Valuing progression in design and technology education

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Abstract
This paper is a deliberately provocative exploration of some of the issues surrounding the challenge of meeting current demands for a highly skilled workforce, whilst at the same time providing a broad and balanced experience for all young people in the UK. It does this by exploring the skills of the future and the breadth of the curriculum. The paper proposes a way of bringing these two objectives together by focusing on depth of understanding as well as providing breadth of experience. It is argued that only by developing a depth of understanding of design processes by structured progression will design and technology education make its unique contribution to pupils' general education. The paper concludes that in order for this to be achieved, the design and technology community in the UK needs to focus on four key issues: outcomes; contexts; perspectives and pedagogy.

Keywords
skills, design, progression

Introduction
It is the contention of this paper that design and technology education should be about developing an understanding of technology – its production, applications and effects. It cannot be, fundamentally, about training for work in the industrial sector. The reason, therefore, that design and technology exists within any statutory curriculum is that it contributes, in a unique way, to the general education of young people. As educators, we need to ensure that the subject not only involves making products, but also facilitates the exploration of design and technological activity in a variety of contexts, along with developing an understanding of the relationship between technology and society. Pupils will still be involved in design and making but with the aim of developing their creativity and problem solving skills, rather than acquiring a defined body of knowledge about specific materials and processes used in the current, and perhaps not the future, manufacturing industry.

Skills of the future
… meeting current demands for a highly skilled and well qualified workforce …
Historically, there has been a crucial link between design and technology education, in its broadest sense, and the design and manufacturing industries. This developed from an age of apprenticeships, where high-level making skills were developed over prolonged periods of time for specific trades, to the current day. Recent employment statistics from the UK Government highlight the fact that the majority of young people will not be employed in the manufacturing sector in the future. In the year 2000 some 3.9 million people were involved in manufacturing, representing only 15.1% of the working population (Ganson, 2002). With the reduced industrial base in the UK and rise in the service and other sectors of the economy, the relationship that pupils' education has with manufacturing industry may need to be reconsidered.

In the future it will be the case that even fewer of the pupils studying design and technology in school will end up as designers. Some will be involved in manufacturing but the majority will not be directly involved in the future production of products. In this context, the role of design and technology education may be quite different than it has been in the past.

Within the context outlined above, what then are the skills needed by a future workforce? Clearly the essential skills of the future are not hand or craft skills but rather those that relate to the gathering, processing and use of information in what has been called our knowledge economy. Some of these have been identified by the UK Government as Key Skills, namely:

- communication
- application of number
- information technology
- working with others
- improving own learning and performance
- problem solving

Recently, there has been an increased interest in these as the acquisition of such skills are seen as being essential for the future as this quote from the Learning Skills Development Agency (LSDA) illustrates:

> 'The Government is committed to the concept that all young people, whether in education or training post-16, should be given a solid basis in the key skills…This is essential if they are to compete effectively in the labour markets of the 21st century.'
>
> (LSDA, 2003)

The current view of employers is quite similar, emphasising the ability to transfer skills and knowledge. The report of the Engineering Council Design and technology in a Knowledge Economy, written by Kimbell and Perry, reflects an important perspective on this:

> '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.'
>
> (Kimbell and Perry, 2001: part 4)

Both statements emphasise general process skills and not necessarily the acquisition of specific skills and knowledge tied to a particular industry or material area (resistant materials, food, textiles etc.). In preparing for the future, therefore, it would appear that it is procedural knowledge and transferable skills that are of significance.

Design and technology education is well placed to make a contribution to the development of key skills. In addition, the subject is of central importance in developing thinking skills useful to pupils, as this quote from the Qualifications and Curriculum Authority (QCA) indicates:

> 'By using thinking skills pupils can focus on 'knowing how' as well as 'knowing what' – learning how to learn.'
>
> (QCA, 1999: 22)

They list thinking skills as:

- information processing skills
- reasoning skills
- enquiry skills
- creative thinking skills
- evaluation skills

All of these terms are likely to be familiar to design and technology educators on a day-to-day basis, given the nature of the subject. More particularly, design and technology education can develop unique problem solving and thinking skills through practical activity. The application of such skills within complex and very real contexts is unique to the subject. It is these future skills that design and technology education can promote and, as educators, we must address. Consequently, the subject is well placed to make a unique contribution to the general education of young people and it is likely that, for this reason alone, the subject will continue to exist within the curriculum. To promote the changing of design and technology education to a more vocationally-oriented manufacturing curriculum (perhaps as a reaction to vocational 'A' Levels and modern apprenticeships) would, I believe, be a grave mistake and jeopardise the continuing future of the subject.

Broad and balanced experience

… ensuring a broad and balanced experience …

The exploration of the expression 'broad and balanced' is divided into different sections.

Breadth of knowledge

The knowledge domain of design and technology education in the UK is defined to a large extent by the National Curriculum. Although teachers may encourage the exploration of materials beyond those listed, the inspection framework, focused on well structured and defined schemes of work, keeps a degree of constraint. Thus the breadth of knowledge of materials is limited, perhaps making pupil-driven work harder to support.

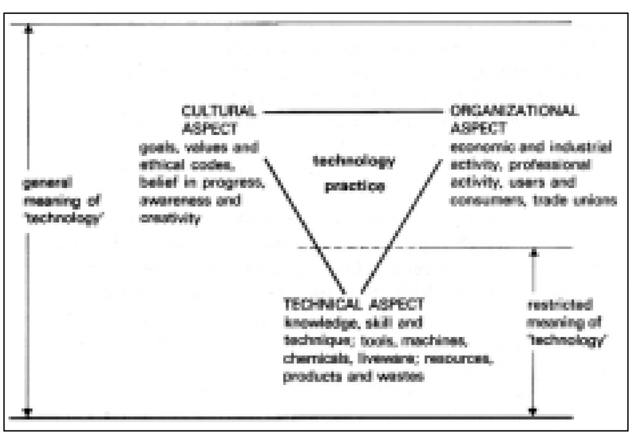
Breadth of skills

There is still a large emphasis on the development of motor skills and the production of products in the UK National Curriculum. Most of the QCA schemes of work have titles that reflect quite specific product outcomes. This emphasis has changed a little in Key Stage 4 with the CAD/CAM Initiative to some extent, but for the majority of the time that pupils undertake design and technological activity (from age 5), they are require to work with their hands and produce products from specific materials.

Breadth of study
Whilst looking at the issue of a broad and balance experience, it makes complete sense to look in-depth at the section of the National Curriculum titled breadth of study. Across the Key Stages there are minor, but significant, changes to the wording. Three particular kinds of activities are suggested: Focused Practical Tasks (FPTs), Product Evaluation activities and Design and Make Activities (DMAs).

Whilst such terms are helpful on one level, the very creation of three distinct headings implies that there are a limited number of activities that can be undertaken in D&T. Of more concern is the misconception, evidenced from discussion with trainee teachers, that all schemes of work must contain product evaluation, focused tasks and design and make assignments. To essentially define the pedagogy of a subject in such a narrow way may restrict pupils' capability.

Breadth of contexts
The first National Curriculum for design and technology in the UK (DES, 1990) suggested a number of contexts such as school, business, community etc. Currently, however, the contexts in which children develop their design and technology capability are defined by units of work and are consequently more limited. Of more significance is the fact that the contexts have boundaries set by the teacher. In this sense, they bear little resemblance to any kind of context in which children live. This makes the connection between their work in school and the technology experienced outside of school difficult to say the least.



(Pacey, 1983)

Developing a broad understanding of technology
In promoting pupils' understanding of technology, it is important for educators to have a broad and general understanding of technology in the way described below:

In the technology curricula of other countries, particularly those referring to technological literacy, broader issues of the role of technology in society, for instance, are included. For example, the Standards for Technological Literacy developed by the International Technology Education Association (ITEA) in the USA state:

> 'A technologically literate person understands, in increasingly sophisticated ways that evolve over time, what technology is, how it is created, and how it shapes society, and in turn is shaped by society.'
>
> (ITEA, 2002: 9)

Whilst the New Zealand technology curriculum, quoted on the Te Kete Ipurangi (TKI) website, highlights the importance of:

> '… understanding the awareness of the relationship between technology and society.'
>
> (TKI, 2003)

The curriculum in the UK does not go as far in covering the relationship between technology and society and might be seen as a little incomplete, tending to promote Pacey's restricted meaning of technology rather than a more general understanding.

The future?
Returning to the theme of the paper, how then can design and technology education help to develop the skills of the future, whilst at the same time providing a broad experience?

The much-revered *unique contribution* statement of the UK National Curriculum for design and technology provides a possible direction for the future:

> 'Design and technology prepares pupils to participate in tomorrow's rapidly changing technologies. They learn to think and intervene **creatively** to improve quality of life. The subject calls for pupils to become **autonomous** and creative **problem solvers**, as individuals and **members of a team**. They must look for needs, wants and opportunities and respond to them by developing a range of ideas and making products and systems. They combine **practical skills** with an understanding of aesthetics, social and environmental issues, function and industrial

practices. As they do so, they **reflect** on and evaluate present and past design and technology, its uses and effects. Through design and technology, all pupils can become **discriminating and informed** users of products, and become innovators.'

(QCA, 1999: 90)

If design and technology education is to make its unique contribution, then we need to look at how every aspect of the unique contribution statement, particularly those highlighted, is being developed. There needs to be, in other words, lines of progression running through the curriculum.

Focus on Key Stages 1 to 3

Before going into detail about progression, it is worth considering which Key Stages to focus on. Currently, qualifications in design and technology in the UK are undertaken by a good number of pupils with approximately 409,000 pupils entered for GCSE design and technology examinations (DfES, 2002) and 9,886 for A' Level in the 2001/2002 academic year (OFSTED, 2002).

The government changes to the curriculum 14-19 will have a significant effect on design and technology in schools. One of the key ways in which the subject will survive is if there is demand from pupils to take up the subject at GCSE level. This means, ensuring that they have a positive, creative and fun experience in Key Stage 1, Key Stage 2 and, particularly, Key Stage 3.

Lines of progression

What follows is a suggestion of possible lines of progression through Key Stage 1 to 3, by the end of which pupils should be some way towards capability as defined by the unique contribution statement.

What is required for a future workforce is not only breadth in the sense of awareness of technology and its effects but depth in terms of the complexity of design projects undertaken. In other words, for pupils to work at a high standard, they will be tackling complex in-depth design and technological activities. To get to this point requires the progressive development of a broad range of skills, more so than the opportunity to work in different materials.

The following (incomplete) list is put forward as potential lines of progression, the detail of which will be the subject of future research.

Constrained, defined making tasks	**> Creative idea generation**
Teacher as source of information	**> Autonomous decision making**
Simple problem solving	**> Complex problem solving**
Individual work	**> Working in teams**
Evaluation within given parameters	**> Evaluation using own criteria**
Teacher task (constrained)	**> Pupil-driven projects (autonomous learners)**
Defined body of knowledge	**> Contextual knowledge**
Value-free	**> Consideration of values at all stages**
Didactic demos	**> Community of practice**
Defined contexts	**> Pupil-chosen context**
Product for self	**> Product for others**
Assessment of product	**> Assessment of product and process**
Safe assignments	**> Risk-laden contexts**
Technology as products	**> Technology as culture**

The above is presented here not as a suggestion for changes to the curriculum at all ages but as a template on which to match pupils' current experiences. Looking at the current National Curriculum, it is clear that not all lines of progression exist in explicit terms. There are a number of them that are only considered at Key Stage 4 and not before. For example, the restriction of contexts in Key Stages 1 to 3.

This being the case, it is possible that pupils only experience open-ended autonomous problem solving for the first time at GCSE or A' Level. They will be expected to work in a different way that they have for the previous nine years.

Responding to the challenge

To enable some of the lines of progression to emerge, I would suggest that there are four changes that need to be made to the curriculum.

1. *Outcomes*

   There needs to be a broader range of outcomes highlighted in the National Curriculum. This can best be done by reforming the schemes of work and consider changing the structure of the National Curriculum itself. In addition, there needs to be recognition of risk taking when designing.

   'Creative and innovative acts are (at least potentially) risky acts, and I have noted earlier the importance of a trust relationship between teacher and student as a pre-condition for creativity. Students will not go out on a limb and take chances if they believe that – should they fail – they will suffer serious penalties.'

   (Kimbell, 2002: 23)

2. *Explore contexts*

The second issue is an increased emphasis on contexts and the exploration of contexts by pupils. It is through such an exploration of increasingly rich and complex designing situations that pupils will develop inquiry skills and the sensitivity required to design for other people. The weighing of different, perhaps conflicting, criteria and making an informed decision is crucial in contemporary design and can only be developed over considerable time.

Alongside this, there is a need to assess thinking and decision making as well as making.

'… an assessment regime that completely fails to recognise and value risk-taking innovativeness.'
(Kimbell, 2002: 27)

3. *Develop a wider perspective*

We need to encourage pupils to take on a broader perspective of technology that encompasses organisational and cultural issues in the way that Pacey suggests (above). One simple way to do this would be to change product evaluation to include evaluating the products of technology.

'The processes of evaluating products provide rich opportunities to explore values issues in the widest sense … If this area is broadened to the evaluation of the products of design and technology, then it will include the systems and environments also created by design and technological activity and the effects of technology beyond those intended.'
(Martin, 2002: 215)

Most importantly, we need to focus on pedagogical issues. How can we teach the things that have been referred to?

4. *Focus on pedagogy*

Teaching and learning processes that are undertaken in the classroom/workshop need to be further developed: the practice of design and technology education needs to be developed. Activities that need to be further researched include evaluating, research, idea generation, modelling, synthesising and many others. Interestingly it could be argued that it is the decision making between 'stages' in designing that reveals capability.

Conclusion

This paper has only touched on what are complex issues. It suggests a number of changes to the structure of the curriculum documentation. In addition, considerable professional development will be required. It may appear to be completely misguided to suggest a reshape of the design and technology curriculum in this way at a time when it needs to be seen as stable. As it is, however, I believe that the subject will not provide its 'unique contribution' to pupils' education in the UK. With the development of pedagogical approaches in particular, design and technology education will match the expectations for its unique contribution to the curriculum.

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