



School-industry STEM links in the UK: A report commissioned by Futurelab



Prepared by:

Dr Anthony Mann

(Education and Employers Taskforce – Anthony.mann@educationandemployers.org)

Professor Adrian Oldknow

(University of Chichester – aoldknow@yahoo.co.uk)

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Purpose, definitions, context and structure of the report

The purpose of this brief report is to provide an critical overview of the character and effectiveness of employer engagement in UK education (relevant to young people within the education system aged 5 to 19) related specifically to participation, achievement and progression in subjects of study and careers related to Science, Technology, Engineering and Mathematics (STEM).¹ Employer engagement is understood to be the range of activities which bring employers/employee volunteers into contact with learners to enrich learning and support positive progression. It would include, notably, provision of short (one or two week) or extended periods of work experience, careers advice, workplace visits and curriculum support/enrichment. Within the UK, a number of employers do support activities aimed at enhancing teacher professionalism, but they not are considered within this short report.

Pupil-focused employer engagement represents a long standing element of UK strategies to increase learner participation and achievement in STEM subjects so increasing the flow of young adults into higher education or directly into the STEM workforce. Over recent years, the UK government, with support from many STEM companies, through the guiding framework of the Strategic and Innovation Investment Framework (H M Treasury, 2004) covering the period from 2004 to 2014 sought to address these factors in increasing the flow of young people with STEM qualifications at all levels into the labour market.

The 2010 review by the UK National Audit Office (NAO, 2010) reviewed government and non-state related strategies to increase the volume and achievement levels of STEM-qualified young people. The review highlighted five critical success factors, of which the first (and to some extent fourth below) is especially relevant to employer engagement:

- Careers information and guidance
- Quality and quantity of school science facilities
- Quality and quantity of science teachers
- Image and interest in STEM subjects (pupil perceptions of interest and enjoyability)
- Availability of separate science subjects (Biology, Physics, Chemistry) at GCSE level (national qualification for learners aged 14 to 16)

This report addresses:

- The range and volume of engagement activities
- The character of delivery
- The impact of engagement activities
- School perspectives on outcomes
- Employer motivations and benefits
- Obstacles to the design, organisation and implementation of effective practice.

¹ UK policy and available related data overwhelmingly considers STEM (rather than MST) subjects and careers. While this use of STEM represents a broader scope than the MST focus of the ECB, there is a very close overlap between the two approaches. Education is a policy area for which the devolved nations of the UK (England, Scotland, Wales, Northern Ireland) have individual responsibility. This report focuses on best available UK and England data.

This report further provides, as annexed, illustrative case studies together with a list of references relevant to the UK experience. It draws on two key sources:

National Audit Office - NAO (November, 2010) *Department for Education – Educating the Next Generation of Scientists*. London: National Audit Office.

Education and Employers Taskforce (forthcoming, 2012), *Review of the Value and Impact of Employer Engagement in England, 2009/10*. London: Education and Employers Taskforce.

The delivery and value of STEM employer engagement in education activities

This section of the report draws heavily on a review of employer engagement in education undertaken by the Education and Employers Taskforce, a national charity initially funded by the English Department for Education to help close the gap between schools, colleges and employers.²

In 2011, the Taskforce research team undertook an extensive review of the volume and impact of employer engagement in England. As in this report, the review focused on direct, personal interactions between employers/employees and schools and colleges to support pupil learning and progression. The results are due for publication during 2012.

The review provides data to allow a best *de minimus* estimate of expenditure on dedicated employer engagement in STEM subjects in England during the school year 2009/10 at £13m. Included within the figure is an assessment of expenditure by national intermediary organisations (c.£7m), local intermediary organisations (c.£2m), the value of employee time contributions (c.£4m) and the value of school time costs (£0.2m). The estimate is based upon assessment of dedicated activity to bring STEM professionals into contact with pupils to support their learning and progression. Alongside such focused activity, schools engage in a wide range of generic employer engagement activities (work-related learning), such as work experience placements at age 15, an uncalculated proportion of which would fall into the STEM arena.

In 2009/10, central government invested some £3m in specific funding (exclusive of generic funding, such as the school grant or to support generic work-related learning) to support employer engagement in STEM subjects. Dedicated funding was channelled primarily through national intermediary organisations, notably STEMNET which received more than 80% of central government funding. Funding for STEMNET has been maintained since 2010. It is interesting to note that dedicated funding for STEM education activities from central government has been ~~funded from~~ provided by the Department for Business, Innovation and Skills, and not the Department for Education (which has been historically responsible for the greater part of generic expenditure enabling employer engagement within school approaches to work-related learning).

Delivery of employer engagement related to STEM education activities in England has been primarily undertaken through three delivery routes:

National intermediary organisations, notably:

- The Engineering Development Trust (EDT)

The Trust runs a range of programs aimed at supporting talented young people, aged 11-21, to progress successfully through to careers in engineering, science and technology. In 2009/10, it spent an estimated £3m on programs supporting school-age (11-18) pupils through employer engagement activities. Approximately half of EDT's income came from contributions from employers and one-sixth from fees from schools. EDT specialises in activity days, curriculum-focused in-company educational experiences, themed projects running over a term, STEM university courses for older pupils and a year in industry (paid

² See: www.educationandemployers.org

work placements) for young people in the year after completing secondary education and before beginning university or as part of a university sandwich degree.

- The Industrial Trust

The charitable Trust had a broader vocational focus than EDT, working to “guide and support young people to... increase their knowledge, understanding and appreciation of the industry, industrial and manufacturing processes...and related research, science, technologies, creative and wealth generating activities”. Like EDT, it received comparable proportions of its income from supportive employers and schools, through fees, to engage in services. The Trust has run a range of activities aimed at school and university learners. Programs focus on bringing young people into companies for tailored day long activities aimed primarily at improving understanding of career options and progression routes. During 2009/10, it is estimated that the Trust expended some £800,000 on enabling school-focused programs. The Trust has since merged with EDT.

- The Smallpeice Trust

The charitable Trust promotes “engineering, manufacturing, enterprise and technology in all its branches as a career to young people” through residential courses and STEM curriculum enhancement activity days. The Trust focuses its work on enabling young people aged 13 to 17 to work alongside engineers and technical specialists from industry. The Trust therefore aims to support pupil learning/attainment as well as career aspiration. It also runs teacher training days, and dedicates expenditure comparable to the Industrial Trust in support of its activities.

- STEMNET (the Science, Technology, Engineering and Mathematics Network)

STEMNET was founded in 2006 to raise the awareness of the importance of STEM subjects and interest in STEM careers, and to support schools to enrich/enhance learning primarily through enabling STEM professionals to engage directly with schools. Initially STEMNET received support from Gatsby, but now it is wholly funded by central government. STEMNET’s flagship program is the STEM Ambassador scheme. Through the program, over 25,000 volunteers are identified, undertake a short training course (2 hours) and are made available to schools. Ambassadors support both promotion of STEM subjects and enhancement of learning primarily through STEM Clubs which explore STEM projects outside of the school timetable/prescribed curriculum. STEMNET’s budget in 2009/10 was approximately £2.5m.

Further information about these four key organisations is annexed.³

Local intermediary organisations

³ Other activity is undertaken by national organisations, such as professional bodies, but tends to be on a much smaller scale or episodic in comparison to the four organisations discussed. Estimates of funding are taken from public annual accounts.

Over the last decade, the greater part of generic employer engagement in schools has been enabled through local intermediary organisations, typically known as Education Business Partnership Organisations (EBPOs). Until April 2011, funding from the English Department for Education (amounting to £25m) supported EBPO provision in every local authority area, with funding often topped up by local authorities themselves with schools paying some fees for services provided. Funding has supported a very wide range of employer engagement activities including some dedicated STEM provision – estimated at approximately 2% of £81m total local expenditure. The focus of activity has been on young people aged 14-16 (Key Stage 4 in the English educational system), serving to subsidise the costs of enacting a loosely phrased statutory requirement to work-related learning for pupils at that age. Primary emphases of such local provision have been on providing work experience placements (typically two weeks at age 15) and in enabling enterprise activities. In all, through local provision, hundreds of thousands of English employers and their employees have supported schools, including provision of some 500,000 work experience placements annually.

From April 2011, dedicated funding for EBPOs was halted with resource devolved directly to schools. In most, but not all, areas EBPOs have transitioned to charging full-costs to schools for services provided. The change in funding is connected to the planned repeal of the statutory requirement to work-related learning at key stage 4. Linked to the repeal of the requirement, government is committed to increasing generic employer engagement within provision for learners aged 16-18, particularly on more vocationally relevant courses of study where direct entry into the labour market is a more likely outcome for young people than university progression (DfE 2011).

Direct relationships between schools and employers

An unknown number of employers maintain direct schemes with schools, bypassing any intermediary organisation. Data on the volume and value of direct relationships between schools and employers has proved impossible to assess with any confidence. Case studies, given at annex 2, provide an insight into the type of relationships which do take place. It is estimated by the Education and Employers Taskforce that large UK employers which engage with schools (and the majority do), typically spend between £11,500 (250-1000 employees) and £47,000 (1000+ employees) on average in funding engagement with schools and colleges. Funding typically covers the costs of dedicated staff members located in either Corporate Responsibility or Human Resources departments responsible for liaising with schools and managing programs of engagement.

Estimating the total volume of employer engagement in STEM education in England

In terms of volume of activities, the review estimates that during 2009/10, some 15,000 employee volunteers spent some 150,000 hours engaged in *dedicated* STEM activities supporting pupil learning and progression. Of these, the great majority (more than 90%) were organised through national, rather than local, intermediary organisations. As noted above, this represents a *de minimus* assessment.

The character of employer engagement activities

UK employer engagement activities to support STEM education provision focus, therefore, on two primary outcome areas: to improve awareness of, and interest in, STEM careers and progression pathways, serving to increase pupil take-up of STEM study within the education system; and, to improve pupil achievement in STEM subjects through enrichment and enhancement activities. A high profile drive from 2008 to offer new, broader qualifications aimed at providing better preparations for vocational areas, including in STEM subject areas and drawing on more systematic employer engagement to enrich learning, has not been supported by the government which came to power in 2010.⁴

⁴ Important reforms to the curriculum undertaken over the last decade which were designed in part to provide new educational pathways into STEM careers through combining vocationally focused academic study with practical experience have been largely discontinued. The development of a new Diploma in Science (available at 14-16 and 16-19) was halted in 2010. The well regarded Diploma in Engineering, delivered from 2008, continues, but with low numbers and is at risk of withering away. Dedicated funding for the well-regarded Young Apprenticeship (which was offered in Engineering among other subjects and aimed at 14-16 year olds including 50 days of work experience) was halted in 2011 and provision is expected to disappear. Looking forward, vocationally-oriented programs of study at 16-19 are set for reform, in light of the 2011 Wolf Review (Wolf, 2011) which calls for more academically rigorous provision aimed more strongly at supporting young people directly into the labour market and delivered with stronger employer engagement than has hitherto been the case.

The impact of engagement activities

The best assessment of English strategies to improve the take-up and achievement of young people in STEM subjects is the 2010 National Audit Office (NAO) review. The NAO scrutinises public spending on behalf of Parliament.⁵

The NAO's 2010 review *Educating the next generation of scientists* considered a wide range of state funded (and independent, related) activities to promote a strong supply of young people with STEM skills under the guiding remit of the 2004 ten-year Science and Innovation Investment Framework. The review considered a wide range of initiatives, linked to five critical success factors (referenced above) which cover, in part, employer engagement initiatives. The review concluded:

- Progress, over the preceding five years, has been made in reversing the decline in young people taking STEM subjects in schools
- Resources have been seen to be focused on appropriate critical success factors to improve take-up and achievement in schools science and maths and has made “good progress” in some areas (e.g., A-level maths) more than others (e.g. A-level Physics).
- The successful reduction of initiatives from over 470 in 2004 aimed at improving take-up and achievement in school science and maths, of which two-thirds were not evaluated, consolidating provision within a much smaller number of programs largely covering science resources/learning materials, teacher quality and pupil attitudes
- Take-up of key programs, including the STEMNET Ambassador scheme, was high. Nine out of ten secondary schools take part in the Ambassador scheme
- “Schools using the programs have a greater proportion of pupils studying (STEM subjects), and several programs are associated with increases in take-up and achievement of separate sciences at GCSE, and maths and science A-level. However, it is difficult to establish whether this is a direct consequence of participating in the programs, or whether schools with an existing focus on science tend to access more such programs as a result.”
- The involvement of STEMNET Ambassadors in schools was identified by regression analysis of one of the interventions “associated with statistically significant increases in numbers of pupils achieving grades A*-C in GCSE sciences
- “Up to a point, take-up and achievement in GCSE science subjects is proportionally associated with the number of different programs in which schools participate. However, there may be diminishing returns when schools access larger numbers of interventions with similar objectives. More generally, ...analysis suggests that participation in these programs has less influence on take-up and achievement than other factors, such as pupil intake.”

While such progress is welcomed and has been confirmed by 2011 examination results, the report highlights declining positive perceptions of English pupils towards STEM subjects and particularly their vocational relevance, since the 1990s (NAO, 27).

⁵ See www.nao.org.uk.

Weakness of careers provision

An outcome weakness highlighted by the NAO review was in careers provision related to STEM subjects. Only 18% of pupils surveyed for the review were satisfied with the advice they had received relevant to STEM careers (NAO, 5). This was a weakness recognised by government prior to the publication of the NAO report and the development of STEM-careers web-resource <http://www.futuremorph.org/> was in part a response to this weakness.⁶ A significant recent review commissioned by the Department for Education considered and questioned the effectiveness of STEM careers advice and guidance in secondary schools. The report *Good Timing* (November 2011) represents the conclusion of a three year project, *Career Awareness Timeline Pilot*, involving the universities of Warwick and Derby. It highlighted risks to the momentum generated in improving STEM provision in schools represented by changes in national policy and recommended that schools adopt a more strategic and co-ordinated approach to careers provision. Two recommendations are particularly noteworthy.

Recommendation 5

“The importance of parents and families in influencing pupils’ career choices is often overlooked. Since many adults are fearful or simply unaware of STEM subjects, Government, schools and other agencies should consider how to increase parents’ awareness and confidence.”

The recommendation aligns with a second, significant review on attitudes to science among young people aged 10-14. This significant ongoing project – ASPIRES Science Aspiration and Career Choice, Age 10-14 - funded by the UK Economic Social Research Council, led by Professor Louise Archer (King’s College) has highlighted the concept of ‘science capital’ (considering the range of information and experiences available to young people) in understanding attitudes towards science study and careers.⁷ Initial findings from the review, from a significant survey of primary school pupils, shows that science capital varies considerably with social characteristics.

Recommendation 6

“Informal STEM learning activity, such as clubs and visits, should be more explicitly linked to careers. There should be more enrichment and enhancement opportunities in mathematics, design and technology, and engineering.”

⁶ A development of interest in this regard is the launch of a new resource by the Times Educational Supplement (weekly UK newspaper aimed at teachers). The Growing Ambitions website collates resources relevant to jobs and careers in all sectors making access easy for teaching professionals seeking to provide pupils with advice and guidance: <http://growingambitions.tes.co.uk/>

⁷ For more information: <http://www.kcl.ac.uk/sspp/departments/education/research/aspires/index.aspx>. Professor Archer presents early findings from the project at: <http://www.educationandemployers.org/research/research-seminars-2011-12/>. An interesting related report considers the perspectives of Black and Minority Ethnic pupils - Iain Springate, Jennie Harland, Pippa Lord and Anne Wilkin (2008). *Why choose physics and chemistry? The influences on physics and chemistry subject choices of BME students*. National Foundation for Educational Research. http://www.plasma.org/activity/policy/Publications/file_36117.pdf

The recommendation highlights a potential weakness within the UK experience of employer engagement. With much activity focused on enhancing learning through extracurricular STEM Clubs, risks exist that benefits will be largely felt by pupils with pre-existing high levels of interest in STEM who self-select into the activity. The recommendation, moreover, highlights a concern that activities focus disproportionately on classic scientific experimentation, at the expense of what might be seen as more applied areas of study and work.

Employer engagement and positive outcomes

From a broader perspective, the UK experience offers some helpful insight into the impact of employer engagement (in a general sense) on the learning and progression of young people. In 2008, the English Department for Education (then called the Department for Children, Schools and Families) published a commissioned report, *The involvement of business in education: a rapid assessment of measurable impacts*, which undertook a review of (primarily) US and UK public and academic literature in search of reliable evidence of causal connections between employer engagement and enhanced pupil attainment. The study highlighted the paucity of high quality evaluations. An initial trawl identified 161 reports of likely relevance. Closer examination showed that just 15, covering a range of very different initiatives held up to scrutiny as using scientifically robust methodologies. Of the 15, all showed positive impacts for young people, including preparedness for work, developing job and work skills, improving work-based competencies, attitudes and behaviours, enhanced employability and higher initial wage rates. None showed employer involvement in education decreasing attainment – an important conclusion as often employer-related activities can be seen as occupying learning time which might otherwise be used to engage learners in traditional teaching methods. Eight reports, related to five specific programs of employer engagement, demonstrated “evidence of measurable improvement in grades, or other measures of student attainment” through application of robust social science methodologies. Put another way, just 9% of the reports, reviews and evaluations identified were felt to be of sufficient quality to form a view, of any sort, on the impact of employer engagement on exam success, and of those relevant reports, 53% showed meaningful increases in grades and all some positive outcome.

Ongoing research into labour market outcomes represents an important new contribution to this sparse literature. Research, due for publication in 2012, was reported at the 2011 Education and Employers Taskforce annual research conference. It looked at the labour market outcomes of young adults 20-24 and found, having controlled for attainment levels, wage premiums (for those in receipt of a salary) positively correlated with the volume of employer engagement activities undertaken between ages of 14 and 19 whilst in education. The research appears to validate social capital theory approaches, as initially articulated by US sociologist Mark Granovetter which suggest the greater exposure to trusted, non-redundant information from labour market actors provides young people with insights and connections which enable better, more strategic decision making through school-to-work transitions and so better ultimate labour market matching.

School perspectives on outcomes

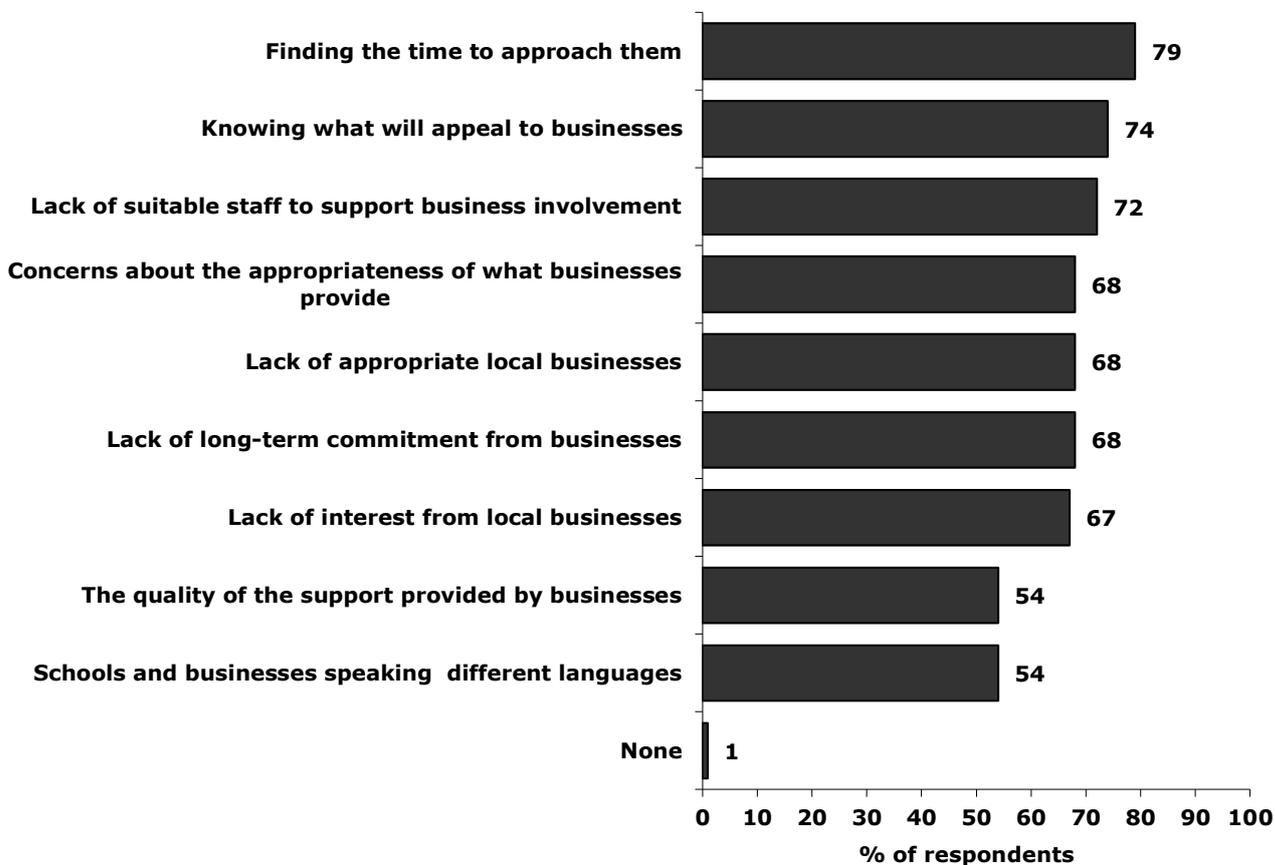
High school demand for employer engagement

A good indicator of demand of employer engagement in English secondary schools is participation in the STEMNET Ambassador scheme. In 2010, the NAO reported that 88% of secondaries took part in activities if with some significant variation across English local authorities (NAO 41-45).

The results are in line with strong demand for generic employer engagement across English schools. The best quality survey material of teacher views shows that just 1% of classroom teachers feel that there is too much employer engagement in English schools and 59% want more (YouGov 2010)

Barriers to greater engagement

In a poorly researched area, one of the better studies of school attitudes towards employer engagement comes from a 2007 survey of 400 English school leaders (Edcoms).



The survey highlighted very heavy demand from schools for employer engagement, notably in science and technology which was seen as the leading subject area where engagement would be valued (by 92% of respondents). This and other data all point towards a clear conclusion: the great majority of schools value employer engagement highly so long as it is easy, relevant and low cost to deliver.

The last two years have seen a significant change in the national delivery of employer engagement activities in England. Schools which had become accustomed to receiving much generic employer engagement at a cost heavily subsidised by national and local government are now required to cover full costs themselves at a time of tight school budgets and poor data on the educational and career outcomes associated with such investment. Anecdotal evidence from EBPOs suggests that the volume of employer engagement undertaken by schools fell by some 40% between 2009-10 and 2011-12. At the same time, schools have become increasingly focused on exam success, across narrowly academic subjects of study (the English Baccalaureate – see below), as the primary measure of institutional success.

In essence, English schools have become heavily engaged in generic employer engagement where it has been low cost and easy to engage in (where organised by an intermediary). With real costs rising and in the absence of easily accessible data on impacts on pupil attainment, new risks emerge to schools choosing to engage.

There is reason to believe that the risks of declining engagement will be lower in the STEM area than in other economic sectors/subject areas. Over a period when the greater part of funding for intermediary organisations has been discontinued, government investment in enabling STEM engagement has continued, most notably in continuing support for STEMNET. Moreover, costs in the STEM arena are shared more evenly between government, employers and schools (where a history of fee contribution exists) than is the case generally. However, it would be an overstatement to say that many in the UK STEM community are not concerned about the long term prospects for increasing, rather than simply preventing the reduction of, engagement levels.

In the longer term, government commitment to publishing data on the destinations of school-leavers 12 months after leaving education may serve to influence schools to place greater emphasis on supporting successful transitions into the workplace or continuing study in comparison to interest in academic attainment.⁸

⁸ Also noteworthy in this discussion are two recently developed programs: *Inspiring the Future* uses web technology to identify employee volunteers willing to speak in schools about their jobs and careers, *Inspiring the Future* offers a very low cost national means of enabling connections between schools and the workplace volunteers willing and able to support them. (www.inspiringthefuture.org). *Speakers for Schools* (www.speakers4schools.org) links high profile speakers, including many from STEM backgrounds, of national prominence with English state schools to broaden the horizons and raise interest of young people in issues of public interest.

Employer motivations and benefits

A reasonable assessment would suggest that between half and two-thirds of UK employers work with schools in some way, most commonly through provision of short work experience placements. A number of studies have sought to understand employer motivations in working with schools and colleges (Mann & Glover). While a range of motivations have been identified, four primary driving factors are consistently found:

Staff recruitment. Typically, the most commonly cited motivations are related to recruitment needs. Two aspects of recruitment are identified. A proportion of employers, particularly those which employ teenagers in paid employment, use work experience as a means of raising awareness of, and testing the suitability of young people for, employment opportunities. This is especially the case with SMEs which commonly recruit informally. Other employers, particularly in the public sector and large employers, engage with schools as a means to increase the ultimate flow of interested, well prepared young adults who would be interested in employment opportunities. This is a specific drive of STEM employers which have, as is common across Europe, often struggled to find a large enough pool of potential employees to satisfy recruitment demands. Routinely, UK studies have shown a sharp misalignment between the career aspirations of young people and the reality of labour market opportunities. One example is the great interest by young people, generated by the media, in forensic pathology.

As well as influencing career aspirations, many employers feel that new recruits lack important “employability skills” (team working, problem solving, effective communications etc) needed to be effective in post. Employer engagement in general, and work experience in particular, have become seen as a primary means of improving these competencies in future recruits. (UKCES)

Both approaches to employer engagement, however, touch on the employer desire to improve the match of new recruits to job vacancies. Linked to such better matching is improved productivity. One recent UK study of productivity uplifts which come from recruitment of better prepared young people, either directly following a (non-STEM) course of study rich in employer engagement, or after further study estimates uplifts to be significant for the first two years of employment and to be sustained, in some form, over a further eight years (Clifford). Arguably in this case, employer engagement provided insights to allow better decisions by young people on career aspirations and study options to achieve them.

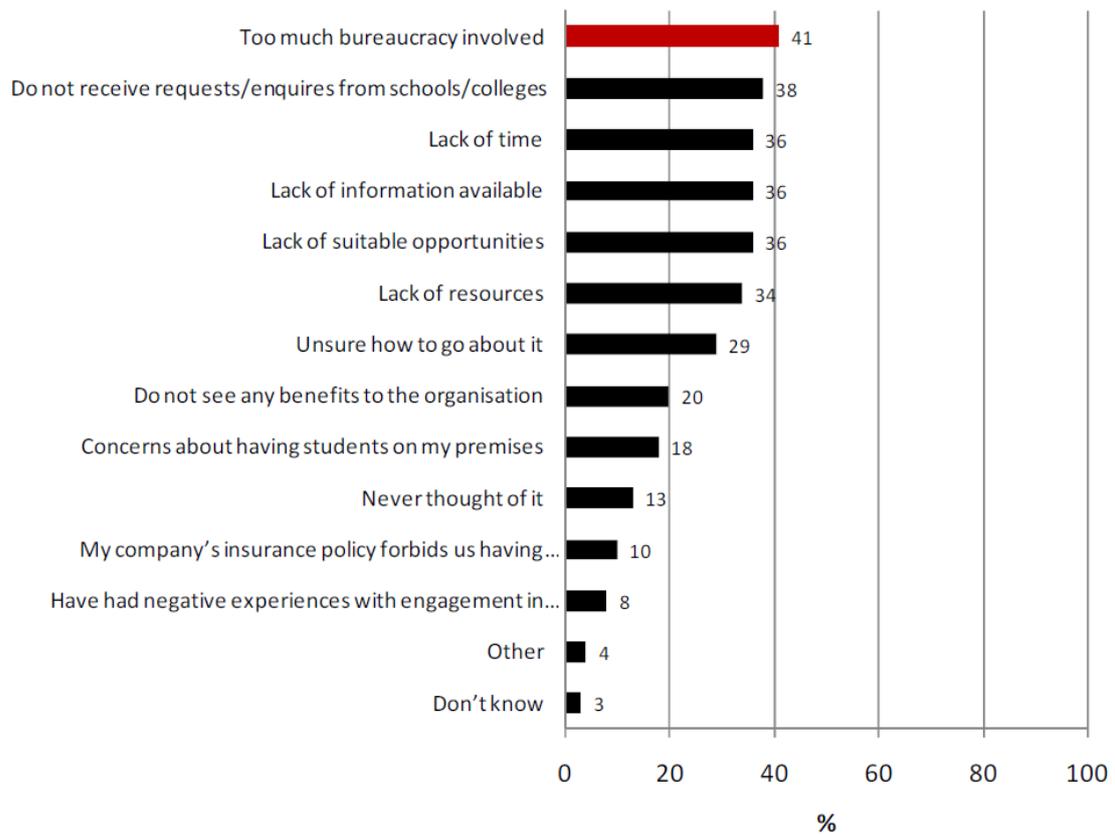
Staff development. A trend across larger UK companies is for management of relationships with schools to move from Corporate Responsibility departments to Human Resource Departments. In part, this move is driven by a recognition that employers have much to gain from engagement activities in terms of staff development. There is a tendency across larger employers to see engagement as particularly valuable to new graduate recruits who learn to become more personally effective through the experience of working with unfamiliar people in an unfamiliar setting. A landmark 2010 report sought to quantify the financial benefits of such development activities and concluded that “there is clear evidence that the skills and competencies developed through volunteering assignments are of direct relevance to companies involved” and that, having taken relative costs and outcomes into consideration, that volunteering assignment in education represent “a highly cost-effective way to develop certain core competencies.” (Corporate Citizenship)

Staff engagement. A further driver for employers to engage with schools is as part of corporate strategies to improve the engagement of staff. A growing HR literature has argued that where employee engagement (with an employer) is high, staff are more motivated, more productive, more willing to act as unprompted advocates for their firm, less likely to be absent and generally show higher levels of “pride and spirit” in the organisation they work for. Corporate responsibility in general and community engagement in particular are seen as important drivers of employer engagement levels. Reviews of the employee perceptions demonstrate that volunteering with education serves to increase motivation and commitment to employers. (Corporate Citizenship)

Corporate Reputation. Perhaps surprisingly, evidence on corporate reputation as a motivating factor for employer engagement with schools is sparse. Education is an especially attractive field of community activity: dependent children live in some 8 million households in the UK. Certainly, schools leaders feel that a primary benefit to employers from their engagement with schools is “improved reputation” and “stronger links with the communities in which they operate.” (Edcoms)

Employer perspectives on working with schools. As with schools, partnership working cannot be seen as a core business function for the great majority of employers. The UK experience demonstrates that employers will invest in supporting schools where it is easy and low cost for them to do so. Overwhelmingly, they are prepared to invest the time of the employees rather than contributing financial resources, save in the case of the largest employers (250+ employees). The majority of employers which work with schools in the UK do so through local or national intermediaries which typically provide services free of charge. Intermediaries provide a more efficient interface with schools. Surveys by UK pollsters, YouGov (YouGov 2010, YouGov 2008), highlight relatively consistent employer attitudes preventing deeper relationships with schools. Table 2 provides details from a 2010 survey.

Table 2: Main factors preventing surveyed organisations engaging more with the education sector



Base: All employers not currently engaged (406)

Conclusions

This review suggests that there is a broadly positive feeling with the UK about the use of employer engagement as a primary means to increase STEM take-up and achievement. Latest available data on pupil take-up and achievement in STEM subjects suggests continuing, if uneven, success. Specific initiatives to enhance STEM take-up and achievement in schools have been *largely* protected from austerity cuts.

However, political-driven changes to education policy may prove to present risks to continuing progress being made. In addition to changing the funding of local employer engagement facilitation, the government has signalled that dedicated funding for careers services delivered through local authorities will end, with the duty of care for providing careers support moving directly to schools from 2012. The change has raised concern across the STEM community that it will become more difficult to deliver a national, strategic approach to STEM careers advice. Finally, on a positive note, while it remains possible for young people to choose not to study any STEM subjects (with the exception of Mathematics) after the age of 14, the introduction of the English Baccalaureate in 2011 will encourage schools to encourage pupils to consider opting to study Physics, Biology or Chemistry at GCSE level.⁹

In future consideration of activity to further enhance activity to improve take-up and progression across STEM subjects, this report highlights three key principles:

- Efficiency – minimising the costs of connecting employers/employee volunteers with schools and pupils.
- Effectiveness – using employer engagement as a conduit to improve the understanding of young people about current and future labour market opportunities.
- Equity – ensuring that those young people whose domestic circumstances mitigate against development of science capital gain fullest access to the additional resource presented by the engagement of STEM volunteers in activities to support STEM learning and progression.

⁹ The English Baccalaureate or E-Bacc is a public information measure. From 2011, government has published information of the extent to which pupils at 14-16 have achieved 5 GCSEs (or equivalent) in five specific subject areas (English, Mathematics, a Language, a Humanities subject and a Science). Information informs highly publicised league tables which are seen as a primary gauge of the success of an individual school in terms of pupil achievement.

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Annex 1: four key national UK intermediary organisations

1. The Engineering Development Trust (EDT)

<http://www.etrust.org.uk/>

The EDT is the largest provider of STEM (science, technology, engineering and mathematics) enrichment activities for UK youth. Engineering Development Trust is constituted under a Trust Deed dated 8 March 1991 and a consolidated Deed dated 6 September 2001 and a Deed of Amendment dated 22 March 2007.

The Trust's range of work-related learning schemes provides opportunities for 11-21 year olds to enhance their technical, personal and employability skills through industry-led projects, industrial placements and specialised courses.

The Trust helps develop partnerships, builds links between education and industry and helps organisations reach talented students and connects them with young engineers and scientists across the UK. Their programs include:

- **First Edition** - Hands-on STEM activity days for Year 7-11 & S1-S5 (11-16 yr old) students which provide opportunities for under-represented groups (girls, ethnic minorities, first in family to consider higher education).
- **Open Industry** - Curriculum focused in-company educational experiences for students of all ages.
- **Go4SET** - Environmentally themed 10-week STEM projects for Year 8/9 & S2 (12-14yr old) pupils.
- **Engineering Education Scheme (England & Scotland)** – Real-life 6-month STEM projects for Year 12 (16-17yr old) students.
- **Headstart** - STEM experience courses at universities for Year 12 & S5 (16-17yr old) students.
- **The Year in Industry** - Paid career development work placements for students completing A-levels, Scottish Highers and equivalent qualifications or as part of a university sandwich year.

Aims and objectives

The objects of the Engineering Development Trust, as set out in its Trust Deed, are the general advancement of education and, in particular, in relation to engineering and technology. The Engineering Development Trust achieves public fund benefit by focussing on its mission, which is to help talented young people achieve their full potential, in particular, through careers in engineering, science and technology.

2. The Industrial Trust

<http://www.industrialtrust.org.uk/index.html>

The Industrial Trust is a charitable company and was set up on 21 July 1997. Since **1999** over **200,000** students and teachers have benefited from Industrial Trust programs, over **20,000** in the last year. The Trust currently works with **900** companies providing real experiences for students from **600** schools across England and Wales.

The Industrial Trust offers a wide range of flexible and innovative services for young people, their teachers and for companies. The Trust enthuses young people about, and helps to equip them for, careers in industry. It does this by taking young people out of school and into companies.

Each visit is carefully structured to meet the needs of the students involved. The Trust liaises between each school and company to develop a program that meets learning objectives agreed with the school. The visits that follow offer memorable experiences which excite and inform young people about particular careers or sectors as well as supporting their own learning.

There are seven programs for young people :

- **Open Industry** - Uses structured educational experiences in companies to deliver agreed learning outcomes. Many hundreds of employers open their doors to young people through Open Industry, providing bespoke experiences tailored to the particular needs of the visitors.
- **Open Horizons** - Is a one day program (it can be divided into 2 separate half-days) which shows young people – typically those in Key Stage 4 – the many exciting and challenging careers that are available to those who aspire to a Higher Education route into employment.
- **Open Enterprise** - To succeed in the contemporary work environment young people need to be flexible, enterprising and self-reliant. Open Enterprise helps young people to manage risk and change in their working and personal lives by developing: economic and business understanding, financial literacy and/or enterprise capability.
- **Open for Business** - An undergraduate program which shows how different businesses offer opportunities to a wide range of graduate subjects.
- **Open Apprenticeships** - Is a one day program that helps young people – typically those in Year 9 (the end of Key Stage 3) - to make informed decisions about Key Stage 4 vocational options by making them aware of the Young Apprentice opportunities open to them in selected sectors (e.g. engineering).
- **Open Science** - Similar to the Open Industry program but with a specific focus on a given science area and application in commercial environments.
- **Open Engineering** - To experience the application of engineering across its range from technicianship to academic study, so that young people can see the opportunity of careers in engineering disciplines.

The Industrial Trust also has the **Insight into Excellence** and the **Insight into Learning** programs which are based on the Open model but with additional learning activities aimed at developing students' capability and motivation in addition to their subject knowledge.

The Trust holds **Discovery Events** which are specifically themed. These events involve many schools and business from the specific industry sector, creating a wider experience for the students who attend.

Aims and objectives

The objectives of the Industrial Trust are to emphasise the education of young people and those who guide and support them to, amongst other things, increase their knowledge, understanding and appreciation of industry, industrial and manufacturing processes of the past, present and future, and the related research, science, technologies, creative and wealth generating activities which help to sustain the well-being of the UK economy.

3. The Smallpeice Trust

<http://www.smallpeicetrust.org.uk>

The Smallpeice Trust is an independent educational charity that runs hands-on Science, Technology, Engineering and Maths (STEM) activities and exciting engineering courses for pupils in Years 6-12. It also delivers Teacher Training Days to bring STEM to life in the classroom. The charity was incorporated on 28 June 1966. Its program of activities includes:

- In-school STEM Days and after-school STEM Club kits where students work in teams on inspirational design-and-make projects.
- Teacher Training Days to help teachers to enhance their delivery of STEM in the classroom.
- 4-day residential courses held at universities and other secure venues to give students the opportunity to find out about specific areas of engineering like Biomedical Engineering, Nanotechnology and Structural Engineering.
- Supervisory opportunities on our residential courses to give you the opportunity to meet like-minded individuals and to work alongside representatives from leading companies.

These programs are carefully planned and implemented by our experienced educational team working in partnership with leading industry, academic and professional bodies. Our activities not only enable students to learn more about engineering, they also help to develop essential skills like problem solving, creative thinking, teamwork and time management which will benefit them in the classroom and in their future careers – whatever they go on to do.

Objectives

The charity promotes the advancement of education and in particular, but not exclusively, supports, encourages, promotes, develops and maintains engineering and technological education. The aim of the charity is to promote engineering, manufacturing, enterprise and technology in all its branches as a career to young people by providing a professionally executed subsidised program of residential courses, in-school STEM curriculum enhancement activity days and associated educational activities. These events provide young people from all backgrounds with the opportunity to enjoy working with engineers and technical specialists from industry to stimulate an interest in engineering. The principal programs and courses are for years 8-12. The strategy of the charity is to expand its activities as quickly as financial constraints safely allow whilst maintaining the value of its investment portfolio.

4. The Science Engineering Technology Mathematics Network (STEMNET)

<http://www.stemnet.org.uk/>

STEMNET exists to create opportunities to inspire young people in Science, Technology, Engineering and Mathematics. These enable young people to develop their creativity, problem-solving and employability skills, to widen their choices and to support the UK's future competitiveness. STEMNET helps encourage young people to be well informed about STEM, to be able to engage fully in debate, and to make decisions about STEM related issues.

STEMNET is a charity limited by guarantee and governed by its Memorandum of Articles of Association as amended on 14 November 2006.

STEMNET runs three programs to help realise its vision:

- **STEM Ambassadors** - The STEM Ambassadors program is STEMNET's flagship program. It is staffed by over 28,000 part-time volunteers who offer their time and support to promote STEM subjects to young learners. It is an invaluable and free resource for teachers, helping them deliver the STEM curriculum in fresh and innovative ways.
- **STEM Clubs Network** - STEM (Science, Technology, Engineering and Mathematics) clubs allow children to explore, investigate and discover STEM subjects in a stimulating learning environment, away from the constraints of the school timetable or a prescribed curriculum. They allow pupils and their club leaders to work together and explore many different ideas and activities. There are more than 2,000 such clubs in schools, primary and secondary.
- **Schools STEM Advisory Network** - STEMNET co-ordinates 45 organisations across the country to offer impartial advice and guidance to schools through the Schools STEM Advisory Network. Through strong links with business organisations the service aims to ensure that all schools and colleges can offer their students programs which support the curriculum and increase the quality and quantity of students moving into further STEM education, training and development.

STEMNET Vision

To increase young peoples' choices and chances through the study of science, technology, engineering and mathematics.

STEMNET Purpose

To be a recognised leader in enabling all young people to achieve their potential in STEM by:

- Ensuring that all young people, regardless of background, are encouraged to understand the excitement and importance of science, technology, engineering and mathematics in their lives, and the career opportunities to which the STEM subjects can lead;
- Helping all schools and colleges across the UK understand the range of STEM Enhancement & Enrichment opportunities available to them and the benefits these can bring to everyone involved; and
- Encouraging businesses, organisations and individuals wanting to support young people in STEM to target their efforts and resources in a way which will deliver the best results for them and for young people.

Annex 2: case studies

A: A national system - STEM Ambassadors

One of the major forms of engagement now widely practiced in the UK is to release employees to spend time working in schools.

A third of businesses (34%) saw encouraging employees to become STEM ambassadors – going into schools to talk about their work and support teaching – as a good way to encourage more young people to study these interesting and valued subjects. Ambassadors report benefits for their personal development including gaining confidence with presentations. CBI/EDI Education & Skills Survey 2010 p.37

The first nationally organised such scheme was introduced by the Institution of Civil Engineers as part of its “Opening Windows on Engineering” program. This became the “Neighbourhood Engineer” scheme and was administered by the Engineering Council of the UK and supported by the Department of Trade and Industry (DTI). As part of Science Year (2001/2) the DTI and the Department for Education and Skills (DfES) jointly funded an initiative to recruit Science and Engineering Ambassadors (SEAs) to inspire young people about science and technology. The scheme was backed by companies including BAE Systems, BP, IBM, Ford and Unilever, who ran their own similar activities with local schools. The scheme aimed to encourage more young people to study science and technology after the age of 16 by helping them find out at first-hand what a career in science and technology could offer them. Ambassadors were recruited to work in schools across the country to explain to young people the importance of science in everyday life and talk about their own careers.

For example BAE Systems doubled the number of their Ambassadors from 500 to 1000 in 2001. In welcoming the overarching organisation that the UK program provided, John Weston, BAE’s Chief Executive, said: “Education liaison activities bring good development opportunities for our employees and bring the excitement and challenge of engineering to young people. Through the UK Ambassadors Program many more organisations, large and small, can give and receive similar benefits.” The Ambassadors recruited were young people with science, technology, engineering and mathematics skills, working in a range of different jobs as scientists, engineers and mathematicians or using those skills in other careers. Their roles included:

- supporting out-of-school activities like clubs, awards and competitions;
- offering mentoring and careers guidance;
- acting as role models; and
- helping to provide work experience placements for teachers and students.

The national co-ordination of the Ambassadors program was carried out by the Science Engineering Technology Mathematics Network (SETNET) which had 58 member organisations representing Government, industry, the engineering professional institutions, education and education charities. SETNET was one of the outcomes of a Government initiative, Action for Engineering, and was aimed

to ensure a flow of well-motivated, high quality people from schools who had an interest in, and an understanding of, engineering and science related subjects.

This system has now been extended and is called the STEM Ambassadors Program. The program is administered by a network of 45 local STEMNET contract holders across England which ensures that all schools and colleges have knowledge of, and access to, STEM Ambassadors in their area. They identify professionals with STEM skills to become STEM Ambassadors and link them with local schools and colleges to act as role models. The Ambassadors help inspire and engage young people about the value of STEM in their daily lives and help local STEM employers engage with schools and colleges in their communities. Each Ambassador is registered, trained and checked with the Criminal Records Bureau (CRB). They also receive insurance cover when they are working on-site in schools. By March 2011 there were over 27,000 STEM Ambassadors nationwide. The STEMNET website <http://www.stemnet.org.uk/listing/ambassador-case-studies> contains a number of case studies from which the following one has been extracted.

STEM Ambassador career case study: Amy Barley, graduate engineer

Amy is a Graduate Engineer at Bombardier Transportation. She left school with 9 GCSEs and although science had always been a passion of hers, Amy kept her academic options open when she went onto Sixth Form, by studying the International Baccalaureate route which sees students specialise in subjects later than the traditional A Level system. 'I studied Business, English and French at Standard Level' says Amy 'but my interest in STEM subjects caused me to continue studying Maths, Physics and Chemistry to Higher Level.' After Sixth Form, Amy then went to the University of Birmingham to gain a BEng (Hons) in Engineering with Business Management. When she graduated from Birmingham, she was recruited by Bombardier and now works as a Material Engineer in Derby: 'It is my job to ensure that all the materials used on rail vehicles meet the performance requirements and safety standards required by both the Railways Group Standards and British Standards.'

As a STEM Ambassador, Amy assists in the delivery of STEM-based activities in schools, provided by the Derbyshire Education Business Partnership (DEBP) who manage STEM Ambassadors in Derbyshire on behalf of STEMNET. Amy represents one of 400 STEM Ambassadors from across Derbyshire who dedicate their time, expertise and experience in helping dispel the stereotypical image of professionals working in STEM-related jobs. 'I became a STEM Ambassador as I wanted to present students and teachers with a fresh, enthusiastic and relevant way to explore, inspire and promote the many opportunities that studying STEM subjects can provide.' Amy is so passionate about the cause that she spends time encouraging her colleagues to become active STEM Ambassadors too!

Amy recently ran a STEM activity at The Long Eaton School, which proved successful in getting students interested in STEM subjects; teacher Sue Taylor commented 'the event was a great success- the positive response from students shows the value of involving industry in helping deliver courses- pupils gained insight into the different career paths available and also had the opportunity to gather evidence for their science qualifications.'

Some STEM Ambassadors are also Bloodhound SSC Ambassadors and help support the work of the education program attached to the Bloodhound Super-Sonic Car project led by Richard Noble: http://www.bloodhoundssc.com/education/bloodhound_education_ambassadors.cfm. As part of

the Bloodhound SSC education programme two large educational centres have been opened in 2011. The first of these is based within the newly opened Manchester Communications Academy (MCA), of which BT, Intel and Promethean are major sponsors. It has been set up to inspire the next generation of engineers and to drive innovation, invention and industry in the North West region and beyond. At its launch, Bloodhound SSC design engineer, Annie Berrisford, explained to the invited audience how she had been enticed into the exciting world of engineering. Annie said: *“My passion was for racing cars – old ones. I race a vintage Frazer Nash and was brought up being told of the land speed record greats such as Malcolm Campbell and Parry Thomas. My internship with JCB gave me the opportunity to work on the Dieselmax project, and I suppose you can say I was hooked on land speed records. But never in my wildest dreams did I expect to be working on what is possibly one of the most exciting projects in the world of engineering at the moment, the BLOODHOUND SSC world land speed record car.”* (Note: JCB Dieselmax is the name of the car, driven by Wing Commander Andy Green and designed by Ron Ayers, which holds the world land speed record for diesel-powered cars at 350mph. Annie Berrisford left school with Arts A-levels and did a foundation year as part of her MEng course in mechanical engineering. Andy Green has a first-class degree in mathematics from Oxford University for which he was sponsored by the RAF.)

BT, formerly British Telecom, has its own variant called The IT Ambassador Scheme. This was developed in collaboration with STEMNET and the educational charity, BrightsideUNIAID. It gives school students the opportunity to interact with and be supported by professionals working in BT. Aimed primarily at the 14-19 age group, the scheme is underpinned by a fully moderated, web-based platform www.itambassadors.org.uk. The platform allows students to exchange messages with their mentor within a properly safeguarded environment and gives them access to an extensive and varied on-line ‘Knowledge base’. This has been developed specifically for young people and along with the information and news articles, contains anonymised profiles of many BT ambassadors including typical ‘day in the life of’ stories.

As the scheme is entirely electronic, location and geography are not an issue. For example, some ambassadors based in Surrey, London and Suffolk are working with students who are based in rural Lincolnshire. Similarly, ambassadors from rural areas work with students in central London. “My students have found the scheme to be really beneficial. One young man used his mentor to help with his extended project which resulted in him exceeding his target and achieving a grade A.”

All IT ambassadors acting as on-line mentors hold a recent enhanced CRB check independently verified by STEMNET. In addition to supporting young people, the scheme also provides teachers with a straightforward way of making contact with BT people - either to seek assistance with development of specific curriculum related resources or simply to answer a few technology or

So here is a major, high-tech public telecommunications company using modern technology to put STEM employees in direct touch with young people in a way which nicely complements the more traditional face-to-face model of ambassadors travelling to visit schools.

B: An engineering example - Caterpillar Articulated Trucks

<http://www.employers-guide.org/media/48203/caterpillar%20case%20study%20final.pdf>

Fred Felton, Apprenticeship Manager with the engineering company Caterpillar, has been visiting local schools and working with students for nearly a decade. He is part of the Business Ambassador scheme run by Durham Education Business Partnership, a scheme designed to raise awareness of career opportunities available to young people, and to help them prepare for the world of work.

<http://www.durhamebp.org.uk/debp/usp.nsf/pws/DEBP+-+Homepage>

He says the scheme pays dividends for the Peterlee-based company as well as in terms of his own professional development. "From Caterpillar's perspective, obviously supporting our local schools is a good thing to do – it's the right thing to do," he says. "Caterpillar currently employs nearly 800 people, and most of them are from the East Durham area. Going into schools allows us to talk to young people who could be our future employees about the skills and attributes we look for. And one of our guiding principles is to develop our people. As Business Ambassadors we have a greater understanding of what goes on in the schools around us. I know a lot more now about education, the Key Stages pupils go through and the curriculum and qualifications than when I started. It's given me the knowledge I need to do my job as Apprentice Manager."

Caterpillar has nine Business Ambassadors, who have a range of jobs from shop floor to management. Last year the company supported around 50 activities in ten secondary schools throughout the North East. All new Business Ambassadors get free training. They always work on group activities and are never expected to take a class without a teacher or a member of the Education Business Partnership present.

As the company's lead Business Ambassador, Fred Felton has the task of organising their visits to suit their schedules and the schools' timetables. Activities with young people are designed to instil the kinds of skills employers seek, such as teamwork and problem solving. Students are also given the chance to undergo practice interviews and learn how to write a successful CV. The company also hosts school visits to its Peterlee factory, and is involved in helping to deliver the new Diploma in Engineering. Mr Felton says this partnership with local schools has a favourable impact on recruitment and retention.

Many of the young people he has worked with on school visits have joined the firm as apprentices. "We have just employed another seven apprentices, and they have all come from local schools. And some of those kids have said to me 'I remember you were at my school three or four years ago'."

C: An SME example - ScienceScope's STEM Enterprise Centre in Writhlington School

Another innovative approach has been taken by the Sciencescope company, which is an SME (small and medium sized enterprise) producing data-logging equipment for education.

In June 2011 ScienceScope Ltd (www.sciencescope.co.uk), in collaboration with Writhlington School (www.wsbe.org.uk), set up the STEM Enterprise Centre (SEC) at the school south of Bath, creating a novel environment in which all students (including gifted and talented and those not engaged in a

traditional academic education) are able to benefit from an intimate working relationship with STEM based companies. The SEC is an independent teaching, learning and creative facility managed by ScienceScope giving students the opportunity to work in close collaboration with an existing technology business.

EDUCATIONAL OPPORTUNITIES

The opportunities which the SEC offers students include the following.

- Close involvement in the process of creativity and discovery so that students not only have a deep understanding of how STEM works in a business oriented context but also enables them to be involved in the development of science and technology based products of the future. The first product developed as a part of this collaboration is the DynaKar which is being launched at the 2012 BETT show at Olympia.
- Use of the business, manufacturing and supply activities to help develop their skills not only in STEM subjects but also in English, Humanities and Modern Foreign Languages. Students are actively involved in an electronics club after school and a lunchtime STEM-based micro-enterprise.
- Access to a centre that is always open. The centre is open all year round and particularly through the summer. Next summer SEC will be organising the first of a series of summer schools in STEM education.

The school uses a standard teaching and learning model for curriculum delivery but significant opportunities will exist for students to become involved in project based activities which combine all aspects of the school curriculum.

For example students have recently visited Laos to set up an Orchid breeding centre for endangered species. As a part of the visit they have been collecting environmental data so that the breeding centre at Writhlington can more closely match the environment that the orchids live in the wild. In another example a group of students are working together with the ScienceScope development team to design, test and evaluate a new product for science education. The activities include:

- Identifying a technology approach to use in development of the product.
- Using electronic and mechanical CAD CAM to create product design concepts.
- Building a prototype
- Carrying out tests to evaluate the effectiveness of the new product in the science laboratory.
- Using mathematics to evaluate these tests.
- Writing a report on the outcomes of the evaluation including identifying ways in which the product could be made more effective or useful.
- Working with the product design team to improve the design from an operational, ergonomic and stylist point of view.

Students at the school are experiencing and contributing to real scientific engineering, mathematical and technology challenges in the work place. They are testing and evaluating new products from concept through to production. In addition to these novel learning experiences SEC will focus on developing an understanding of the core mathematical and scientific principals and methods through an immersive approach to learning in which practical investigations will form a key part of all the work that is done.

TEACHER INVOLVEMENT

In November ScienceScope, in collaboration with the Science Learning Centre South West, held the first of a series of termly day-time courses on the use of ICT in Science Education for all the science staff at the school and for teachers from schools in the region. Science teachers and technicians are now transforming their laboratory activities based on work done during the course including more effective use of data logging in the classroom, use of high speed photography for analysis of rocket motion and explosions, and developing further understanding of the orchid breeding program through data capture and analysis.

WORKING WITH THE UNIVERSITY OF BATH

The centre has developed a close working relationship with the University of Bath. In particular, ScienceScope is sponsoring an EngD student to work in the school as a part of the university Centre for Digital Entertainment. The work is focusing particularly on how information and data can be visualised more effectively for learning. SEC has just completed a video which will shortly be released on the University web site to explain how the centre works and to bring world-of-work experiences to the students in the schools as a part of a Knowledge Transfer Account project. ScienceScope has also just won an INet award to develop novel data-logging technology which will be developed jointly by the company, the university and the school.

FACILITY MANAGEMENT

The centre is being developed as a local resource for the school, other schools in the area and high technology business start ups. ScienceScope engages with the school by the following means.

- Working closely with Mr Mark Everett (Headteacher) and Mr Simon Pugh Jones (Enterprise Manager) to promote the centre and create activities which benefit the school, the businesses and the local community.
- Developing, in collaboration with SEMTA, a apprenticeship program in electronics and design. SEMTA is the Sector Skills Council for Science, Engineering and Manufacturing Technologies: <http://www.semta.org.uk/>.
- Bidding for funds to carry out product development projects, working closely with other schools and colleges in the area to ensure comprehensive coverage of all STEM activities. In particular, we will work with Hayesfield School.
- Developing further university-based collaborative projects.

- Planning with school staff how to integrate the activities most effectively within the school curriculum
- Identifying and developing business start up activities at the centre.

BENEFITS OF THE INNOVATION CENTRE FOR EDUCATION AND EMPLOYMENT

- The SEC brings together innovative high technology businesses and a school in a way that has not been achieved before. This synergy is helping to maximise the return for public investment in schools and innovative industries.
- SEC partners are confident that SEC will lead to the creation of new innovative businesses and provide a stimulating learning environment which will be a model for development across the UK.
- Students experience real career options in STEM subjects while they are at school. Students contribute to STEM innovation in a business context.

ScienceScope has been working in the field of science education for 30 years and is a world leader in the development and supply of ICT based equipment for science education and research.

D: An IT example – INTEL

For over 40 years, Intel Corporation has developed technology enabling the computer and Internet revolution that has changed the world. Founded in 1968 to build semiconductor memory products, Intel introduced the world's first microprocessor in 1971. Today, Intel supplies the computing and communications industries with chips, boards, systems, and software building blocks that are the "ingredients" of computers, servers and networking and communications products. These products are used by industry members to create advanced computing and communications systems. Intel's mission is to be the preeminent building block supplier to the Internet economy. It has a large UK site in Swindon, Wiltshire, as well as a major manufacturing plant in Ireland, www.intel.co.uk.

As a company its educational focus is on promoting engagement with STEM subjects and the professional development of teachers in 21st century learning and teaching. In the USA it is a major contributor to President Obama's 'Change the Equation' campaign for STEM education: <http://www.changetheequation.org/>. Internationally, its Intel Teach Programme helps teachers to be more effective educators by training them how to integrate technology into their lessons to promote problem-solving, critical thinking and collaboration skills among their students. Intel has trained more than 10 million teachers in over 60 countries —and is committed to train millions more. Intel Teach is the largest, most successful program of its kind. In the UK, Intel Teach is delivered through the Specialist Schools and Academies Trust (now The Schools Network) which works directly with schools and colleges, providing them with training.

Intel provides STEM-related teaching and learning resources via the 'Skool' website www.skool.com, as well as support for educators via the 'Maths and STEM Community': <http://inteledcentre.co.uk/community/skool-maths-and-stem-community>. Skool provides valuable resources to help students **Learn** and **Revise** for their Exams, and to enable students and

teachers to **Explore** the wider world of education. The objective is to provide a rich and integrated approach to Science and Maths.

Alongside Intel's technology support for the Bloodhound SSC project (HPCs, IT suite in Bristol office, web hosting, in-car electronics system), Intel has provided time for around 30 Swindon employees to be Bloodhound Ambassadors. The objective of this is to partner with schools and colleges to motivate their students towards STEM subjects. Intel's focus is not simply on the technology it makes—it is also on what that technology make possible for people around the world. Intel believes that to foster innovation and drive economic growth, everyone needs to have access to support for the relevant educational and entrepreneurial skills, which is a goal they share with governments, NGOs and development agencies. They also support the empowerment of women and girls in order to improve the lives of their children, families and communities. Intel is actively engaged in programs for young people which provide them with access to technology. They offer scholarships and grants which encourage the pursuit of education in technical fields, enable them to pursue entrepreneurial paths, and offer substantial development opportunities in the workplace.

One example of this is the international program of competitions which Intel offer, among the most prestigious of which is the Intel International Science and Engineering Fair (ISEF), which takes 1,500 award-winning national students from a field of more than 7 million high schools students to compete for high-value prizes worth a total of more the \$4 million at an annual event in the USA – this year in Los Angeles. More than 1,000 science, engineering, and industry professionals volunteer at Intel ISEF to judge the student projects and award prizes.

<http://www.intel.com/about/corporateresponsibility/education/isef/profiles.htm>. One of the award winners this year is a 17-year old student, Aseem Mishra, of Hymers College, Hull, UK. His invention – a pair of jeans which simulates a complete drum kit – is now being taken to market:

<http://www.new-edge.com/press-release--drum-jeans.html>.

In 2005 one of the award winners at ISEF in Phoenix, Arizona was a high-school student from Budapest, Daniel Rátai, whose Leonar3Do project won six first prize awards including the Best of Category in Computer Sciences and the Best of The Best awards. In addition, it offered Daniel with the opportunity to give a lecture in Stockholm at a seminar organized by SIYSS and to attend the Nobel Prize Ceremonies of 2005. One widely quoted jury member comment was "World leading companies and research institutes spend billions of dollars on solving a problem, when a 19-year old teenager comes by and puts the system together using straws, Christmas lights, and fence wires." 3D for All Ltd. was founded shortly after the Phoenix event as a family business and succeeded by 2010 to turn Daniel's invention into a finished product which began manufacturing the Leonar3Do VR kits. In 2011, Portfolion decided to invest venture capital into the business, enabling the company to put into action its plans to bring affordable, no-compromise virtual reality to the global markets led by a British entrepreneur, Stuart Oldroyd: <http://leonar3do.com/>.