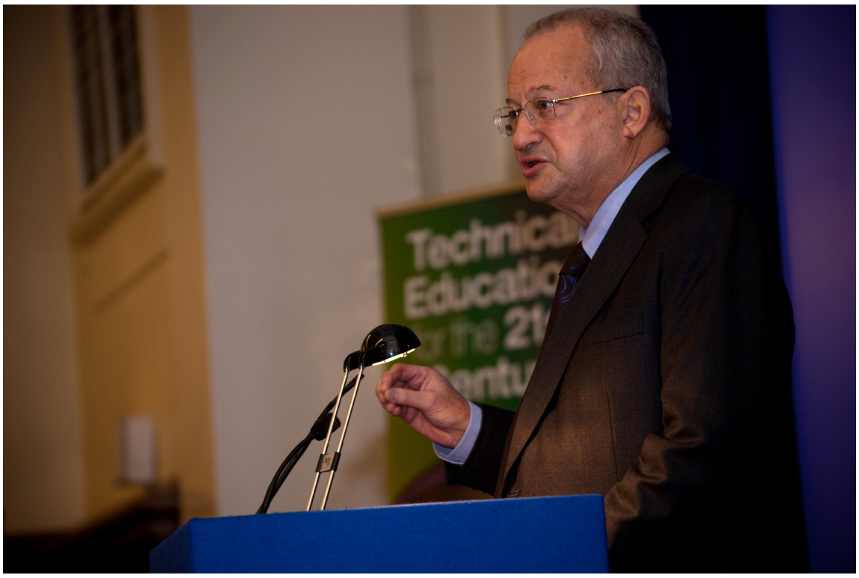
Technical Education for the 21st Century

Tuesday 14 December 2010

Conference Report



Introduction

The Technical Education for the 21st Century Conference brought together policy-makers and stakeholders to explore how best to meet the current and future demand for STEM skills and, in particular, how to increase the number of science and engineering technicians by improving their status, education and training.

During the day delegates listened to and discussed presentations by a number of senior stakeholders. This report summarises those presentations and discussions, and includes the background papers commissioned to stimulate debate at the conference.

There was a strong sense at the conference that there is a real opportunity to improve technical education in the UK.

The conference was held on Tuesday 14th December 2010 and jointly hosted by the Gatsby Charitable Foundation and the Edge Foundation.

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Welcome and introduction

Lord Sainsbury, founder of the Gatsby Charitable Foundation

Lord Sainsbury welcomed delegates, explained the reasons why Gatsby and Edge had called stakeholders together to discuss technical education, and outlined the key elements necessary to develop a world class system of technical education.

A lack of high-quality technical education and training has stopped individuals accessing the higher wages and improved social mobility that come with higher skills. In turn, by failing to secure a higher-skilled workforce, the country as a whole is less prosperous. It is predicted that by 2020 we will fall short of our target for the number of people in the workforce with Level 3 qualifications by some 3.4 million. Of these, a significant proportion will be in the STEM-related sectors.

These people, the technicians of the 21st century, will be key to the decommissioning of our ageing nuclear power stations and the construction and maintenance of new ones; to ensuring that the switchover to digital television occurs on schedule; and to manufacturing the high-tech products we will need to sell to the rest of the world in the future. We must ensure that we have an education system capable of supplying the tens of thousands of technicians who will design, assemble, install, monitor and maintain all of the technology that will ensure we all have a higher standard of living in this century than the last.

For the UK to develop a world class system of technical education there must be:

- A well-understood system of qualifications which deliver the transferable skills that industry actually needs, thus enhancing employment prospects and delivering higher wages to those who possess them. Crucially, these qualifications must be seen as clear proof that an individual has gained a rigorous knowledge base and genuine practical skills
- An appropriate infrastructure to deliver technical education in schools and colleges, including suitably qualified lecturers and teachers, and appropriately equipped workshops and laboratories that reflect the modern workplace
- A funding system that allows both younger and older workers to get the qualifications they need

Our future economic prosperity depends on making technical education work. However, the shortcomings in the current system will not be solved overnight or without considerable effort from a wide range of organisations. The conference marks a first step in trying to enlist the help of the key people who can ensure that we have a system of technical education that is fit for the 21st century.

Lord Sainsbury thanked delegates for attending the conference and invited them to work with Gatsby to improve technical education.

An enquiry into the value of work

Matt Crawford, University of Virginia and author of The Case for Working with Your Hands

Matt Crawford drew on his experiences of working as an electrician and motorbike mechanic to challenge conventional thinking about education and the world of work.

The acts of making and fixing things have significance beyond that afforded them in the modern world, and recognising this could help us to think again about education and work as we consider technical education in the 21st century.

The modern personality is being reformed in passivity and dependence through a learned helplessness. Increasing complexity makes things harder to repair at the same time that the general public's technical skills for doing so have disappeared. Replacements have also become cheaper. When things go wrong, we call an expert or simply throw them away. This has implications beyond sustainability. Where once there was individual agency, now we have no experience of seeing the direct effect of our actions in the world and knowing those actions are genuinely our own. As we don't feel we affect the world, we don't feel responsible for it.

In contrast, working with your hands gives the experience of agency and competence, and does so with a social reality. Achievements are visible - the car starts; the lights are on - to you and to others. In such work we are constantly using our own judgement rather than blindly following processes. It leads to attentiveness and embeds us in society. It encourages individual responsibility and provides us with the vivid experience of failure - both crucial for our moral education.

Moreover, increasingly the real split between workers will be between those who can deliver their services over wire and those who cannot. The economic reality leaves the first group vulnerable to outsourcing, but you cannot fix my leaking pipe in Virginia from China.

This means the question of what a good job looks like is a bit more open than it has been, but this has not been reflected by changes in our education systems. We have developed an educational mono-culture where every young person feels pressured to follow a certain route – school; college; white collar job - working on the assumption that they have no other choice. This ignores both economic reality and diversity of disposition, and yet too often young people with real talent for working with their hands are seen as eccentric or self-destructive for looking beyond academia.

Rehabilitating these attitudes in schools and beyond is a significant challenge, and one that will require great courage in the face of wariness and hostility from older generations taught that there is only one route.

The current situation: the UK workforce's need for technicians

Chris Humphries, Chief Executive of UK Commission for Employment and Skills

Chris Humphries presented research on future skills needs by the UK Commission for Employment and Skills (UKCES) which shows growing demand for STEM skills and technicians.

One of the roles of the UKCES is to understand how UK labour markets operate in order to help policymakers ensure they are as efficient as possible. In the current labour market there is a shortage of STEM skills despite increases in the numbers of young people studying STEM subjects at school and university. The UK is being overtaken by other countries as modest progress at home fails to keep pace with changes internationally. The economy's demand for STEM technicians is outstripping supply from the UK, with the shortfall being met largely by non-EU migrants. Of the 38 occupations where the UK allows non-EU migration, 26 are STEM-related.

The research predicts 58% of new jobs will be created in STEM areas of the economy, with strong growth in the demand for staff with STEM skills at levels 3, 4 and 5. The research has identified priority occupational areas where action is needed based on projected supply and demand and the lead-in time before changes in education and training are reflected in the economy. In 17 of 23 priority areas, STEM skills are key.

However, the problem is not only in the supply of skills: 2.7 million people say their existing skills are underused in the workplace. As well as guaranteeing the supply of skills, work needs to be done to ensure skills are properly utilised.

The Technician Council

Steve Holliday, Chief Executive of National Grid plc & Chairman of the Technician Council

Steve Holliday talked about anticipated changes in the economy that will drive greater demand for technicians, outlined the reasons why the UK is ill-prepared to meet this demand, and described how the Technician Council is being set-up to tackle this.

Power generation is undergoing a revolution in Britain as the country transforms itself from a carbon-intensive model to a broader mix of supply, with considerable growth in nuclear and renewable energy. There will be more change in the industry than for 30 to 40 years and it will need to take place over a very short time.

This transformation will depend on technicians, but these highly trained staff are in short supply and there is a low level of awareness of the opportunities to gain the necessary skills.

The challenge in terms of workforce education and training can be seen in the demographics of current technicians. The average age of National Grid's technicians is 46 (48 in the US) and 25% of them will be retiring in a few years.

Yet the sector is trying to recruit a large cohort of new apprentices at a time when there is poor understanding of technical careers among young people. Six out of 10 young people cannot name a recent engineering achievement. Research has also shown that:

- Many cannot visualise what an engineer does
- Teachers too often don't know enough to recommend engineering as a career
- Girls are 10 times less likely to pursue engineering as a career than boys

This is despite the many opportunities technical careers offer. Indeed, industries like power supply themselves destroy the myth that "if you don't go to university you are a failure". Of the senior executives in National Grid, 40% are not traditional graduates, while 20% did an apprenticeship and then took their degree later.

The newly-established Technician Council is aiming to help employers highlight these opportunities by raising the status of technicians; developing professional registration and standards; and developing technician initiatives across engineering and other sectors. It will also explore what companies have done in isolation and in frustration with the current system to see where lessons can be learned. Ultimately, it wants to open up more pathways to success for young people while ensuring the needs of the UK economy are met.

For further information about the Technician Council see www.techniciancouncil.org.uk

Apprenticeships in STEM

Allan Cook, Chairman of the Sector Skills Council for Science, Engineering and Manufacturing Technologies

Allan Cook outlined the fast pace of changes in the nature of employment that technology is driving, showed how this is reflected in the growing demand for STEM skills, and described the changes needed to allow employers to meet this demand through apprenticeship schemes.

A recent survey of business needs found the top ten careers that will be looking to recruit in the near future did not even exist in 2004. The rate of change in STEM technologies is enormous and the question is how do we deal with this.

Previous attempts to tackle this through apprenticeships have faltered because firms could not be persuaded to invest what was necessary. They cite three obstacles:

- Cost (although this is really a perceived barrier, as apprentices give higher value to an employer than staff without apprenticeships)
- Firms' individual resources to provide apprenticeships
- Bureaucracy

Of course, major firms within the sector capable of overcoming these obstacles already run successful and very popular apprenticeship schemes. However, they are already oversubscribed and are still failing to recruit significant numbers of women.

Furthermore, it is not the major firms but the small and medium firms that make up the bulk of the manufacturing sector, with 50,000 of the 70,000 manufacturing firms in the country having 10 employees or less. It is these firms that represent the real potential growth area for apprenticeships, and we have to develop new ways to help them overcome the obstacles and provide apprenticeships.

This is possible, but the challenges are significant. The question is whether the UK's philosophical abhorrence of barriers to entry coupled with an insistence on a minimum wage will fatally undermine any significant attempt to expand the apprenticeship system.

Paths to technical education: lessons from abroad

Professor Alan Smithers, University of Buckingham

Alan Smithers described how one of his first projects as an educational researcher was to try to understand why the flow of well-qualified and able technicians joining the steel industry in Sheffield was drying up in the 1960s. He found that local technical colleges had converted to university status, changing several courses as a result so that they were no longer appropriate for technicians. He argued such changes have undermined - and continue to undermine - technical education in the UK, particularly when compared to the country's competitors.

The result of valuing academia above everything means the UK continually suffers academic drift towards one type of university, offering traditional subjects and carrying out traditional research.

In contrast, most of the UK's competitors have different kinds of higher education institutions combined with distinct paths at upper secondary level. Many countries with a strong tradition of technical education, such as those in northern Europe, offer undifferentiated lower secondary education followed by different routes in upper secondary, enabling them to develop technical streams and secure the supply of technicians.

In addition, technical education in the UK has been undermined by a lack of consistency and clarity about technical and vocational qualifications in England, stopping employers and young people from understanding their value.

Furthermore, the rigour of technical education has been thrown into doubt by the explosion of vocational courses in school, which some suspect are "soft".

To address this situation we need to:

- Compile a good, quantitative picture of the current situation in technical education
- Review the role of GCSE in light of raising the participation age to 18
- Resolve the ambiguity with regards to 16-18 or 14-18 being the upper secondary phase, exploring the strong case for moving the GCSE to 14
- Develop more technical routes with valued qualifications as part of an array of pathways
- Do more to make a foundation degree a career qualification for SET technicians

Professor Smithers' report comparing school systems across 30 OECD countries is available on the Sutton Trust website at http://bit.ly/gVXEfV

Careers information and guidance for aspirant technicians

Sir John Holman, University of York

Sir John Holman argued there is a clear need for better careers information and guidance if we are to persuade more talented young people to follow the technician route.

Young people get careers advice from parents, teachers and careers advisors. Most young people don't have a career plan, but the die is cast very young in terms of deciding the type of route they want to follow - often before they reach 14.

This is particularly problematic for technical routes. Career options are identified and explored at school, where pupils can think teachers will be disappointed if they do not follow an academic route. Furthermore, technical routes are complex and teachers often do not understand them in contrast to the clearly defined academic routes which they have generally followed themselves.

Improving the impartiality of careers information - both as to institutions and subjects for further study - is crucial, however there is often a conflict of interest with regard to funding formulae that has to be addressed. Professional standards for careers advisors may help in this respect.

We must also work to outline the full benefits of the technician route as part of careers guidance by enabling better access to labour market information. Clear, readily available information on where shortages exist can act as a strong pull factor into the technician route. Employers must also extend this information to the local level, making it as relevant as possible to the young people in their area. By going into schools, sending clear messages about what they need, and using ambassadors from their workforce as role models they can have a powerful impact on young people's choices.

Sir John Holman's report on STEM Careers is available on the National STEM Centre website at http://bit.ly/gOq3rO

University Technical Colleges: theory and practice

Lord Baker & Professor Alison Halstead, Baker Dearing Educational Trust & Aston University

Lord Baker described the main features of University Technical Colleges (UTCs) - a new type of secondary school aiming to transform English education to provide significant numbers of technically trained young people.

UTCs are new, small and specialised secondary schools which will offer the sort of technical education that has not really been available in England before, even though it has been a longstanding feature of other countries' school systems. UTCs will provide a modern technical education to young people aged 14 to 19, with practical and academic subjects taught together under one roof, based on the assumption that students are more likely to be enthused about academic subjects by seeing them in a practical situation. There will be a clear focus on engineering.

Students at UTCs will work from 8:30-5:00, preparing them for a working day. The five terms of eight weeks each will lead to 14 additional teaching weeks overall.

Students will benefit from improved equipment and machinery, specialist teaching staff - including many people from industry - and links with local companies. The curriculum will be employer-led, equipping young people with skills valued in the labour market. Schools will work with employers to select specialisms directly relevant to the local labour market. For example, in Walsall employer involvement has seen the UTC being developed there changing its specialism from general engineering to process engineering.

UTCs will also have close links to universities, providing clear pathways to foundation and higher degrees, and access to cutting edge research.

One academy, JCB in Staffordshire, has already been set up on UTC lines. In addition, 40-45 schools are now being discussed, against a long term target of 400 - about 10% of English secondary schools.

Alison Halstead described the reasons her university was involved in the establishment of a UTC, highlighting the unique opportunities to:

- Embed an employer-led engineering curriculum into 14+ education
- Raise young people's aspirations for careers in engineering
- Blend academic and vocational qualifications
- Provide clear pathways to apprenticeships, work or education
- Input to the professional development of educators and academic practice

For further information about UTCs see www.utcolleges.org

Feedback from the day to the Minister for Universities and Science

Anthony Tomei, Director of the Nuffield Foundation

Anthony Tomei outlined four key observations from the conference:

- **Careers** - Could changes to student funding lead to a rebalancing of the system, with young people looking again at the costs and benefits of university degrees compared to apprenticeships? For young people to make informed choices they need to have access to much better labour market information.
- **Apprenticeships** - Apprenticeships are a vital element in improving technical skills. We need to increase the number of apprenticeships, while maintaining their quality and ensuring that the expansion is in sectors where there will be long terms benefits to both apprentices and the UK economy. Encouraging more SMEs to take on apprentices is key to this agenda.
- **Fitness for purpose** - Vocational education has been constrained by bureaucracy that sought homogeneity across qualifications rather than reflecting the needs of employers and young people. Technical education must be subject to a fitness for purpose test, e.g. that it develops not only the skills and knowledge valued by employers, but also the transferable skills that give individuals the opportunities for long and fruitful careers.
- **The role of government** - We need to ask what role the government should play in terms of establishing a well-understood system of qualifications, plus the infrastructure and funding to deliver them.

Response from the Minister

David Willets MP, Minister of State for Universities and Science

The Minister gave a clear message to the conference that the Government believes there must be a well-defined technical route recognised by young people and employers. He outlined plans for apprenticeships and proposed potential measures that he wanted all stakeholders to consider further.

The Government's approach to technical education is based on its confidence in the ability of individuals to make well-informed choices if they are provided with the relevant information. This applies both to increasing the numbers following the technical route, and for ensuring that technical education is fit for purpose.

At the moment there is a clear route for the 40% or so of young people who go on to university. There is not the same clarity for those on other routes. We now need to focus on improving the clarity of those other routes to help learners make choices. It is no good to keep redefining and renaming qualifications, and qualifications must either provide a route into university or be valued in the labour market. We must look at employer kite-marking of routes.

We want to expand the number of apprenticeships at level 3, with 50,000 more places this year, rising to 75,000 in the future. We must lower bureaucratic barriers for employers who want to run apprenticeship schemes.

We must also make apprenticeships more attractive. One way to do so would be to find a way of recognising the achievement of completing an apprenticeship. Perhaps apprentices could become technicians in the same way that successful undergraduates become graduates.

We will also have to examine whether licence to practise can be introduced, particularly in sectors where the UK is dependent on migrant labour, and may have to consider options such as reintroducing training levies in some sectors.

The Government wants to have a radical debate about all these issues to determine the best way forward.

Roundtable discussions

What are the distinguishing characteristics of a technical education?

There was debate about the detailed definition of technical education, but there was also some agreement of the broad outline of what it is and how it differs from other forms of education. Delegates' comments included:

- May be limited to STEM subjects
- A blend of knowledge, skills, managerial and personal education
- Exposure to and awareness of technology
- May involve practical and experiential as well as classroom-based learning
- Includes problem-solving and a range of other transferable skills
- Can lead to technician roles, but does not limit learners to them
- Is present to a varying extent throughout 5-19 education and beyond
- May be costly because of the exposure to and use of technology
- Includes numeracy but excludes craft skills
- Practical delivery but with cognitive richness
- Sector-specific and relevant, but portable between roles and employers

What could be done to raise the status of technicians and technical education?

Views covered a number of aspects of this issue, with delegates asking that policy makers:

- Avoid equivalence
- Make routes clearer
- Raise awareness of opportunities and earnings of technicians
- Introduce licence to practise
- Ensure that all learners at KS4 take a mixture of general academic and vocational qualifications
- Raise the quality of foundation degrees
- Give employers a greater role in setting standards

Delegates also suggested ways for stakeholders to better explain the benefits of technical education to young people and those that influence them, including:

- Raise awareness of former apprentices who are now industry leaders
- Highlight the flexibility of STEM qualifications in opening the door to a range of different occupations
- Raise awareness of what engineers and scientists actually do
- Develop awareness of routes among ethnic minorities through specific work
- Use the better data now available to demonstrate the added earnings gained by people following a technical route

Delegates also identified a number of questions and areas where further work needed to be done, including:

- Does the profile of teachers in technical subjects need to be raised?
- Does the technology curriculum need to be re-invigorated? Perhaps the forthcoming review of the National Curriculum provides an opportunity to refocus the technology curriculum towards the high-tech end
- Are there ways of incentivising schools to offer more technical education (avoiding some of the negative impacts of other policies, such as GCSE equivalence of vocational courses)?
- As well as young people, how can we reach adults, given the potential to solve some of the supply issues from the existing workforce?

What role should employers play in technical education?

Delegates discussed the importance of employers in providing apprenticeships, work experience, qualification approval and development.

In terms of technical education more broadly, delegates felt employers should:

- Provide better information about which qualifications are valued in industry
- Help to shape the curriculum
- Be involved in education from the primary phase onwards

Delegates also felt that employers have a crucial role to play in helping schools to deliver careers education, and should:

- Move from superficial activity in schools to sustained involvement
- Be used for their expertise rather than for extra funding
- Provide more placements and release more individuals to be mentors as part of their own CPD
- Do more to encourage girls and young women to follow a technical route
- Become STEM ambassadors through STEMNET

Discussion about the role of employers in expanding the provision of apprenticeships suggested:

- Public sector organisations need to play a role in securing the technicians they need
- Existing funding to help employers should be reviewed to see how it can be used more effectively
- There should be incentives offered to encourage employers to engage, perhaps linked to National Insurance contributions or based around procurement and the supply chain
- Large firms could work with SMEs to assist them in running apprenticeship schemes
- Industry-wide consortia should be used to allow apprentices to develop broader experiences
- The risk for SMEs of investing in apprenticeships needs to be removed. An apprenticeship training agency model may help for some SMEs, removing bureaucracy and providing vocational training alongside work-based learning

What are the keys to the delivery of high-quality technical education?

The discussion focused on areas such as teacher quality, the curriculum, careers information and the role of Government. Comments included:

The curriculum

- There needs to be greater stability in the system
- Professional STEM bodies need to exert greater influence over qualifications
- There needs to be more of a focus on transferable skills rather than the assessment of narrow occupational standards
- Qualifications should not be constrained by being made to fit into a framework that is not appropriate
- What really matters is the quality of qualifications and their currency with employers
- Technical education before the age of 14 needs to better prepare pupils for choices at that age
- The English Bac may lead to schools turning away from technical education

Schools and resources

- UTCs should be marketed directly to young people and their parents, not through other schools
- Should we try to keep the Diploma model of shared resources and labs?
- Longer school days would help to accommodate the additional content that would be delivered as part of technical education
- Need to ensure the support of Heads and parents for technical education
- Parents are a key group and need to be offered better information about technical education

Teachers

- More work is needed to promote teachers coming from industry
- Could more sharing of staff take place between schools and businesses?
- Specialist teachers are the key to improving the quality of delivery and CPD could play an important role in helping develop specialism
- Free up access to teaching so people other than teachers can support technician education
- The right teachers are those who are self-confident and willing to take risks
- Teachers need to be supported by experts from the world of work
- We need more programmes which give teachers real world experience in STEM contexts

Background papers

This paper is part of a series that was commissioned to provide some background information and stimulate debate at the Technical Education for the 21st Century conference, organised by the Gatsby Foundation and the Edge Foundation.

The papers explore a range of perspectives on technical education – including its strengths and weaknesses and opportunities to improve quality – and they discuss the challenges facing government, employers and the education sector.

While the papers were commissioned by the Gatsby Foundation, the views expressed are those of the authors.

School-based technical and vocational education in England

David Harbourne, Edge Foundation

Technical schools before and after the Second World War

"Germany thirty years ago, as compared with England, was simply nowhere; but placing English and German workshops side by side now, we should find that the progress in the latter had been positively marvellous. During all these years the Germans had been following the English step by step, importing their machinery and tools, engaging, when they could, the best men from the best shops, copying their methods of work and the organisation of their industries; but, besides this, they had devoted special attention to a matter which England had almost ignored: the scientific or technical instruction of their own people."

These are the words of an English manager of a Bavarian engineering works, quoted in the first report of the Royal Commission on Technical Education (the Samuelson Report) in 1882.

The Royal Commission was set up precisely because of growing concern that weaknesses in the education system had contributed to a gradual erosion of Britain's competitiveness relative to the emerging economies of Europe and North America. Samuelson made a number of recommendations for strengthening technical education, taking account of good practice witnessed elsewhere in Europe.

The Government was reluctant to impose strict requirements on local school boards. Instead, the Technical Instruction Act 1889 merely permitted county councils to support technical and manual instruction. Furthermore, as Dick Evans has noted, the Act:

"expressly stated that schools should not be involved in the instruction of any trade or industry. This approach was in stark contrast to similar schools elsewhere in Europe, which emphasised the importance of workshop practice and the apprenticeship."

Attempts to establish robust forms of technical secondary education were further impeded by the Regulations for Secondary Schools introduced in 1904-5, which emphasised the provision of general courses for boys and girls between the ages of 11/12 and 16/17, and positively discouraged any vocational specialisation.

Nevertheless, two broad types of technical school did emerge in some parts of the country: junior technical schools and trade schools. These were examined by the Consultative Committee on Secondary Education in the 1930s. The Committee's report (the Spens Report, 1938) concluded that technical schools should have a place in the education system:

"We are convinced that it is of great importance to establish a new type of higher school of technical character quite distinct from the traditional academic Grammar School."

Together with the Norwood Report (1943), the Spens Report provided the basis for many of the education policies of the immediate post-war period, symbolised by the Education Act 1944. Just as in 1889, local authorities were given considerable discretion: they were required to submit proposals for reorganising secondary education in their areas, but the Act did not specify what these plans should look like. That said, it was widely assumed that secondary schools should be based on a tri-partite system of grammar, technical and modern schools, with children allocated to schools on the basis of an examination at the age of 11.

Although a number of local authorities enthusiastically embraced the idea of secondary technical schools, the plain fact is that most did not. The Crowther Report noted in 1958 that there were 683,000 pupils in grammar schools, over 1.5 million in secondary modern and equivalent schools, and only 95,000 in secondary technical schools. The report concluded that *"we do not now have, and never have had, a tripartite system"*.

Why was there so little enthusiasm for technical schools?

One problem was providing the right specialist facilities and equipment. Many schools soldiered on in pre-war buildings. A relatively small number of entirely new technical schools were built during the 1950s, but cost was often an issue: the Ministry of Education imposed cost limits which encouraged the use of prefabricated materials and limited the overall size of buildings. Reese Edwards visited over 200 secondary technical schools in 1958-59 and reported a general standard of buildings which could:

"only be described as most unsatisfactory in the main and appalling in many instances … Annexes consisted of pre-fabricated huts, private houses, old vicarages, parochial halls and even dance halls."

But perhaps the most significant problem was one which the Spens Committee had identified in 1938 – status:

"The natural ambition of the clever child has been turned towards the Grammar School and the professional occupations rather than towards Technical High Schools and industry. This tends inevitably to create a disproportion in the distribution of brain power as between what may be broadly termed the professional and industrial worlds. Furthermore, there is the regrettable and undesirable difference in social esteem."

Post-war technical schools made very little difference to this issue. Rightly or wrongly, parents, teachers and children believed that if you were clever enough to pass the 11+, you should go to a grammar school, because this offered the best chance of a career in a secure white-collar job.

Meanwhile, secondary modern schools provided remarkably little technical or vocational education. The Newsom Report (1963) noted that modern schools offered a mix of traditional academic subjects (maths, English, science, history and so on) and practical subjects including art, craft, technical drawing, needlework, housecraft, handicraft (mainly woodwork and metalwork), music and physical education. A minority of schools offered additional subjects ranging from rural studies to film-making. However, the Newsom Report's survey of fourth form timetables – what we now call Year 10 – showed that very few subjects taught in modern schools included any meaningful technical or vocational content; and these subjects accounted for less than a fifth of the average fourth former's school week.

The era of comprehensive education

In 1958, the Crowther Report noted that "more and more people are coming to believe that it is wrong to label children for all time at 11"; and of course, it was not long before the majority of local authorities abandoned selection at 11 in favour of comprehensive education. Technical schools were transformed into comprehensive schools, or merged with other schools nearby. To the extent that comprehensive schools offered technical or vocational options, these were very largely based on what they inherited from secondary modern schools – woodwork, metalwork, domestic science and so on.

In 1976, Prime Minister James Callaghan triggered a "Great Debate" about the aims of education. In his Ruskin College speech, Callaghan said he heard:

"complaints from industry that new recruits from the schools sometimes do not have the basic tools to do the job that is required."

He went on:

"I have been concerned to find out that many of our best trained students who have completed the higher levels of education at university or polytechnic have no desire to join industry. Their preferences are to stay in academic life or to find their way into the civil service. There seems to be a need for more technological bias in science teaching that will lead towards practical applications in industry rather than towards academic studies."

The Department of Education and Science then embarked on a series of consultation events around the country, which they reported to Parliament in 1977:

"It was said that the school system is geared to promote the importance of academic learning and careers with the result that pupils, especially the more able, are prejudiced against work in productive industry and trade; that teachers lack experience, knowledge and understanding of trade and industry; that curricula are not related to the realities of most pupils' work after leaving school; and that pupils leave school with little or no understanding of the workings, or importance, of the wealth-producing sector of our economy."

The 1977 consultative document proposed a review of curricular arrangements in each local authority area. This led to the DES circular "Local Authority Arrangements for the School Curriculum", published shortly before the 1979 general election.

Political interest in the school curriculum straddled party boundaries. The incoming Conservative Government published "A Framework for the School Curriculum" early in 1980, and followed it with "The School Curriculum" in 1981. This stated that every pupil should follow a broad curriculum up to age 16. Whilst the report did not use the words "technical" or "vocational", it did say that:

"the curriculum needs to include more applied and practical work, particularly in science and mathematics."

Across Whitehall, Ministers at the Department for Employment were grappling with the problem of rapidly rising youth unemployment. On 12 November 1982, Prime Minister Margaret Thatcher announced she had asked the chairman of the Manpower Services Commission, together with the Secretaries of State for Education and Science, Employment and Wales to develop new institutional arrangements for technical and vocational education for 14 to 18-year-olds. This soon became known as the Technical and Vocation Education Initiative (TVEI). It was piloted in 14 areas in 1983 and made more widely available from 1984 onwards.

A key aim of TVEI was to introduce vocational subjects into the curriculum for 14 to 16-year-olds and encourage co-operation between schools and local further education colleges. The Manpower Services Commission (MSC) was given the task of funding technical and vocational education in schools and even, if need be, to establish new schools.

TVEI was immensely controversial. It presented a direct challenge to the educational establishment's control over the curriculum. Local authorities also complained that it was a direct challenge to local democratic control over education policy.

Nevertheless, the prospect of additional funding was a powerful incentive to get involved, and many schools and local authorities did – though not, perhaps, in the way TVEI's original architects had expected. The Secretary of State for Employment, Norman Tebbitt, and the chairman of the MSC, David Young, imagined that schools would introduce explicitly vocational, skills-based courses. In practice, schools generally developed approaches which the existing teaching staff could deliver. Since few had the occupational expertise to teach explicitly vocational subjects, they were more likely to favour classroom-based applied learning. Schools were also influenced by budgetary considerations: in the early days, TVEI offered access to capital funding which was otherwise in short supply.

Meanwhile, Education Ministers were also planning reforms, including the introduction (for the first time) of a national curriculum. Aims included equipping young people with the knowledge, skills and understanding needed for adult life and employment. Nevertheless, the national curriculum remained very largely based on traditional disciplines such as English, maths, science, art, geography, history, music, foreign languages and PE.

The Education Reform Act 1988 introduced not just the national curriculum, but also permitted schools to opt out of local authority control, and paved the way for the establishment of City Technology Colleges. The website, TeacherNet, sums up CTCs as follows:

"City Technology Colleges (CTCs) are independent all-ability, non fee-paying schools for pupils aged 11 to 18. Their purpose is to offer pupils of all abilities in urban areas across England the opportunity to study successfully a curriculum geared, with the help of private-sector sponsors, towards the world of work … From the applicants of different abilities CTCs select those who are most likely to benefit from the college's emphasis on science and technology, have the strongest motivation to succeed and intend to continue in full-time education or training up to the age of 18."

A total of 15 CTCs opened in the following four years. They tended to offer curricula which favoured the use of technology (particularly ICT) rather than explicitly vocational programmes. Because of their urban location, they also tended to attract pupils from working class and lower middle class backgrounds. Nevertheless, they achieved some remarkable successes, and paved the way for the Labour Government's Academies programme.

TVEI survived to the mid-90s, albeit in a less controversial form. During this period, all young people became entitled to a work experience placement during Key Stage 4, and General National Vocational Qualifications (GNVQs) were introduced as a means of helping young people learn about general occupational areas in a classroom setting.

In a sense, GNVQs were proof of TVEI's failure. An explicitly vocational curriculum had failed to take hold; the school curriculum remained firmly rooted in the classroom. Nor did TVEI improve the status of technical and vocational learning.

1997 and all that

Rather than attempt a detailed, chronological account of everything that happened under the Labour Governments of 1997-2010, let us move straight to an intriguing snapshot of technical and vocational education in schools today, using qualifications as a proxy.

In 2009, the Edge Foundation published a comprehensive survey of vocational qualifications awarded in the previous year. A striking finding was the rapid growth in the number of National Vocational Qualifications and Vocationally-Related Qualifications achieved by young people below the age of 16:

"Increasingly young people, including under-16s, are gaining vocational qualifications originally designed for adults. Such courses include over 30 Level 1 and 2 NVQs in sectors ranging from Food and Drink to IT; and professional qualifications such as the Association of Accounting Technicians' Level 2 Certificate in Accounting. The trend is most notable with VRQs, where a rapidly increasing number continue to be achieved by 14 to 16 year-olds – 486,000, up nearly 70 per cent on the previous year. The biggest increase was in children achieving VRQs at school – 311,000, over double the previous year – reflecting the growing importance of work-related learning in the school curriculum. A relatively small but growing number of NVQs continue to be achieved by 14-16s – over 43,000 in 2007-8, up 10 per cent on the previous year. In addition, 300 under-16s completed a full Level 2 Apprenticeship, doing a large amount of practical learning with an employer."

Ofqual's Annual Qualifications Market Report, published in March 2010, reported a further 6% growth in the number of VRQs awarded in 2008-09. However, this was not broken down to compare growth in schools and other settings.

This growth in a range of VRQs, from a number of different awarding bodies, has tended to eclipse the Diploma, which was intended to be Labour's flagship qualification for young people aged 14-19.

The key point is that technical and vocational education appears to have taken off to a quite unprecedented degree in many schools across England. Why?

One possibility is that some students prefer technical and vocational subjects to the more traditional subjects listed in the national curriculum. Pearson, owner of the Edexcel awarding body, says this about its family of vocational qualifications:

"BTEC is popular with schools because it supports the dual purposes of good vocational education – it gives the option of a different approach to learning and assessment, and so increases participation and engagement, driving improved performance across subjects; on the other hand, the style of curriculum and learning begins to address a long term need to reconfigure our education system to develop skills for a new, global economy – not just specialist skills but core employability and workplace skills, and so is attractive to both further and higher education and employers … Vocational qualifications are by no means solely taken by "lower ability" students and we believe that this perception has undermined the important role that good vocational education can play for students performing at all levels."

Others argue that VRQs are easier to pass than more traditional GCSEs, and help boost schools' positions in the league tables. The think-tank, Civitas, has researched the rapid growth in VRQs achieved by students in academies, noting a high pass rate. An interim report published in 2009 said:

"[It] may be that Academies are particularly successful at vocational subjects. Yet, as Academies are not being sold as specialist vocational schools, even were this to be the case, it would still be a fairly indefensible position. A more plausible argument is that it is simply easier to succeed in vocational subjects."

Civitas also claims that VRQs fall between two stools:

"As the Quality Improvement Agency (QIA) has stated: 'these qualifications focus on learning about the working world, rather than learning **about** *a specific job' (emphasis added). The basic problem is that these qualifications on offer for 14-16 year-olds are neither vocational nor academic; rather they are both pseudo-vocational and pseudo-academic."*

Taking office in May 2010, the new Secretary of State for Education, Michael Gove, is well aware of the criticisms levelled at VRQs by Civitas and others. This lies behind his decision to commission a review of 14-19 vocational education by Professor Alison Wolf. In his letter to Prof Wolf, Mr Gove said:

"For many years our education system has failed to value practical education, choosing to give far greater emphasis to purely academic achievements. This has left a gap in the country's skills base and, as a result, a shortage of appropriately trained and educated young people to fulfil the needs of our employers. To help support our economic recovery, we need to ensure that this position does not continue.

"We have agreed that you will consider how we can improve vocational education for 14-19 year olds and thereby promote successful progression into the labour market and into higher level education and training routes."

Prof Wolf has been asked to prepare an interim report by the end of 2010 and a final report by spring 2011.

Edge's vision for the future

Edge believes all young people should be able to experience vocational education even before the age of 14. This is not because we believe they should be made to choose career pathways at such an early age (though, in fact, some already do). Rather, we believe taster courses, visits and opportunities to meet people from many walks of life will help young people make informed choices at 14. In our "Six Steps to Change Manifesto", Step 1 calls for "a broad curriculum up to age 14 with opportunities to develop life skills and experience a range of future options".

Step 2 recommends that all young people should have an individual profile of attainment, skills and aptitudes, which would be used by young people, parents and teachers to guide choices at 14 and beyond. This leads to Step 3:

"At 14 all students, in addition to continuing a broad curriculum, including English, maths and science, would be supported in choosing a pathway matched to their interests and abilities, each with a different balance of theoretical and practical learning."

This is not about dividing young people into academic sheep and vocational goats. There is ample evidence that practical and vocational education re-engages the interest of many young people who see the traditional, "academic" curriculum as boring and irrelevant. However, we are convinced that very many young people capable of good GCSE results *also* enjoy and could benefit from practical and vocational learning as part of a broad curriculum offer, just as young people who have already set their sights on a vocational route benefit from continuing to study maths, English, science and so on.

Step 4 concerns teaching of vocational courses in specialist facilities or institutions, and by appropriately experienced staff.

Specialist facilities could be in a stand-alone University Technical College (UTC), as proposed by the Baker Dearing Educational Trust. Indeed, this is in many ways the ideal solution, as UTCs will blend dedicated, high-quality technical and vocational learning with core national curriculum subjects including English, maths and science.

In order to teach a vocational course in England, teachers in secondary schools are required to have a degree, but they are not required to have any experience of the vocational area they are teaching. Meanwhile, people with extensive vocational experience can teach in further education by achieving Qualified Teacher Learning and Skills accreditation – but they may only work in schools as "instructors", not as teachers. We believe this is an unreasonable restriction. We also believe that all teachers of vocational subjects should have access to employer placements as part of their commitment to CPD, so they can keep their subject-specific knowledge up to date.

Step 5 recommends that *"at 16 students would choose to specialise within their pathway, change to another pathway or enter employment with training"*.

Students who take (quality assured) vocational courses at 14 will gain knowledge and skills in their chosen sector which would allow them to choose a more specialist route, such as an Apprenticeship. Others will move on to general qualifications, including A levels, or a further blend of academic and vocational options. In either case, skills and knowledge gained by taking vocational options during Key Stage 4 will be of lasting value, not least in relation to what the CBI and UK Commission for Employment and Skills call employability skills.

Between them, these steps describe a set of common sense changes which can help transform the image, reputation and success of technical and vocational education in schools, finally delivering the broad and engaging education which so many young people want, and which so many employers need.

Why we need change

In July 2010, the UKCES published a report on progress towards the aims set out in the 2006 Leitch Report, "Prosperity for All in the Global Economy – World Class Skills". Echoing the 19th century quotation at the start of this paper, the UKCES reported that *"whilst UK skills levels have been progressing, so too have those in other countries, often at a faster rate"*.

Specifically, the UK ranks 11th in the OECD for people with high skills (degree level), 19th in terms of low skills and 21st for people with intermediate skills. In the context of technical and vocational education, it is this last figure that is the most worrying. It tells us that we are falling behind our international competitors, just as we did in the 19th century.

The challenge is therefore entirely familiar: how do we make sure young people are better prepared for careers in a world economy that is developing faster than ever? The answer lies in giving young people a taste for learning by making and doing things, and in raising the status of this style of learning so that it appeals to more young people (and has the approval of their parents and teachers).

And if we need any further prompting, take these results of a survey of 15-year-olds carried out as part of a Eurydice study on science education, the Relevance of Science Education (ROSE) project. Young people in a number of countries were asked (amongst other things) if they would like to be a scientist, and if they would like to get a job in technology. In England, about 25% of boys and 14% of girls said they would like to be scientists. In Gujarat (India), 75% of boys and 68% of girls wanted to be scientists. In Uganda, it was 90% and 86%.

More English boys said they would like a job in technology – 50% – but this is streets ahead of the 18% of girls who wanted a job in technology. In Mumbai, the figures were 85% and 69%. And in the Philippines, 82% and 76%.

So what do English 15-year-olds want to do? The short answer is to work with people rather than things, which was the answer given by 62% of English boys and 81% of English girls.

It is no surprise, therefore, that:

"A quarter (25%) of manufacturing firms highlight technicians as an area of recruitment difficulty, and a similar proportion (24%) report it is difficult to find qualified apprentices."

In reality, jobs which involve practical and technical skills usually involve working with other people, and vice versa. It's just that young people seem not to understand this. It is vital to help them appreciate the social and economic benefits which can be achieved through practical, technical and vocational education: benefits which will be felt not just by individuals, but by the economy and society as well.

David Harbourne

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Selected reading

Montague, F. C. (1887). Technical Education: A Summary of the Report of the Royal Commission Appointed to Inquire into the State of Technical Instruction. London: Cassell and Company.

Evans, R. (2007). The History of Technical Education: A Short Introduction. Cambridge: T Magazine Ltd.

Board of Education (1938). Report of the Consultative Committee on Secondary Education (the Spens Report). London: HMSO.

Board of Education (1943). Curriculum and Examinations in Secondary Schools: Report of the Committee of the Secondary School Examinations Council (the Norwood Report). London: HMSO.

Ministry of Education (1959). 15 to 18: A Report of the Central Advisory Council for Education (England) (the Crowther Report). London: HMSO.

Callaghan, J. (1976). A Rational Debate Based on the Facts: speech delivered at Ruskin College, Oxford, 18 October 1976. Transcript at **www.educationengland.org.uk/documents/speeches/1976ruskin.html** Accessed 13 November 2010.

Cmnd 6869 (1977). Education in Schools: A Consultative Document. London: HMSO.

Edge Foundation (2009). The VQ Landscape 2009: A Review of Vocational Qualification Achievements in the UK. London: Edge Foundation.

Ofqual (2010). Annual Qualifications Market Report. Coventry: Qualifications and Curriculum Authority.

Pearson (2010). Maximising the benefits of vocational education to learners and the wider community: Pearson's Submission to the Wolf Review of Vocational Learning (unpublished).

de Waal, A. (2009). The Secrets of Academies' Success. London: Civitas **www.civitas.org.uk/pdf/secrets_success_academies.pdf** Accessed 12 November 2010.

Spilsbury, M., Giles, L. and Campbell, M. (2010). Ambition 2010: World Class Skills and Jobs for the UK. Wath-upon-Dearne: UKCES.

Sjoberg, S. and Schreiner, C. (2010). The ROSE Project: An Overview and Key Findings. Oslo: University of Oslo. **http://folk.uio.no/sveinsj/ROSE-overview_Sjoberg_Schreiner_2010.pdf** Accessed 12 November 2010.

CBI (2010). Ready to grow: business priorities for education and skills. Education and skills survey 2010. London: CBI.

Parity of esteem between academic and vocational qualifications: time to abandon a misguided notion

Tim Oates, Cambridge Assessment

An opinion piece

Over a decade ago I wrote, with John Hillier – the Chief Executive of the National Council for Vocational Qualifications – an article which emphasised that the pursuit of parity of esteem between vocational and academic qualifications should be seriously questioned. We argued the following: 'we should recast the debate, constructing policy on ideas of 'fitness for purpose' rather than 'system tidiness'.' However, a few lone voices questioning prevailing orthodoxy are not likely to effect much change. Regrettably, parity of esteem continues to be the principal policy objective. It continues to permeate discourse on the relationship between vocational and academic qualifications, and appears both in the analyses of those promoting unified systems and in those opposed to them, who advocate 'tracked' systems. The fact that opposed camps are equally preoccupied with parity of esteem might be taken as proof that is it a vital element of a successful education and training system. Surely it is self-evident that we must avoid qualification routes which are second-class, which carry lower status, which label people? What I am going to argue here is that the pursuit of parity of esteem is misguided and, indeed, is so confused that it is preventing us from developing arrangements which stand international scrutiny.

At a recent international conference in Sweden, a group of English researchers staged a seminar on parity of esteem which in England would most likely have generated considerable, heated debate. But the continental researchers and developers in attendance were simply bemused by the English preoccupation with the idea. 'We don't get it' they said. 'Vocational and academic qualifications are different … they are intended for different people and to achieve different personal, social and economic aims' – and this from countries with very successful vocational routes. If pursuit of parity of esteem did not figure in the development of arrangements in these countries, if the dominant debates in education and training in these nations do not include references to it, perhaps we should not be so preoccupied with it.

Is there any evidence that attempts to create parity of esteem have damaged the education and training system and the opportunities which it offers? The following examples are salutary, and they cover both past and present events.

Firstly, the vexed history of General National Vocational Qualifications (GNVQs). First taught in 1992, GNVQs were designed by a small team at the National Council for Vocational Qualifications (1986-1997) as 16-19 vocational provision capable of being delivered in full-time educational settings. Part of their function was to reduce the number of National Vocational Qualifications – designed for workplace delivery – being taught full-time in colleges. By 1997, GNVQs had grown substantially (188,759 registrations in that year), helped not least by specific provisions of funding council arrangements. Of specific interest to the parity of esteem debate, GNVQs had opened up a new route into an expanding HE system. Few analysts and commentators were aware that Advanced Level GNVQs (level 3) were functioning well as HE admissions qualifications. Again in 1997, there were 22,853 applicants to HE who possessed level 3 GNVQs. Of these, 93.6% were offered places in HE (source: UCAS), which compared more than favourably with the UCAS average of 92% across the whole system, including A levels. This was not a qualification which, in any obvious way, was failing to hold its own against other qualifications in respect of HE admissions. Further inspection of the data revealed that of these, two-thirds were receiving offers on degree programmes and the remaining third on Higher National Diplomas (HNDs) and other vocationally-related higher education provision. Follow-up work with students showed an interesting pattern amongst those enrolling onto sub-degree programmes, with many converting to degree-level provision once in higher education.

By 1997 it was clear – at least to those closely involved in delivering and developing it – that GNVQs were occupying an important niche in the system, and growing steadily. Although some researchers were concerned that the English system remained one in which there were distinctive 'tracks' (comprising academic, general vocational and occupational pathways), many schools and colleges embraced GNVQs as a full-time qualification which met genuine learner needs in the same way in which the Technical and Vocational Education Initiative had met the needs of learners otherwise poorly served by the system.

But the seeds of destruction had inadvertently been sown by Lord Dearing's 1996 Review of 16-19 Qualifications. Concerns over quality and cumbersome processes had led to the 1995 Capey Review of GNVQs, and the Beaumont Review of NVQs. In the case of GNVQs, the recommendations of the Capey Review did not lead to a carefully-designed programme of improvement for GNVQs. Rather, they fuelled the argument in the Dearing Review that GNVQs needed revision in order to gain parity of esteem. The analysis in the Review suggested that the only way in which GNVQs would gain sufficient status would be by turning them into vocational A levels. This failed to recognise that – using HE progression as a measure – they were indeed already well-established in their own right. This recommendation formed a cornerstone of the Dearing Review's recommendations, and this coincided, in 1997, with the dissolution of the original GNVQ design teams on the merger of the Schools Curriculum and Assessment Authority and NCVQ into the Qualifications and Curriculum Authority (QCA). From that point, colleges and schools complained that GNVQs had undergone severe 'academic drift'. Indeed, some argued that the Advanced Vocational Certificates of Education (AVCEs) which QCA designed were 'neither fish nor fowl', and no longer met the needs of the types of students for which GNVQs were originally designed.

My view on this is the GNVQ succumbed to a depressing syndrome which is characteristic of the English education and training system – namely, well-meaning analysts attempted to increase the status of vocational qualifications by using existing high status qualifications as a model. Underneath this lurks a hidden elitism – that things can only be of value if they correspond in form and content to that which is already highly valued.

What this fails to recognise is that meeting the needs of individuals, society and the economy is the most important issue, and that ‘fitness for purpose’ should be a principal driver of the qualifications system, not system tidiness or parity of esteem. The eventual demise of AVCE offers clear proof of this: despite its growing success in its original form, once GNVQs were transformed into AVCEs, the qualifications no longer enjoyed the confidence of learners or providing institutions. Once again, the creation of a mass-participation, high-quality vocational route in 16-19 education had come to nought – following in the footsteps of the catastrophic decline of the apprenticeship route during the 1970s and the failure of the Technical School development of the 1944 Education Act.

For me at least, this sorry history is clear evidence of the problems which have been created by pursuit of ‘parity of esteem’. But the problems associated with parity of esteem have not stopped there. Interestingly, the traffic has not all been in the same direction. Part of the Curriculum 2000 development was the wholesale adoption of modular qualifications. Interestingly, the elements of revised A levels and vocational qualifications were termed ‘units’ rather than ‘modules’ – thus borrowing a key term from vocational qualifications. Units were designed to be of equal or comparable size across the system. This moved the system more towards ‘unification’ – that is, a system where different elements could be more readily combined. Again, the notion of parity of esteem occurs as part of the rationale for this development. However, this direction of travel appears to have accumulated problems for A level (particularly in respect of ‘standards over time’).

Increasingly, commentary from different parts of the education establishment has suggested that the top-down prescription and imposition of a specific model of unitization for A levels has created a tendency to treat units as self-contained programmes of study, rather than as interdependent and cumulative elements of a single programme. In the face of this specific model, awarding bodies have had to work hard to retain and establish forms of modularised A levels which seek to avoid this significant problem. Parity of esteem – adopted as a rigid common model in the Curriculum 2000 reforms – has thus been responsible for serious tensions in one of the most critical parts of the education system.

Leading schools have argued that non-unitised A levels should be returned to the system – the PreU development has been successfully implemented, with first full certifications completed in Summer 2010 – while HE has vociferously demanded that ‘stretch and challenge’ be a clear feature of advanced qualifications. Pursuit of parity of esteem played a key role in the demise of GNVQs, but ironically it appears to have played a regrettable role in tarnishing the reputation of A level – a qualification of remarkable longevity and educational quality.

Have the adverse effects of pursuit of parity of esteem now ceased? Far from it. It appears all too frequently in official policy statements and in the educational press, and seemed to be alive and well – like an indestructible virus – in Diploma developments. In my view, Tomlinson offered a bridge too far in suggesting scrapping GCSEs, A levels and general vocational qualifications in their existing form and replacing them with a single, four level, diploma system at a time when government did not wish to embrace total upheaval of the system. Nor indeed, is transnational evidence wholly supportive of the Tomlinson ‘unified system’ approach – an issue I deal with elsewhere. In place of adoption of Tomlinson, the old sequence unfolded – the syndrome of parity of esteem. The original statement on Diplomas was they would provide a high quality, full-time vocational route. This of course is curiously reminiscent of GNVQs. Almost immediately there was a flurry of concern at the highest levels of government that this would be a second-class route (although giving them high levels of funding, and excess performance table and tariff recognition would most likely establish them in the system whatever they were called). The term ‘vocational’ was quickly dropped, causing considerable confusion. In mid-2007, the Guardian announced ‘a dramatic shift in policy’ in the announcement of academic diplomas – initially in Languages, Science and Humanities. While in government thinking the production of academic diplomas was motivated not least by a concern to ensure that non-academic diplomas are held in esteem by virtue of the existence of academic diplomas, many commentators simply felt that they confused the system, not clarified it. Indeed, David Forrester, a highly respected senior education civil servant, stated ‘why have all these diplomas if you still need A levels?” (Guardian Nov 6 2007). I believe it was right that the incoming Coalition Government cancelled the development of academic Diplomas and withdrew from Ed Balls’ notion of the Diploma concept being ‘the qualification of choice for all’.

The tortured logic of ‘parity of esteem’ has seen: successful GNVQs transformed into unsuccessful AVCEs, with numbers plummeting; Vocational Diplomas seeking legitimacy by being extended to academic subjects and therefore eroding the status of well-established flagship qualifications, with scant rationale other than legitimating the Diploma brand and offering academic options of poor educational integrity; and contentious and corrosive ‘equivalences’ in performance tables (parity of value) which have eroded the credibility of vocational options in schools. In the face of this, the Wolf Review is more than necessary.

And through all of this there has been summary failure to address the structural issues associated with establishing a high quality, high volume vocational route from 16. Embedded in this are complex problems of the legitimacy and effectiveness of a ‘routed’ system (as opposed to a Tomlinson-like ‘unified’ system), questions of employer ownership of and responsibility for initial vocational training, and sound structural design of an employer-based route. I now turn to those in some detail.

Stop subsidising substitution – decide, and make clear, who is responsible for what

Government has, over the past four decades, expressed rising concern at the reduction of the propensity of employers to participate in long-duration initial training (although note that from 2000 to 2005 employer spend on training ***overall*** went from £23.5 billion to £33.3 billion and fees paid to colleges and training providers went from £2.6 billion to £2.4 billion over the same period). In 2002 Ruth Lea produced the Institute of Director’s overview of education and training, making the bold claim (supported by contemporaneous statements from the CBI) that employers should be responsible neither for the training of young people (initial vocational education and training) nor the training of low-skilled adult workers. The responsibility of employers was seen to start and stop at developing only the skills and knowledge which could not be obtained from the open market. This contradicts the approaches in some of the most advanced economies, where initial vocational education and training (VET), in particular, is part-funded by employers and part-funded by the state. One of the most difficult trends to counter has been the decay of underlying employer commitment to long-duration initial VET, but the more sophisticated commentators actually see government action as contributing to this decline rather than halting it – principally by government failing to understand the need to manage a complex set of incentive structures, opting instead for direct funding of employer-based training provisions. The model has been 'temporary funding (for short term relief or to stimulate new arrangements) as seed-corn'.

When each scheme has resulted in substitution, and reduction of underlying volumes of employer-based training when funding is pulled, new schemes with a different name or superficially different structure but ***based on the same fundamental model*** have been rolled out. This has occurred time after time. The successor programmes, unsurprisingly, have enjoyed the same unfortunate history. Most recently, this has culminated in massive substitution under 'Train to Gain'. As the success of each scheme has been questioned, successor schemes have tended to be increasingly bureaucratic – increasing 'strings' attached to funding contracts in order to try to transfer responsibility for training to employers and to prevent low quality and/or substitution. Again, this has had the reverse effect to that intended. Such bureaucracy is a strong disincentive to employers. Within these arrangements, there has been a huge (and invisible) shift of training from employers to private training providers, who, very misleadingly, are identified in the statistics as providing 'employer-based training'.

To arrest this trend, what is needed is a very clear articulation of the respective roles of the state, employers and VET providers. An increase in employers' propensity to train, and a genuine shift back to true employment-based training ***can*** be effected – both for initial and continuing VET – but requires multi-faceted policy, where strategy directly focused on VET must be linked with policy on regulation, wage rate and licence to practice. I outline the specifics below. Clear demarcation of responsibilities and delineation of necessary partnership between employers and the state (e.g. the state funding the more general education elements of young people's initial VET) should both be the basis of policy and of public perceptions of how VET should operate – in other words, the 'common understanding of the social and economic deal'.

Limit the label 'apprenticeship' to high quality, long-duration, employer-based level 3 provision

Entering a time of financial hardship places considerable pressure on VET strategy. From history we know that in such times government-funded VET can all too readily be seen as a means of 'warehousing' young people in the most cost-effective way possible. Officials may be tempted to drive up apprenticeship numbers by increasing apprenticeship numbers in public sector occupations. While it may deal with short-term 'warehousing' of young people at risk from unemployment, this strategy carries grave risk. It decreases officials' propensity even to try to increase employers' willingness to train, associates apprenticeship even more tightly with state funding, and threatens attempts to embed training in innovative sectors and enterprises.

The term 'apprenticeship' increasingly has become debased, as more and more short-duration or lower level government-funded training has been titled 'apprenticeship' (not least as an effort to raise the status of this lower-level provision). The term is thus no longer uniquely associated with high quality, long-duration level 3 provision, as it was in the past in the UK, and as it remains in many apprenticeship-based systems elsewhere. There are other distinctive elements of these systems which have also become diluted in the English system of apprenticeship. It is vital to recognise that the apparent rigidities of level 3 apprenticeship in other nations are deceptive. The 360 training 'lines' in the German system, in which students specialise for their three or four years, appear inflexible and over-specialised. However, all of these lines include protracted socialisation into work processes, social learning, deep technical learning, proximity to work, and a sense of identification with a single employer who is committed to training, as well as general education elements. These elements are possible in a long-duration training programme which is genuinely employer-based. They contribute to a system in which 40% of trainees successfully start work in an occupation other than the one for which they have been specifically trained. At the heart of the system is the sense of 'beruf' – of entering a profession and becoming a professional – across all occupations. This is 'training for stock' but at the level of the individual. The intensity and volume of learning is impressive, and allows considerable labour market flexibility – vital for individuals, employers and the economy together. Overall, while some worthy apprenticeships in England do reproduce aspects of such arrangements, attempts to replicate this flexibility in England have focused on creating more flexible qualifications – outcomes-oriented modules and units, which can be combined in different ways, supplemented by key skills units. This tends to produce a pale, 'administrative' reflection of the rich learning and experiences which lie at the heart of a continental level 3 apprenticeship.

High quality apprenticeships sound expensive, but they are not – again, appearances are deceptive. By being of long-duration, and by securing a differential between trainee and experienced worker rates, the internal economies are actually attractive to employers. It is counter-intuitive, but with careful design, ***longer-duration*** rather than ***shorter-duration*** initial training are based on internal economics which make them far more attractive to employers. However, longer-duration initial training appears very expensive if fully-funded by the state. Since the state has indeed been the principal funder, this has resulted in pressures to shorten training times, in the mistaken belief that this is more efficient. Longer-duration training (as detailed below) can play a key role in transferring responsibility for training to employers, since (with managed trainee wage rates) it carries clear financial benefit to the employer. I explain this below in more detail.

Differentiate Vocational Education and Training (VET) policy – and arrangements – for young learners and adult learners

Carefully developed arrangements which focus on the quality of learning (systematic immersion in the workplace) appear highly functional for initial VET for young people. As I state above, 'flexible qualifications' (the mantra of QCDA) do not necessarily promote this. By contrast, the flexibility of English qualification arrangements seems to be well-adjusted for adult learners, where individuals can have very different learning needs and may require anything between substantial re-orientation and minor 'top-ups'. VET strategy should differentiate the policy and system requirements of young learners and adult learners.

What's wrong with routes?

The majority of UK analysts and commentators are highly averse to 'tracked systems' or systems which have distinctive academic and vocational routes. I believe that this aversion derives from some modern conceptions of egalitarianism, which suggest that to have routes is to condemn certain groups to 'lower class routes' – language such as *'developing a system* *which condemns people to being sheep or goats'* abounds. But this denies the very real hierarchies and inequalities which have been established by current, putatively egalitarian, arrangements. Researchers have interviewed young people (and ONS have had their surveys unintentionally corrupted by the same young people) who claim that they 'have no GCSEs'. What they mean is that they 'have no GCSEs above grade C'. This is not challenging the need to emphasise higher grade attainment in GCSE. Rather, it punches a hole in the claim that the 'single route' system as it stands is entirely egalitarian. The German, Swiss, Austrian, Finnish and Dutch systems all operate vocational routes. In each case, they include general education elements which are contextualised in vocational settings – motivating certain groups of learners who otherwise are less than motivated by general education content (such as mathematics) - and thus driving up learning volumes. Yes, these routes are not considered to be the most elite in the system, but they establish the value of vocational learning, and by their focus, clarity of purpose, and fitness for purpose, raise the standard of attainment of learners to a considerable degree.

If a system is based on routes, then the selection (or adoption) processes for them should be sound and fair. Guidance and support needs to be of a high quality (one of the few well-evidenced policy recommendations of the Leitch Report), to ensure efficiency in labour market signaling back into education and training, and to ensure routes are well-matched to learners' attainments and aspirations. Processes for moving from route to route, should different aspirations or capabilities arise in individual learners, must be in place. In Germany, problems experienced by high-trained technicians wishing to enter HE were not addressed by removing the vocational route from the system, but by constructing specific 'bridging arrangements' for workers at that level. This is targeted strategy, not wholesale, naïve egalitarianism.

The international evidence on this is clear – there is no simple rule that suggests 'routes bad, unitary system good'. Fitness for purpose is all, and many tracked systems provide the best overall opportunities for learners and for driving up overall learning volumes.

Forget frameworks – support qualifications which are 'fit for purpose'

A key point to recognise here is that VET in the UK has been driven too much by policy which assumes qualifications (in the form of modules or units) policy is enough to develop high quality VET. They are indeed the easiest thing for government to change in the system and do indeed have a powerful 'washback effect' into learning – most frequently not of the right kind. The lesson from the study of other successful VET systems is that it is the learning processes which are really crucial – immersion in adult work, socialisation into work, high status knowledge transferred from adult workers to trainees, etc. Workplace pedagogy is complex and subtle. By contrast, qualifications are blunt change agents; the washback effects difficult to predict with precision. As successive government-initiated changes in qualifications have not yielded the precise, intended effect, we have seen a constant cycle of repeated change in qualifications – not only are they the easiest thing for government to change, using them as the principal means of structuring workplace learning and transferring responsibility for learning to employers ***has not worked.*** In the face of this failure, governments have not questioned the wisdom of the fundamental strategy; they've simply implemented yet more rounds of qualifications reform. The consequences of this constant change are reduction of employer confidence in qualifications, reduction in capacity in the training system as reform follows reform and energy is directed at implementing the changes rather than delivering learning, and the development of increasingly intrusive mechanisms such as credit frameworks and national qualifications frameworks.

The lessons from this? Qualifications should be a stable feature of the system; the principal focus of VET policy should not be on meeting qualifications targets but on developing high quality learning processes in the workplace.

In addition, credit frameworks and national qualifications frameworks should no longer be a preoccupation of policy makers. It is simply unclear why level 2 hairdressing and level 2 engineering should somehow be equated. Yet this is exactly what the policy of the past ten years has done. This approach has distorted the content of qualifications right across the system. I believe that vertical progression is vital. That is, if you are working in a sector such as engineering, there needs to be clear progression pathways – in engineering. Introducing commonality across the entire system simply represents policy-makers' neurotic preoccupation with system tidiness. This has been falsely legitimated by claims that 'employers find the system confusing'. This is disingenuous at best and deliberately misleading at worst. All the talk of 'employers not understanding the qualifications system' actually relates to the rate of government-managed change in qualifications. Historically, employers in construction have understood qualifications in their sector. Employers in engineering have understood qualifications in their sector. They do not need to understand the shape of the total system. At most, they may need to understand adjacent, cognate qualifications if they experience a skills shortage and need to recruit from similar sectors from which they have not frequently recruited.

Learners need to understand progression routes, and, at times, the means of bridging into ***related*** sectors where they can redeploy their skills. Crucially, qualifications need to be 'tuned' to the needs of specific sectors. If one sector needs a qualifications 'ladder' which starts at level 3 then so be it. If it needs 12 levels upwards from there, then so be it. If another starts at level 1 and only needs 3 levels in total, then so be it. Efficiency comes from fitness for purpose. Employers will not 'own' qualifications when they have been largely determined by the state. The notion that qualifications have, more recently, been designed by industry is very misleading. Predominantly, they have been designed by government-initiated bodies, within very tightly prescribed frameworks. Compared with other successful VET systems, genuine employer involvement – and thus ownership - is not a strong feature of the system. Here, I am arguing for a vocational version of the Sykes Report's recommendations regarding the increased role of HE in relation to A levels.

The focus on learning process and sector-tailored qualifications is very important. While group training arrangements may be enough to ensure transmission of good practice in localities there may be a need to introduce a new training inspectorate. Not one which is designed to police national frameworks and criteria, but one which is oriented towards the detection of good practice, the transmission of good practice around the system, and the detection of very poor quality provision. But I would proceed slowly with this. David Sherlock (Adult Learning Inspectorate) was correctly orienting the ALI to this – its later demise was thus regrettable. A new version of the ALI may need to be considered, but focused primarily on securing quality in long-duration training for young people.

Use adjuvant drivers, including licence to practice – deliver truly 'joined-up policy'

A further important lesson to learn from history, and feeding straight into VET policy, is sophistication in understanding the adjuvant drivers for participation. For example, health and safety legislation can immediately drive up training volumes, as workers and learners seek certification to meet the requirements. The European Airline Maintenance standards have had a major, and beneficial, impact on the volume and quality of training of airline maintenance technicians and engineers. Where training has been linked to reduced insurance premiums (e.g. in the travel industry re ABTA bonding) it has had the same effect. QCDA was taken entirely by surprise when participation in Level 2 Care qualifications went through the roof – this level of qualification had been made a labour market requirement by the Department of Health.

It is important to note that the tendency for the CBI to argue against all forms of regulation is not shared by individual employers, who – with more subtlety – differentiate between appropriate and inappropriate forms of regulation. Many employers are not calling for reduced safety regulation or for removal of clear standards; indeed, there are examples of enterprises pulling out of countries with inadequate regulations. Enterprises can work with regulation which clearly brings some economic and/or public goods with it. While inappropriate regulation is clearly a 'dead hand', by contrast, appropriate regulation (health and safety, licence to practice, technical standards) not only drives up standards in each industry, it demonstrably increases education and training volumes. Yet successive UK governments have failed to link these elements of policy. Licence to practise was viewed, under the last Labour Government, as unduly restrictive. Yet the Treasury is beginning to be receptive to research which suggests that the balance of public goods stimulated by licence to practise (including economic benefit) may be positive. In Germany, the propensity of young learners to take the vocational, long-duration route in the Dual System of training (and accept a lower training wage for the period) is driven by the dominance of licence to practise in almost all professions and sectors. It is a key part of the system, incentivising young people, assuring the internal economics of long-duration initial training, and supporting quality processes in industry.

Re-establish the internal economies of long-duration initial training

In the UK, trainee wage rates have risen to nearly that of qualified workers. The gradual erosion of trainee-experienced worker differentials has destroyed the internal economies of long-duration initial training. To make matters worse, this has been combined with a 'train to minimum competence' model for a large proportion of government-funded training programmes.

In contrast, a high trainee-worker differential wage rate, combined with a three-year training programme and not 'leaving at the point of competence' achieves the following:

- incentivises employers to be interested in the training curriculum, since once a person has qualified, employers have to pay more, and require demonstrable value-added
- incentivises learners to learn, since without qualification they cannot access higher wage rates
- re-establishes the internal economics of long-duration apprenticeship and can play a major role in shifting responsibility for training to employers (and from the state), since the latter half of the programme (where a person is productive yet being paid a trainee rate) pays for the first half of the training (where the person is not yet productive and consumes resource).

The habit of government of striving to shorten the duration of training (in the name of apparent 'efficiency') and thus reduce the burden on the public purse actually condemns the system to ***ever-increasing levels of public funding,*** since the internal economics provides very poor incentives for employers to take on ownership of the apprenticeship schemes (employers increasingly refuse to take on apprentices without high levels of public funding – and even then we are seeing a shortage of places).

The seemingly counter-intuitive policy recommendation from this analysis is that the effective route to decreasing public ownership and funding is to ***lengthen*** initial VET and to introduce stronger differentials between trainee and experienced workers rates. Combined with licence to practise, this is likely to increase supply of apprenticeship places considerably (a major problem in the system at present). Such arrangements would not be an incentive to young people as long as there is a vibrant labour market for young workers with low levels of qualification. Removing this would require restriction – blocking low skill routes to wages. A suitable wage premium associated with qualification (through licence to practise) would be necessary to construct the motivation mechanisms. The huge public funding of apprenticeship should surely stop, but this requires sophisticated and careful system management to achieve, through use of the measures I describe here. Public funding of minor elements of apprenticeship might continue. In Germany, the 'deal' between state and employer is that the employer funds three days per week in the workplace, while the state funds the more general education and training of the two days in college.

Acknowledge that a large proportion of HE is vocational in character

The parity of esteem debate also links to higher education, where the importance of vocational and/or professional degrees often is misunderstood. Much HE provision is vocational (medicine, law, surveying, accountancy, etc), yet institutional tie-up with FE frequently tends to be poor (with the exception of some excellent Foundation Degree provision, for example in aircraft engineering). The funding of HE does not recognise well this vocational orientation. Policy and funding should be far more oriented towards the economic function of specific HE, rather than the notion of 'graduation' (in any subject) being a universal good – differential rates of return continue across different subjects, with the highest rates of graduate employment being associated with vocational provision in universities. We need research-intensive, highly academic institutions. The best of these use mechanisms such as science parks, innovation schemes and revised terms of intellectual property to bridge from academe back into society and the economy. But the incentive systems and funding arrangements currently used in HE do not support these mechanisms adequately.

Establish better signalling processes

The need for enhanced guidance to young people and adults was emphasised in the Leitch Report and in many other reviews. Signalling (of return, of labour market opportunity, etc) is vital for system efficiency. Good signalling cuts across a parity of esteem debate dominated by assertions amongst educationalists – qualifications become associated with genuine value rather than by assuming status on the basis of resembling other qualifications. The Austrian Economic Institute identified two interesting features of the US labour market – a putatively low restriction labour market. Firstly, if you look for federal regulation of technical professions it is not visible. People thus assume that there are low levels of regulation. In fact, regulation in the form of labour market licensing (which I deal with above) is present strongly at the district level. This sends strong signals to technicians in respect of necessary skill levels and qualification. Secondly, what the federal government does require is that all enterprises submit investment figures. These are published by state, thus rendering individual enterprises anonymous (protecting individual commercial interests). However, these send strong signals to government, to individuals and to education and training providers regarding the growth trajectories of specific sectors and forthcoming labour requirements. Rather than command-style management, this information feeds into good investment decisions by individuals – to forego freedoms and capital in training for occupations which will indeed exist and from which they will benefit through enhanced return. Developments in the wake of the Browne recommendations are likely to change signalling associated with specific degrees and institutions. Higher fees may encourage greater consideration of returns to specific HE qualifications. Anna Vignoles' work has pointed to higher returns associated with STEM subjects.

In summary – where are we with 'parity of esteem'?

Unfortunately, misplaced attempts to assert and impose parity of esteem are not yet dead. Despite its absence in highly successful education and training system in nations beyond the UK, we appear obsessed with the notion. By inappropriately prioritising it, I would argue that this approach does great damage to the education and training system. I believe that seeking parity of esteem has, ironically, actually prevented us from achieving the very thing which it is designed to deliver – a mass participation, high quality vocational route.

I believe we should simply drop all attempts to pursue it, and concentrate on the things which have lent most quality to vocational qualifications, past and present. We should focus on 'fitness for purpose', on linking vocational qualifications to the content of work and the labour market, and on ensuring that they give rise to effective progression to work, to training, and to further and higher education. Striving for parity of esteem and commonality in the form and content of qualifications across the system should be regarded as a bankrupt and obsessive concern. Only when we decisively reject bankrupt notions of 'parity of esteem' will we stand the chance of having a qualifications offer which will genuinely meet the diverse needs of society, the economy, and – most important of all – young people themselves.

Suggested further reading

The Tomlinson Report: 14-19 curriculum and qualifications (2005).

Robinson, P. (1997) *The myth of parity of esteem: earnings and qualifications.* CEP discussion paper; CEPDP0354, 354. Centre for Economic Performance, London School of Economics and Political Science, London, UK. http://eprints.lse.ac.uk/2326/

Vickers, P. and Bekhradnia, B. (2007) *Vocational A levels and university entry: is there parity of esteem?* www.hepi.ac.uk/466/all/2/Reports.html?sort

Paton, G. Daily Telegraph, August 27 2009: *GCSEs should be scrapped because they are too "complex and expensive", according to Sir Mike Tomlinson, the former head of Ofsted.*

The future demand for technicians and underlying STEM skills

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Summary

Forecasting the demand for technicians is not straightforward as there is no single agreed definition of the technician role. Most labour market analysis uses data based on broad occupation classifications but these may not be sufficiently granular to accurately portray the extent of demand for technicians.

However, even given these caveats, there is some evidence that in-migration (from outside the EU to the UK) may currently – and be required to continue to – alleviate technician shortages. Technician occupations figure prominently in lists of occupational groups which have high levels of migrant employment or high levels of migrant penetration (i.e. the proportion of total employment in an occupation taken by non-UK workers).

Looking to the future, there is a clear trend for the growth in technician employment to be associated with roles requiring higher skills. Demand is rising for technicians across a range of sectors driven by:

- growing technological complexity – driving up skill levels across the production sectors;
- the growing attention given to higher value-added product market strategies – accentuating the need for higher and intermediate vocational and technical skills;
- the changing skill mix in some professions, for example in the public and professional services.

When considering the future demand for technicians it is vital to factor in replacement demand as well as growth. Replacement demand for technicians is significant at intermediate and higher skills levels.

The National Skills Audit stresses the growing importance of technicians – workers with the ability to apply an in-depth understanding of a particular field in a practical setting – especially in specialist STEM areas. It says ensuring the future supply of technicians is critically important to our future prosperity and requires immediate action.

Introduction

This paper examines evidence on demand for technicians and associated STEM skills both now and in the future.

It is important to see the changes in technicians' employment within the context of overall labour market trends. The labour market is subject to consistent change – short term (affected by the economic cycle) and long term, in which the total number of jobs and the balance of jobs can change within the economy.

In terms of overall jobs, the last decade in the UK has seen steadily rising employment levels. The recession in the last two years has, inevitably, seen a decline in numbers in employment. However, there are just over 28 million people in work in 2010 – substantially more than in 2000 (27 million).

Perhaps of more interest is the balance of jobs and how this relates to the demand for technicians and underlying STEM skills. The last 30 years has seen a fundamental shift in the balance of our workforce, with a consistent and steady increase in the number and proportion employed in the higher skilled occupations and a consistent and steady decline in the number and proportion employed in the lowest level occupations. The picture regarding intermediate occupations has been (and is forecast to be) more mixed, with increases in some but declines in others.

Because of both this dynamic in the labour market and the inflexibility of individuals to transfer between occupations, mismatches in the labour market are to be expected, with some jobs and associated skill-sets facing shortages and some individuals and their associated skill-sets being in surplus.

Relating occupations to STEM skills

Much of the analysis in this paper makes use of the Standard Occupational Classification (SOC). The SOC codes are used to classify jobs in terms of their skill level and skill content. SOC is used for career information to labour market entrants, job matching by employment agencies and the development of government labour market policies. Table 1 lists the major SOC groups and the associated descriptions of qualifications, training and experience.

Table 1: General nature of qualifications, training and experience for occupations in major groups

	Major group	General nature of qualifications, training and experience for occupations in the major group
1	Managers, directors and senior officials	A significant amount of knowledge and experience of the production processes and service requirements associated with the efficient functioning of organisations and businesses.
2	Professional occupations	A degree or equivalent qualification, with some occupations requiring postgraduate qualifications and/or a formal period of experience-related training.
3	**Associate professional and technical occupations**	**An associated high-level vocational qualification, often involving a substantial period of full-time training or further study. Some additional task-related training is usually provided through a formal period of induction.**

4 Administrative and secretarial occupations	A good standard of general education. Certain occupations will require further additional vocational training to a well-defined standard (e.g. office skills).
5 Skilled trades occupations	**A substantial period of training, often provided by means of a work-based training programme.**
6 Caring, leisure and other service occupations	A good standard of general education. Certain occupations will require further additional vocational training, often provided by means of a work-based training programme.
7 Sales and customer service occupations	A general education and a programme of work-based training related to sales procedures. Some occupations require additional specific technical knowledge but are included in this major group because the primary task involves selling.
8 Process, plant and machine operatives	The knowledge and experience necessary to operate vehicles and other mobile and stationary machinery, to operate and monitor industrial plant and equipment, to assemble products from component parts according to strict rules and procedures and subject assembled parts to routine tests. Most occupations in this major group will specify a minimum standard of competence for associated tasks and will have a related period of formal training.
9 Elementary occupations	Occupations classified at this level will usually require a minimum general level of education (i.e. that which is acquired by the end of the period of compulsory education). Some occupations at this level will also have short periods of work-related training in areas such as health and safety, food hygiene, and customer service requirements.

The analysis of Technician groups and associated STEM skills tends to relate, naturally, to the two broad occupational groups of SOC Group 3 – Associate professional and technical occupations, and SOC Group 5 – Skilled trades occupations. However, as with much discussion on occupations, the devil lies in the detail, and it is as well to be aware of the more detailed occupation groups which lay within these broad categories and, indeed, the even more detailed jobs which lie within these. This hierarchy is illustrated in Table 2.

It is also important to note that whilst we can infer from the nature of some jobs that they are more likely to require STEM skills than others, there is not, of course, a complete match between an occupation and the need for STEM skills.

Table 2: Exemplar SOC 3 and 5 occupations and sub-level occupations

Associate professional and technical occupations:

31 Science and Technology Associate Professional	Science and engineering technicians (laboratory technicians, electrical and electronic technicians, engineering technicians, building and civil engineering technicians, quality assurance technicians, etc)
	Draughtspersons and building inspectors (architectural technologists and town planning technicians, draughtspersons, building inspectors)
	IT service delivery occupations (IT operations technicians, IT user support technicians)
32 Health Associate Professionals	Health associate professionals (nurses, midwives, paramedics, medical radiographers, chiropodists, dispensing opticians, pharmaceutical dispensers, medical and dental technicians)
	Therapists (physiotherapists, occupational therapists, speech and language therapists, etc)
	Social welfare associate professionals (youth and community workers, housing and welfare officers)
34 Culture, Media and Sport Occupations	Artistic and literary occupations (artists, authors and writers, actors and entertainers, dancers and choreographers, musicians, arts officers, producers and directors)
	Design associate professionals (graphic designers, product, clothing and related designers)
	Media associate professionals (journalists, newspaper and periodical editors, broadcasting associate professionals, PR officers, photographers and AV equipment operators)

	Sports and fitness occupations (sports players, sports coaches, instructors and officials, fitness instructors, etc)
Skilled trades occupations:	
52 Skilled Metal and Electrical Trades	Metal forming, welding and related trades (smiths and forge workers, moulders, core makers and die casters, sheet metal workers, metal plate workers, shipwrights, welders, pipe fitters)
	Metal machining, fitting and instrument making (setters and setting operators, tool makers and fitters, production and maintenance fitters, precision instrument makers and repairers)
	Vehicle trades (motor mechanics and engineers, vehicle body builders and repairers, auto electricians, spray painters)
	Electrical trades (electricians and electrical fitters, telecommunications engineer, line repairer and cable jointer, TV, video and audio engineer, computer engineer, installation and maintenance, etc)
53 Skilled Construction Trades	Construction trades (steel erectors, bricklayers, roofers, plumbers, heating and ventilating engineers, carpenters and joiners, glaziers, etc)
	Building trades (plasterers, floorers and wall tillers, painters and decorators)

In short, whilst SOC groups 3 and 5 are often used as shorthand for technicians – and indeed the remainder of this paper goes on to do the same – the situation is more complicated than this. These broad SOCs contain some jobs which probably should not be classified as ‘technician’ roles and at the same time exclude other jobs which perhaps should.

Evidence on current deficiencies of STEM skills

One important measure of skills deficiencies is the number of Skill Shortage Vacancies (SSVs). SSVs are vacancies defined as hard-to-fill because of applicants’ lack of skills, work experience or qualifications. They are related to deficiencies in the external labour pool. The number and rate of SSVs is expected to increase as the economy recovers but they will, by their very nature, still remain a small proportion of all employment.

Table 3: SSVs by occupation from UKCES Skills for Jobs – Today and Tomorrow

Occupation	Vacancies	SSVs	SSVs per 1K workers	% vacancies as SSVs	
				2007	2009
Managers & senior officials	19,750	3,725	0.9	21%	19%
Professionals	36,825	8,300	3.2	28%	23%
Associate professionals	64,125	12,700	7.4	22%	20%
Administrative/secretarial	45,525	4,575	1.4	12%	10%
Skilled trades	28,975	8,900	5.5	37%	31%
Personal services	54,700	9,125	5.1	21%	17%
Sales and customer service	46,325	5,475	1.8	15%	12%
Machine operatives	20,125	2,900	1.9	24%	14%
Elementary occupations	61,300	6,925	2.1	15%	11%
All England occupations	385,675	63,100	2.7	21%	16%

As Table 3 shows, the technician occupations (Associate professionals and Skilled trades) are more likely than average to be affected by SSVs. The two groups under examination here together account for over 21,000 of these SSVs (with 12,700 SSVs for Associate professionals and 8,900 SSVs for Skilled trade occupations), which represents over a third of all SSVs in the economy.

Another indicator of skills deficiencies comes from the skill shortage occupation list produced by the Migration Advisory Committee (MAC). This list identifies occupations which are (i) skilled; (ii) in relative shortage; and (iii) which can sensibly be filled from abroad. This list contains a number of jobs which sit within our ‘technician’ category (SOCs 3 and 5) and seem to require significant STEM skills. These are shown in Table 4.

Table 4: Skill shortage occupations identified by MAC, 2009

Occupational title	SOC code	Job titles included on the shortage occupation list
Engineering technicians	3113	Only: commissioning engineers
Science and engineering technicians nec	3119	Only: production controllers in the electricity generation industry
Nurses	3211	Only: (i) specialist nurses working in operating theatres, (ii) operating department practitioner and (iii) specialist nurses working in neonatal intensive care units
Medical radiographers	3214	Only: (i) HPC registered diagnostic radiographer and (ii) HPC registered therapeutic radiographer and sonographer
Medical and dental technicians	3218	Only: (i) nuclear medicine technologist and (ii) radiography technologist
Speech and language therapists	3223	Only: speech and language therapist (agenda for change bands 7+ or their independent sector equivalents)
Therapists nec	3229	Only: HPC registered orthoptist
Dancers and choreographers	3414	Only: skilled classical ballet dancer and skilled contemporary dancer
Musicians	3415	Only: Skilled orchestral musicians
Photographers and AV equipment operators	3434	Only: (i) roles within visual effects and 2D/3D computer animation for film, television or video games, (ii) animation supervisor, (iii) animator, (iv) computer graphics supervisor, (v) technical director, (vi) CG supervisor, (vii) modeller, (viii) rigging supervisor, (ix) rigger, (x) matte painter, (xi) texture artist (xii) composting artist, (xiii) producer, (xiv) production manager, (xv) editor, (xvi) R&D tools, (xvii) R&D software, (xviii) software engineer and (xix) system engineer
Welding trades	5215	Only: high integrity pipe welder
Metal working production and maintenance fitters	5223	Only: licensed and military certifying engineer/inspector technician and (ii) airframe fitter
Line repairers and cable jointers	5243	Only: overhead lineworker within the electricity transmission and distribution industry
Electrical and electronic engineers nec	5249	Only: site supervisor within the electricity transmission and distribution industry
Butchers and meat cutters	5431	Only: skilled meat boner and skilled meat trimmer
Chefs and cooks	5434	Only: skilled chefs

Note: nec stands for 'not elsewhere classified'

The MAC list goes to a finer level of granularity than the broader occupational categories available in the National Employer Skills Survey (NESS), and so whilst it does identify a number of jobs which sit within our 'technician' category, in real labour market terms their numbers are relatively small. But it is worth noting that the MAC has, after a period of extensive study and consultation, decided that these jobs are ones which have shortages and that we will not fill these from within the UK (or EU) education and training system, so in-migration will be allowed to continue.

The role of migration in meeting employer demand for technicians

Migration is an indication of a mismatch in the labour market. Both migrants and employers will respond to situations where the skills available in the labour market do not match those that are needed. Analysis of occupations which are highly reliant on migrant labour shows us that:

- occupations with a high proportion of migrant employment include a mix of higher and lower level occupations and include a number which fall into our 'technician' category, such as food preparation trades (26% of employment taken by non-UK workers) and health associate professionals (18%); and
- occupations which have a high level of migrant employment include health associate professionals (130,000), construction trades (91,000), business and finance associate professionals (79,000).

It is interesting to note that these occupations vary with regards to whether the migrant is from within the EEA or outside. On the whole, non-EEA immigrants tend to be employed in relatively high level occupations, which include occupations within our 'technician' class.

The future growth of STEM-related occupations

Looking to the future we rely on two sources of information: detailed multi-sectoral occupational projections which are available from Working Futures 2007-2017 and the National Strategic Skills Audit for England, 2010.

Looking first at Working Futures 2007-2017, these projections were developed in the first half of 2008, before the onset of the recession. As a result they should be treated as indicative, representing what might happen if past trends and current patterns of behaviour continue over the next decade.

In general terms, despite the short term economic uncertainties, the medium to long term projections for the UK remain positive, with substantial employment growth (of nearly 2 million) expected, driven by rising population. In general terms, growth in employment is expected to be fastest for those at the higher end of the labour market, whilst the number of those in employment in lower level occupations is expected to decline.

Specifically relating to the 'technician' occupations, the picture is mixed. There are expected to be increases in the numbers working in Associate professional and technical occupations, but decreases in the numbers employed in Skilled trades occupations.

Thus, the number employed in Associate and professional occupations is forecast to increase by 642,000 (an increase on the 2007 level of 15%) and the number working in Skilled trades occupations will decrease by 226,000 (a decrease of 7%). If we consider the entire expansion of employment by 2017, we can say that over a fifth (22%) is due to growth in employment in these technician occupations, but that if we actually looked at the relative change in employment of these broad occupational groups separately, over a third (34%) of all growth in employment is due to increased numbers of Associate professional and technical workers.

Looking at the more detailed occupational changes in Table 5, we can see forecasted increases for each of the sub-occupational groups within Associate professional and technical, particularly for Business and public service associate professionals (an anticipated growth of 295,000), Health associate professionals (155,000) and Culture, media and sport professionals (152,000), with the latter being a particularly steep rise from a relatively small starting base. Conversely, the sub-groups within SOC 5 – except those within Construction – are forecast to experience falls.

Table 5: Projected change in employment in the UK by occupation

	Employment levels (000s)		
	2007	**2017**	**Net change**
Managers and senior officials	4,828	5,700	872
Professional occupations	4,091	4,733	643
Associate professional and technical	**4,472**	**5,126**	**654**
Science and Technology Associate Professional	546	586	40
Health Associate Professionals	1,215	1,370	155
Protective Service Occupations	372	384	12
Culture, Media and Sport Occupations	685	837	152
Business and Public Service Associate Professionals	1,654	1,949	295
Administrative and secretarial	3,715	3,319	- 396
Skilled trades occupations	**3,404**	**3,178**	**- 226**
Skilled Agricultural Trades	308	275	-33
Skilled Metal and Electrical Trades	1,222	1,078	-144
Skilled Construction Trades	1,258	1,350	92
Textiles, Printing and Other Skilled Trades	616	476	-141
Personal service occupations	2,482	2,925	443
Sales and customer service occupations	2,418	2,522	104
Machine and transport operatives	2,290	2,173	- 117
Elementary occupations	3,536	3,507	- 29
Total	**31,234**	**33,184**	**1,949**

Source: Working Futures 2007-2017

This data suggests a shift of share in employment within the technician class. In 2007, employment in the SOC groups relevant to technicians was just below 8 million – with some 4.4 million (57%) employed as Associate professionals and technical workers and 3.4 million (43%) employed in Skilled trades occupations. These forecasts suggest that by 2017, within the total technician employment of 8.3 million, some 5.1 million will be Associate professional and technical workers (62%) and 3.2 million will be in Skilled trades occupations (a fall to 32%). Given that those employed as Associate professionals are more likely to be qualified to Level 4, and those in Skilled trades are more likely to be qualified to Level 2 or 3, this rebalancing suggests that there will be a gradual upskilling in the technician class.

The projections of occupational employment summarised above focus on the total number of people expected to be employed in these jobs in the future. As such they are a useful indicator of likely change. However, they do not give a full picture of job opportunities in the future (and of future training needs) because they do not include an estimate of 'replacement demand' i.e. that demand which comes about because of the need to replace those workers who leave due to retirement, career moves or other reasons.

An analysis of replacement and expansion demand is shown in Table 6. It shows that when we take the balance of these two forces together, the net requirement for workers is positive in every occupational group. This is because replacement demand is substantial and outweighs any negative expansion demand. Indeed, overall, replacement demand of 11.5 million is about 6 times larger than expansion demand.

Looking specifically at our technician occupations, we can see that overall net requirement by 2017 is over 3 million, made up of 2.2 million Associate professional and technicians and 893,000 Skilled trades occupations. Replacement demand adds to the expected net expansion demand for Associate professionals and outweighs the expected negative expansion demand for Skilled trades workers.

Table 6: Expansion demand and replacement demand to 2017 by occupation in the UK

	Change in employment levels (000s)		
	Expansion demand	**Replacement demand**	**Net requirement**
Managers and senior officials	872	1,767	2,639
Professional occupations	643	1,525	2,168
Associate professional and technical	654	1,556	2,219
Science and Technology Associate Professional	40	165	205
Health Associate Professionals	155	493	648
Protective Service Occupations	12	97	109
Culture, Media and Sport Occupations	152	233	385
Business and Public Service Associate Professionals	295	568	863
Administrative and secretarial	- 396	1,549	1,153
Skilled trade occupations	- 226	1,119	893
Skilled Agricultural Trades	-33	127	94
Skilled Metal and Electrical Trades	-144	378	234
Skilled Construction Trades	92	392	484
Textiles, Printing and Other Skilled Trades	-141	222	81
Personal service occupations	443	1,002	1,445
Sales and customer service occupations	104	858	963
Machine and transport operatives	- 117	817	700
Elementary occupations	- 29	1,308	1,279
Total	**1,949**	**11,501**	**13,450**

Source: Working Futures 2007-2017

National Strategic Skills Audit for England, 2010

Complementing the quantitative Working Futures projections is the National Strategic Skills Audit for England, 2010. The Audit draws on Working Futures data and a number of additional sources of information – including those from the Sector Skills Councils (annual Sector Skills Assessments and 'cluster' reports on emerging sectors) – to provide insight into England's strategic skills needs. As such, the Audit provides an assessment less constrained by past patterns of development, and of a more nuanced and granular nature.

With respect to technician roles, the Audit highlights the expected expansion of Associate professional and technical occupations. At a high level, the drivers for this are the expansion of employment as a whole and the change in the proportions of the workforce working at different occupational levels (more so the latter).

More specifically, the Audit identifies four ways in which demand for technicians is being, and will continue to be, driven up:

- Increasingly advanced production processes combined with the decline in traditional manufacturing.

  The analysis provided by a number of Sector Skills Councils used in the Audit highlights that the decline of traditional manufacturing will squeeze jobs from the lower end of the technician spectrum. Combined with an expansion of opportunities for technicians in roles at the higher end of the skills spectrum, created by the increasing complexity of producing goods and services across the economy, this will result in an 'up-skilling' effect.

- Global value chains encourage a focus on product development and innovation, which demand higher skills.

  Sectors in the domestic economy which are vulnerable to the effects of globalisation and the off-shoring of production are likely to become more dependent on product development and innovation aspects of their activities for survival. Such aspects require higher skills.

- The increasing need to deliver high quality services in a cost effective manner.

  The public sector in particular has been, and will continue to be, exposed to pressures to deliver services using more efficient staffing methods. Recent innovations have seen the delegation of discrete tasks and functions of professional roles to associate professionals or technicians with a clearly defined area of competence, or to paraprofessionals who are able to provide a general support within a tightly prescribed set of powers.

- Growth in new sectors which may require a high proportion of technician type roles.

  STEM skills were present amongst the needs identified by the Audit in six emerging sectors: the Low Carbon Economy; Advanced Manufacturing; Engineering Construction; Profession and Financial Services; the Digital Economy; and Pharmaceutical and Life Sciences. Developing forms of low carbon energy generation, such as wind, marine and carbon capture and storage, will require specialist technician roles in a number of engineering disciplines related to geology, aeronautics and marine technology. Across the economy more widely, there will be pressure to adopt more efficient means of production and energy use. The ability to design, implement, evaluate and monitor systems of energy use is therefore key to business process improvements and highlights the importance of technician roles.

The National Skills Audit identified skills deficits and gave each an importance rating depending on how much of a priority it is for action. The extract below identifies the future supply of technicians as a high priority area rated red, meaning that the skills are ***of critical importance to the economy and require immediate action, either because there are current skills needs already not being met and/or because lead times are such that early action is required to fully optimise economic growth potential and avoid deficits in future.***

Another key skills requirement will involve **associate professional and technical roles in a broad range of sectors, particularly manufacturing, process sectors, including oil, gas, electricity, chemicals, life sciences and pharmaceuticals, automotive, engineering, and broadcasting.** They are likely to be required in large numbers, will require breadth as well as depth of knowledge including generic product lifecycles and manufacturing techniques, and are essential to survival if competitive strategies of moving into higher value added markets are pursued. In particular, one of the most striking themes to emerge from the Audit is the growing importance of technicians, especially in specialist STEM areas – workers with the ability to apply an in-depth understanding of a particular field in a practical setting. Demand is rising for technicians across a range of sectors driven by:

- growing technological complexity – driving up skill levels across the production sectors;
- the growing attention given to higher value added product market strategies – accentuating the need for higher and intermediate vocational and technical skills;
- changing skill mix in some professions, for example in the public and professional services.

  There are pressing strategic skills issues at intermediate skills levels too. The increasing importance of **higher and intermediate jobs in some of our key existing and emerging sectors (such manufacturing, processes industries, engineering),** places a growing emphasis on strengthening the intermediate vocational career pathways (from level 3 up), to ensure that the skill requirements for these jobs can be met and people can progress into intermediate and higher skill areas. However, there has been little change in the proportion of people taking up intermediate qualifications (level 3), and consequently, this has raised questions over the adequacy of supply. Indeed, the highest and most persistent skills shortages occur in many of these **intermediate jobs (such as skilled trades)**. In addition, whilst there are indications that in some of the traditional sectors, key skilled trades are forecast to decline, many of these areas comprise a largely ageing workforce and when replacement demand is taken into account, this highlights significant pressing skills supply needs. Further, there will also be emerging opportunities amongst the *New Industry, New Jobs* emerging sectors for skilled trades too which will need to be met. This includes a range of skillsets across traditional and emerging sectors: builders, engineering and electrical trades, plumbing, joinery, heating, ventilation and air-conditioning.

Skills for Jobs: Today and Tomorrow: The National Strategic Skills Audit for England, 2010, pg82.

Selected further reading

National Employer Skills Survey, 2007

National Employer Skills Survey, 2009

Skills for Jobs: Today and Tomorrow: The National Strategic Skills Audit for England, 2010, UK Commission for Employment and Skills, 2010

Wilson, R, Homenidou, R, and Gambin, L, 2008, Working Futures 2007-2017, UK Commission Evidence Report No. 2, UK Commission for Employment and Skills, Wath-upon-Dearne. Available at: www.ukces.org.uk/evidence-reports/working-futures-2007-2017-evidence-report-2

Technical education for the 21st century: qualifications landscape

Andy Frost and Clive Greatorex, Development Focus

1) Introduction

This paper reviews the range, level and type of technical qualifications below first degree level that are available and being taken in England. The paper uses this review to assess the penetration of technical education into mainstream education, the extent that technical education is reaching all sections of society and the distribution of technical education across Science, Technology, Engineering and Mathematics (STEM).

2) Definitions, Limitations and Sources

Definition of a Technical Qualification

As part of the "Research Project: FE and Skills STEM Data" (BIS/RAE 2010), representatives of the Science, Technology, Engineering and Mathematics communities identified the qualifications below first degree level that could be classified as supporting progression in Science, Technology, Engineering or Mathematics. This classification will be used in this paper, with the exception that no distinction is made between STEM and STEM-related qualifications.

The project identified more than 9,000 QCF qualifications that could be classed as STEM or STEM-related. However, in any given period far fewer qualifications are offered by educational providers. For example, 2,453 different qualifications were offered by the FE & Skills sector in England in the academic year 2009/10. The impact of learners and employers having to choose between large numbers of different qualifications is examined in section 6.

Types and Levels of Qualification

A useful summary of the type of qualifications available at different NQF levels and what they provide a learner was described in the national skills strategy "Skills for Growth" and is reproduced in Annex 1.

For the purposes of this paper the following broad classifications are used:

- **Vocational and Occupational Qualifications:** While there is a distinction between Occupational qualifications (e.g. NVQ in Vehicle Maintenance and Repair) and Vocational qualifications (e.g. Certificate in Vehicle Maintenance and Repair) based on the location of the provision and the type of assessment, this distinction is becoming less relevant with the implementation of the Qualifications and Credit Framework and the increasing use of programmes of learning. Therefore, the two classes of qualifications have been grouped together to simplify reporting. A pen portrait of a Level 3 NVQ is given in Annex 2.
- **General Qualifications:** GCE A levels and AS levels were identified by the STEM community as key qualifications in STEM progression. GCSEs have not been included in the review as predominantly they are taken by under-16 year olds as part of their compulsory general education.
- **Apprenticeships:** As programmes of learning rather than qualifications, the individual is required to obtain a number of qualifications from a portfolio of possible qualifications to achieve an apprenticeship. An example would be a Level 3 Advanced Apprenticeship in Manufacturing where the learner could take the following three qualifications:

  – NVQ in Mechanical Manufacturing Engineering

  – Diploma in Engineering and Technology

  – Key Skills in Working with Others

As the same Apprenticeship can have a different mix of qualifications and as the same qualification can be taken as part of different Apprenticeships, it can be misleading to directly compare Apprenticeships with single qualifications. Therefore, in this paper, the numbers of NVQs being taken as part of an Apprenticeship or Advanced Apprenticeship are used to make comparisons and to estimate the number of Apprenticeships in a specific STEM area, as only one NVQ can be taken as part of an Apprenticeship.

The distribution of Apprenticeships, Vocational/Occupational and General qualifications being taken by learners is described at aggregate levels in section 3 and further assessed in terms of specific qualifications in section 4, and for Apprenticeships in section 5.

Qualifications and Credit Framework (QCF)

The QCF is the new framework for creating and accrediting qualifications in England, Wales and Northern Ireland. It is at the heart of a major reform of the vocational qualifications system, aiming to make it simpler to understand and use, more accessible to a wider range of learners, and more relevant to learners' and employers' needs. A further benefit of the QCF is that it is aligned with the European Qualifications Framework.

QCF requires each qualification to consist of units that will have a standard credit value based on size (each credit represents 10 hours' work) and level (NQF level). A major change is that units will be interchangeable between qualifications, with learners being able to build up units over time and put them towards a full qualification, and employers being able to shape training around their business needs using relevant QCF units, influence the qualifications being developed, and accredit the training they provide as QCF units and, potentially, qualifications.

The QCF requires all qualifications to be one of three standard sizes and that the size is then reflected in the qualification title, with Awards having 1 - 12 units (10 to 120 hours of learning), Certificates having 13 - 36 credits (130 - 360 hours) and Diplomas 37+ credits (370 plus hours) credits. Thus, the QCF aims to increase transparency with all QCF qualifications having straightforward titles that state how long each one takes to complete, its difficulty and its subject matter. Thus as NVQs differ in size as well as levels, NVQs are being renamed under QCF to NVQ Awards, NVQ Certificates, NVQ Diplomas.

Further information on QCF is available from www.qcda.gov.uk/qcf

Technical Qualifications and Technician Progression

While this paper describes the technical qualifications that have been taken, it is only possible to surmise whether an individual who takes these qualifications will become a technician, as progression data are not available at a national level.

This was also the conclusion of the recent study to explore the supply of, and demand for, technician level Science, Engineering and Technology (SET) underpinning skills within the UK (SET Based Technicians: Lessons from the UK and European Labour Force Surveys. IES 2010). This study observed that as many technicians are qualified at below degree level it is not possible to identify technicians on the basis of the subject and level of their highest qualification using official data sources.

Nevertheless, the study was able to differentiate between SET Technician occupations using the 2000 version of the Standard Occupational Classification (SOC 2000) and associated data on highest level of qualification achieved, dividing them into Level 4 SET based technician occupations and Level 3 SET based technician occupations.

Importantly for this paper, the study regarded the Level 4 group linked predominantly to the outcomes of Advanced Apprenticeship (NQF Level 3), while the Level 3 group linked to Apprenticeships (NQF Level 2).

In the near future it may be possible to relate qualifications to progression, once the Learner Record data are available for statistically valid samples of the population. This will substantially change the level of evidence available on the effectiveness of different qualifications and progression routes being taken.

Data Sources

The data for this paper came from analysis of the national collections of the Schools and FE & Skills sector, and unless stated the data are for publicly funded qualifications for academic year 2008/09 in England.

3) Overview of Technical Qualifications Taken in England

In reviewing the STEM qualifications taken each year it is informative to consider both the level of these qualifications and the age of the learners taking them.

Main Observations:

The scale of technical education in England:

While the extent of interpretation that such high level aggregate numbers affords is limited, they do serve to provide a context and do indicate the general themes in the technical qualification landscape, not least being that 3.5 million publicly funded STEM qualifications are taken in England each year. These totals have not varied by more than 5% for at least the last four years, including 2009/10.

The large number of Entry / Level 1 Technical qualifications:

The number taking Entry and Level 1 qualifications is substantial in both the adult (19 and above) and 16-18 populations. This is a direct reflection of government's continued drive to increase the base skills of the population with the emphasis on literacy, numeracy and IT user skills. However, while such qualifications may be prerequisites, they do not in themselves provide progression in Technical education. It is questionable whether it is appropriate that so much remedial training should be undertaken as part of Apprenticeships if they are to be the vanguard programme for developing technician skills in the 21st century.

Different focus of adult and 16 -18 Technical qualifications:

While the number of STEM qualifications taken by adults and 16-18 age groups are similar, which is itself of interest, the levels of the qualifications taken do vary, with nearly 50% of technical qualifications taken by adults being at Level 2, while over 50% of qualifications taken by 16-18 year olds are at Level 3. While the focus on Level 3 for 16-18 is to be expected, it is a matter of debate whether or not adult non-tertiary education and training should have a similar focus given the needs of a post-industrial economy.

Impact of Apprenticeships:

While Apprenticeships are well established and heavily supported, they still account for a small proportion of technical qualifications taken, with the exception of Level 3 adult provision. That Apprenticeships account for less of the 16-18 provision than they do for adult provision - and in particular for Level 3 provision - is of interest given that they are being presented as the alternative for young people to university-orientated general education.

Numbers of qualifications taken at Level 4 and above:

The very low proportion of non-tertiary technical qualifications being taken at Level 4 and above must be strong evidence that this level has yet to become an established route for Technician education. There is some evidence that the numbers are lower (at least relatively) than they were 20 years ago. There may well be a large number of reasons for this situation, not least being the focus on first degrees as the preferred qualification.

Table 1: Adult enrolments in STEM qualifications for academic year 2008/09 in England

	Vocational/Occupational		A level		Qualifications as part of Apprenticeship		Overall	
Level	Enrolments	Percentage of enrolments by level	Enrolments	Percentage of enrolments by level	Enrolments	Percentage of enrolments by level	Enrolments	Percentage of total
Entry	199,352	100%			22	0%	199,374	11%
1	420,413	77%			124,740	23%	545,153	29%
2	671,632	78%			187,125	22%	858,757	46%
3	114,235	49%	13,501	6%	103,777	45%	231,513	12%
4 and above	13,562	99%			182	1%	13,744	1%
No level assigned	16,847	99%			212	1%	17,059	1%
Total	1,436,041	77%	13,501	1%	416,058	22%	1,865,600	100%
Total Sector			55,401		587,772		10,948,276	

Table 2: 16-18 year old enrolments in STEM qualifications for academic year 2008/09 in England

	Vocational/Occupational		A level		Qualifications as part of Apprenticeship		Overall	
Level	Enrolments	Percentage of enrolments by level	Enrolments	Percentage of enrolments by level	Enrolments	Percentage of enrolments by level	Enrolments	Percentage of total
Entry	55,509	100%			56	0%	55,565	3%
1	232,366	71%			96,508	29%	328,874	18%
2	263,690	68%			126,845	32%	390,535	22%
3	149,887	15%	816,076	80%	50,678	5%	1,016,641	57%
4 and above	635	94%			44	6%	679	0%
No level assigned	5,314	98%			113	2%	5,427	0%
Total	707,401	39%	816,076	45%	274,244	15%	1,797,721	100%
Total Sector	5,248,250		1,807,075		352,561		7,407,886	

This conclusion is indirectly supported by the comparative study of technician skills across Europe, which found that while the proportion of UK physical science and engineering technicians with intermediate qualifications (Level 3 equivalent) is substantially less than the European average (47% vs 62% respectively), the relationship is reversed for higher qualifications (degree equivalent: 47% vs 29%). Given the very low numbers taking Level 4 and above vocational qualifications, it seems reasonable to suggest most of these higher qualified technicians have first degrees. This may also be one of reasons why the UK has one of the lowest numbers of SET technicians, as a proportion of the overall workforce, across the whole European Community.

4) Specific Technical Qualifications Being Taken

To provide a more tangible description of the technical qualifications being taken in England, the five most popular qualifications in each STEM area by NQF level are listed in Table 3. During the STEM classification a qualification could be classified as relevant to progression in more than one area of STEM: for example, IT Practitioner qualifications were regarded as supporting progression in Engineering and Technology.

The data cover all ages and combines STEM and STEM related qualifications for England in academic year 2008/09.

The commentary will focus on Levels 2 and 3 as the listings reiterate the observations made on the aggregate data for both Entry / Level 1 qualifications and Level 4 and above qualifications.

For both Science and Mathematics, the main technical qualifications being taken at Level 3 are GCE A and AS levels. Furthermore, while Mathematics is part of STEM and skills in Mathematics are key requirements for many technician roles, the Mathematics qualifications being taken at Levels 2 and 3 do not suggest they are directly related to technician progression, except, perhaps, for vocational qualifications in Accounting.

In Science, vocational qualifications would not seem to be the primary route for Science technicians. At Level 2, vocational qualifications in Science-related subjects are primarily taken to fulfil work requirements not necessarily related to STEM: for example, ‘Award in Food Safety’ is required by anyone working in food preparation and handling. At Level 3, the take-up of vocational qualifications is higher, but again mainly in areas that do not necessarily support STEM technician progression.

Technology and related qualifications at Level 2 and Level 3 tend to fall in four main areas, two of which have an ambiguous relationship with STEM technician progression:

- Art and Design qualifications (mainly at Level 3 for 16-18 year olds), while relevant to STEM progression can also lead to progression in non-STEM areas.
- Qualifications in IT user skills cannot be considered in themselves routes to technician occupations, even though they are prerequisites for functioning in the modern economy.
- IT practitioner qualifications are the main Technology qualifications that can be considered as directly supporting technician progression. IT practitioner qualifications are also considered to directly support progression in Engineering.
- The fourth main set of qualifications in Technology is the Technical Media qualifications, which are considered as directly supporting STEM technician progression.

Therefore, it is not unreasonable to conclude that the main technical qualifications being taken at Levels 2 and 3, other than IT Practitioner qualifications and GCE Science and Mathematics A levels, are in Engineering. However, it is also the STEM area with the greatest proportion of technical qualifications being taken at Level 2 and below, when general numeracy, literacy and IT skills are discounted. It is also noticeable that the majority of the qualifications are in what are often regarded as the traditional areas of Engineering, e.g. electrical, vehicle maintenance and repair, or manufacturing and plant operations.

The paper will focus on three specific areas to further illuminate the Technical qualifications landscape:

5) Apprenticeships

When Apprenticeships are analysed by STEM area it is clear that the majority of STEM Apprenticeships are Engineering Apprenticeships both at Level 2 and Level 3.

Table 4: Enrolments in Apprenticeships in England in 2008/09 for all ages

		Level 2 enrolments	Level 2 as percentage of overall	Level 3 enrolments	Level 3 as percentage of overall
STEM	Science and related	2,636	3%	4,131	5%
	Technology and related	9,000	12%	6,425	8%
	Engineering and related	65,436	84%	72,008	87%
	Mathematics and related	4,890	6%	5,309	6%
	Overall	77,546		82,384	

This dominance is partly explained by the success of converting people to take Apprenticeships in Engineering, rather than taking the qualifications in isolation, with the noticeable exception of qualifications related to manufacturing operations.

Table 3: Description of five most popular Technical qualifications by STEM area and NQF level

	Science		Technology		Engineering		Mathematics	
	Qualification title		Qualification title		Qualification title		Qualification title	
Level Entry and 1	Foundation Programme	1,461	Key Skills in Information and Communication Technology	98,444	Foundation Construction Award	6,988	Key Skills in Application of Number - level 1	253,413
	Certificate in Land-based Studies (QCF)	1,236	Certificate for IT Users (New CLAiT)	32,068	NVQ in Performing Engineering Operations	5,460	Certificate in Adult Numeracy	247,760
	Certificate in Science	824	Certificate for IT Users (ECDL Part 1)	27,865	Award in Vehicle Maintenance and Repair	4,661	Basic Numeracy Course, Entry Level	25,540
	BTEC Introductory Diploma in Land and Environment	642	Certificate in Using ICT (Entry 3)	19,336	Certificate in Preparation for Employment in Construction Industries (Entry 2 and 3)	3,772	Online - National Test in Adult Numeracy	24,701
	BTEC Introductory Diploma in Applied Science	179	Certificate in ICT Skills for Life	16,411	Certificate in Introductory Welding Skills	3,255	Everyday Maths Skills - Whole Numbers (Level 1)	21,964
Level 2	Award in Food Safety in Catering	16,059	Key Skills in Information and Communication Technology	100,950	NVQ in Plant Operations	37,435	Key Skills in Application of Number - level 2	198,740
	Award in Food Safety in Catering (QCF)	15,763	NVQ for IT Users (ITQ)	52,981	Certificate in Electrotechnical Technology	35,669	Certificate in Adult Numeracy	91,058
	Award in Food Safety in Catering	14,543	Certificate for IT users (ECDL Part 2)	22,393	Construction Award	34,742	NVQ in Business-Improvement Techniques	38,302
	Certificate in Horticulture	2,438	IT2 Word Processing - MS 2003 (EP)	12,238	NVQ in Performing Engineering Operations	24,178	Online - National Test in Adult Numeracy	26,764
	BTEC First Diploma in Animal Care	2,401	IT2 Spreadsheets - MS 2003 (EP)	9,301	Certificate in Basic Plumbing Studies	21,600	Everyday Maths Skills - Whole Numbers (Level 2)	17,356
Level 3	BTEC National Diploma in Sport and Exercise Sciences	5,319	BTEC National Diploma in Art and Design	25,509	Certificate in Electrotechnical Technology	24,342	NVQ in Accounting	13,704
	BTEC National Diploma in Animal Management	5,143	Key Skills in Information and Communication Technology	15,334	NVQ in Electrotechnical Services	24,128	Key Skills in Application of Number - level 3	4,529
	BTEC National Diploma in Applied Science	4,459	BTEC National Diploma for IT Practitioners	13,028	BTEC National Diploma for IT Practitioners	13,028	NVQ in Business-Improvement Techniques	2,638
	NVQ in Dental Nursing	3,671	BTEC National Diploma in Media Production	10,731	Certificate in the Requirements for Electrical Installations (BS 7671 June 2008)	9,379	Certificate in Financial Studies	2,445
	Diploma in Anatomy and Physiology	3,411	BTEC Foundation Diploma in Art and Design	7,737	NVQ in Engineering Maintenance	9,087	Advanced Certificate in Accounting	1,575
Level 4 and above	BTEC Higher National Diploma in Nautical Science	191	Diploma in Foundation Studies in Art, Design and Media	45	NVQ in Construction Site Management	1,591	NVQ in Accounting	8,773
	HND in Nautical Science	69	BTEC Higher National Diploma in Computing (General)	33	Certificate in Site Management	272	Diploma in Accounting	786

Table 5: Percentage of Technical qualifications taken as part of Apprenticeships in England in 2008/09 for all ages: Highest and lowest percents

Qualification title	Vocational/	Part of	Overall	Vocational/ occupational	Part of Apprenticeship
NVQ in Aeronautical Engineering (level 3)	36	1,692	1,728	2%	98%
NVQ for Communication Technology Professionals (level 3)	80	2,519	2,599	3%	97%
NVQ in Mechanical Manufacturing Engineering (level 3)	398	5,491	5,889	7%	93%
NVQ in Vehicle Maintenance and Repair (level 2)	979	13,498	14,477	7%	93%
NVQ in Fabrication and Welding (level 3)	219	2,170	2,389	9%	91%
NVQ in Electrotechnical Services (level 3)	2,262	21,866	24,128	9%	91%
NVQ in Business-Improvement Techniques (level 2)	38,275	27	38,302	100%	0%
NVQ in Business-Improvement Techniques (level 3)	2,637	1	2,638	100%	0%
NVQ in Waste Management Operations (level 2)	6,147	0	6,147	100%	0%
NVQ in Specialised Plant and Machinery Operations (Lifting and Transferring) (level 2)	3,892	0	3,892	100%	0%
NVQ in Construction Site Supervision (level 3)	2,821	0	2,821	100%	0%
NVQ in Insulation and Building Treatments (Construction) (level 2)	1,204	0	1,204	100%	0%
NVQ in Specialised Plant and Machinery Operations (level 2)	1,012	0	1,012	100%	0%

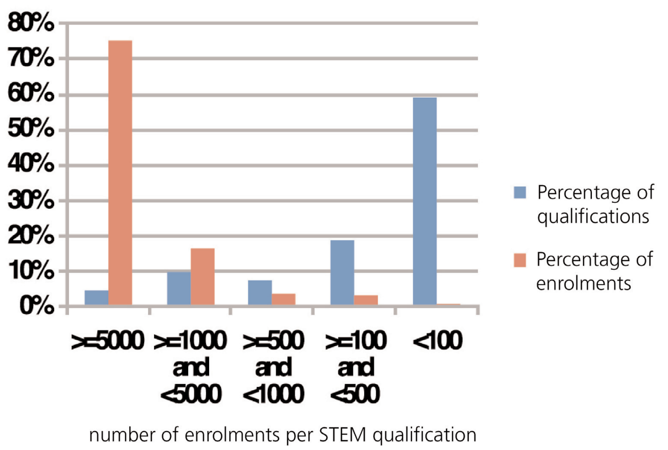
However, the take-up of STEM Apprenticeships (at both Level 2 and Level 3) seems to be gender and ethnic specific, when compared to the take-up of all Technical qualifications.

Table 6: Gender and ethnicity of people taking Apprenticeships in England in 2008/09

Gender	Apprenticeships		All qualifications	
Female	19,376	12%	1,330,830	41%
Male	140,554	88%	1,907,155	59%
Total	159,930	100%	3,237,985	100%

Census ethnicity	Apprenticeships		All qualifications	
Asian or Asian British	2,879	2%	226,611	7%
Black or Black British	1,861	1%	183,228	6%
Chinese or other ethnic group	628	0%	56,680	2%
Missing/Unknown	1,086	1%	46,027	1%
Mixed	1,940	1%	71,201	2%
White	151,536	95%	2,654,238	82%
Grand Total	159,930	100%	3,237,985	100%

Figure 1: Distribution of enrolments, based on number of enrolments per STEM qualification, in England for academic year 2009/10



6) Analysis of the Distribution of Numbers Taking Specific Qualifications

In the introduction it was observed that while there are a large number of different STEM qualifications that are potentially available to learners, the number taken in any one year is far lower. Nevertheless, the number of different STEM qualifications taken is still large, particularly when one considers that 1,531 of 2,596 (59%) different qualifications taken in 2008/09 were each taken by less than 100 people nationally and that 109 qualifications accounted for 75% of the total enrolments on STEM qualifications in the FE & Skills sector.

One must ask: is this large number of different qualifications being taken by very few people really serving the needs of the country to meet the challenge of developing technician and STEM capabilities?

QCF is, in part, a response to the large number of different qualifications. Instead of reducing the number of qualifications it is using transparency to reduce user confusion. The impact so far has been to increase the number of potential STEM qualifications, with a further 2,500 qualifications being added to the national catalogue in 2009/10, so time will tell if the learners and employers find the new approach any less daunting.

QCF's other aim of increasing flexibility through units and credits also impacts on the perceived complexity of Technical qualifications and the management load on the education sector, given the permutations of potential units that can comprise a qualification and the number of possible pathways across units and qualifications a learner can take.

Therefore, while flexibility will be increased, one should ask: at what cost? The first challenge, and thus cost, is obtaining consistent and comprehensive adoption of the protocols for the specification of assessment criteria of credit based units, so that units are viewed as equivalent by all stakeholders. The second challenge is to have consistent adoption of rigorous rules for combination of units into qualifications, which are also transparent to all users. The third challenge is to manage the increase in information load: estimates are that the QCF will increase the management information system load on the education sector, and the FE and Skills sector in particular, by ten to forty fold. While this increase in magnitude may not present a technical problem with the capabilities of modern IT, it may present a significant management challenge and associated costs to the education sector.

7) Non-funded Technical Qualifications

All of the previous analyses were based on publicly funded provision. However, anecdotal evidence suggests that many people acquire their technical qualifications, and particularly their continuing professional development, through privately funded provision, whether funded by their employers or by the individual. Given the current trends in funding, it is likely this form of provision will grow.

While no official figures are available, it is possible to get an indication from the national data collected from the FE & Skills sector on non-funded provision. While these data are likely to under-represent significantly the actual levels of privately funded technical education, and because of technical reasons they include European Social Funded (ESF) provision, they can provide an indication of the levels of privately funded provision, given that ESF provision typically accounts for fewer than 10,000 enrolments per year.

In the data collected for funding purposes for the FE and Skills sector in England for 2008/09, there were 259,640 enrolments that were non-funded or European Social Funded (ESF) provision, which equates to 8% of the publicly funded enrolments in STEM qualifications.

This non-funded provision covers a diverse set of qualifications including:

- Vocational qualifications such as Level 3 Certificate in the Requirements for Electrical Installations, or Level 2 Award in Food Safety Catering;
- NVQs, for example: NVQ for IT users at Levels 1, 2 and 3;
- Vocational study in Engineering and Manufacturing Technologies not leading to a recognised qualification;
- Numeracy qualifications such as Certificates in Adult Numeracy taken at Entry, and Levels 1 and 2;
- Key Skills Units, e.g. Level 1 Key Skills in Application of Number.

Of particular note is that there appear to be far more Technical qualifications taken at Level 4 and above that are privately funded (24,022 enrolments) than are publicly funded (14,422 enrolments), at least in England during academic year 2009/10.

8) Conclusions and Recommendations

Acquisition of technical qualifications by adults (19 years old and above) is still a major pathway by which technical skills and knowledge are being developed in the population. Given the need for life-long learning and the upgrading and updating of skills, this form of provision should be strongly supported.

The vast majority of 16-18 year olds are acquiring technical education and skills through general education, and, with the exception of Engineering, Apprenticeships are a minor pathway.

There seems to be gender and ethnicity specificity in the take-up of Apprenticeships at both NQF Levels 2 and 3, and there is evidence that these biases exists beyond Apprenticeships in Engineering. If they are confirmed by further analysis, intervention would seem to be warranted.

It is important to consider whether the wide range of technical qualifications taken by very few people represents an efficient means of increasing the technical capabilities of the country. The QCF may make qualifications more transparent, but it may not make it less confusing to the learner/employer nor reduce the management burden in the sector.

Privately funded provision is an important if somewhat overlooked area of provision. Attempts should be made to both recognise and integrate this provision in any national strategy.

The single most important gap is the lack of Level 4 and above technical education. The reasons for the very low take-up should be investigated.

Within the next year or two, the rapidly increasing adoption of the Learner Record should allow, for the first time, detailed analysis of technician progression by allowing for the tracking of qualification routes taken by young people and the continuing professional development of the adult population. How this data can be made available to the STEM community should be investigated as a priority.

Development Focus is a small independent consultancy specialising in the quantitative and qualitative analysis of post 16 education in the UK for policy makers, implementation agencies, employers and educational providers.

The members of Development Focus who led the work described in this paper are Andy Frost and Clive Greatorex.

The views expressed in this paper are solely those of the authors and not necessarily those of Development Focus Ltd.

Annex 1: Types of qualifications at the different NQF levels (Skills for Growth 2009)

NQF Level pre- Jan 2006	NQF Level post- Jan 2006	Example of qualifications	What they give you
Entry	Entry	• Entry Level certificate • Skills for Life • Functional Skills at Entry Level (English, maths and ICT)	• Basic knowledge and skills • Ability to apply learning in everyday situations • Not geared towards specific occupations
1	1	• GCSEs grades D-G • BTEC Introductory Diplomas and Certificates • OCR Nationals • Key Skills Level 1 • NVQs at Level 1 • Skills for Life	• Basic knowledge and skills • Ability to apply learning with guidance or supervision • May be linked to job competence
2	2	• GCSEs grades A*-C • BTEC First Diplomas and Certificates • OCR Nationals • Key Skills Level 2 • NVQs at Level 2 • Skills for Life • Apprenticeships	• Good knowledge and understanding of a subject • Ability to perform variety of tasks with some guidance or supervision • Appropriate for many job roles • Apprentices work towards work-based learning qualifications such as an NVQ Level 2, Key Skills and, in some cases, a relevant knowledge-based qualification such as a BTEC.
3	3	• A levels • Advanced Extension Awards • GCE in applied subjects • International Baccalaureate • Key Skills Level 3 • NVQs at Level 3 • BTEC Diplomas, Certificates and Awards • BTEC Nationals • OCR Nationals • Advanced apprenticeships	• Ability to gain or apply a range of knowledge, skills and understanding, at a detailed level • Appropriate if you plan to go to university, work independently, or (in some cases) supervise and train others in their field of work • Advanced apprentices work towards work-based learning qualifications such as NVQ Level 3, Key Skills and, in most cases, a relevant knowledge based certificate such as a BTEC.
4	4	• NVQs at Level 4 • BTEC Professional Diplomas, Certificates and Awards • Higher apprenticeships	• Specialist learning, involving detailed analysis of a high level of information and knowledge in an area of work or study • Appropriate for people working in technical and professional jobs, and/or managing and developing others • Higher apprenticeships work towards work-based learning qualifications such as NVQ Level 4 and, in some cases, a knowledge-based qualification such as a Foundation degree.
4	5	• HNCs and HNDs • NVQs • BTEC Professional Diplomas, Certificates and Awards • Foundation degree	• Ability to increase the depth of knowledge and understanding of an area of work or study, so you can respond to complex problems and situations • Involves high level of work expertise and competence in managing and training others • Appropriate for people working as higher grade technicians, professionals or managers • Foundation degrees combine academic study with workplace learning to equip people with the relevant knowledge, understanding and skills to improve performance and productivity

Annex 2: Description of a Level 3 NVQ

NVQs (National Vocational Qualifications) are 'competence-based' qualifications, where the learner engages in practical, work-related tasks to develop their skills and knowledge to do a job effectively.

NVQs are based on national standards for various occupations. The standards say what a competent person in a job could be expected to do and describe the units of an NVQ. As the learner progresses through the units, their skills and knowledge are compared with these standards, acting both as targets for the learner and the basis for formal assessment.

Assessment is through practical assignments and a portfolio of evidence, with a qualified assessor observing and questioning the learner on their knowledge and understanding as well as assessing their performance in the prescribed tasks. The assessor 'signs-off' individual units within the NVQ when the learner has reached the required standard.

NVQs are part of the Qualifications and Credit Framework. They can be taken at Levels 1 to 5 and exist for all of the STEM areas and all other Sector Subject Areas.

Example: City & Guilds Level 3 NVQ in Process Engineering Maintenance

The learner can take three variants (or pathways) of this NVQ based on three of the engineering disciplines in Process Manufacture: Mechanical; Electrical and Instrumentation and Control. The full qualification requires achievement of 12 units for each pathway which is made up of 5 Mandatory units and 7 Option units that are pathway specific.

Group A: Mandatory units – learner must demonstrate competence in each unit:

- Hand over process engineering plant and equipment
- Reinstate the work area after completing the maintenance of process engineering plant and equipment
- Minimise risks to life, property and the environment
- Work safely, minimise risk and comply with emergency procedures
- Contribute to effective working relationships

Group B: Option units (pathway specific: example is Mechanical): learner must demonstrate competence in 7 of the units:

- Carry out planned maintenance procedures on mechanical plant and equipment
- Deal with variations and defects in mechanical plant and equipment
- Diagnose and determine the causes of faults in mechanical plant and equipment
- Prepare work areas for the maintenance of process engineering plant and equipment
- Prepare equipment in support of engineering activities
- Prepare materials for the maintenance of mechanical plant and equipment
- Adjust mechanical plant and equipment to meet operational requirements
- Remove components from mechanical plant and equipment
- Replace components in mechanical plant and equipment
- Determine the feasibility of repair of components from mechanical plant and equipment
- Interpret detailed mechanical information from technical sources
- Read and extract information from mechanical engineering drawings and specifications
- Identify and suggest improvements to working practices and procedures whilst maintaining mechanical plant and equipment
- Establish that an engineering maintenance process has been completed to specification
- Test and monitor the performance and condition of mechanical plant and equipment
- Monitor the performance and condition of mechanical plant and equipment
- Asses the performance and condition of mechanical plant and equipment
- Asses the performance and condition of mechanical plant and equipment
- Inspect mechanical plant and equipment

Annex 3: Suggested further reading and selected data sources

There are two main reports which offer further details and a number of data sources were used. The main data sources are listed below the reports:

Research Project: FE and Skills STEM data (BIS/RAE 2010)

SET Based Technicians: Lessons from the UK and European Labour Force Surveys (IES 2010)

The QCDA site on QCF

The Data Service (www.thedataservice.org.uk)

The Learner Record Service (www.learningrecordsservice.org.uk)

Apprenticeship training

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Introduction and summary

This paper mainly focuses on England (though sometimes on the UK). It draws comparisons with a number of other countries. The UK has spent more than two decades trying to develop a viable new form of apprenticeship. There have been some real improvements, but, relative to the size of the country, apprenticeship is still small compared to some other European countries. The quality of apprenticeships in terms of length and content still lags behind other comparable countries, though recently completion rates have improved. Apprenticeship provides real benefits for both employers and ex-apprentices. However, progression beyond apprenticeship is not well structured. The lag behind some other comparable countries and the challenges of continuing to improve the amount of provision raise a series of questions for policy makers, employers, and other stakeholders.

Background

Apprenticeship training has a long history in the UK. Up to the 1950s, the UK probably had the largest and one of the best systems of apprenticeship training in the world. The traditional system was slowly reformed in the 1950s and 1960s, with the introduction of more widespread day release and a movement away from time-serving. However, from the mid-1960s onwards, the number of apprentices declined. In part this reflected a decline in British manufacturing. But even allowing for that, ratios of apprentices to skilled workers declined. This was due to a number of factors: a failure to sufficiently modernise the system; the high cost of apprenticeships to employers, especially in high apprentice wages; and a combination of alternating government support and government indifference. In the early 1990s, the then Conservative Government launched the so-called 'Modern Apprenticeship', and with that began a prolonged search for a new format and new support for apprenticeship.

The system and evidence on its operation

At present, apprentices may be taken on at various ages, but are normally aged 16-19 (though around one-quarter are now in their mid-twenties). Today's apprenticeships are in three parts. The first involves on-the-job training, usually provided by an employer and designed to equip apprentices with the practical skills required for their job. The successful completion of this part of the training is marked by the award of a National Vocational Qualification (NVQ), which certifies the occupational competency of the trainee. The second part involves apprentices acquiring the theoretical knowledge which underpins their trade. The training for this is usually provided off-the-job in a further education college. In STEM subjects, for example, apprentices typically have one day a week of off-the-job training. The successful completion of this element of the apprentice framework is marked by the award of a 'technical certificate' qualification (e.g. an ONC). Third, apprentices also receive training in key or functional skills such as numeracy and literacy, usually at college.

For the full (advanced) apprenticeship, both the NVQ and the technical certificate are supposed to be at level 3 (equivalent to A-levels), while the key skills requirement is pitched at level 2 (the equivalent of GCSE+). Completing all three parts of the apprenticeship framework leads to the award of an Advanced Apprenticeship qualification. The assessment of the various components of the apprenticeship is usually carried out by external training providers. Assessment typically involves less by way of written exams and practical tests than in Germany, Austria or Switzerland.

Employers pay the wage of the young person and government funds most of the off-the-job training, with the latter ranging from around £3,000 to £14,000+ over the apprenticeship. The precise level of government funding depends on the age of the apprentice and the sector, being higher for younger apprentices and in areas such as engineering. Where the main contract-holder with the government is a specialist training provider, the employer takes responsibility only for the on-the-job training and the government funds flow mainly to the training provider. Few apprenticeships exist outside of the government-funded system (Ryan *et al.* 2007). This is not the case in Germany, Austria and Switzerland. As will be explained below, in these countries the state provides other kinds of support, such as legal support. Along with the lower costs of apprenticeship training, such support means that government funding is less crucial to apprenticeship training.

Numbers

The total number of people starting an apprenticeship at level 2 has increased from 122,800 in 2005/06 to 158,500 in 2008/09. The corresponding figures for level 3 apprenticeships are 52,100 and 81,400 (DBIS 2010: Table 6.1). Apprentices are spread across a large number of different types. These range from traditional (construction, engineering) to new (business administration, ICT, hospitality). Young women are overrepresented in service sector apprenticeships, but this is the case in other countries. STEM apprentices are to be found across a number of frameworks, including manufacturing technologies, engineering and ICT. In 2008/09, engineering and ICT accounted for 17% of the total number of apprentices starting at level 2, and 23% of starts at level 3 (DBIS 2010: Table S6.1). Moving on to levels of achievement, a total of 98,100 people completed a level 2 apprenticeship in 2008/09, while 45,200 achieved an advanced (level 3) apprenticeship. The number of completions in engineering and ICT over that period was 17,100 (17% of the total) at level 2 and 11,400 (14% of the total) at level 3 (DBIS 2010: Table S6.2).

The number of apprentices per 1,000 employed in England is 11: this compares with 43 in Switzerland, 40 in Germany, and 33 in Austria. Taking other Anglo-Saxon countries: Australia has a ratio of 39 and Ireland 11 (though apprenticeships in Ireland are confined to traditional trades). It should be noted that the ratio is considerably lower in the US, where more use is made of community college and on-the-job upgrade training. These routes largely supply the skills deemed necessary in the US, though many in the US also favour a revival of apprenticeship. However, outside of a very few sectors, the decline of apprenticeship has probably proceeded too far in that country.

Of course, there are other sources of supply of skilled labour which need to be set against apprenticeships. For example, more 16-19 year olds are in full-time vocational courses – though these clearly do not involve the same amount of practical, on-the-job training as an apprenticeship.

Unfortunately there have been no good studies of what effect these alternative forms of provision have on the take-up of full apprenticeships.

In STEM areas use may also be made of graduates with relevant degrees (e.g. in biosciences). This may be problematic, both because they will often lack relevant practical experience and also because their employment at technician level may well imply the underutilisation of the more theoretical knowledge they acquired at university. In addition, depending on their circumstances, employers may rely on a combination of recruitment or upgrade training, either hiring workers who already possess the relevant skills from the external labour market, or providing additional, often *ad hoc* on-the-job training for established but less skilled staff (Ryan *et al.* 2007). This is a disincentive to youth apprenticeships which might provide progression to higher levels of skills.

Practice

Young people may be given some pre-apprentice training or given an introduction to apprentice careers at school. However, as one recent study has suggested, there is an 'indifference and sometimes hostility towards work-based training in schools and often little or no advice is provided' (Steedman 2010, 3). In the STEM areas in particular, bright young people may be automatically directed to further and higher education and away from the work-based route. The difficulty that this causes for attempts to attract a sufficient supply of talented young people into apprenticeships is exacerbated by widespread misperceptions amongst young people and their parents about the nature of many STEM occupations, which are erroneously viewed as dirty, insecure and physically taxing.

There is considerable variation between apprenticeship frameworks in terms of attributes such as the amount of on- and off-the-job training provided. For example, engineering apprentices typically receive three or even four times more 'guided learning hours' of teaching than apprentices in, say, retailing. Variations in the technical educational content of apprenticeships have potentially important implications for the quality of the training offered. They also have equally important implications for the scope for apprenticeships to form part of a robust vocational ladder of progression to higher education and, in the case of STEM disciplines in particular, to chartered status (Ryan *et al.* 2006; House of Lords 2008). Inter-sectoral differences of this kind tend to be less marked in other European countries, where apprenticeship training programmes are subject to statutory regulation which sets minimum standards for apprenticeship programmes and makes provision for their governance and adaptation (Brockmann *et al.* 2010).

The average time to complete an apprenticeship is between about a year for level 2 and two years in total for level 3. For the latter, this is about half the length of time taken in continental European countries and in Ireland and Australia. This is in part because in England it is deemed acceptable to complete an apprenticeship at level 2, which is the most common level for completion of some frameworks. This would not be possible in continental European systems where level 3 is the norm. Although completion rates are improving, around 30% of apprentices still failed to complete their training in 2008/09 (DBIS 2010: Table 3.3). This may reflect a number of factors, including the recruitment of inadequately prepared young people onto programmes, and also the fact that in some cases once employers and young people have been matched, both parties may agree that completing the full apprenticeship programme is no longer worthwhile. Furthermore, in construction, for example, young people may take the level 2 skills they have and just go off and get a better paid 'real' job.

Very few apprentices progress to level 4 or to HND and even fewer progress to a degree. Such progression is higher in France and is being further developed in Germany and Switzerland. This may be because of the lack of clear routes, insufficient encouragement and worse funding support in the UK.

In England, apprentice pay is high – on an index of England = 100, Germany is 73, Austria 55 and Switzerland 36 (UKCES 2008). In these latter countries, lower pay combined with longer apprenticeships helps to offset costs to the employer. In part this is because in these countries collective agreements and industry norms set arrangements from which all employers can benefit.

Employer commitment in terms of time, money and resources is less than in other apprentice countries (Steedman 2010). In England 8% of employers offered apprenticeships in 2009, much lower than in continental Europe or similar systems in Australia and Ireland. In part this may reflect higher net costs in the UK, but it also reflects the weakness of employers' organisations compared to continental European countries with apprenticeship, as suggested above.

Economic returns to apprenticeship – for employers and employees

For the employer, we have suggested that costs are higher than in other countries. However, there are real benefits in terms of attracting good young people, who tend to stay and who often become supervisors and managers. Costs are quickly recouped and pay-back to the employer is one year (IT) to three years (engineering) (Institute for Employment Research 2008). For employees, apprenticeship has a high economic value, especially in STEM-related sectors. The economic value of apprenticeship is particularly high in engineering and construction, relative to apprenticeships in service sectors (McIntosh 2006). These high rates of return mean there is real potential to promote apprenticeship, as there is growing awareness of the costs of higher education and the low rates of return from some university degrees. Changes in higher education funding may also create an opportunity for the work-based route of progression to level 4 and beyond.

Conclusions: implications and further questions

The skills and knowledge gained through an apprenticeship are in demand in the labour market, especially in the STEM areas. There is a reasonable demand for apprentice places from young people. There is less good provision of apprentice places by employers. As a result, the supply of young people seeking an apprenticeship outstrips demand in good schemes.

Some of the comparisons drawn above put the UK situation in an unfavourable light, but in practice the glass is at least half full. Apprenticeship frameworks have been developed which have real advantages. Though they may suffer in comparison with Germany and some other continental countries, level 3, with related underpinning knowledge, can still set good standards. Some apprenticeships in the STEM area are excellent, e.g. Rolls Royce and BAE in engineering; NG Bailey in electrical construction; British Gas in gas and related services; and some universities and research laboratories in the public sector. However, such schemes still have to be promoted to young people. Employers may be reluctant to train apprentices because they fear that, having done so, the newly trained workers will be poached by other employers. Yet the evidence suggests that newly minted apprentices will not necessarily be enticed away: offering training is a means for employers to demonstrate their commitment to their workforce and to show employees that they are valued and have good career prospects within the organisation, thereby building loyalty and reducing the likelihood that workers will leave (Guest *et al.* 2003).

For STEM areas, it would be useful to take a look at current apprenticeship frameworks and see whether they are adequate across all these areas. It would also be worth exploring whether more use can be made of Group Training Associations and Apprenticeship Training Associations to help employers, especially small and medium enterprises, to learn more about the merits of apprenticeships and to navigate the associated bureaucracy (Gospel and Foreman 2006). One question worth posing is whether current frameworks are adequate. Might it be useful to devise a broad framework common to a large number of STEM occupations, but incorporating some occupational specific modules?

The Engineering and Science Councils have started on an ambitious plan for the registration of technicians in engineering, science, IT and health. This raises a range of questions for the sector, policymakers and other stakeholders. Will registration really act as an incentive to employers to take on more apprentices? Will level 3 and some experience be sufficient for registration or might it be necessary to examine underpinning knowledge in some sort of way? And if additional underpinning knowledge is thought necessary, what form should it take – an HND, a Foundation Degree, or are there other qualifications which may be better suited to providing this? How do Higher Apprenticeships fit into the changing landscape of qualifications and registration?

As we have said, there seems to be a reasonable supply of young people wanting to undertake good apprenticeships. However, in the STEM areas, there are other options, especially full-time further and higher education. What can be done at school level and in terms of building the profile of apprenticeships to convince more able young people to follow this route? Finally, there is the perennial question of how to develop employer commitment. Many approaches and devices have been suggested and it is worth assessing what works best in the current economic climate.

Further reading

Brockmann, M., L. Clarke and C. Winch (2010). 'The Apprenticeship Framework in England: A New Beginning or a Continuing Sham?' *Journal of Education and Work,* 23: 111-27.

Department of Business, Innovation and Skills (2010). 'Statistical First Release DS/SFR5.' Coventry: The Data Service.

Fuller, A. and L. Unwin (2003). 'Creating a "Modern Apprenticeship": A Critique of the UK's Multi-Sector, Social Inclusion Approach.' *Journal of Education and Work,* 16, 5-25.

Gospel, H. and J. Foreman (2006). 'Inter-firm Training Coordination in Britain.' *British Journal of Industrial Relations,* 44: 191–214.

Guest, D.E., J. Michie, N. Conway and M. Sheehan (2003). 'Human Resource Management and corporate performance in the UK'. *British Journal of Industrial Relations,* 41: 291–314.

House of Lords (2008). *Apprenticeship: Recent Developments.* London: The Stationary Office.

Institute for Employment Research (2008). *The Net Benefits to Employer Investment in Apprenticeship Training.*

McIntosh, S. (2005). 'The returns to apprenticeship training.' *Journal of Education and Work,* 18, 251-282.

Ryan, P., H. Gospel and P. Lewis (2006). 'Educational and Contractual Attributes of the Apprenticeship Programmes of Large Employers in Britain.' *Journal of Vocational Education and Training,* 58: 359-83.

Ryan, P., H. Gospel, and P. Lewis (2007). 'Large Employers and Apprenticeship Training in Britain.' *British Journal of Industrial Relations,* 45: 127-53.

Steedman, H. (2010). *The State of Apprenticeship in 2010,* A report for the Apprenticeship Ambassadors Network, CEP, LSE.

UK Commission on Employment and Skills (2008). *Time to Look Again at Apprentice Pay.* London.

Still finding our way? A second look at vocational education in England

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In a 2003 paper titled 'Finding Our Way: Vocational Education in England', West and Steedman argued that the organisation of vocational education in England was not fit for purpose. The paper proposed that it was both desirable and feasible to designate a single set of vocational qualifications for 16 to 19-year-old students in England which would complement and strengthen the well-established apprenticeship route to skill.

A number of arguments were put forward in the 2003 paper to support our case.

We offered evidence that very many 16-year-olds were led into 'dead end' Level 1 and 2 qualifications as a result of the bewildering amount of choice opened up to them at this stage. In 2001 there were 2,015 different vocational qualifications approved for use by those under 18.

In part because of poor choices and consequent discouragement, progression during post-16 study to Level 3 was poor in 2001. We quoted enrolment rates for 16 and 17-year-olds in 2001 which showed that enrolment of 17-year-olds on vocational courses at Level 3 hardly increased over the rate of 16-year-olds, indicating little progression on the vocational route from Level 2 to Level 3 at 17.

We pointed out that there already existed a well-respected set of vocational qualifications in a wide range of occupational areas, offered in FE Colleges since the early post-war period. These qualifications, originally validated by the Business Education Council and the Technician Education Council – later merged into BTEC and subsequently EdExcel – provided progression on a part-time (ONC/HNC) and full-time (OND/HND) route through to NVQ Level 4 and above. It is interesting to note that the proportion of home domiciled students accepted for university first degree courses having BTEC ONC/OND has increased from 5% in 1999 to 9% in 2009 (HESA 2010). These students enjoyed the confidence of teachers and high brand recognition from employers, particularly in manufacturing and business. We recommended that they should be designated as the alternative to A-level study for all 16 to 18-year-olds with the expectation that all students should aim to achieve a Level 3 qualification either by age 18/19 or subsequently in a job with part-time study.

The paper pressed for Level 3 to be the goal for a full-time vocational route for a number of reasons.

First, because research showed this as the qualification level which offered significant wage returns and therefore corresponded to a level of skill that could be used productively on the labour market (Dearden et al. 2000). Second, because a Level 3 qualification could open up the option of continuing to Further and/or Higher Education at Levels 4 and 5. Third, because a substantial period of study allowed for technical specialisation to be combined with more general educational skills which would provide breadth and flexibility as a basis for future career choices.

It was noted that Level 3 is the norm for full-time vocational programmes offered to 16 to 19-year-olds in other countries, notably Sweden, France, Austria and Denmark. Although the BTEC qualifications usually provided less hands-on workshop practice than in Europe, they nevertheless were of a broadly comparable standard in terms of technical and general education.

If we are to assess progress in England, it is important to first examine how these comparator countries' systems have developed before assessing how far recent changes here have helped narrow the gap.

What has happened to vocational education in Europe since 2000?

Increasingly in Europe, full-time vocational education and apprenticeship are perceived as complementary. Different ways of articulating the two are being introduced and consolidated.

In France, the two are tightly bound together by a common set of national vocational qualifications available from craft through to post-graduate level, and available in full-time and apprenticeship routes. In Germany, full-time vocational preparatory programmes precede and prepare for apprenticeship, especially in the case of those who must 'queue' for an apprenticeship place. Full-time Danish vocational programmes with work experience provide supplementary places when employer demand is insufficient to absorb the supply of young people. In Sweden, some apprenticeship places will now be offered alongside full-time vocational education programmes.

Developments on the continent contrast with England, where articulation between full-time vocational education and apprenticeship is as yet undeveloped. The technical certificate – specified for all Level 2 and Level 3 apprenticeships and frequently delivered off-the-job in college or by another provider – could and should become a common element of full-time vocational provision. Further and closer articulation could reduce apprenticeship costs and encourage progression.

Where full-time vocational programmes are followed by apprenticeship, learners acquire the skills and values necessary for craft/professional status in the workplace. Where full-time vocational education is not associated with a period of employment, as in France and Sweden, practical skills are delivered by the college, either in a simulated workplace or college workshop, usually taking up a third or more of all contact hours. A substantial period of work experience – 10 or more consecutive weeks – helps to develop employability skills.

Technicians are expected to study to NVQ Level 4 (France, Germany, Austria) continuing to a two year full or part-time course following Level 3.

Full-time vocational education in Europe offers several important points of contrast with England:

- a single range of nationally available programmes leading to Level 3
- a platform for progression to Level 4
- skill acquisition and employability skills acquired through workshop, work simulation and/or work experience

Have we gone forward or backward since the early 2000s?

So while England does not offer the same strength and breadth of provision, we need to consider whether we have narrowed the gap with continental countries. Sadly, the verdict on this question is a bleak one: we seem to have made little or no progress.

First, the confused and incoherent offering post-16 available in 2000 is now infinitely more confused and incoherent. For example, Camden Council invites 16 to 19-year-olds to select from the following drop-down list on their website for post-16 choice: A2 Level, Advanced Extension Award, AS Level, Basic Skills, BTECs and VRQs, Entry Level, ESOL, Free Standing Mathematics Qualifications, GCSE, Higher Level, Key Skills, NVQ, New Diploma, New Diploma Functional Skills, New Diploma Principal Learning, New Diploma (Project), Occupational Qualifications, Qualifications and Credit Framework, Vocational Certificate of Education, Vocational Certification of Education Advanced Level.

More qualification types have been added: a Qualifications and Credit Framework has been devised which appears to have multiplied the 2,000-odd vocational qualifications eligible for government funding in 2001 to an unthinkable 9,170! See: www.education.gov.uk/section96/

A further consequence of the 'standardisation' process applied by the immensely costly QCF exercise is that EdExcel are no longer permitted to use the title Ordinary National Certificate/Diploma or Higher National Certificate/Diploma on their awards, thus losing the valuable brand recognition built up over many decades.

It is said that GNVQ has 'migrated' to become Double Award Vocational A-levels. In 2009/10 some 8,000 students were entered for these awards, of whom 1,000 studied ICT and 500 Applied Science.

The GNVQ was removed to make way for the New Diploma, which in 2008 was introduced in five subject areas at Foundation (Level 1), Higher (Level 2 - 3000 entries in 2009/10) and Advanced (Level 3 - 600 entries in 2009/10). It is too early to judge the impact of the Diploma on STEM.

Progression from a Level 2 Vocational Qualification to a Level 3 Vocational Qualification at 17 continues to be poor (Table 1). In 2008 some 12% of 16-year-olds were studying at vocational Level 2 and some 11% at vocational Level 3. Since Vocational Level 2 would normally be a one year full-time course, we might expect the percentage of 17-year-olds on a Vocational Level 3 to increase as those who achieved a Level 2 qualification at 16/17 transferred to Level 3. However, after allowing for those enrolled at vocational Level 3 age 16 to move onto the second year of the course at age 17, vocational Level 3 only grew marginally (less than 3%) instead of the 10% increase that might have been expected if those on Level 2 had progressed on this route.

Table 1: Qualification aims of 16-year-olds in FTE in 2008 and 17-year-olds in FTE in England, 2009

	16 in 2008	17 in 2009
Vocational Level 2 (a)	11.9%	7.4%
Vocational Level 3 (b)	10.6%	13.1%

Source: SFR 18 2010 Supplementary Tables C1 and C4

Apprenticeship is another area where progress has been mixed. Apprenticeships provide valuable STEM learning for 16 to 18-year-olds, but here too the supply of young people on the work-based learning route has fallen and, with it, it must be presumed, the STEM skills that this route produces. Since 2001, although the overall number of apprenticeships has increased slightly, the 16-18 share of those apprenticeships has been squeezed and declined steadily (Figure 1). Numbers of 16 to 18-year-olds working for Level 3 Apprenticeship qualifications have halved from 60,000 in 2000 to 30,000 in 2009.

Meanwhile, full-time enrolments of 16 to 18-year-olds have increased. This appears to be the result of the September Guarantee 'rolled out' in 2007 (which obliges LAs to offer a place in FTE or training to any 16 or 17-year-old who wants one) combined with worsening labour-market prospects for young people.

On the positive side there has been an increase in the number of young people taking full-time vocational qualifications, but the increase has been much smaller than for academic subjects. In 1985, when participation post-16 was very much lower than in 2009, participation in vocational and academic routes was not too different – 18% working for academic qualifications and 13% for vocational. By 2001, this gap had widened enormously – encouraged by easier access to HE, 40% were studying for A-level or already in HE and only 18% were working for vocational qualifications. The latest figures, relating to 2009, show a narrowing again, with A-levels still at 40% but vocational qualifications up to 28% – an increase of 10% over 2001.

However, we also need to consider progression, where less has been achieved. To assess the learning of STEM skills we need to look at higher level (Level 3) vocational qualifications.

Table 2 below shows that 17-year-olds with a Level 3 vocational qualification aim in full-time education account for just 14% of the age group in 2009 – a figure which falls to 11% at age 18. This is, however, a considerable improvement on 2000 when the corresponding figures were 7% and 5% respectively.

Table 2: 17 and 18-year-olds in FTE with Level 3 vocational qualification aim in England, 2000, 2009

Age	2000	2009
17	7%	14%
18	5%	11%

Source: SFR 18 2010 Supplementary Tables C4, C10

Not all who aim for a qualification will succeed or stay the course. The proportion of 18-year-olds who gain a Level 3 qualification on the vocational route (full-time and apprenticeship) appears fairly stable at around 10% in both 2000 and 2008 (B01/2010 July 2010 Table 2.2.3). It is from this small pool of young people that England must develop much-needed STEM skills.

Conclusions

In 2003 we proposed a way of moving forward and building a strong vocational offering for 16 to 18-year-olds in full-time education.

While there have been some successes, with a greater percentage of young people studying vocational qualifications, progression is poor and the system still does not have a clear vocational route.

In fact, the past decade has witnessed ever greater proliferation of courses and qualifications for this age group, and little progress in improving achievement at Level 3. This failure to exploit the potential of the vocational route – a potential clearly demonstrated in continental Europe – deprives young people and the economy of much-needed skills. Instead of aiming to provide an excellent vocational education, previous reforms have aimed to achieve so-called 'parity of esteem' which is, by definition, both unachievable and irrelevant to vocational programmes.

Like the benefit system in England, built up by addition and accretion over many decades and with no strong sense of direction, the variety of 16-18 vocational education has become dysfunctional and an obstacle to the aim of high quality vocational learning.

A single unified qualification is needed for 16-18 vocational learning to provide focus for students, and to simplify and encourage the active involvement of business and industry. As in other European countries, the courses should offer substantial periods of work experience and practical skills learning. Technical skills should be developed in broadly-based courses to Level 3 with specialisation at Level 4.

Greater articulation is needed between the building blocks of vocational learning. Full-time vocational courses are already modular and these modules could be more widely used as technical certificates in Apprenticeship. It is vital that there is an avenue from vocational programmes to HE, but this is far from saying that all who complete an upper secondary vocational programme should expect to enter HE, or that they will have a wide choice of institutions and HE programmes when they do. The French BTS (Brevet de Technicien Superieur) or the German Techniker qualifications constitute good models here.

Further reading

West, J and Steedman, H (2003) *Finding Our Way: Vocational Education in England*. CEP Occasional Paper 18. May 2003.
http://cep.lse.ac.uk/pubs/download/occasional/OP018.pdf

Dearden, L, McIntosh, S, Myck, M and Vignoles, A (2000) *The Returns to Academic, Vocational and Basic Skills in Britain*. DfEE. 2000.

Registration and technical education

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Introduction

This paper explores the possible regulation of technician occupations through professional registration, and the role this might play in improving the status of technical education and increasing the clarity, stability and uptake of technical pathways.

The link between professional registration and technical education may not be immediately apparent. However, professional registers recognise competence – the possession of the knowledge, skills and understanding necessary to undertake particular activities. One purpose of technical education and training is to develop competence. Thus registration can benchmark success in technical education.

Furthermore, vocational qualifications are held in relatively low esteem in the UK. Partly this is due to employers' difficulties in assessing the content, value and comparability of a vast range of vocational qualifications. Consequently, there is a lack of clarity about the employment benefits such qualifications confer, which in turn dissuades individuals from following such technical pathways.

A common framework of technician registers, maintained by the professions themselves, would set the standard of competence demanded of individuals by employers, allowing Awarding Organisations to develop vocational qualifications that attest to such competence and thus have genuine value in the labour market. Such a register could therefore ensure technical education meets the needs of individuals, employers and the wider economy.

Regulating occupations

Many occupations are regulated by government legislation. For example, in order to teach in a maintained school, an individual must have a 'licence to practise' from the government through Qualified Teacher Status.

But regulation has a long history and was not originally the concern of government. Most notably, until the 19th Century the guilds controlled the supply and training of craftsmen through the terms and conditions they imposed on apprentices and their masters. As the arbiters of contracts between masters and apprentices, the guilds ensured that both parties gained from the arrangement and thus helped to ensure investment in the adequate training of craftsmen.

Today, regulation covers a wide spectrum of occupations, including doctors and dentists, lawyers, certain kinds of engineer, nurses, teachers, gas fitters, taxi and Heavy Goods Vehicle drivers, and security guards. As this list shows, regulation is frequently linked to health and safety concerns rather than levels of craftsmanship.

Different forms of regulation

There are many forms of occupational regulation, ranging from registration through certification to licensure.

Registration exists where an agency registers the names, addresses, and other relevant details of individuals in a particular occupation. A qualification may be required to join the register.

Certification refers to situations where individuals must meet a certain level of skill or qualification to have the right to a title of some kind (e.g. certified accountants or chartered surveyors). Non-certified workers can carry out the work, but cannot use the title.

Licensure is a more onerous form of regulation, where only individuals who are registered and certificated have the legal right to practise a certain trade (e.g. doctors) or to perform certain functions (e.g. gas fitters). In all these cases, there may also be requirements for continuing personal development and ongoing training.

The picture in the UK

In the UK, the occupations covered by these forms of regulation and whose practitioners usually have intermediate level skills include: gas fitters (licensing); electricians (licensing of certain kinds of work); security guards (registration with a training requirement); construction workers (voluntary registration under the Construction Skills Certification Scheme); and pharmacy technicians (mandatory registration to begin in June 2011).

About 14 per cent of the UK labour force, covering 353 occupational groups, is in occupations which require a specific qualification or registration with some agency. This number excludes voluntary registration and partial licensing of certain functions (e.g. specific types of electrical or welding work). The corresponding figure for the USA is 29 per cent.

Technicians and the low take up of technician qualifications

The term technician became firmly linked to science and technology in the middle of the last century. The change in usage from one being skilled in a technique to one working in or with technology reflects the growing role that science and technology play in the modern workforce.

Searching a database of job titles reveals about 300 containing the term technician, with about 95 per cent of these associated with STEM sectors.

The UK's lack of technicians is a problem which has been known about for decades, and the shortage of people with intermediate technical skills will be one of the most significant challenges facing the economy over the coming years. These technical skills, generally at level 3 and above, have commonly been developed through vocational education, with the practical skills required in the workplace supplemented by a more academic knowledge component.

However, there is evidence to suggest fewer people are becoming technicians through the vocational education route. This may reflect a lack of confidence from employers in the available level 3 & 4 vocational qualifications, resulting in them recruiting graduates and 'de-skilling' them to operate as technicians. This also lowers the value of vocational STEM qualifications to young people, who perceive few benefits in terms of enhancing employability or wages. Consequently there is very low take up of the vocational courses intended for technicians.

The key to encouraging greater take up of technician qualifications is to ensure that any qualification carries a financial premium in the workplace. One way of achieving this would be to associate technician roles with licences to practise derived from qualification requirements.

However, research has suggested that while occupational licensing benefits the individual, it can have a negative impact on the economy by limiting the supply of skills. Therefore, licensing should probably be restricted to areas where there are significant safety or financial risks associated with underperformance.

Technician registration and its possible impact on technical education

Currently there are registers in Science, Engineering, ICT and Health at postgraduate levels (e.g. Chartered Scientist), but technician-level registration only exists in Engineering and ICT. In order to join these registers, an individual needs to demonstrate both their competence to perform professional work to the necessary standards, and their commitment to maintain that competence, work within codes of conduct and participate actively within the profession. The knowledge and skills enshrined within registration standards reflect the demands of the workplace but are broader than those that would be accredited through NVQs or other occupational qualifications. Once an individual has successfully registered they are entitled to use the appropriate post-nominal (e.g. EngTech). Retaining this designation requires continued membership of the admitting institution and payment of an annual fee.

One of the key elements to technician registration is that it recognises some of the transferable skills that might not be valued within competency based qualifications. These transferable skills are vital for technicians whose jobs depend on being able to respond quickly to changes in technology.

Although it is possible to demonstrate professional competence entirely through workplace performance, the majority of current registrants use qualifications to demonstrate that they have the requisite formal education. In order to facilitate this process, professional bodies often accredit or approve qualifications. For example, the Institute of Physics accredits physics degrees, so that graduates of accredited Integrated Masters degrees have fulfilled the educational requirements for Chartered Physicist status. The accreditation process has enabled the Institute to exert considerable influence over the content of physics degrees.

Within a common framework of professional registers for technicians, professional bodies (co-ordinated by the Engineering Council and Science Council) would set the benchmarks for technician registration standards. By mapping qualifications to these standards, the professional bodies could exert influence on the length, content and assessment of training programmes and associated qualifications. This is because Awarding Organisations would be keen to ensure their qualifications attested to meeting these standards, as possible trainees would perceive such qualifications to carry a financial premium and other benefits.

Benefits of professional bodies' involvement with technical education

Registration is only financially viable for professional bodies if it is sufficiently attractive to individual technicians for them to pay their registration fees. This is only the case if registration standards reflect the needs of employers. Professional bodies are thus incentivised to stay attuned to the competence required of technicians by employers, even as this changes over time due to technological innovation and shifts in the economy. Professional bodies' influence on the content of qualifications would therefore ensure the relevance of these qualifications, increasing employers' confidence in them and increasing their attractiveness to potential trainees.

Furthermore, by mapping apprenticeship frameworks to registration standards, professional bodies could protect apprenticeships from the academic drift that has been fatal for many vocational qualifications. Recently there has been considerable interest in ensuring that there is the potential to progress into the professions from apprenticeships. Much of the discussion seems to have focused around using apprenticeships for entry to universities. However, by linking the different levels of apprenticeships to the relevant level of professional registration it should be possible to build a truly vocational pathway into the professions. In many ways this echoes the earlier role of the guilds in ensuring the standards that an individual had to meet before becoming a journeyman and then a master craftsman.

Moreover, growing concerns about skills have resulted in an increase in short-term political interference that has created significant instability in technical education. Since professional bodies are less vulnerable to short-term political pressure than government agencies, they could bring stability and encourage a focus on the long-run needs of employers, employees and the economy as a whole rather than on short-term political goals. Granting independence to the Bank of England has arguably enhanced the credibility of monetary policy. Creating the Office for Budgetary Responsibility is intended to enhance the credibility of government economic forecasts. Increasing the role of professional bodies would invest vocational education and training programmes like apprenticeships with greater credibility, thereby enhancing their reputation, quality and attractiveness to employers and trainees alike.

Further benefits of registration

For individuals, registration should lead to increased employability through greater recognition of their knowledge and skills – in particular those transferable skills that will enable them to respond to future changes driven by technological innovation or shifts in the economy. The status registration confers, including through the award of a post-nominal, allows registrants to distinguish themselves in a crowded employment market. This can enhance individuals' prospects for promotion within the organisation that currently employs them, and can also act as a credible signal of their skills and ability to employers more generally, thereby improving individuals' job and career prospects more generally. Registration and the associated membership of a professional body would also enable technicians to access professional development, improving their opportunities to progress through the professions.

There are also benefits for employers. Registration allows employers to have much clearer expectations about what they can expect from potential employees – professional registration is a recognised, stable and externally validated way of confirming a competence standard has been achieved without having to delve into the detail of the vast range of vocational qualifications.

Registration could also be valuable to employers in other ways. As well as demonstrating a commitment to the training and development of staff, registration allows organisations to demonstrate their staff's competence and commitment to ethical behaviour, which could be an important feature in procurement and liability issues.

Next steps

It is clear that technicians, like scientists and engineers, will increasingly have to work in interdisciplinary teams, thus the term 'Registered Technician' needs to have some common currency across science, engineering and technology.

The Technician Council has been tasked with developing a common framework of registration standards that commands the support of the different communities in STEM. The Technician Council comprises senior stakeholders with an interest in the registration and training of technicians, including key professional bodies, employers, UKCES and the National Apprenticeship Service.

Conclusion

The shortage of people with intermediate technical skills will be one of the most significant challenges facing the economy over the coming years. These technical skills, generally at level 3 and above, have commonly been developed through vocational education, but at present most employers neither understand nor sufficiently value the vast array of vocational qualifications, dissuading individuals from technical pathways.

Regulating technicians through a common framework of technician registers maintained by professional bodies could transform the qualifications landscape. Through the Technician Council, stakeholders will agree the standard of competence demanded of individuals in order to register. By mapping qualifications to these standards, influence can be exerted on the length, content and assessment of qualifications, ensuring they meet the demands of employers and thus have genuine value in the labour market, delivering enhanced employability and wages to those who achieve them. Where political interference has created instability, confusion and a focus on short term targets, registration should deliver a stable, rationalised system, responsive to current demand and changes wrought by future technological innovation and shifts in the economy. Taken together, this should drive an increased uptake of a new form of technical education that meets the needs of individuals, employers and the wider economy.

Further reading

UK Standard for Professional Engineering Competence (UK-SPEC)
www.engc.org.uk/professional-qualifications/standards/uk-spec

Humphris, A., M. Kleiner, and M. Koumenta (2010) *'How does Government Regulate Occupations in the UK and the US? Issues and Policy Implications'*
http://blog.lib.umn.edu/gpa/globalnotes/Kleiner%20paper.pdf

Stephen R. Barley and Julian E. Orr, *Between Craft and Science: Technical Work in the United States (Collection on Technology and Work)*

The economic value of qualifications

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Summary

One way that we can measure the economic benefit of education is to consider the impact of education on individuals' earnings. The wage gain from acquiring education can be seen as a rate of return earned on an investment. By this measure, the economic value of education remains high, despite the rapid expansion of the UK education system and the increase in the number of skilled workers in the labour market. Certainly individuals with more schooling earn more in the UK: each additional year of schooling earns an individual around 5-10% higher wages. This high value of education in the labour market reflects the rising demand for skilled workers in modern economies.

However, it is not the case that all types of education have the same economic value. The particular qualifications that people acquire and the subject area which they study influences their wage gain. Here we consider the economic value of different types of qualification, focusing specifically on the wage gain from STEM qualifications.

Many STEM qualifications are very valuable in the labour market. Quantitative skills are particularly in demand by employers. Hence having good basic skills in numeracy or indeed A level mathematics yields a substantial wage gain for workers. At degree level, graduates with mathematics, science and numerate degrees generally earn more than graduates with arts or humanities degrees. On the vocational side, it is harder to ascertain the value of STEM qualifications due to data limitations. However, the value of vocational qualifications does vary substantially according to the particular type of qualification acquired, and some vocational qualifications provide a good wage gain for individuals working in STEM-related sectors.

The evidence

A number of key studies, listed under further reading, have investigated the wage gain from different types of UK qualifications. We start by considering the value of academic qualifications before focusing on vocational STEM qualifications.

Academic qualifications

Academic qualifications tend to have higher economic value than vocational qualifications. This may be because such qualifications are more generally applicable and less occupation specific. However, it is also true that more able individuals in the UK tend to take the academic route and this means that an academic qualification is a stronger signal of a person's ability to employers. Whilst the academic literature takes this so called "ability bias" into account, it is nonetheless true that vocational qualifications are often seen as the poor relations to academic ones. This is particularly true at lower levels (e.g. level 2 which is equivalent to GCSE).

Our interest, however, is in STEM qualifications specifically. Academic STEM skills and qualifications are often particularly highly valued by employers. For instance, good basic numeracy skills are associated with both higher earnings and better employability. Equally, mathematics A level attracts an additional wage premium of 10% over and above the average wage gain from having other A level subjects.

At degree level, however, the story is more complex. A study by Walker and Zhu (2006) suggests that recent graduates have seen a slight fall in their relative earnings but it is still the case that degrees are valuable. An average graduate earns just under 30% more than someone who stopped at A level. Not all degrees have similar value however: there is substantial variation depending on the subject. Numerate degrees tend to have higher economic value. The top paying degrees for males are accountancy, electrical engineering, maths and computing and mechanical engineering. Male graduates in these subjects earn around 40% more than an arts graduate for instance. The top four high paying degrees for women by contrast are accountancy, medicine, law and education. Thus, although employers seem to value some technical and mathematically based degrees particularly highly, not all the top paying degrees are STEM degrees.

Vocational qualifications

At lower levels of skill some vocational qualifications are valuable whilst others are not. For instance, low level NVQ qualifications (level 1 and level 2) produce extremely small gains in wages, if any at all. The most positive study suggests that women with NVQ2 as their highest qualification may earn around 4% more than those with no qualifications at all. However, this does not mean that all low level vocational qualifications have little economic value. By contrast, men with BTEC and City and Guilds level 2 qualifications and women with RSA level 2 qualifications experience wage gains of up to 20% from these lower level qualifications. This evidence clearly suggests that the content, rather than just the level, of the particular qualification is crucial in determining its economic value. NVQs in particular were originally designed to accredit existing competencies and skills. It is unsurprising therefore, that some lower level NVQs do not produce substantial wage gains, as they do not necessarily provide the individual with new skills.

At higher levels of vocational qualifications we see a similar pattern. Basically, the average wage gain from having level 3 qualifications (equivalent to A levels) is greater than at level 2 but there are still major differences in the wage gain from different types of vocational qualification. Broadly NVQs have relative lower economic value than say BTEC, ONC/OND or HNC/HND qualifications.

What is most striking however is that the value of different vocational qualifications varies hugely by sector (Jenkins (2007) is a key study here). Consider the NVQ2 qualifications discussed above. Although on average the wage gain from having these qualifications is virtually zero, this is not true in all sectors. For example, the wage gain from having a NVQ2 is high in the construction and energy and water sectors, though the gain varies by gender. BTEC level 2 qualifications are particularly valuable in finance and distribution, hotels and restaurant industries. City and Guilds qualifications at level 2 have high value in manufacturing and the distribution/hotel sectors. RSA level 2 qualifications have particularly high value in manufacturing and construction.

There are a number of potential explanations for these differences in the economic value of vocational qualifications across sectors. The obvious explanation is that the curriculum content of some vocational qualifications is more appropriate in some sectors than others. There is little specific evidence on this issue, although researchers have argued that many vocational qualifications are unrelated to businesses' real needs and that the UK is over-reliant on a qualification based approach to "solving" the apparent skills deficit (Felstead et al. 2010). Certainly employers are extremely varied in their needs and since vocational qualifications are sector specific, the economic value of such qualifications is likely to vary according to how well the qualifications actually meet the needs of businesses in each sector.

The fact that the economic value of some vocational qualifications is high (or low) in certain sectors should prompt further research into effective curriculum design. Successive governments have long recognised the need for better design of vocational qualifications. There have been many attempts, for example, to improve employer involvement in the design and development of qualifications (e.g. under the auspices of the Sector Skills Development Agency and the sector skills councils). Yet attempts to involve the full range of employers in all sectors in the design of vocational qualifications have had limited success, not least because of the significant demands it places on employers and the problems of getting employers to engage when there is constant change in the number and nature of vocational qualifications available (Huddleston 2005).

In any case, looking at the value of qualifications by sector cannot of course tell us about the value of vocational STEM skills specifically – for that we need to know the specific subject of the vocational qualification acquired. An analysis by Jenkins et al (2007) did not find large differences in the wage premium from vocational qualifications according to the subject area that they were in. However, this analysis was tentative and this is an area for further research. For now we can only note that some vocational qualification have good economic value in sectors that make great use of STEM qualifications (e.g. manufacturing).

Apprenticeship

Another type of vocational qualification that has high economic value is apprenticeship. Apprenticeships do seem to have even greater value in some STEM-related sectors. For example, work by Steven McIntosh (2006) has found that the economic value of apprenticeship is particularly high in construction and engineering, relative to apprenticeships in service sectors. The fact that apprenticeships, which are by their very nature geared towards the needs of the business, generally have higher value than lower level vocational qualifications that are not always taken as part of an apprenticeship underlines the need for vocational qualifications to genuinely meet the needs of employers if they are to have good economic value.

Implications and conclusions

We conclude that academic STEM skills (A levels, degrees) are certainly in great demand in the labour market. Some types of vocational qualifications also have high value, particularly in key STEM sectors. Hence, in general terms, the evidence clearly supports the view that STEM skills are particularly valuable in the labour market. This high demand for STEM skills is partly because technological change in the UK and elsewhere has tended to be skill biased – prompting this increased demand for analytical, numerical and scientific skills. Hence individuals with scientific and analytical skills will tend to have an advantage in the labour market. However, we also know that at the moment those with good scientific/numerical skills are often attracted by high salaries into non-scientific jobs, leading to continued supply issues in STEM occupations. This relative shortage of STEM skills in turn keeps the price of such skills high.

Against this background of high economic value for STEM skills, there is a genuine need to inform young people about the value of such skills in the labour market. Since STEM qualifications, or at least numerate qualifications, have strong labour market value, it is crucial that young people know this when making decisions about their choice of qualification. We need to highlight the high rate of return to STEM degrees in particular and encourage more young people to take the appropriate choices at 16 and 18 to enable them to take a route into a STEM degree if they want to. Students are not always aware of these routes or the importance of GCSE and A level choices. Therefore advice and guidance on these issues continues to be a priority. However, we also need to ensure that we genuinely increase the STEM skills of our labour force and not simply increase the number of "STEM qualifications" young people acquire. There is a danger that a purely qualification based approach to solving the problem of STEM skills leads to a proliferation of different vocational qualifications, many of which have limited economic value in the labour market as they do not genuinely meet the needs of employers (Felstead et al. 2010).

A final point is that a number of key gaps in the evidence base remain. Firstly, we still need to better understand why some vocational qualifications have high value in some sectors. This may be due to differences in curriculum content or perhaps other factors, such as de facto licenses to practise that require individuals to have certain vocational qualifications in order to find work in some sectors. Clearly the policy implications of these two possible explanations for the differences in the economic value of qualifications across sectors are quite different. We also need to improve our understanding of the differences in the wage premium from vocational qualifications according to the subject area they are in (as opposed to the sector they are used in). To do this, research is required to measure the extent to which some types of vocational qualifications, particularly those in STEM subjects, are "portable" i.e. have some economic value across a range of sectors. Lastly, a primary policy objective of the attempt to upskill our workforce is to improve the UK's productivity and economic growth. Yet we still have relatively limited understanding about the impact of investing in STEM skills and qualifications on economic growth. We know that economic growth is related to the quality of a country's education system, but more research is needed to understand the role of STEM skills specifically.

Further reading

A number of key studies have been conducted in this area and make for interesting reading (in particular Dearden et al. (2004) and Jenkins et al. (2007)).

Dearden, L., McGranahan, L. and Sianesi, B. (2004) *An In-Depth Analysis of the Returns to National Vocational Qualifications Obtained at Level 2.* Centre for the Economics of Education Discussion Paper 46.

Felstead, A., Fuller, A., Jewson, N. and Unwin, L. (2010) *Improving Working as Learning.* Routledge.

Huddleston, P., Keep, E. and Unwin, L. (2005) 'What might the Tomlinson and White Paper proposals mean for vocational education and work-based learning?' Nuffield Review of 14-19 Education and Training Discussion Paper 33.

Jenkins, A., Greenwood, C. and Vignoles, A. (2007) *The Returns to Qualifications in England: Updating the Evidence Base on Level 2 and Level 3 Vocational Qualifications.* Centre for the Economics of Education Discussion Paper 89.

McIntosh, S. (2005) 'The returns to apprenticeship training.' *Journal of Education and Work,* 18, 251-282.

Sloane, P.J. and O'Leary, N.C. (2004) *The return to a university education in Great Britain.* IZA Discussion Paper No 1199. Bonn, Germany.

Walker, I. and Zhu, Y. (2005) *The college wage premium, over education and the expansion of higher education in the UK.* IZA Discussion Paper No 1627. Bonn, Germany.

Careers guidance towards technical and vocational routes

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Introduction

People who enter technical training routes often do so by chance rather than by guidance, and many learners never consider such routes. High quality, impartial careers advice should be available to all people, but especially those who would benefit most from training for a technical career. The routes to these careers can be complex and are often not well understood by learners, their families and their teachers. Guidance needs to start at the beginning of secondary school at the latest.

Often young people think their teachers regard anything other than a pre-university qualification as second class, and sometimes schools and teachers are explicit about this. These prejudices lead to stereotyping and can deny people the career opportunities most suited to them.

Summary

This paper makes a series of recommendations on developing a greater role for teachers and employers in providing higher quality labour market information (LMI); making routes clearer; providing better quality information; and improving the drivers which encourage schools and colleges to deliver a better careers advisory service.

Careers advisors, however good and well-informed, cannot do the job on their own. They need the active support of subject teachers, pastoral staff and senior leaders within the school or college. All these people need access to much higher quality LMI about the rewards that technical careers bring, and where the opportunities lie. There is a need for a comprehensive database of LMI that is readily accessed electronically by advisers, teachers, and directly by learners and their families.

Employers and ambassadors can be very influential on decisions to follow a vocational route, and schools and colleges should actively seek to bring in ambassadors who have themselves followed a technical route. In the long term, the complex mix of technical qualifications needs to be simplified to make the routes easier to follow.

The careers advice profession is in flux, as it moves to an all-age service that is more focused on the provision of high quality information for all, and less specifically on those at risk of unemployment. This is adding to uncertainty and low morale, but there are moves within the profession itself to make it better trained and to define professional benchmarks. These changes present opportunities to improve the provision of advice about technical occupations and routes.

Why careers advice and guidance is important

The context

This paper takes as its starting point the fact that the UK needs more people with qualifications and skills at the technician level. The UK Commission for Employment and Skills (UKCES) in its audit of skills needs reports: 'One of the most striking themes to emerge from the Audit is the growing importance of technicians, especially in specialist STEM areas.' Employers value people with STEM qualifications not only for their specific knowledge and skills, but also for the advanced skills that STEM qualifications typically bring: technical competence; analytical and problem-solving skills; numeracy and intellectual rigour.

Obstacles to providing high quality LMI

Despite the importance of STEM and the job opportunities it offers, learners – and their teachers and families – often know little about the routes to technical and occupational qualifications, the rewards for people with these qualifications, and the value of the transferable skills they bring. It is people from the least advantaged backgrounds who can most benefit from guidance.

Learners often feel that their teachers consider anything other than an academic route to be second class. Families and friends are often the major source of careers advice for young people, and their advice may tend to perpetuate established patterns rather than challenge career assumptions. Many learners embarking on apprenticeships do so as a result of being encouraged by employers – typically, having worked with the employer who then suggested they could enroll on an apprenticeship – rather than following this route as a result of careers advice.

Many learners on vocational courses report that they entered them by chance rather than having a career plan. Certainly, learners enter technical and vocational routes largely as a result of a number of influences lying outside the formal careers guidance system. As a result, many people may fail to enter such a route even though it may be the most appropriate one for them, and stereotypical attitudes and behaviours are reinforced. A more systematic approach is needed, with high-quality, well-informed guidance on careers and qualification routes available to all young people, so they can make informed decisions from an early age. This is important for social mobility, both to help disadvantaged people get into rewarding careers, and to prevent people entering stereotypical but inappropriate routes.

Current policy issues

The importance of starting young. For better informed choice, there is abundant evidence of the need to start young – much younger than the careers advisory service is currently configured towards. High quality careers advice is needed right through to adulthood, but the evidence is clear that decisions about directions of travel are often made at a very early age. Children begin in primary school to form a picture of what their future lives will be like, leading, by the age of 14, to the first of a series of formal decisions about their future subject and qualifications choices which will open or close their career options.

Therefore it is critically important that the work of building general awareness of careers options begins in primary schools and at key stage 3, so that when learners make subject and qualifications decisions, they do so in the light of good information about their long-term value. Formal decisions may be made at ages 14 or 16, but in people's minds they are often made much earlier. If learners have no awareness of the options available for training at technician level, they will often fall into default choices, particularly because young people often fear their teachers or families will regard them as 'failures' if they do not pursue academic careers.

Rather than relying on a small number of 'careers lessons' and careers interviews, a better approach is to drip-feed information about careers throughout a learner's time at school or college. This implies the involvement of subject teachers as well as career guidance specialists.

The need to improve careers advice in schools and colleges. This paper is mainly about the situation for young learners in English schools and colleges, where the provision of careers education and guidance is very mixed. Typically, schools have a member of staff (the 'careers co-ordinator') whose role it is to co-ordinate careers advisory activities, often together with work experience, to meet statutory requirements. They may not have any specialist training, and they cannot possibly have expert knowledge in the multiplicity of career options and qualification routes. Often, the school will bring in 'expert' advisers from the careers service, or private careers advisers to augment the in-house careers staff.

Typically, careers advice will be configured to concentrate around times of future choices, especially at ages 14 and 16. 'Careers lessons' are likely to be provided as part of Personal, Social and Health Education (PSHE). Such lessons are not generally held in high esteem by learners, or indeed by teachers.

In England, there has been substantial criticism levelled at Connexions, the youth service set up in 1999. This is perhaps best illustrated in the Final Report of the Panel on Fair Access to the Professions, chaired by Alan Milburn MP. The Panel recommended that the Government remove careers responsibility from the service and reallocate the estimated £20 million to schools and colleges to give them freedom to tender for careers services from a range of providers. Criticism of Connexions included that its broad remit and resource constraints were limiting its ability to deliver careers guidance to a large proportion of young people. The policy focus on supporting those not in education, employment or training (NEETs) was at the core of the criticism.

Offering genuine impartiality to support choice. The notion of impartiality is a fundamental tenet of careers advice. It means giving advice that is solely in the interest of the person's future, and it has two senses: impartiality as to choice of institution, and impartiality as to subject and qualifications choice. There is a temptation in 11-18 schools for guidance to be skewed towards encouraging young people to stay within the institution, whereas courses leading to technician qualifications are often found in Further Education (FE) colleges. So institutional impartiality is essential.

In the case of careers advice towards technician qualification routes, there are all sorts of reasons why advice might not be impartial, including ignorance of the qualifications, built-in incentives to guide people towards qualifications which appear easier, and an implicit assumption that academic qualifications are superior to technical and vocational ones.

Securing impartiality is an essential part of the professionalisation of the careers advisory service (see section 3.2).

Improving the careers advice profession. The careers advice and guidance profession is in flux. Government proposes that it should become an all-age service. Schools and colleges are likely to move to becoming purchasers in a mixed market of careers guidance, with some provided in-house and some bought in. Careers advice professionals often see themselves as having low status within schools and colleges, and professionalisation will go some way to raising their esteem and morale.

Addressing the complexity of routes. The routes to pre-university qualifications (especially A level) are well understood by most learners and their families, and by all teachers – not surprisingly, since this is the route that the majority of teachers took themselves. In contrast, the routes to technical and vocational qualifications, and indeed these qualifications themselves, are much less clearly understood. This is partly because there are so many vocational qualifications. The Royal Academy of Engineering report that 350,000 learners began an engineering qualification in further education in September 2009 (compared with 26,000 in HE), and these learners were signed up for one of 605 engineering qualifications.

In the face of such complexity, it is hard to give learners a clear overview of the vocational options that are available to them. The Secretary of State for Education has identified the importance of meaningful vocational educational routes, but previous efforts to overhaul technical and vocational routes have not succeeded in developing clear systems and challenging deeply rooted cultural prejudices in a system where vocational options are deemed suitable for those not capable of academic study, rather than suited to young people with particular dispositions and talents.

This picture was reproduced vividly in our survey when respondents were asked how well served young people in England are in finding out about routes into STEM qualifications and careers. Though 76% felt that young people are well served about academic routes, this contrasted markedly with the 36% who felt that vocational routes into STEM were well served.

Emerging policy

The new Skills minister is John Hayes, whose departmental base is in both the Department for Education (DfE) and the Department for Business, Innovation and Skills (BIS). He has moved quickly with a range of policy announcements in the careers advice field, and any recommendations for making the situation better need to have these in mind.

Moving towards an all-age careers service and a mixed market. The young people's careers service Connexions is to be merged with the adult careers service Next Step into a single all-age service. While this makes the demands on advisers even more challenging, it is potentially a good thing because it will bring a unified approach across the school, college and adult sectors. It should be easier for employers to have a relationship with a single careers service.

At the same time, ministers are moving more strongly towards a situation where schools and colleges purchase the careers advice they need from a range of sources, including private providers. This has implications for quality assurance.

Professionalisation of careers guidance. The Careers Profession Task Force, set up by the previous Government and chaired by Dame Ruth Silver, has published its independent report *Towards a Strong Careers Profession,* in which it states the need for 'professionalisation of careers professionals' with better and more systematic training. The present Government appears to back the model whereby the careers profession sets and regulates its own standards, and this should – if implemented well – go some way to improving the morale, status and effectiveness of the profession.

Such a move represents an opportunity to ensure that expert knowledge of technical and apprenticeship routes are a part of every professional's initial and in-service training.

Developing an information-rich service. The Connexions service has in recent years focused principally on those young people at risk of not continuing their education or moving into employment or training (NEETs). The result has been a more general youth advisory service, which has influenced the skills set of careers professionals away from knowledge of labour markets.

The Government has indicated that it wishes to see the careers advice profession move towards the provision and mediation of high quality information to all clients on careers and the labour market, and away from the focused support of the minority of individuals at risk of unemployment, which should be the responsibility of local authorities.

Recommended policy response

An ideal careers guidance service would be a significant development from the current one and a series of significant changes are recommended to achieve this transformation.

A snapshot of what transformed provision would look like

Every school and college would have at least one careers advice professional who was well-informed about labour market information (LMI) and qualifications routes. They would be adept at using all information sources, especially those on the internet. They would be able to offer guidance through the complexity of vocational and technical qualifications routes. They would understand the courses and qualifications on offer at other local schools and colleges, and they would offer impartial advice on which to go to, based solely on the individual's needs. They would convey no bias towards any particular route, and their advice would not be influenced by stereotypical assumptions about the individual. Careers advice would be available on demand to everyone, whatever their age.

The work of providing careers advice would be shared across the whole school or college. Careers information would be unobtrusively fed into subject lessons, school and college gatherings, PSHE lessons and visits from and to local employers. The process of drip-feeding information would begin at the start of secondary school, and, where possible, in primary school.

Outside of school and college, young people and their parents would have access to rich information about labour markets and qualification routes through the internet.

What needs to be done now to make this happen

The following steps are recommended to secure this transformation. It is anticipated that there would be a high level of challenge in managing this transition.

Providing clarity of routes. Government policy should focus on simplifying and clarifying vocational routes and making transparent the careers available at the end. In the shorter term, it would be worth investigating the possibility of developing a simple web-based interactive guide to vocational routes that leads students through the available choices.

Transparent information. High quality careers guidance, based on accurate LMI about the routes to technical qualifications and apprenticeships is particularly important if *all* people – especially those with no immediate family with experience of such routes – are to keep open the option of following technical careers.

At present, LMI is fragmented, inconsistent and difficult for students, parents, teachers and even careers guidance professionals to access. There are good overseas models for the creation of a single database of LMI which can readily be accessed by all groups. It is particularly important that parents – especially mothers – can have ready and direct access to this information because they are the most important single influence on young people's choices.

Using the web effectively. The internet offers some striking opportunities for providing LMI. The STEM Careers Review recommends the creation of a single, comprehensive and constantly updated database and portal of careers opportunities and LMI across all employment sectors.

This database should have a web portal with different interfaces for students and their parents; for employers; and for teachers and careers professionals. The interface for students and parents should link to the Science Council's Future Morph portal. There would need to be a training programme for careers professionals in the use of the portal.

Using subject teachers. Dedicated careers guidance lessons do not have a good reputation in schools. We recommend that subject teachers – particularly of science, mathematics, engineering and technology – should take opportunities where appropriate to embed elements of careers awareness to contextualise their teaching and help bring their subjects to life. This should become second nature to the teacher and appear seamless with the subject content for students.

This approach would create a training need in both initial and in-service training, and subject teachers will need to be conversant with the sources of available information, particularly the web-based database of LMI recommended above.

Hearing it from the employers. Employers are often vociferous about the need for technical skills and qualifications among those leaving schools, yet they do not articulate their wishes clearly to learners and their families. They need to be transparent about their preferences if they are to send the right signals to students. This is particularly important for learners and families who have no inside knowledge of the employment market.

The employer's voice is particularly important for technical and vocational routes, because advisers in schools and colleges may well know little about them. Many young people entering apprenticeships do so at the direct suggestion of employers.

Employers can show students what it is like to have a technical career by sending role models into schools and colleges. This kind of ambassador activity (for example, the STEM Ambassador scheme) is often confined to graduates, but schools and colleges should enrol technicians and apprentices – preferably from among their former students – to come in and talk about their work and the route that took them there.

Evidence base for this paper

This paper is based on the STEM Careers Review (see section 6 Selected Reading for details of how to access this report). The evidence base for the STEM Careers Review comprises:

- A literature review drawing on UK and international studies
- Nineteen interviews with key stakeholders in the careers guidance profession and STEM community
- Meetings with the Skills Minister John Hayes MP and senior officials in The Department for Education (DfE) and The Department for Business, Innovation and Skills (BIS)

- An online survey of the STEM and careers guidance communities, with 105 respondents representing 95 institutions
- Two workshops: one for educators and careers professionals, and one for employers.

Selected reading

Holman, J., and Finegold, P., Gatsby Charitable Foundation, 2010. STEM Careers Review. www.nationalstemcentre.org.uk/news/report-on-stem-careers-published

Atkins, L. and Flint, K., 2010. Young people's perceptions of vocational education. *City and Guilds Centre for Skills Development.*

Blenkinsop, McCrone, Wade and Morris, NFER, 2006. How do Young People Make Choices at 14 and 16?"

Hooley, T., Hutchinson, J. and Watts, A.G., UKCES, 2010. Careering Through The Web: The potential of Web 2.0 and 3.0 technologies for career development and career support services.

Hutchinson, J., Stagg, P. and Bentley, K., 2009. STEM Careers Awareness Timelines. Attitudes and Ambitions Towards Science, Technology, Engineering and Maths (STEM at Key Stage 3). iCEeGS.

Organisation for Economic Co-operation and Development (OECD), 2003. OECD review of career guidance policies: United Kingdom country note. Paris: OECD.

Websites

www.bestCourse4me.com

O*Net OnLine (OOL) www.onetonline.org

The Occupational Handbook www.bls.gov/oco/.

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Technical and vocational education in Germany, the USA, Japan and Sweden

David Harbourne, Edge Foundation

This paper offers a short account of the development of technical and vocational education at the school level in Germany, the USA, Japan and Sweden. In the main, the paper focuses on developments since 1945. It is drawn from a longer report written by Professor William Richardson (University of Exeter) and Dr Susanne Wiborg (Institute of Education) for the Baker Dearing Educational Trust, "English Technical and Vocational Education in Historical and Comparative Perspective", which is available from www.edge.co.uk/media/16991/considerations_for_university_technical_colleges.pdf

Technical and vocational education from the late 19th century

Technical and vocational education became more prominent in Germany, the USA and Japan during the 1880s, and in Sweden in the early 1900s, in marked contrast to England. Despite a number of attempts to catch up, the gap between the comparator countries and England persists to this day.

However, it is important to note that there are significant differences between the education systems of Germany, the USA, Japan and Sweden. There are different emphasises on the amount of specialised technical provision; progression routes; and the proportion of young people who progress to apprenticeships.

Furthermore, the four countries have found different ways to respond to long term economic and social change, as the demand for technical skills has increased and as patterns of school provision have changed.

Germany

Germany continues to run a tri-partite secondary system with strong technical schools and significant progression to apprenticeships, many of which are at level 3. The system is changing to respond to employers' needs for a more highly educated workforce with better technical and academic qualifications.

The education system established after World War II in the German Federal Republic (West Germany) was administered regionally through 11 *Länder.* These state governments displayed little appetite for reform of secondary education, and consequently the pre-war structures of school education were carried forward largely intact. Across all of the *Länder*, a common stage of primary education was in place for children up to the age of 10, after which pupils began to be differentiated. A minority transferred to other institutions: either at 10+ to the *Gymnasium*, preparing students for university entry at age 19, or to the *Realschule/Mittelschule* at 10+ or 12+, preparing students for employment at the age of 16. However, a majority of the cohort remained in primary education (at *Volksschulen*) before proceeding to apprenticeship at the age of 14 or 15. Indeed, by 1960 over half of all 16-19 year-olds were in apprenticeships, of whom 35% were in craft trades and 58% were in industry and commerce. All apprentices were required to attend a part-time vocational school (Berufsschule) as part of their training.

Reform plans of 1959, implemented from 1964, instigated a more common and universal stage of lower secondary education for the 10-16 age group, but still differentiated. By the early-1980s the result was arrangements within most *Länder* in which primary schools (*Grundschulen*) recommended pupils at the age of 9/10 to one of three types (and tiers) of lower secondary school, each of which provided a two-year 'orientation stage' for pupils aged 10-11: *Gymnasium* (academic orientation: 15% of entrants in 1963/18% in 1979); *Realschule* (technical/intermediate: 12%/24%); and *Hauptschule* (vocational: 69%/49%). Between 1969 and 1982, 78 comprehensive schools (*Gesamtschulen*) were introduced across most of the *Länder* (mainly in Northern Germany), but these were not comprehensive schools as the word implies, but a fourth option next to the three existing school types. They had experimental status in law and were allowed to exist only alongside the main school types.

Meanwhile, the apprenticeship system with its associated vocational training schools was also under review. In 1964, the term 'dual system' was adopted to describe the on- and off-the-job components of apprenticeship. Then in 1969, the Vocational Training Act (the basis of the present-day apprenticeship system in Germany) expanded the occupations subject to federal law to all those outside the public service, so constituting the widest framework of its kind in Europe. By 1990, 74.8% of 16 to 19-year-olds were in apprenticeships.

The apprenticeship system came under new pressure during the 1990s and 2000s as Germany and its economy changed. These pressures included the combined effects of the cost of German reunification in June 1991; the imbalance of the supply and demand for skilled labour within the expanded country; the threat that globalisation posed to the highly specialist and essentially conservative model of apprenticeship; and an increasing preference among large multinational firms for graduates rather than apprentices.

In 2000, the German school system experienced a severe jolt following publication of results from the first PISA (Programme for International Student Assessment) study of pupil performance at the age of 15 across 32 countries in mathematics, science and reading literacy. German 15-year-olds were found to perform well below the average in each curriculum area. This prompted significant efforts to increase the academic component of the curriculum in both the *Realschule* and *Hauptschule* sectors, while in Hamburg and Berlin there are current (2010) attempts to abolish these two school-types in favour of the *Gesamtschulen* ('comprehensive') schools that achieved formal recognition in 1982 in a majority of the 16 *Länder*.

In 2005, only 21% of lower secondary school pupils in Germany attended *Hauptschulen,* which were increasingly seen as problematic 'leftover' schools (akin to the image of some English secondary moderns of the 1960s). The *Realschulen* had gained in prestige and 'market share' (up from 24% in 1979 to 28% in 2005), but the *Gymnasien* increased their 'share' even more: up from 18% in 1979 to 34% in 2005. Despite the growth experienced by *Gymnasien*, the German higher education sector remains small by OECD standards, with 'upward' pressure from teenagers channelled instead into the expansion of a variety of full-time, post-secondary vocational schools, including those specialising in technology, social sciences, business, economics and administration. Furthermore, apprenticeships remain immensely popular: in 2006, almost 60% of school leavers aged 16 (that is, about half of the age cohort), entered apprenticeships, supplemented by a sizeable group of *Abitur*-holders taking up apprenticeship at age 18 rather than progressing from *Gymnasien* to university.

The USA

Comprehensive education developed in the USA before some other competitor countries, although after Scandinavia. The US education system has a strong tradition of general education (the college) and a weaker formalised VET system like those in Europe. This is shown in higher education enrolment, as a much higher number of students go to university (above OECD average) and fewer students progress into vocational tracks. The USA also had a higher staying-on rate at an earlier stage in its history. However, there has also been much better technical provision than in England, with some specialist technical schools and a wide range of technical education offered in comprehensive high schools.

By 1920, one-quarter of all 14 to 17-year-olds in the USA were in high schools – the proportion rose to a half by 1930 and two-thirds by 1940. It is striking that the equivalent figure in England and Wales for 13 to 14-year-olds in state-maintained secondary schools (all of which were selective and most of which charged fees) was 13%, even in 1940.

The dominance of comprehensive high schools masked a huge variety of local models. In 1960 there were more than 40,000 local school districts. As supervisors of the districts, the individual states operated what were, in effect, 50 separate education and training systems. The duration of compulsory attendance varied in the 1960s - and still does today - from age 6, 7 or 8 to age 16, 17 or 18.

Federal funding for vocational education was first enacted in 1917. There was renewed interest in education after World War II, and the 'Sputnik shock' of 1957 served to stimulate the development of science education and, in the last two years of upper secondary schooling, a wave of federally-funded vocational provision. A significant expansion of vocational programmes in high schools peaked around 1982, when a quarter of all courses taken by students were vocational. Two-year community college programmes (at 17+ or 18+) also expanded significantly. Meanwhile, a small number of urban specialist schools had survived from early in the century, often devoted to technology and the sciences, recruiting via selective entry at 12+, 14+ or 15+.

There was a second phase of federal concern in the 1980s. The 1983 report *A Nation at Risk* and a range of similar reports commented on technical education at a time of declining competitiveness in industries such as steel and electronics.

The effect of concern about technical education was more mixed in the 1980s. On the one hand, as schools were exhorted to focus on academic subjects, leaders of vocational programmes in high schools came under pressure to justify their provision and found their enrolments falling. On the other hand, the political stimulus served to breathe new life into justifications for 'VocEd' in high schools.

These events created new configurations of technical and vocational education at the secondary school level, serving to reintroduce some of the variety of school type seen at the start of the twentieth century.

In the first place there were the surviving specialist high schools of longstanding and high repute. These were supplemented, from the 1960s, by a parallel specialist, or 'magnet' school movement, in part stimulated by a drive to desegregate school attendance. Some of these took the form of new vocational high schools established in school districts on a relatively small scale (400-500 students) and enrolling a minority of adults. By the mid-1980s there were 225 such schools recognised nationally, though it must be said that vocational and technical education is a relatively small-scale aspect of the broader magnet school phenomenon, now accounting for 4-5% of all US high schools.

More broadly, federally-funded programmes continued to address technical and vocational priorities in the comprehensive high schools. This took place in a system which had a mid-table ranking (in terms of raw scores) in the 2000 PISA study of tasks in reading, mathematics and science taken by 15-year-old students.

The Career and Technical Education Improvement Act of 2006 reauthorised federal support for vocational education, in the form of Career and Technical Education (CTE). Those receiving federal funding must offer at least one programme of career-related learning through "Programs of Study". Like Diplomas in England, these are linked to sectors of the economy such as healthcare, business and finance, communications media, and transportation technology. They also require schools and colleges to co-operate – like Diplomas.

Japan

Technical education has also been a higher priority in Japan than in England. After the age of 16, students progress to a range of more specialised senior high schools, many of which are technical or commercial.

Prior to World War II, large corporations with complex internal job markets dominated employment. This encouraged a fiercely meritocratic school system. From 1947, comprehensive reorganisation (to the age of 15) was imposed by the American occupying authorities with the support of local teachers. Universal elementary and lower secondary schools to 15+ were established beneath an upper secondary stage (instituted in 1948), with administrative responsibility devolved for the first time to locally-elected school boards.

From 1951 there was renewed emphasis on technical provision in response to demand from employers and students. This resulted in a sharp increase in the number of specialist schools and courses at the upper secondary level. There was a surge in participation which between 1950 and 1970 saw the proportion of the age group staying in full-time state school after the age of 15 increase from 43% to 82%. Large employers were encouraged to become involved in high schools and from 1966 the Ministry of Education stimulated further the growth of technical high school education by promoting the 'diversification' of secondary education based on ability, aptitude, future career and local conditions.

At the lower secondary stage the curriculum is centrally prescribed by the Ministry and education has traditionally been highly intensive (six days per week for 40 weeks of the year). This phase is dominated by preparation for the post-compulsory higher secondary education, which almost all students attend.

Since the early 1980s, the pattern of post-compulsory education has been relatively settled with about three-quarters sitting entry tests for admittance to a clear-cut hierarchy of three-year general high schools. A small group enter work (c.6% in the mid-1980s, falling to 1.4% by 1997). The final quarter proceed to technical or commercial high schools (also for three years) – enrolment in this sector has declined from a peak of 40% during 1955-75.

It is important to note the high standards attained in Japan. Across secondary schools as a whole, Japanese 15-year-olds testing for the 2000 PISA study scored highest for mathematics, second for science and eighth for reading literacy out of the 32 participating countries, a result which maintains Japan's top scores for mathematics and science established in pioneering international studies of this kind during the 1960s.

Sweden

Technical provision in Sweden shares some features with the other three countries, and has been described as being closest to France in that vocational training is school-based. Students remain in comprehensive schools from grade 1 to 9 and continue into upper secondary comprehensive schools. They follow the same curriculum until the age of 16. At upper secondary level they can then chose from 17 programmes, most of which are technical or vocational. Policy has recently been reviewed and appears to be moving towards more technical and vocational education.

A long period of social democratic dominance helped the education system to develop on egalitarian lines, with an emphasis on full-time and general schooling rather than apprenticeship training.

Sweden moved to a system where students remained in the same institution for nine years up to the age of 16. There was a common curriculum until students were 15, followed by a differentiated final year offering alternatives among three streams, 'g' (*gymnasium*/academic), 'a' (*allmänn*/general) and 'y' (*yrkes*/vocational).

Practical courses were unpopular and many more pupils than expected chose theoretical options (75%-80% of the cohort). From 1969, separate streams in the final year were abolished and pupils were permitted, within a mixed ability setting, to continue the type of option subjects with which they had become familiar during their preceding two years.

Many students remain in comprehensive schools after 16, although part-time vocational schools were introduced for those over 16 from 1966.

Initially, there were 23 'lines' within the upper school in three broad fields of study - Arts & Social Studies; Economics; and Science & Technology - derived from the separate institutions of the pre-1971 system and of varying lengths (2, 3 and 4 years). Regardless of their origins, all were now given a more or less vocational label. The 23 lines were subjected to review from 1976 and, from 1994, reduced in number to 16 (17 from 2000, 13 of which are vocational), each of three years' duration and with increased common elements.

Within the current curriculum framework offering choice among 17 national programmes, students study a common core of eight subjects (30% of their whole programme) and choose a set of additional general or vocational courses. In 2006/07, this resulted in uptake across all national programmes of 53% general studies and 47% vocational studies (the latter requiring a minimum of 15% of time in the workplace). In 2008, a reform commission responded to criticism that upper secondary education had become too uniform by recommending replacing the 17 national programmes at upper secondary level with a set of 19 – 16 of which would be vocational – to be taken either in school or through an apprenticeship, and leading to a common qualification.

A brief comparison of developments between 1980 and 2010

The curriculum questions confronting Swedish planners of comprehensive upper secondary schools from the early 1970s included the extent and volume of technical and vocational education appropriate to the age group when in common schools (along with the difficulty of providing the full curriculum outside the cities and larger towns).

The USA already had 90%+ levels of participation to 18+, and here attention was directed to the extent of parental and political satisfaction with the very concept of the 14-18 neighbourhood school. One result was for 'magnet' schools to become a vehicle for states to experiment with 'school choice' policies, opening the way for a revival of the specialist high school movement of 1890-1920, including very high performing 14-18 career academies – successors to the turn of the century technical high school.

This partial breaking up of the secondary-level common school moved the USA closer to the situation in Japan, where participation rates to 18+ were also already at the 90%+ level and specialist schools (public and private) had been maintained at the upper-secondary (15-18) stage. Here, however, the technical high schools were losing ground rapidly as the labour shortages of the 1960s eased. The system whereby companies link to schools on a semi-contractual basis to offer leavers a job (*jisseki-kankei*), came under strain but survived the long 1990s recession. Nevertheless, it appears that the malaise of the Japanese technical high school is less a question of its security in the school structure (enrolment is steady at about one-quarter of the 15+ cohort) and related more to the rigidity of highly gendered links to employment and further education at a time when the Japanese labour market, itself rigid by overseas standards, is now much less buoyant than during the long post-war boom.

In Germany, the grammar schools (*Gymnasien*) have experienced by far the largest proportional growth in enrolment among the three types of secondary school, but the higher education sector remains small. Apprenticeship and full-time vocational colleges have broadened their intakes so as to accommodate increased demand at a time when there is significant uncertainty as to how well the 'dual system' can survive the global pressures facing German manufacturing.

Conclusion

There remains a significant difference between the level of school-based provision in England and other countries. The greatest differences are with Germany and Japan, which have longstanding technical school sectors. There have also been differences with the USA and Sweden, where more technical content has been delivered in comprehensive systems. Attempts to offer more technical education in English schools through technical grammar schools and TVEI have not been very successful, as discussed in the other Edge paper.

However, provision in England has recently started to change with the rise of technical and vocational education in the 14-19 phase. There is now a new opportunity to offer high quality technical provision in specialised schools in England through the new University Technical Colleges, and England can learn from models used in other countries to develop these.

Further reading

Bosch, G. and J. Charest (eds.) (2010) *Vocational Training. International Perspectives.* London: Routledge.

Brown, A, A. Green and H. Lauder (2001) *High Skills: Globalisation, competitiveness, and skill formation.* London: Oxford University Press.

Crouch, C, D. Finegold and M. Sako (1999) *Are skills the answer? The Political Economy of Skill Creation in Advanced Industrial Countries*. Oxford: Oxford University Press.

Thelen, K. (2004) *How Institutions Evolve. The Political Economy of Skills in Germany, Britain, the United States, and Japan.* Cambridge, Cambridge University Press.

Unwin, L. (2001) *Young Peoples Perspectives on Education, Training and Employment: Realising their potential.*

Wiborg, S. (2009) *Education and Social Integration. Comprehensive Schooling in Europe.* New York: Palgrave MacMillan.

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The Gatsby Charitable Foundation

More about Gatsby's work in education

For more than two decades Gatsby has developed and managed a range of innovative projects to strengthen science, technology, engineering and mathematics (STEM) education in UK schools and colleges. Gatsby's current work is structured around three key aims:

- To support an increase in Level 3 and Level 4 STEM skills within the UK workforce by promoting a recognition of the importance of technicians, supporting the development of technical training pathways (eg Apprenticeships, Foundation Degrees and relevant 14-19 qualifications such as BTECs), and developing professional development opportunities for FE lecturers.
- To support the teaching of physical science 11-19 by piloting innovative approaches to teacher recruitment and professional development, and by supporting activities which encourage innovation and stimulate the use of engaging practical activity in science lessons and after-school clubs.
- To support a coherent national system of STEM education by partnering key organisations in the delivery of initiatives which promote greater collaboration across the sector, and through targeted research which informs government policy.

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Edge There are many paths to success

More about Edge

Edge is an independent education foundation, dedicated to raising the status of practical, technical and vocational learning. Edge wants all young people to have the opportunity to achieve their potential to ensure that the UK's future workforce is equipped with the skills to succeed.

Edge believes that 'learning by doing' should be valued equally with academic learning and that there are many paths to success.

Edge wants to see fundamental changes in the education system. We believe that practical learning should be part of every young person's education. So we want all young people to learn the skills they need for life and work, improved educational facilities, better careers guidance for young people, more opportunity for learners' voices to be heard, increased employer engagement at all levels, and an overhaul of teacher training, particularly in practical, technical and vocational subjects.