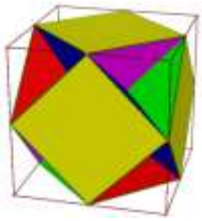
Reforming UK Technological Education in schools – the smarter way

Tony Houghton and Adrian Oldknow www.ccite.org
The Centre for Innovation in Technological Education in Cambridge



The Design Brief – as it's broke, let's fix it

The STEM strategy for schools has not had the desired effect on meeting the skills shortages threatening UK economic competitiveness. We need therefore to design a solution to restore the UK's position as a world leader in technological education which can be implemented as speedily, cheaply and with as little disruption as possible.

A bit of background

In March 2001, the UK Government's Treasury commissioned Sir Gareth Roberts to undertake a review into the supply of science and engineering skills in the UK. The final report, entitled `SET for Success' was published on 15 April 2003. The report set out thirty-seven recommendations to the Government, employers and other organisations about how to maintain and develop the supply of people with science, technology, engineering and mathematical (STEM) skills into research and industry. All his recommendations were accepted by the Government, including the establishment of a national and nine regional Science Learning Centres. It also established the Science Council, alongside the Engineering Council, and effectively recognised mathematics as a science. The DTI and the DfES STEM Programme Report of 2004 said that: "*Our proposals work towards a vision that aims to ensure that STEM support is delivered in the most effective way to every school, college, learning provider and learner... We have a responsibility to capture the imagination of young people who will become the scientists, technologists, engineers and mathematicians of the future, and help them reach their full potential. Through delivery of our proposals we will make this a reality. The future success of the British economy depends on their contribution*." This led to the establishment of the current `STEM Cohesion Strategy' which has in reality concentrated mainly on enhancement and enrichment in science, with some provision for mathematics, whose main aim was to increase numbers of candidates for science and maths A-levels. That strategy has paid little or no attention to technology and engineering, and none to computing. It has not attempted to establish any coherence in the sense of cross-curricular (aka inter-disciplinary) activities across STEM subjects, nor in the encouragement of the personal, learning and thinking skills which the late QCDA's "Big Picture of the Curriculum" sought to develop on the advice of employers and HE alike. Since the election, STEM education 5-18 has been very much on the back-burner in schools, despite the Chancellor's `UK Plan for Growth' having "*Creating a more educated workforce that is the most flexible in Europe*" as one of its four key planks!

Some calls to arms

The CBI and other employers' federations have regularly reported over the past 5 years on the effects of skills shortages on key UK business, such as aerospace. NESTA published its `Next Gen.' report from Ian Livingstone and Alex Hope in 2011 which pointed to the severe skills shortage threatening UK's leadership in the international video, games, animations and special effects aspects of the creative industries. This resulted in the successful `Next Gen Skills Campaign', backed by Google, Microsoft, BCS and e-skills, which has resulted in ICT being replaced by Computing on the school curriculum. This received a significant boost from the challenge made by Google's chairman, Eric Schmidt at the Edinburgh Festival: *"Over the past century, the UK has stopped nurturing its polymaths. You need to bring art and science back together."* http://www.guardian.co.uk/technology/2011/aug/26/eric-schmidt-chairman-google-education. The Royal Academy of Engineering published `Jobs and Growth: the importance of engineering skills to the UK economy' in September: http://www.raeng.org.uk/news/publications/list/reports/Jobs_and_Growth.pdf . When Messrs Clegg and Gove announced intended reforms of GCSEs last Autumn, they were roundly criticised by both Lord Ken Baker (UCTs) and Neil Carberry (CBI) as being irrelevant tinkering with the academic end of the school spectrum while completely ignoring the more pressing vocational needs. The CBI have been working with organisations such as the Association of School and College Leaders (ASCL) to produce their `First Steps' report criticising the way schools have become `exam factories' and calling for a broader curriculum equipping students with employability skills. At the CBI conference in November, their Director General, John Cridland, announced the new `Ambition For All In Schools" educational campaign backed by business and industry: http://www.cbi.org.uk/campaigns/education-campaign-ambition-for-all/. In January the Commons Select Committee on Science & Engineering published their critical report on `Educating Tomorrow's Engineers': http://www.publications.parliament.uk/pa/cm201213/cmselect/cmsctech/665/66502.htm. At the moment, though, despite all these calls that "your country needs you", there is still no sign of the government being willing to take the lead in persuading schools to play their part in addressing the skills crisis.

Meanwhile, on the home front

The DfE has now published the long awaited outcomes of its curriculum review – which has pulled back from the original advice of its Expert Group, which was only to specify in detail the curriculum for maths, science and English. The Education For Engineering (E4E) group held a conference at the Royal Academy of Engineering in March on `Technological Subjects In The National Curriculum' chaired by Dick Olver, Chairman of BAE Systems, who roundly criticised the DfE proposals for Design & Technology, and called for a more demanding curriculum in which students work in teams, solve problems and apply their knowledge and skills in designing, making and testing artefacts. By contrast there was a general feeling that the Computing proposals were a considerable improvement over the current ICT curriculum, which is past its sell-by date, and which fairly closely follows the BCS and RAEng proposals. Another contrast between D&T and Computing is in the recognition of Computing as a science and hence a place in the EBac. The salt has been further rubbed in the wounds by the announcement by the DfE of funding for professional development of Computing teachers: https://www.gov.uk/government/news/facebook-microsoft-and-bcs-back-government-funding-for-computer-science-teaching. Whatever the final wording of the Programmes of Study (PoS) for D&T and Computing, it is now clear that schools will have considerable adjustments to make in delivering them from September 2014. So maybe it's an ill wind which just may have the effect of encouraging schools to review the way in which technological education is embedded in the curriculum for all pupils 5-14 and beyond?

In order to provide an up-to-date and broadly balanced curriculum reflecting the ways digital and other technologies permeate work practice, schools will be left with other problems to address in terms of coherence and relevance. While the mathematics PoS retains the statement "They should also apply their mathematical knowledge in science and other subjects", it has dropped "In both primary and secondary, a wider range of new technology should be considered, including teaching through the use of the graphing, dynamic geometry, spread sheet and simulation software available. Many ICT tools allow pupils to use different mathematical representations (e.g. number, algebra, graphs) to aid conceptual development. As technology changes, teachers need to assess what the latest innovations offer in teaching mathematics." The detailed content of the maths, science, D&T, and Art & Design proposals contain almost no references to the relationships between the subjects or the ways in which IT tools are used by their practitioners.

It's good news week

In the Spring of 2011 the now defunct Becta organised a series of think-tanks called `Fit For The Future' to take forward the educational aspects of Futurelab's seminal `Beyond Current Horizons' report. One of these was on `Future Skills' and concentrated on fast-tracking a whole school approach to STEM education. With the change of government and the demise of Becta a group of school leaders' and STEM subject teachers' professional associations (ASCL, ASE, CAS, DATA, MA, NSEAD and Primary Engineer) decided to carry through the approach by developing a strategy for schools to embed STEM education in the curriculum for all pupils. The resulting SySTEMiC strategy was very well received, but no organisation was forthcoming to take it on board. So, as a Big Society venture, we decided to do it ourselves and established the Centre for Innovation in Technological Education in Cambridge (CCITE – http://ccite.org/). ASCL and CBI are supporting CCITE's development of its `Technological Education For All Pupils' strategy in response to the CBI's `Ambition For All In Schools' with the support of business and industry, By the end of 2014 CCITE will have assembled and tested a complete know-how kit for schools, colleges and academies (8-18) on how to deliver and manage a whole-school approach to technological education. This will support schools delivering the new D&T and Computing curricula as well as making the maths and science curricula more relevant and interesting, while also enhancing pupils' general personal learning and thinking skills in aspects such as problem-solving, team work and communication sought after by employers.

A key component of this strategy is a collection of resources to support 20 half-termly, cross-curricular, problem-solving projects in each of Key Stage 2 (8-11) and Key Stage 3 (11-14) – the `20-20 CCITE STEM projects'. Through these projects students apply maths, science and computing skills to designing solutions to challenging and authentic problems and to making artefacts. Through these projects students not only make us of relevant software (much of it free) but also use IT to access information, collaborate with others and to present their results. They build up an accredited portfolio of their personal work, and are in a position to make well-informed choices about future subject and pathway choices. They are also better equipped to see the importance of curriculum subjects such as science, D&T, computing and mathematics and will be better motivated to achieve good results. Teachers mentoring and supporting student projects will learn on-the-job about the relevance of their subjects in the wider world and be better placed to make their teaching of those subjects more engaging, relevant and challenging. Schools will receive guidance and support on a variety of ways to engage talented members from a wider community including parents, governors, older students, employers and employees.

The CCITE logo was created in Autodesk's Inventor 3D modelling software which is free to education. It is based on a cube whose six faces represent the Science, Technology, Engineering and Mathematics from the STEM acronym combined with both Computing and Personal skills. The pyramids around each vertex have been pushed inwards to reveal some of the essential inter-dependencies between these aspects of a modern technological education.

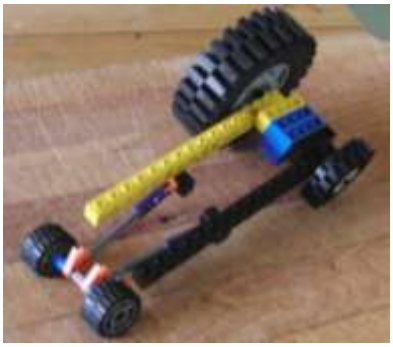
So let's get started

Putting UK's technological education on a secure footing is a vital and challenging task. We believe we have come up with the design principles to tackle this successfully within the constraints of time, money and disruption. We estimate the costs involved to flesh these out, test, modify and disseminate to be of the order of £3m over 2/3 years. It is important for the financial stakeholders to be drawn widely – mainly from business and industry, but also to give opportunities for charities, philanthropists, government and other organisations to participate. So we hope that we can find up to 60 contributors to take out shares in multiples of £50k to raise the capital required. As well as help in raising funds, we need participation of experts from many fields in fleshing out the detail – particularly the content of the 20-20 projects. We also need trial and early adaptor schools, colleges and academies (5-19) to test out and help develop the materials. Of course we also need leadership from politicians, industrialists and thought leaders in driving the message home just why it so important for the UK to fix its technological education in the shortest time possible. It should not be difficult to convince school managers and governors to engage in reforming their school's technological education for all pupils and students as:

a. the country needs better skilled school-leavers to maintain international economic competitiveness;
b. all pupils deserve to have the opportunity to develop their full potential and access rewarding careers;
c. schools have the autonomy to develop a broader, more coherent and relevant curriculum;
d. better motivated students and better informed teachers will result in better examination results and
e. our society will benefit from the contribution skilled technologists make to improving our lives.

You can contact us at: Dr. Tony Houghton – CCITE Education Development Director ajh249@gmail.com
Prof. Adrian Oldknow – CCITE Founder adrian@ccite.org

The challenge is to replace the current "**S**te**M** Mark 1" model with a world-beating combination!



UK youth deserves the best!

A picture challenge – match the twelve photos below to the UK engineer and/or designer!

Mike Burrows
Sir Norman Foster
Gordon Lewis
David Noble

Sir Tim Berners-Lee
Godfrey Hounsfield
Peter Molyneux
Andrew Ritchie

Ian Callum
Sir Jony Ive
Robert Moog
John Shuttleworth