

'iSTEM+' (read "i-STEM Plus") stands for '*integrated STEM education including more subjects, skills and people*'. It is an organisational tool to support a whole-school approach to embedding joined-up STEM education & skills in the curriculum for all learners. Such schools are called '**Skilful Schools**' and they work with other partners including nearby schools, parents and employers in '**iSTEM+ local clusters**' providing cross-curricular opportunities for the development of both STEM and employability skills.

The origins of the acronym STEM are in the *SET for Success Report* of Sir Gareth [Roberts' Review](#) of the supply of people with Science, Technology, Engineering and Mathematical skills for HM Treasury published in March 2002. This identified a number of issues in school, further and higher education, as well as in the labour market for science and engineering skills, that needed to be addressed in order to secure a strong future supply of scientists and engineers in the UK. This formed the basis of the last [Government's policy](#): "*Science and research are major contributors to the prosperity of the UK. For our prosperity to continue, the government believes we need high levels of skills in science, technology, engineering and maths (STEM), and citizens that value them.*" The same policy is being taken forward by the current [Government](#). STEM skills are required to support other Government policies such as [Business Enterprise, Industry, Media & Creative Industries, Research & Development, Science & Innovation, UK Economic Growth](#) and the impending [UK Digital Strategy](#). A new aspect is that of Digital Skills. This was the subject of the House of Lords [Make or Break](#) report in 2015 and of the current House of Commons [Digital Skills Enquiry](#).

Employer's organisations have consistently reported increasing shortages of STEM-skilled people as a major factor in inhibiting economic growth – see the 2015 CBI [Inspiring growth](#) education and skills survey. Most schools provide STEM enrichment activities such as clubs, visits and competitions for some of their pupils. There are many organisations supporting such activities such as [STEMNet](#), [STEM Learning](#), [Tomorrow's Engineers](#) and [Your Life](#). But these have not been sufficient to meet the increasing demands of employers. Building on preparatory work by Becta's 2010 [Fit For The Future](#) project, a group from the STEM teachers' professional associations ([ASE](#), [ATM](#), [CAS](#), [DATA](#), [MA](#), [NSEAD](#), [YST](#)) and the Association of School and College Leaders ([ASCL](#)), has developed a whole-school, bottom-up strategy to embed an integrated approach to STEM education and skills in the curriculum for all students 5-19. This has been developed by the Cambridge Centre for Innovation in Technological Education [CCITE](#) into the 'iSTEM+ approach'.

The aim is to restore the UK to the position of a world-leader in technological education it previously held. In the 1980s the UK responded to the skills crisis of the day, the '[Challenge of the chip](#)', with the [BBC's digital literacy](#) campaign (and [BBC micro](#)), the Microelectronics Education Programme [MEP](#), the '[Micros in Schools](#)' initiative and the Technical & Vocational Education Initiative [TVEI](#). This was a cross-government response from Mrs. Thatcher's first Government led by the Departments of Industry, Employment and Education. Two of the chief architects of that response, Lord Baker and Lord Young, are still actively engaged with educational reform through the [University Technical Colleges](#) and [Enterprise Education](#).

Now, 35 years later, we are in a position to respond to the [criticisms](#) made of our [technological education](#) by Google's chairman, Dr. [Eric Schmidt](#). Digital technologies, especially mobile ones, are now all pervasive, powerful and affordable. All students in England now follow a [Computing curriculum](#) 5-16 which requires them to learn how to program a computer. The BBC has launched its '[Make it Digital](#)' initiative and, together with partners, is providing the BBC [micro:bit](#) free to all 11-year olds with a plethora of supporting [materials](#). The [Raspberry Pi](#) has sold more than 5m and recently launched [two new models](#). The [Pi Zero](#) and [Crumble](#) devices are less than £5, my grandson's pocket money. The [Digital Inc.](#) initiative enables schools to provide heavily discounted connectivity and platforms which can be paid for from Pupil Premium.

The DfE has established its Careers & Enterprise Company [C&EC](#) which is working through the 39 English Local Enterprise Partnerships [LEPs](#) to provide every state secondary school and college 12-18 with a volunteer Enterprise Adviser [EA](#) from a local employer. In his [speech](#) at the January [CaSE](#) Lecture, the Science Minister, [Jo Johnson](#), announced new funding to put the UK at the forefront of international research and inspire the next generation of world-class scientists. Since September, CCITE has been in discussion with DfE Ministers [Caroline Dinanage](#) and [Nick Boles](#) about developing the iSTEM+ approach as the basis for a new integrated STEM education & skills strategy for all learners 5-19. CCITE is now discussing with [Ed Vaizey](#), Minister for the Digital Economy, and DCMS officials, ways in which the UK Digital Strategy can support STEM education & skills in schools as well as promoting digital literacy. These include:

1. **Preparing young people to contribute to the digital economy.** In order to give students experience of working together to solve problems and create objects, supported by digital technologies, both primary and secondary schools should provide regular opportunities for cross-curricular group project work within the normal school timetable.
Such projects enable students, working in teams, to apply aspects of school subjects such as Science, Design Technology, Computing and Mathematics in realistic contexts. With effective planning, students develop their personal and employability skills, while teachers further their professional development.
2. **Learning to use the tools of the trade.** The current Computing curriculum in primary and secondary schools requires learners to write computer programs to develop their skills in computational thinking. This should be extended to other subjects such as Science, where students use appropriate IT tools to collect data from experiments using sensors and probes, analyse data, present and share results, and make mathematical models. In Art & Design students should use 3D creative tools to realise and improve designs and to create artefacts. In Design Technology students should develop systems which respond to sensed changes. The free [GeoGebra](#) software is the mathematical equivalent of Office.
3. **Connecting schools and colleges with digital industries.** The digital sector of the economy is volatile, and has a large number of quite small enterprises. Many of the largest companies have developed impressive educational strategies, but it is much more difficult for small companies to understand how and why they should contribute. There are now several organisations which facilitate this, including the [STEM Ambassador](#) programme, the new Careers & Enterprise Company's volunteer [Enterprise Advisers](#), the [Founders4Schools](#) initiative and the [National STEM Learning Centre](#)'s new Teachers' Industrial Placement scheme [TIPS](#). These programmes should continue to be supported by Government to provide a stable support environment. As a sector whose growth requires well-skilled school leavers it is particularly important for it to engage with schools and colleges to keep them informed.

Against that background we can now examine the iSTEM+ approach in greater detail. The world has changed since STEM was coined in 2002. Computing is now on the curriculum. Art&Design, Geography, History, PE&Sports are some of the other subjects which now have strong STEM connections. Schools have a long tradition, and considerable experience, in equipping young people with a variety of skills in sports, performing arts and in personal, social, health and economic education [PSHE](#). Employers are demanding that school leavers are equipped with the kinds of [employability skills](#) identified by STEMNet's industrial partners including AstraZeneca, BP, EDF, Nokia, QinetiQ, Shell and Siemens:

Communication and interpersonal skills	Problem solving skills
Using your initiative and being self-motivated	Working under pressure and to deadlines
Organisational skills	Team working
Ability to learn and adapt	Numeracy
Valuing diversity and difference	Negotiation skills

Such skills are not learned in isolation, but in the context of undertaking activities with others. The iSTEM+ approach to the development of such skills is through the provision of cross-curricular thematic projects in which learners work together in groups, perhaps competing with others, to solve problems and create artefacts. These can be provided at any Key Stage, but the most significant times are at Key Stages 2 and 3 (8-14) before students chose their GCSE options. Teachers mentoring such projects are not expected to be

experts, but can become co-learners with their students, thus gaining 'on the job' professional development. Students undertaking such projects become aware of the applications of subjects such as Mathematics, Science and Computing to the world around them, and are thus more likely to be motivated to learn them.

Project-based learning is a well-tried technique in education. The [Innovation Unit](#) has published a teachers' guide to project-based learning [Work That Matters](#). Among CCITE's partner organisations are [Activate Learning](#) and the [Aspirations Academies Trust](#), both of which take innovative approaches to project-based STEM learning. Activate's [Reading UTC](#) uses cross-curricular projects designed with its industrial sponsors in which students 14-18 work in small companies. It was rated 'Outstanding' by Ofsted last summer. As well as running primary and secondary academies, Aspirations also has Studio Schools such as the [Space Studio](#) in Banbury. The other 'more' in the iSTEM+ approach is for 'more people' i.e. engaging a wider learning community including peers, families, Governors, Ambassadors, employers and HE.

The term 'school' is used here to mean any school, academy or college providing full-time education for students between the ages of 5 and 19 – whether state or independent. An essential feature of a 'Skilful School' is greater cohesion between the various subjects and aspects of the school curriculum both in planning and delivery. That requires a shift in the habits of mind of those managing, planning and organising students' experiences on a daily basis. With the widespread abandonment of coursework at GCSE and reduction in provision for assessed practical work in Science, students now have very few opportunities to experience practical applications of the subjects they are studying. They have even less opportunity to work with others in solving problems and in designing and making artefacts and thus to develop the range of skills sought by employers. Another essential ingredient of a 'Skilful School' is the provision of opportunities for students to work in groups on practical activities which involve problem-solving and project work.

You can [download](#) and print the net of a coloured cuboctahedron which provides a graphic illustration of a 'Skilful School' in which four of the six squares represent the existing STEM subjects of Science, DT, Computing and Maths and the other two represent Engineering and Other subjects. These are glued together with eight triangles representing the integrating factors (the 8 P's) of:

- | | | | |
|--------------------|--------------------|--------------|------------------------------|
| Practical activity | Problem-solving | Project work | Personal 21stC skills |
| Professionalism | Pride and pleasure | Purpose | Pulling-in a wider community |

Any school, academy or college which implements the iSTEM+ approach is entitled to call itself a 'Skilful School' – the approach is completely open-source, and ownership is totally in the school's hands.

A Model for a Skilful School, Academy or College.

Adrian Oldknow adrian@ccite.org

Cut out round the shape, score, fold and glue.

Find some friends and form an iSTEM+ Cluster 5-19.

Read more at:
<http://www.nationalstemcentre.org.uk/elibrary/media-file/11480/a-quiet-istem-revolution-pdf/c89b0e98>

Visit <http://www.ccite.org/> and <http://www.nationalstemcentre.org.uk/elibrary/media/620/istem-an-etep-response-to-stem-skills-shortage-5-19>

View the presentation at <https://prezi.com/kblyesfwot/reforming-technological-education-5-19-the-istem-approach/>

In order to help schools make the transition into 'Skilful Schools' they are encouraged to form supportive, cross-phase 'iSTEM+ local clusters' with nearby schools and employers. The first such cluster was formed in May 2015 in Gosport, Hants with two Junior Schools (8-11), a state 11-16 secondary school, an 11-19 academy and a 16+ FE college. An example of the approach being taken at Gomer Junior School is at its 'gSTEM' website. Other clusters in formation are in Alton, Hants, in Newbury, W. Berks and in Bishops Stortford, Herts. The Worshipful Company of Information Technologists [WCIT](#) has entered into a [Memorandum of Understanding](#) with Northamptonshire County Council to support its 'Race to the Top' strategy for school improvement, which involves introducing the iSTEM+ approach across the County. The Northamptonshire LEP was one of the [pilot regions](#) for the Careers & Enterprise Company.

Our experience is that schools welcome the iSTEM+ approach on the grounds of Personal, Societal and Economic advantages. All of those concerned with education want to enable every student to achieve their maximal potential, which includes equipping them with the personal skills they need for employment. In order to maintain and improve our quality of life we need bright people to develop new and smarter ways to do so. In order to maintain national economic prosperity our industry must have the skilled workforce it needs. But, to use the hackneyed 'win-win' phrase, changing the habits of mind of schools to enhance and enrich the opportunities for their students to apply and extend their subject knowledge through interesting and relevant projects will also make them more motivated learners and hence more likely to do well in examinations. Engaging subject teachers in mentoring projects will up-date and enhance their subject knowledge and understanding as well as helping them to be more inspiring teachers. Involving a wider community in designing and supporting these projects (families, peers, employers, practitioners etc.) will break down the isolation between schools and the real-world their students inhabit as well as giving them the career advice and inspiration employers seek. These projects will also help deliver particular aspects of the new DT and Computing programmes of study which schools are currently struggling to provide and staff.

So, the scene is set and the table is laid. What is needed now is a clear message from Government and Industry to schools that "Our country needs you" to equip its future citizens with the STEM education and skills, as well as digital literacy, required to sustain economic prosperity, as well as to restore the UK as a world leader in technological education for all 5-19.

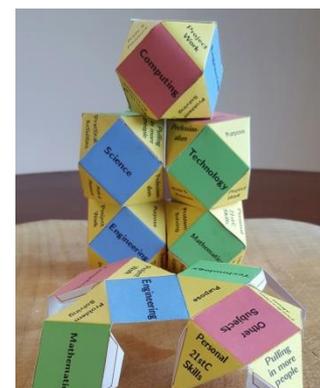
That costs nothing! But schools do need to be able to up-skill staff and to re-tool resources, and that does cost money. So we do need industry and Government to work together with education to ensure that our young people are taught by teachers with up-to-date skills using up-to-date equipment.



Get ready to:

- become a Skilful School
- form an iSTEM+ cluster
- help prepare for tomorrow's world
- make the UK great again

when the revolution comes.



[Fusion](#) is nearer than you think.