The Engineering Council Supporting Curriculum Debate and Innovation

RESEARCH

Ruth Wright

Executive, General Education, Engineering Council

Abstract

When David Hargreaves took over as Chief Executive of the Qualifications and Curriculum Authority (QCA), he sent out a clear and simple message: 'Generate the evidence of what works' (Hargreaves, Nov 2000). In this paper I will outline the rolling programme of research papers generated over the last year through the activities of the Engineering Council. These papers have been commissioned and published to celebrate the continuing successes of design and technology and in doing so we hope that they will contribute to the pool of evidence sought by Hargreaves.

In late 1999 a modest but rolling programme of commissioning reference papers was set in motion by the Engineering Council with partner organisations, including the Design and Technology Association (DATA). This programme is integral to the quarterly seminar programme at and with QCA.

The purpose of commissioning the studies was to look into the future and get insights into what might work in a different model of curriculum. The Engineeering Council takes the view that 'The school curriculum covers the totality of children's experience in, or connected with, school' – and is particularly interested in:

- breaking down subject boundaries
- inclusion
- progression issues
- 'open' schools.

As an outcome of seeking advice and support from the wider education and business community two initial papers were commissioned in 1999 by the Engineering Council with some financial support from the Engineering Employers' Federation (EEF). These two papers were:

- 'Interaction: The Relationship between Science and Design and Technology in the Secondary Curriculum' (Dr David Barlex and James Pitt)
- The Continuum of Design Education for Engineering (Professor Geoffrey Harrison).

Interaction has a focus on joining-up across the curriculum and was commissioned because, with a National Curriculum packed full of content in some subjects (e.g. science) there was pressure for 'removal' or 'integration' (particularly at Key Stage 4) of those parts that were deemed less important. Furthermore, the Engineering Council took the view that there was an opportunity to investigate and try to break down some of the learning barriers that we suspected had grown up between 'subjects' over the last 10 years of the National Curriculum. Such integration is absolutely central to effectiveness in engineering. The Engineering Council was aware of the debate concerning the future role and style of the English National Curriculum; the possibility of a different sort of National Curriculum; and/or the emerging idea of a 'Schools' Curriculum'. Finally, we were aware that QCA was investigating the art and design: design and technology relationship, and it seemed that it would be helpful if we supported a science: design and technology investigation.

Interaction clearly concludes that 'integration' of design and technology with science is an **inappropriate** form of relationship. It goes further to say 'science and design and technology are so significantly different from one another that to subsume them under a 'science and technology' label is both illogical and **highly dangerous to the education of pupils**. 'However, we believe that there are opportunities for working more closely with science (as well as, for example, art and design, maths and so on) that are worthy of further investigation.

'science and design and technology are so significantly different from one another that to subsume them under a 'science and technology' label is both illogical and **highly dangerous to the education of pupils**.'

The Interaction summary (as published) is reproduced below.

Interaction: the relationship between science and design and technology in the secondary curriculum

Dr David Barlex and James Pitt

The nature of science and technology

The report begins by exploring the nature of science and technology and clearly identifies their unique and distinguishing features so that this can underpin the discussion of the subjects within the school curriculum. In essence science is concerned with the production of tested knowledge whereas technology is concerned to transform this and other sorts of knowledge into techniques and artefacts for which there is human demand.

Science and design and technology in school

The report discusses the nature and purpose of science and design and technology education as revealed in the National Curriculum of England and how this is perceived by leading figures in science and design and technology education. This indicates that if there is to be a useful relationship between science and design and technology in secondary schools, the initial step will be to find ways in which the two communities of teachers can begin to understand each other.

Restraints in the current situation

The next section discusses the relationship that currently exists between science and design and technology and identifies the following restraints:

- in schools a separate and almost unrelated relationship exists between science and design and technology in direct contrast to that between science and technology in the world outside school. This is encouraged by the structure and content of the National Curriculum.
- science and design and technology teachers have an interest in developing pupil's ability to reflect on their own practice but as yet do not co-operate in developing pupil's metacognitive skills
- mental modelling is an essential component of both science and design and technology but teachers do not share approaches or expertise
- curriculum materials designed to encourage pupils to use science in design and technology lessons appear to have had little impact on classroom practice
- curriculum materials designed to enable science teachers to use technological contexts to motivate students and improve learning appear to have had only limited uptake.

Better relationships

The report describes three possible relationships between science and design and technology.

- Co-ordination
  Teachers in each subject become au fait with the work carried out in the other and plan their curricula so that the timing of topics within each subject is sensitive to each other's needs.
- Collaboration
  Teachers in each subject plan their curricula so that some, but not all, activities within each subject are designed to establish an effective relationship.
- Integration
  This involves forming a single subject called science and technology. This is an inappropriate form of the relationship. Science and design and technology are so significantly different from one another that to subsume them under a 'science and technology' label is both illogical and highly dangerous to the education of pupils.

In developing an appropriate relationship between science and design and technology, schools should limit themselves to co-ordination and collaboration.

Recommendations

The report identifies a range of bodies and organisations that could co-operate in working towards implementing the recommendations.

Recommendation 1: Concerning the development of good practice

Partnerships should be identified that will release funding to enable teachers in secondary schools to work together to form appropriate relationships between science and design and technology. Initially this will involve developing and providing effective in service training for some teachers from science and design and technology departments who are receptive to the idea of working together and developing a more productive relationship between the subjects.

Recommendation 2: Concerning the evaluation of good practice

Partnerships should be identified that will release funding to enable the work of the teachers developing a more productive relationship between science and design and technology to be monitored to identify how it can be carried out with maximum benefit to pupils' learning in both subjects.

Recommendation 3: Concerning the dissemination of good practice

Partnerships should be identified that will release funding to enable the models of good practice that have been developed and validated to be widely disseminated to both science and design and technology teachers.

The Interaction Pilot Project will now go forward, supported by the Engineering Council, the Royal Society, DfEE, EEF (Engineering Employers' Federation), DATA and the Association for Science Education (ASE) and hopefully further partners. David Barlex will co-ordinate the Pilot Project.

The project has been warmly welcomed. Over 2,000 hard copies of the report have been distributed and the report is also available for downloading from the Engineering Council web site. An article about taking the project forward to pilot phase has appeared in the Times Educational Supplement (TES) and a range of other publications. A number of schools and universities have indicated their interest in the project.

The second commissioned report

Continuum focuses on joining-up across the curriculum. At a seminar in 1997, and in a paper presented in 1999, Harrison had suggested that how '*a culture of engineering*' was developed in an individual was important. The Engineering Council was interested in this idea but sought further clarification, and the idea of an illustrated booklet (mainly using images from design and technology) would, we felt, be useful to others as well as ourselves. We needed to be able to explain to others why we saw design and technology as being able to 'provide the heart and model' of education for and about engineering and technology. Two of the major emerging issues in education related to dips in learning between phases and how these might be overcome (progression) and to individual learning styles (individual learning plans). The Engineering Council decided to contribute to the debate to illuminate these areas.

> we saw design and technology as being able to 'provide the heart and model' of education for and about engineering and technology

This booklet, through illustrated examples, examines the development of engineering expertise from the very early years through to professional practice and makes recommendations on ways to harness, encourage, facilitate and reward it. Below is a brief description of Continuum – taken directly from the booklet text.

The Continuum of Design Education for Engineering

Professor Geoffrey Harrison

Background

A seminar held at the Royal Society in February 1997 examined chronic problems on the 'Supply Side' of engineering manpower. The prime recommendation from the seminar was to 'identify and promote the culture of engineering'.

That seminar led to a paper being presented to the 21st SEED Annual Design Conference held in Glasgow in September 1999, entitled 'The Discipline of Engineering Design, from School to Higher Education' (Chaplin, R., Harrison, G. and Macleod, I.) It traced design education for engineering as a consistent, progressive, academic discipline, from primary to higher education; a discipline based on a recognition of the nature of creativity, both tacit and articulate knowledge and understanding, and how creativity and understanding work together in the processes of designing, making, and innovating.

The design continuum of engineering education

The theme of this booklet is the continuous and seamless development of engineering understanding, capability, and motivation which make up the personal qualities and competences of those individuals who eventually become contributors to, and users of, our national engineering infrastructure:

- knowledge and understanding progress from the *intuitive* towards the *articulate*
- skills develop from the *innate* to the *disciplined*
- creativity develops from the *casual* to the *harnessed*
- capability develops from the *natural* to the *disciplined combination of creativity, skills and understanding*
- motivation develops from *pure pleasure* from making something to *excitement and determination* to be creative and effective.

This continuum lies in the development of the individual but it also reflects the development of engineering design itself over the millennia since the earliest civilisations.

Recommendation 1: Recognise 'alternative roads' and individuality of talent

We must recognize that the '*academic ... is not the only road by which good minds can travel. If the country is to benefit fully from the intelligence of all its able boys and girls, it will*

be necessary to rehabilitate the word 'practical' in educational circles – it is often used in a pejorative sense – and to define it more clearly' (Crowther Report, '15 to 18', 1959).

We should take a democratic view of the significance of diverse personal individuality. We should be prepared to recognise and reward creativity and flair in all its forms and offer training, and routes to qualifications, better matched to the particular attributes of the individual rather than expect individuals to conform to common standards.

Recommendation 2: Actively manage the learning continuum for Engineering

The learning continuum for engineering should form part of general education and be open to all young people. It must be able to stand up and be recognised in all forms of school, specialist or general, single or mixed sex, large or small, regardless of environment.

Each of the strands of the continuum has its own meanings and significance for students on their own *alternative road*. It is, therefore, important for the strands to be explained and illustrated in sufficient detail for teachers and students to be confident of following a soundly based learning progression.

Design and technology is one part of the school curriculum that integrates practical and academic learning, making practical sense of other subjects. It draws on different experiences, developing and using different skills, and motivates able youngsters towards engineering in all its forms. It recognises achievement in many different forms. It provides a range of alternative roads to success. It could provide the heart and model of the continuum of design education for engineering.

However, design and technology is a new subject in the school curriculum, currently evolving its own academic discipline of content, concepts, intellectual and practical skills; as it evolves, it should foster its integrating role and should systematically build students' learning on what came earlier and prepare for what comes later. Above all, each phase should nurture creativity, recognise it and celebrate it.

The Annex to the booklet lays out suggested strategies for achieving these general recommendations. Draft copies of the booklet were circulated to key organisations and individuals and in a major speech in November 2000 David Hargreaves, Chief Executive of QCA, commented:

> 'Design and technology is moving from the periphery of the school curriculum to its heart, as a model of the combination of knowledge and skills that will be at a premium in the knowledge economy, and it is from the best practice that other subjects can learn about effective teaching and learning for innovativeness. Geoffrey Harrison's forthcoming booklet on *The Continuum of Design Education for Engineering* wonderfully illustrates the combination of creativity and discipline that is involved, from the three-year-old to the postgraduate engineer.' (Hargreaves, D. [22 November 2000] *Towards Education for Innovation*)

Interaction and Continuum focus on different matters. However, there are areas on which each comments – for example on relationships with science. Whilst both clarify that engineers and technologists may need to call on science as well as other areas, each makes it equally clear that neither engineering nor design and technology ***is*** science. Rather they assert, in fact, that engineering or technology can be ***ahead*** of scientific understanding. This is neatly underlined by an engineer:

> 'Many aspects of engineering are fundamentally different in approach to 'science'. Engineering frequently applies phenomena to create benefits in socially useful devices, but without necessarily fully understanding the science involved. In this we often leave the scientists to follow, sometimes many years later. Scientific discoveries rarely lead to beneficial exploitation and we should be wary of reducing our engineering innovations in the UK to a similar level. We should rather encourage greater success in developing the end products.'
> (Bernard Challen, Chief Executive, Shoreham Services, Letter to *The Times*, 16 March 2001: 25)

The third commissioned report

Early in 2001 it became apparent that although curriculum developments in general were moving on fast-forward in a very positive way, design and technology might yet again be at risk. The factors at work this time were multiple and involved Key Stage 3 changes, proposed changes to the science curriculum and 14-19 phase proposals. QCA would be reporting to the Minister on its recommendations in March 2001.

There was also a growing lobby of pressure on the science front. Declining numbers of pupils were taking science post-16; science was doing badly in the 'favourite subjects' stakes; it was widely acknowledged (for example, 'Beyond 2000: science education for the future' report [Robin Millar and Jonathan Osborne, 1998, Kings College London]) that something needed to be done to make school

science more relevant and more attractive. Of course design and technology was doing well in the attractiveness stakes and slowly but surely building post-16 take-up. The writing on the wall said 'science take-over of design and technology'. As established by ***Interaction*** (Barlex and Pitt) science and design and technology are two different animals. 'Applying science' is not the same thing, by a long-shot, as design and technology. However, this was not necessarily widely appreciated, even by Ministers and other key curriculum influencers.

It therefore became urgent to commission a paper that carried the heaviest weight of authority on why design and technology is so important to the engineering and technology community and to society in general. Professor Richard Kimbell agreed to lead a small working party to produce a paper before the end of February. Which he did.

Furthermore, the Engineering Council wanted to support David Hargreaves in his call for evidence to support his arguments. The Engineering Council decided that the report should get down on paper what it was about design and technology that we could see as a model on which a future curriculum could be based – a curriculum that would be relevant in the 21st century, and reflecting the values that we would wish for in the 21st century. We also wanted something that could help both engineers and people in education and training to understand the synergy between design and technology and engineering and technology.

The report is in four parts and is prefaced with a foreword by the Engineering Council. The summary of the report is reproduced below as published.

Design and Technology in a Knowledge Economy

Professor Richard Kimbell and David Perry

Foreword by the Engineering Council

This paper sets out the distinctive contribution which design and technology makes to the school curriculum. It describes the unique characteristics which make design and technology more than just a subject. It is a learning experience which is unbounded by fixed bodies of traditional knowledge, and transcends the academic/practical divide. It has been aptly described by David Hargreaves as 'a domain in which different bodies of knowledge and skill come together ... not only a bridge linking the arts to science and mathematics in the interest of curriculum coherence; it is also a highly fertile ground for activities that support innovation'. Hargreaves believes that design and technology is moving to the heart of the school curriculum, becoming a model of the combination of skills needed in the knowledge economy, and an exemplar for other subjects in delivering effective teaching and learning.

The Engineering Council believes that all those concerned with curriculum policy should understand the importance of design and technology. Decisions are due to be taken about the future nature of the curriculum at national level. These offer welcome possibilities, but it is crucial that the role of design and technology is understood and built upon. This paper, we hope, will help this to come about.

A report 'The Universe of Engineering' published by the Royal Academy of Engineering last year, drew attention to the pervasive nature of engineering in the economy and society. It noted that this role went far wider than implied by traditional definitions of engineering, and that most emerging technologies were made possible by engineering know-how. The report stressed the importance of engineering process, which had received less consideration than engineering knowledge over the years. In describing engineering process, it used very similar terms to those used here to describe design and technology – using different domains of knowledge, managing uncertainty and risk, value-laden activities, and so on. The two papers make clear why design and technology has to be important for all those concerned with engineering.

As this paper makes clear, however, design and technology is about far more than career preparation. More than any other area of the curriculum, it is about capability for all. We

hope that this paper will add to understanding of its importance, and help to ensure a continuing prominent place for it in the curriculum for all.

Part 1: The domain of design and technology

The made world

The subject matter of design and technology is our made world; our clothes, our food, our means of travel, our shelters, our communication systems. But, more than that, design and technology is about *creating change* in the made world; about understanding the processes of change and becoming capable in the exercise of change-making. When Honda produces a new car; Westwood a new outfit; Boeing a new airliner, Saloman a new ski, Bovis a new house, or Ericsson a new mobile phone, they exemplify not only the diversity of our material culture but also the creativity underpinning the change-making process.

Science provides *explanations* of how the world works, mathematics gives us numbers and procedures through which to explore it, and languages enable us to *communicate* within it. But uniquely, design and technology *empowers us to change the made world.*

> Among the multitude of animals that scamper, fly, burrow and swim around us, man is the only one who is not locked into his environment. His imagination, his reason, his emotional subtlety and toughness make it possible for him not to accept the environment but to change it. And (this) derives ... from the ability to visualise the future, to foresee what may happen and plan to anticipate it, and to represent it to ourselves as images that we project and move about inside our head. Man is not the most majestic of the creatures. But he has what no other animal possesses, a jigsaw of faculties which alone, over three thousand million years of life, make him creative. (Bronowski, 1973, *The Ascent of Man*, British Broadcasting Corporation)

Design and technology in the curriculum

The curriculum manifestation of design and technology has evolved since the late 1960s. Schools Council projects, HMI and LEA initiatives and school examinations all contributed to its progressive articulation, but the driving force behind its development has always been individual teachers exploring new approaches in their own workshops, studios and classrooms.

The 1990 Order for Technology was visionary; based on the best practice that could be found across the country. But little account was taken of the fact that such good practice was not common-practice and probably existed in 5-10% of schools. In the subsequent 10 years we have established a far broader base of understanding and expertise in design and technology than has ever been the case hitherto. Good practice has spread from a few centres of excellence to a far greater proportion of design and technology teachers.

This development has not been taking place in isolation from the rest of the world. In the UK we originated the concept of design and technology and we were the first nation to establish it as an entitlement for all children from 5-16. In doing so, we have provided a model that much of the world has followed. In South Africa, Australia, the USA (in parts), Botswana, Israel, Cyprus, Finland, Singapore, New Zealand, Russia and Chile, to give but some examples, our vision of design and technology informs curriculum debate and classroom practice.

Part 2: A distinctive pedagogy

At the heart of design and technology lies a distinctive model of teaching and learning. It is project-based and involves learners taking a task from inception to completion within constraints of time, cost and resources. This methodology has a number of features and consequences both for students and for teachers.

a) Unpacking the wickedness of tasks

Students must learn to unpack the complexity of tasks to enable them to identify their purposes and focus on the central issues that need to be addressed.

b) Identifying values

Design and technology is not just about change, it is about improvement and the concept of improvement is essentially value-laden. The user, the purchaser, the designer, the manufacturer, the retailer, will all bring different values to the task and teachers can exploit this diversity to illuminate the value issues that inevitably lie inside any claim for 'improvement'.

c) Creative exploration

Design and technology involves living in a future world; conceiving and planning what does not yet exist. It is therefore inevitably and continually concerned with imagination, uncertainty and risk. Early exploratory thinking is inevitably (and properly) fuzzy, as students speculate and explore multiple 'what-ifs'.

d) Modelling futures

Design and technology requires learners to model their concepts of the future, to enable them to experience it and make informed judgements about it *before* committting

themselves to it. Modelling is therefore not only a powerful tool for designers, it is an invaluable tool for any decision-maker.

e) Managing complexity and uncertainty
Design tasks are typically multi-dimensional, messy and value-laden, and designers have to manage projects from inception to completion. At the end, they need to be holistic thinkers, capable of drawing together the disparate and often contradictory strands of ideas within a project. Designers learn to handle complexity and uncertainty.

The aim of design and technology is to develop students' 'capability', that combination of qualities, abilities and experience that transcends understanding and enables creative development. The pupil is required to be an active participant. Not so much studying design and technology as being a design and technologist. The capable student sees the made world as inadequate, and can make it better.

Task related knowledge and skills
In too much of the curriculum, propositional ('know-that') knowledge, has been elevated beyond its real value. The explosion of technological knowledge, particularly in the last century, makes it impossible to contain within a curriculum and, moreover, the task-centred nature of design and technology demands a different approach. Beyond a carefully defined core of knowledge, we emphasise the need for students to acquire and create new, task-related knowledge. The everyday experience of design and technology is of task-centred knowledge creation.

Performance assessment
In assessment terms, this throws the spotlight on students' ability to *use* their understandings and skills when they are tackling a real task. Capability in design and technology involves the *active, purposeful deployment* of understandings and skills – not just their passive demonstration. This has serious implications for assessment, since isolated tests of knowledge and skills are quite inappropriate. Over the last 30 years, through a series of innovations, design and technology teachers have become the curriculum experts in project-based performance assessment.

Part 3: A distinctive view of the learner

Individual learning styles and differentiated challenge
Learning is what happens when we realise that things are not quite as we previously thought. It is a constructive process – building on our existing framework of concepts and schema. Every learner will have their *own* pre-existing framework, which Kelly describes as their own 'personal construct'. Gardner particularised the component forms of 'intelligence' (Linguistic, logical-mathematical, spatial, bodily-kinesthetic, inter-personal, intra-personal) that teachers must seek to enhance.

In the context of design and technology, the importance of these views of learning is not merely that design and technology draws upon *different* learning styles than do other subjects in the National Curriculum. Rather, the point is that design and technology draws on a *richer range* of these learning styles and intelligences than do most areas of the curriculum. As a direct consequence of this breadth of demand, learners who approach design and technology from very different starting points can be led to appreciate it. As when playing an organ, the teacher can pull out different stops for different learners – emphasising this or that approach – essentially customising it to the requirements of individuals. The low truancy rates in design and technology reported by Ofsted provide one indicator of teachers' accomplishment in this process.

Design and technology therefore offers a differentiated learning experience, in which we work *from* and promote the learners' strengths, whilst encouraging them to grapple with their weaknesses. The activity presents teachers with a flexible tool that gives access to the many different styles and talents of the gifted, the underachiever, ethnic and gender groups or indeed any other stratification in the learning community.

Designers, decision-makers, thinkers
The essence of the process exists in the interaction of cognitive modelling ('in the mind's eye') with the hard reality of the material world. It is *iterative* as ideas are bounced back and forth, formulated, tested against reality and then reformulated. It is best described as 'thought in action'. Schon (1991) sees design as a powerful vehicle for learning, *important for everyone*, not because they might become designers, but because (through experiencing designing) they will become more accomplished thinkers and decision-makers.

Collaborative team players
Learners can regularly be seen subjecting their work to progress reviews; work in progess being critiqued by their teacher and their peers. Because of the openness of the visual, concrete language of design, students' work is public, viewable by others as it progresses. Other, more intense forms of collaboration are also commonplace, with learners operating in teams towards the achievement of team goals, and even collaborating with partners external to the school.

Learning and valuing

We have described designing as a process of improving the made world. But improvement for whom? Whether you see something as being 'better' will depend entirely on your value position. Design and technology is therefore at the cutting edge of social conscience where the concepts of 'need' and 'improvement' are far from clear and are often contentious.

The important issue here is that tackling values in design and technology is not an abstract intellectual activity. It is a hard reality made concrete through decisions realised in products. Made-world *products* are the focus of attention, even when one is debating globalisation or global warming. Teachers' experience of helping learners to make explicit the values underlying products, brings to life what can otherwise seem the remote, academic world of ethics and morality.

Part 4: A distinctive view of the future

Modernising design and technology

The core principles of design and technology, outlined above, remain the rock on which we have built our curriculum practice over the last 30 years. But we recognise the imperative to move forward, and design and technology teachers – supported by their professional association – are grasping the nettle of innovation.

Many initiatives are opening up imaginative opportunities, from high-tech 'smart' materials and programmable chips, to user-focused resources in an expanding repertoire of contexts. Designing and making is increasingly being explored through computer-aided designing and manufacturing techniques (CAD/CAM) and using electronic and communications technologies (ECT). Students are in a position to use sophisticated professional engineering design software and transmit their design files electronically to remote sites, where parts that they have designed can be manufactured, using computer controlled machinery.

The made-world, project-centred nature of design and technology makes it an ideal vehicle through which to contribute to new broadly-based curriculum initiatives. Two examples illustrate this potential. Design and technology teachers will be at the heart of the emerging 'citizenship' agenda. Our students and teachers are familiar with the challenge of articulating (and responding to) the values that *do*, or *might*, or *ought to* inform product development. The 'sustainability' and 'consumption' debates are real in design and technology and powerful in the lives of youngsters. Equally, design and technology is uniquely placed to contribute to the 'Young Foresight' initiative, exploring future trends, consumer behaviour and technological opportunities.

Modernising assessment

We are firmly of the belief that assessment must not be allowed to limit learning. In the 30 years that we have been struggling with capability-based (i.e. project-located) assessment, we have developed a strong understanding of some of its subtleties. As a result, we have in design and technology, the most accomplished classroom practitioners of this subtle art. In this context, we look forward to the challenge of key skills assessment. Whilst the 'first' three skills (literacy, numeracy and ICT) are to some extent susceptible to traditional approaches to assessment, this quite clearly cannot be the case with the 'second' three. Managing one's own learning, problem solving, and teamwork are the three key skills that employers constantly prioritise, and these skills demand more subtle assessment approaches. The expertise to lead such assessment resides in design and technology teachers.

The challenge of a knowledge economy

Part of the discomfort that has been experienced by design and technology over the last 30 years arises from its awkward insistence on being neither a specialist art nor a specialist science. It is deliberately and actively interdisciplinary. It is a creative, restive, itinerant, non-discipline.

In the context of a knowledge economy, the interdisciplinary imperative of design and technology is increasingly recognised as a strength rather than a weakness. The 'skills challenge' of such an economy involves learning structured around projects; based on identifying and solving problems; in a range of contexts in which students (often in teams) transfer knowledge across different domains; using portfolio models of exploration, presentation and assessment. This is precisely the model of learning through which design and technology operates. We have been pursuing and refining these approaches for thirty years, and our teachers are in the vanguard of those preparing youngsters for employment in the knowledge economy.

On 27 February Richard Kimbell presented the report at an Engineering Council Research and Seminar Project seminar at QCA. On 28 February 2001 Malcolm Shirley, Director General of the Engineering Council, sent a copy of the report summary to Ministers and to key government officials as well as to partner organisations (including DATA). In his letter to Ministers and others, Malcolm Shirley wrote:

> 'It is crucial that the vital role of design and technology is understood and built upon. As this paper makes clear, design and technology is about far more than career preparation. More than any other area of the curriculum, it is about capability for all. The paper sets out the unique contribution which design and technology makes to the school curriculum. The Engineering Council fully endorses these statements.' (Malcolm Shirley, 28 February 2001, Engineering Council)

Following a brief article in *Engineering First* (the Engineering Council magazine sent to all registrants) about commissioning the paper, we have received an unusually large number of responses. These are from engineers wishing to support design and technology and to add their weight to the cause. The paper has also been welcomed by many key influencers including Lord Sainsbury of Turville, Minister for Science and Innovation, and David Hargreaves, Chief Executive, Qualifications and Curriculum Authority.

End piece

All the reports have been strongly welcomed. They each throw light on different issues: design and technology's relationships with other subjects; individual development of expertise in engineering and technology; the distinctive model of design and technology.

Collectively we hope these reports will make a major contribution to supporting the continuation and further development of design and technology in the curriculum. We also hope that they will provide insights into how a different model of the wider curriculum might be established. The expertise to take learning through into a different model lies with design and technology teachers and with those pupils who have been fortunate enough to have developed their capability to create change. The Engineering Council, with its partners, is already taking all this work forward. It must be built upon. It must not end here.

Please do feed-back any comments you may have to RWright@engc.org.uk

Interaction is available.

Continuum will be published in May 2001.

Design and Technology in a Knowledge Economy will be published in April 2001 on the Engineering Council web site or in hard copy from staff@engc.org.uk.