing. No other A level does this so well.

It should also be noted that since it is not possible to insist that all students have Computing A level (it is not available universally) then there has been a problem for HE teachers dealing with mixed classes. Some HEIs have used this as a reason to discourage people from the A level.

HEIs change very slowly. To "achieve balance", recruitment literature usually stresses courses that have recruitment difficulty but plenty of research-active staff (analysis of column inches in prospectus devoted to Chemistry or Modern Languages in the period 1985 –present when compared with the student numbers is a good example). Indeed any sensible analysis would suggest doing that. From the point of view of maximizing funds from the relevant HE funding body, the best financial strategy for an HEI is roughly to fit undergraduate numbers to existing successfully research active academic staff as far as it can. Until relatively recently, degrees in Computer Science or IT had little difficulty in recruiting and so had very small resources or skills in support of recruitment etc. – and this has not yet been fully turned round. In addition, students with A level Mathematics rather than Computing are arguably better prepared and more likely to be persuaded to change course or option choice towards areas in need of students.

Finally, there is still very likely to be a substantial self image factor at work. "Not doing A level Computing did me no harm in pursuing an academic career in CS so the same must be true for those at school now."

10. Perceptions among learners, teachers and heads?
This should be the subject of specific evidence from other sources. Again, good data here would be of ongoing value to education researchers.

11. Are these issues unique to the UK?
No, but it is possible that we have an "attitude problem" that is greater than most –as with some other disciplines such as engineering and even mathematics. There is a considerable difference between Europe and other aging economies and the newer economies where these effects are weaker or non existent.

In other parts of the world, competencies relating to the use of technology as well as Computer Science and IT as subjects are viewed as essential elements in building successful economies. In many parts of Asia the educational level in computing expected of knowledge society workers is likely to go some way beyond that expected in the UK, and Computing is also seen as a good vehicle in which to situate teaching the skills of analysis and problem solving.

12. What can universities do to improve the situation?

- get more involved in design and delivery of A level syllabus, help with materials or support for decisions in year 8/9, and specify HE requirements.
- provide networking opportunities for teachers and learners in Schools and FE.
- provide fine granularity CPD for teachers using technology; but above all
- rework their handling of Computing and IT in education departments and include teaching using technology as an urgent part of any learner's preparation for school teaching.

13. Curriculum reform?

Yes, it is necessary and must cover teaching methods, blended learning and frequency of refreshment – see above. Much of the current syllabus is inherently obsolete before delivery for the first cohort is concluded.

14. Recognition as part of STEM

The digital literacies referred to in previous answers are part of STEM. So are many of the skills of A level Computing.

15. What happens if we do nothing?

Even when posed as "What happens if nothing is done?" this is difficult to answer. It is a counterfactual question. The call for evidence suggests that there exist problems which inaction would do nothing to alleviate. Asking about the result of inaction from a specific group of people such as the Royal Society or the members of this committee (not clear who "we" are) is even harder to address.

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